STUDY ON STORAGE CAPACITIES AND LOGISTICAL INFRASTRUCTURE FOR EU AGRICULTURAL COMMODITIES TRADE

(with a special focus on Cereals, the Oilseed Complex and Protein Crops (COP))

Final Report
This report has been prepared by

Areté Research & Consulting in Economics
Via Del Gomito, 26/4 – 40127 Bologna
Tel: +39.051.4388500
Fax: +39.051.511186
Email: info@areteonline.net
Web: www.areteonline.net

This evaluation was directed by Mauro Bruni (Areté), Project Leader, with the participation of:

**Areté s.r.l. (IT)**
Enrica Gentile (Project Manager)
Alberico Loi
Mario Gentile

**Karlsruhe Institute of Technology (KIT) – Institute for Industrial Production (IIP) (DE)**
Andreas Rudi
Sonja Rosenberg
Carmen Mayer
Frank Schultmann

**Agra CEAS Consulting (BE)**
Dylan Bradley
Maria Christodoulou
John Nganga
Blezat Consulting (FR)
Bertrand Oudin
Claire-Marie Luitaud

Institute for Food Studies & Agroindustrial Development (IFAU) (DK)
Karen Thorsted Hamann

Incatema Consulting (ES)
Miguel Salvo Mendívil
Joaquin Quiñonero Robles
Ana González Altozano

Agroges (PT)
Pedro Serrano

NAREE International Limited (RC)
Kaiyu Lyu

Natural Resources Institute Finland (LUKE) (FI)
Sirpa Karppinen

Agrifood and Bioenergy Consulting (DE)
Conrad Caspari

Independent experts
Jarka Chloupkova (CZ)
Jolanta Drozdz (LT)
Nikolov Dimitre (BG)
Matei Marcel Duda (RO)
Wieslaw Dzwonkowski (PL)
Ales Kuhar (HR)
Ofelia Nalbant (RO)
Laszlo Rieger (HU)
Matteo Vittuari (IT)
STUDY ON STORAGE CAPACITIES AND LOGISTICAL INFRASTRUCTURE FOR EU AGRICULTURAL COMMODITIES TRADE
(with a special focus on Cereals, the Oilseed Complex and Protein Crops (COP))
Abstract

The study provides an overview and mapping of the storage capacity and logistical infrastructure for cereals, the oilseed complex and protein crops (COP) in the EU, identifies the related bottlenecks, and analyses their evolution since 2005.

The current storage capacity for COP in the EU28 amounts to 359 million tonnes, up 20% from 2005. EU COP production increased by 11% in the same period. Structural shortage of COP storage capacity currently affects a limited number of Member States. Storage capacity has increased in all 28 MS, with substantial growth especially in Eastern EU Member States. Some key factors behind this evolution are specific to the COP supply chain, such as growth in yields, production and exports, and increased price volatility. The switch to just-in-time inventory management models by processors also played a role, especially in the United Kingdom and Germany.

Inland waterways and railways handle almost all long-distance COP tonnage (60-70% for inland waterways, 30-40% for railways) along the four main COP transportation corridors (Baltic-Adriatic, North Sea-Baltic, Rhine-Alpine and Rhine-Danube); truck transportation prevails in short-distance moves.

Member States which have increased COP exports have often also improved their availability of storage capacity compared to their theoretical needs. Location of additional COP storage capacity at sites with access to adequate logistical infrastructure can address the identified bottlenecks for storage capacity.

Solutions to address infrastructural bottlenecks include the completion of missing links in the main COP transportation corridors, capacity increases and technological upgrade on critical corridor sections and at key hubs, enhancement of intermodal COP transportation and harmonisation of technological standards in transportation infrastructure.

Résumé

L'étude fournit un aperçu et une cartographie de la capacité de stockage et de l'infrastructure logistique pour les céréales, le complexe oléagineux et des protéagineux (COP) dans l'UE, identifie les goulots d'étranglement correspondants et analyse leur évolution depuis 2005.

La capacité de stockage actuelle des COP dans l'UE28 s'élève à 359 millions de tonnes (plus 20 % par rapport à 2005). La production des COP dans l'UE a augmenté de 11 % pendant la même période. La pénurie structurelle de la capacité de stockage des COP touche actuellement un nombre limité des États membres. La capacité de stockage a augmenté dans l'ensemble des 28 EM avec une croissance importante, notamment dans les États membres de l'UE en Europe de l'Est. Certains des facteurs clés derrière cette progression sont spécifiques à la chaîne logistique des COP, comme p. ex. la croissance des rendements, de la production et des exportations, et la volatilité accrue des prix. Le passage aux modèles de gestion des stocks juste-à-temps par les transformateurs a également joué un rôle, en particulier au Royaume-Uni et en Allemagne.

Les voies navigables intérieures et les voies ferrées prennent en charge presque tout le tonnage longue distance des COP (60 - 70 % pour les voies navigables intérieures, 30-40 % pour les voies ferrées) le long des quatre corridors principaux de transport des COP (Baltique - Adriatique, Mer du Nord - Baltique, Rhin - Alpes et Rhin - Danube) ; le transport par camion prévaut dans les déplacements à courte distance.

Les États membres qui ont augmenté les exportations de COP ont souvent augmenté parallèlement leur disponibilité de capacité de stockage par rapport à leurs besoins théoriques. Implanter la capacité de stockage supplémentaire des COP sur des sites ayant accès aux infrastructures logistiques adéquates peut répondre aux problèmes identifiés de goulots d'étranglement de la capacité de stockage. Les solutions pour remédier aux goulots d'étranglement infrastructuraux comprennent l'achèvement des liaisons manquantes dans les corridors principaux de transport des COP, l'augmentation de la capacité et la modernisation technologique de sections des corridors critiques et au niveau des carrefours clés, l'amélioration du transport intermodal des COP et l'harmonisation des normes technologiques dans l'infrastructure des transports.
TABLE OF CONTENTS

INTRODUCTION ........................................................................................................................................ 11
Context of the study ................................................................................................................................... 11
Objectives of the study .............................................................................................................................. 11
Content of the study report ...................................................................................................................... 11

1 METHODOLOGY .................................................................................................................................. 13

1.1 Methodology for the mapping of storage capacity and logistical infrastructure ................................. 13
  1.1.1 Methodology for the mapping of storage capacity ........................................................................ 13
  1.1.2 Methodology for the mapping of logistical infrastructure ............................................................... 14

1.2 Methodology for replying to study questions ..................................................................................... 15
  1.2.1 Study questions under Theme 1 – Storage capacity ...................................................................... 15
  1.2.2 Study questions under Theme 2 – Logistical infrastructure ............................................................. 17
  1.2.3 Study questions under Theme 3 – Bottlenecks ............................................................................. 19

2 OVERVIEW AND MAPPING UNDER THEMES 1 AND 2 ................................................................. 22

2.1 Mapping of storage capacity (Theme 1) .............................................................................................. 22
  2.1.1 On-farm storage and storage by cooperative structures ................................................................. 23
  2.1.2 Storage at processing plants .......................................................................................................... 24
  2.1.3 Storage at transportation hubs and storage by traders ................................................................. 24
  2.1.4 Graphic representation of current EU storage capacity and of its evolution ............................... 24

2.2 Mapping of logistical infrastructure (Theme 2) .................................................................................. 32
  2.2.1 Different modes of transport of COP crops and their interconnection ......................................... 32
  2.2.2 Role, function and costs of transport of COP crops .................................................................... 43
  2.2.3 Logistical infrastructure for COP crops ....................................................................................... 48

3 REPLIES TO STUDY QUESTIONS UNDER THEMES 1, 2 AND 3 ..................................................... 87

3.1 Replies to study questions under Theme 1 (storage capacity) .......................................................... 87
  3.1.1 Question 1.1: Current need of storage capacity ........................................................................... 87
  3.1.2 Question 1.2: Evolution of storage capacity since 2005 ............................................................... 96
  3.1.3 Question 1.3: Factors influencing the evolution of storage capacity .......................................... 100
  3.1.4 Question 1.4: Investments in storage capacity ........................................................................... 102

3.2 Replies to study questions under Theme 2 (logistical infrastructure) .............................................. 105
  3.2.1 Question 2.1: Evolution of intra and extra-EU trade flows in COP crops since 2005 ................. 105
3.2.2 Question 2.2: Evolution of logistical infrastructure for COP crops since 2005 ........................................ 122
3.2.3 Question 2.3: Factors influencing the evolution of logistical infrastructure ............................................. 135
3.2.4 Question 2.4: Investments in logistical infrastructure ........................................................................... 138

3.3 Replies to study questions under Theme 3 (bottlenecks) ............................................................................. 150
3.3.1 Question 3.1: Identification, location and analysis of bottlenecks for storage capacity and logistical infrastructures for COP crops .......................................................... 150
3.3.2 Question 3.2: Evolution of bottlenecks since 2005 ................................................................. 197
3.3.3 Question 3.3: Factors influencing the evolution of bottlenecks ................................................. 218
3.3.4 Question 3.4: Influence of bottlenecks on EU internal and external trade in COP crops ....... 227
3.3.5 Question 3.5: Identification of solutions to overcome existing bottlenecks ....................... 234
3.3.6 Question 3.6: Opportunities for future investments in storage capacity and logistical infrastructure ................................................................. 246

4 CONCLUSIONS ........................................................................................................................................... 251
4.1 Mapping of storage capacity ............................................................................................................. 251
4.2 Mapping of logistical infrastructure ................................................................................................ 252
4.3 Study questions under Theme 1 – storage capacity ........................................................................ 254
4.4 Study questions under Theme 2 – logistical infrastructure ................................................................ 256
4.5 Study questions under Theme 3 – bottlenecks ................................................................................ 257
4.5.1 Bottlenecks for storage capacity ................................................................................................. 257
4.5.2 Bottlenecks for logistical infrastructure .................................................................................... 259
4.5.3 Influence of bottlenecks on EU internal and external trade in COP crops ................................ 260
4.6 Case studies ............................................................................................................................................. 261
4.6.1 EU case studies: Germany, Hungary, Romania .............................................................................. 261
4.6.2 Case study on China ...................................................................................................................... 263
4.7 Solutions to address bottlenecks ........................................................................................................ 264
4.7.1 Solutions to address bottlenecks for storage capacity ............................................................... 264
4.7.2 Solutions to address bottlenecks for logistical infrastructure .................................................... 264

5 BIBLIOGRAPHY ......................................................................................................................................... 266

6 ANNEXES .................................................................................................................................................. 270
INDEX OF FIGURES

Figure 2.1 – Current national storage capacity in the EU-28 Member States, by size classes .......... 25
Figure 2.2 – Percentage increases in national storage capacity in the EU-28 Member States, 2005-2015 ................................................................................................................................. 26
Figure 2.3 – Current regional storage capacity in the EU28 NUTS 2 regions, by size classes .......... 27
Figure 2.4 – Current storage capacity at different stages of the COP supply chain and % composition ........................................................................................................................................... 28
Figure 2.5 – Current storage capacity for COP and allocation among the stages of the supply chain, by Member State ........................................................................................................ 29
Figure 2.6 – Storage capacity for COP and allocation among the stages of the supply chain, by Member State, 2005 .................................................................................................................. 30
Figure 2.7 – Allocation of current and 2005 storage capacity for COP among the stages of the supply chain, by Member State (% shares of national total) .................................................................................. 31
Figure 2.8 – COP transportation modes .................................................................................. 33
Figure 2.9 - Typical truck-trailer combination for COP transportation .................................................. 35
Figure 2.10 - Share of road network by speed level class and total length of road network .......... 36
Figure 2.11 - Different toll charging systems in the EU ...................................................................... 37
Figure 2.12 - Typical agricultural transport wagon ("covered hopper") ................................................. 39
Figure 2.13 – Maximum permitted train length in EU Member States ............................................. 40
Figure 2.14 - Classification of European IWW vessels and combinations according to Resolution NO 92/2 of the European Conference of Ministers of Transport ...................................................................... 42
Figure 2.15 – Pushed convoy of barges with a capacity of 10 000 tonnes on the Danube River .......... 42
Figure 2.16 – Logistics of a classic agricultural supply chain in international trade ................................ 44
Figure 2.17 – Illustration of actors involved in the COP transportation chain .................................. 44
Figure 2.18 – Hourly earnings in the transport sector per EU MS in 2014 ................................................ 47
Figure 2.19 – EU road transportation core network .......................................................................... 49
Figure 2.20 – Total length of planned motorways in the EU, per Member State in 2015 ...................... 50
Figure 2.21 – Number of Rail-to-Road terminals in comparison to land area (km²), by Member State ........................................................ ......................................................... 51
Figure 2.22 – Road transportation of dry bulk freight (including COP) in the 5 Member States with the highest deviation, 2005 - 2015 ........................................................................................................ 51
Figure 2.23 – National road transportation of cereals by distance class in 2005 (000 tonnes) ............ 53
Figure 2.24 – National road transportation of cereals by distance class in 2015 (000 tonnes) ............. 53
Figure 2.25 – National road transportation of oilseed complex by distance class in 2005 (000 tonnes) ........................................................................................................................................... 54
Figure 2.26 – National road transportation of oilseed complex by distance class in 2015 (000 tonnes) ........................................................................................................................................... 54
Figure 2.27 – National annual road transportation in terms of loading minus unloading quantities for cereals, by NUTS 3 regions, 2005 (000 tonnes) .............................................................................................. 55
Figure 2.28 – National annual road transportation in terms of loading minus unloading quantities for cereals, by NUTS 3 regions, 2015 (000 tonnes) .............................................................................................. 56
Figure 2.29 – National annual road transportation in terms of loading minus unloading quantities for oilseed complex, by NUTS 3 regions, 2005 (000 tonnes) .............................................................................................. 57
Figure 2.30 – National annual road transportation in terms of loading minus unloading quantities for oilseed complex, by NUTS 3 regions, 2015 (000 tonnes) .............................................................................................. 58
Figure 2.31 – Top 25 international road transportation flows of agricultural goods in 2015 .......... 61
Figure 2.32 – Top 100 national road transportation flows of agricultural goods in 2015..............................63
Figure 2.33 – European inland waterway core network and main COP crop ports........................................66
Figure 2.34 – Volumes of agricultural and food products shipped on the Rhine (German section) in million tonnes ........................................................................................................................................68
Figure 2.35 – Domestic IWW transport of agricultural and food products - French pavilion (for own account or reward, in Tkm)........................................................................................................69
Figure 2.36 – Agricultural products shipped on the Upper Danube (Austria)....................................................70
Figure 2.37 – Inland waterway traffic in the seaport of Rotterdam (million tonnes, all goods)......................72
Figure 2.38 – Inland waterway traffic in the seaport of Hamburg (million tonnes, all goods)......................72
Figure 2.39 – Inland waterway traffic in the seaport of Antwerp (million tonnes, all goods)......................73
Figure 2.40 – Rhine-Danube corridor........................................................................................................76
Figure 2.41 – IWW transportation of cereals on the Danube river in 2015 by NUTS 2 region.......................77
Figure 2.42 – IWW transportation of cereals on the North-South river axis in 2015 by NUTS 2 region..........................................................78
Figure 2.43 – European core railway network.............................................................................................79
Figure 2.44 – Top 25 international rail transportation flows of agricultural goods in 2015.........................82
Figure 2.45 – Top 100 national rail transportation flows of agricultural goods in 2015.........................84
Figure 3.1 – Monthly peaks* of COP exports at Member State level over the 2005-2015 period.............95
Figure 3.2 – Evolution of the available storage capacity in selected Member States: 2005 vs. 2015........96
Figure 3.3 – NUTS 2 regions with the highest increase of storage capacity between 2005 and 2015. ..........................97
Figure 3.4 – NUTS 2 regions with the highest decrease of storage capacity between 2005 and 2015. ..........................97
Figure 3.5 – 2005 and 2015 storage capacity by level of the supply chain and % increase......................98
Figure 3.6 – Member States with the highest 2005-15 increase in storage capacity by level of the supply chain..........................................................98
Figure 3.7 – Annual COP imports by Member State: EU vs. non-EU origins (average 2005-15)........106
Figure 3.8 – Annual COP exports by Member State: EU vs. non-EU destinations (average 2005-15)..........................106
Figure 3.9 – Top 10 EU importers of COP from extra-EU countries (average 2005-15).........................107
Figure 3.10 – Top 10 EU importers of COP to extra-EU countries (average 2005-15)..............................107
Figure 3.11 – Main extra-EU COP imports by macro-areas (average 2005-15)........................................109
Figure 3.12 – Main extra-EU COP exports by macro-areas (average 2005-15)........................................110
Figure 3.13 – Key trends in the evolution of COP imports for the leading EU importers, 2005-2015114
Figure 3.14 – Absolute variation of COP import volumes (2005 vs. 2015*)..............................................115
Figure 3.15 – Comparative analysis of COP imports from non-EU macro-areas (2004-06 vs. 2013-15) ..........................116
Figure 3.16 – Key trends in the evolution of COP exports for the leading EU exporters, 2005-2015118
Figure 3.17 – Absolute variation of COP export volumes (2005 vs 2015*)..............................................119
Figure 3.18 - Comparative analysis of COP exports to non-EU macro-areas (2004-06 vs. 2013-15) 120
Figure 3.19 – Average net trade position for COP by Member State (2004-06 vs. 2013-15).............121
Figure 3.20 – Average COP production by Member State (2004-06 vs. 2013-15)....................................121
Figure 3.21 – European TEN-T corridor network......................................................................................123
Figure 3.22 – Main COP transportation corridors connecting Eastern and Central Europe: A - Baltic-Adriatic; B – North Sea-Baltic; F – Rhine-Alpine; I – Rhine-Danube......................................................125
Figure 3.23 – Evolution of motorway length of selected Eastern EU Member States..............................127
Figure 3.24 – Development of motorways of selected EU Member States for 2005 and 2015........127
STUDY ON STORAGE CAPACITIES AND LOGISTICAL INFRASTRUCTURE FOR EU AGRICULTURAL COMMODITIES TRADE
(with a special focus on Cereals, the Oilseed Complex and Protein Crops (COP))

Final Report

Figure 3.25 – Motorway length in comparison to land area [km/ 1000 square km] in Eastern Europe for 2005 .................................................................................................................. 128
Figure 3.26 – Motorway length in comparison to land area [km/ 1000 square km] in Eastern Europe for 2015 .................................................................................................................. 128
Figure 3.27 – Evolution of top 10 regions with highest motorway growth (2005-2015) ................. 129
Figure 3.28 – Evolution of load capacity in the EU, 2005 vs. 2015 ...................................................... 129
Figure 3.29 – Top 10 NUTS 2 regions for increase/decrease (+/-) of road tractor stock .................. 130
Figure 3.30 – Road freight transportation of cereals (except rice), leguminous crops and oilseeds (number of journeys) ............................................................................................................... 131
Figure 3.31 – Top 10 NUTS 2 regions in terms of evolution of navigable river network (length in kilometres) .................................................................................................................... 132
Figure 3.32 – Availability of fairway depth on the Danube from 2012 until 2015 ............................. 133
Figure 3.33 – Evolution in the length of total railway lines by NUTS 2 regions (kilometres) .......... 134
Figure 3.34 – Evolution in the length of railway lines with multiple tracks by NUTS 2 regions (kilometres) .......................................................................................................................... 134
Figure 3.35 – Evolution in the length of electrified railway lines by NUTS 2 regions (kilometres) ... 135
Figure 3.36 – Subject areas of R & D projects (in terms of number of projects) in Austria ............. 137
Figure 3.37 – Researched infrastructure in R&D projects in Austria (2015) ................................. 138
Figure 3.38 – Distribution of TEN-T/CEF Projects ........................................................................ 139
Figure 3.39 – Historical distribution of TEN-T priority projects (number of projects) .................. 140
Figure 3.40 – Overview of possible funding options for infrastructural projects ............................ 142
Figure 3.41 – CEF funding for building of cross-border infrastructure (2014-2015 calls for proposals) ........................................................................................................................................ 144
Figure 3.42 – CEF funding to flagship projects (2014-2015 calls for proposals) ............................ 145
Figure 3.43 – Recommended CEF funding by type of investment for the 2016 call for proposals (million Euros) ......................................................................................................................... 146
Figure 3.44 – Relevant Corridors for projects of the 2016 call for proposals .................................. 146
Figure 3.45 – Recommended CEF funding by priority for the 2016 call for proposals (million Euros) ................................................................................................................................................ 147
Figure 3.46 – Total budget for the development of infrastructure in transport and energy, by Member State ........................................................................................................................................... 149
Figure 3.47 – Member States with the most serious shortages in 2015 ............................................ 152
Figure 3.48 – NUTS 2 regions with the most serious storage capacity shortages in 2015 ............... 153
Figure 3.49 – Illustration of administrative railway interoperability in European cross-border transport ................................................................................................................................................ 155
Figure 3.50 – Illustration of bottlenecks in Austrian infrastructure .................................................. 161
Figure 3.51 – Illustration of bottlenecks in Bulgaria’s infrastructure ................................................. 165
Figure 3.52 – Illustration of bottlenecks in the Czech Republic’s infrastructure ............................. 169
Figure 3.53 – Illustration of bottlenecks in French infrastructure ..................................................... 174
Figure 3.54 – Illustration of Bottlenecks in Germany’s infrastructure .............................................. 178
Figure 3.55 – Illustration of bottlenecks in Hungary’s infrastructure ................................................ 183
Figure 3.56 – Bottlenecks in Poland’s infrastructure ......................................................................... 187
Figure 3.57 – Illustration of bottlenecks in Romanian infrastructure 2015 .................................... 192
Figure 3.58 – Illustration of bottlenecks in Slovakia’s infrastructure ............................................... 196
Figure 3.59 – Storage capacity shortages/surpluses at Member State level: evolution over the observed period .......................................................................................................................... 198
Figure 3.60 – Evolution experienced in the regions recording the most substantial positive variations in available storage capacity (2005-2015) ........................................................................................................ 200
Figure 3.61 – Evolution experienced in the regions recording the most substantial negative variations in available storage capacity (2005-2015) ........................................................................................................ 201
Figure 3.62 – Largest positive and negative variations in available storage capacity at regional level (2005-2015) ........................................................................................................ 202
Figure 3.63 – Modal split of international freight traffic on the North-Sea-Baltic corridor in 2010 .... 205
Figure 3.64 – The crossroad of Meuse and Albert Canal ................................................................. 206
Figure 3.65 – End date deviation by mode of 2007-2013 funded projects according to mid-term review in 2010 ..................................................................................................................... 208
Figure 3.66 – End date deviation by project type of 2007-2013 funded projects according to mid-term review in 2010 ..................................................................................................................... 209
Figure 3.67 – Variation in budgeted costs by mode of 2007-2013 funded projects according to mid-term review 2010 ..................................................................................................................... 209
Figure 3.68 – LPI of selected EU Member States .................................................................................. 211
Figure 3.69 – Quality index and EU rank of Austrian infrastructure from 2007 until 2015 .......... 212
Figure 3.70 – Quality index and EU rank of Bulgarian infrastructure from 2007 until 2015 ........... 213
Figure 3.71 – Quality index and EU rank of Czech Republic infrastructure from 2007 until 2015 ... 213
Figure 3.72 – Quality index and EU rank of French infrastructure from 2007 until 2015 ............. 214
Figure 3.73 – Quality index and EU rank of German infrastructure from 2007 until 2015 .......... 215
Figure 3.74 – Quality index and EU rank of Hungarian infrastructure from 2007 until 2015 ....... 215
Figure 3.75 – Quality index and EU rank of Polish infrastructure from 2007 until 2015 ............. 216
Figure 3.76 – Quality index and EU rank of Romanian infrastructure from 2007 until 2015 ...... 217
Figure 3.77 – Quality index and EU rank of Slovakian infrastructure from 2007 until 2015 ......... 217
Figure 3.78 – Comparative analysis of the evolution of storage capacity and storage needs for selected Member States, 2005-2015 .......................................................... 219
Figure 3.79 – Road infrastructure investments per one thousand units of GDP in EUR (2005-2015) 220
Figure 3.80 – Rail infrastructure investments per one thousand units of GDP in EUR (2005-2015) . 221
Figure 3.81 – IWW infrastructure investments per one thousand units of GDP in EUR (2005-2015) 221
Figure 3.82 – White Paper: possible impact on policies of the selected scenarios ...................... 223
Figure 3.83 – Strategic objectives of the Bulgarian Integrated Transport Strategy for the period until 2030 and the defined priorities .................................................................................. 224
Figure 3.84 – Capacity issues for rail and road transportation on the Rhine-Alpine corridor in 2015 237
Figure 3.85 – Share of EU train drivers with an EC license .............................................................. 249
**LIST OF ACRONYMS**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>3PL</td>
<td>3rd Party Logistics providers</td>
</tr>
<tr>
<td>AIF</td>
<td>Alternative Investment Funds</td>
</tr>
<tr>
<td>AT</td>
<td>Austria</td>
</tr>
<tr>
<td>AVG</td>
<td>Average</td>
</tr>
<tr>
<td>BE</td>
<td>Belgium</td>
</tr>
<tr>
<td>BG</td>
<td>Bulgaria</td>
</tr>
<tr>
<td>CEF</td>
<td>Connecting Europe Facility</td>
</tr>
<tr>
<td>CF</td>
<td>Cohesion Fund</td>
</tr>
<tr>
<td>COP</td>
<td>Cereals, the oilseeds complex and protein crops</td>
</tr>
<tr>
<td>CY</td>
<td>Cyprus</td>
</tr>
<tr>
<td>CZ</td>
<td>Czech Republic</td>
</tr>
<tr>
<td>DE</td>
<td>Germany</td>
</tr>
<tr>
<td>DK</td>
<td>Denmark</td>
</tr>
<tr>
<td>EAFRD</td>
<td>European Agricultural Fund for Rural Development</td>
</tr>
<tr>
<td>EE</td>
<td>Estonia</td>
</tr>
<tr>
<td>EFSI</td>
<td>European Fund for Strategic Investments</td>
</tr>
<tr>
<td>EIB</td>
<td>European Investment Bank</td>
</tr>
<tr>
<td>EL</td>
<td>Greece</td>
</tr>
<tr>
<td>ELTIFs</td>
<td>European long-term investment funds</td>
</tr>
<tr>
<td>EMS</td>
<td>European Modular System</td>
</tr>
<tr>
<td>ERDF</td>
<td>European Regional Development Fund</td>
</tr>
<tr>
<td>ERTMS</td>
<td>European Rail Traffic Management System</td>
</tr>
<tr>
<td>ES</td>
<td>Spain</td>
</tr>
<tr>
<td>ESF</td>
<td>European Social Fund</td>
</tr>
<tr>
<td>ESIF</td>
<td>European Structural and Investment Funds</td>
</tr>
<tr>
<td>ETCS</td>
<td>European Train Control System</td>
</tr>
<tr>
<td>ETS</td>
<td>Emission allowance Trading System</td>
</tr>
<tr>
<td>FI</td>
<td>Finland</td>
</tr>
<tr>
<td>FR</td>
<td>France</td>
</tr>
<tr>
<td>HR</td>
<td>Croatia</td>
</tr>
<tr>
<td>HU</td>
<td>Hungary</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographical Information System</td>
</tr>
<tr>
<td>GNI</td>
<td>Gross National Income</td>
</tr>
<tr>
<td>IE</td>
<td>Ireland</td>
</tr>
<tr>
<td>IT</td>
<td>Italy</td>
</tr>
<tr>
<td>ITS</td>
<td>Intelligent Transport System</td>
</tr>
<tr>
<td>IWW</td>
<td>Inland waterways</td>
</tr>
<tr>
<td>LGTT</td>
<td>Loan Guarantee instrument for Trans-European Transport networks projects</td>
</tr>
<tr>
<td>LPI</td>
<td>Logistics Performance Index</td>
</tr>
<tr>
<td>LT</td>
<td>Lithuania</td>
</tr>
<tr>
<td>LU</td>
<td>Luxembourg</td>
</tr>
<tr>
<td>LV</td>
<td>Latvia</td>
</tr>
<tr>
<td>MS</td>
<td>Member State</td>
</tr>
<tr>
<td>MT</td>
<td>Malta</td>
</tr>
<tr>
<td>NL</td>
<td>Netherlands</td>
</tr>
<tr>
<td>NUTS</td>
<td>Nomenclature des Unités Territoriales Statistiques</td>
</tr>
<tr>
<td>PL</td>
<td>Poland</td>
</tr>
<tr>
<td>PPP</td>
<td>Public-Private Partnerships</td>
</tr>
<tr>
<td>PT</td>
<td>Portugal</td>
</tr>
<tr>
<td>RDP</td>
<td>Rural Development Program</td>
</tr>
<tr>
<td>RO</td>
<td>Romania</td>
</tr>
<tr>
<td>Ro-Ro</td>
<td>Roll-on/Roll-off</td>
</tr>
</tbody>
</table>
### Acronym | Definition
---|---
RR | Rail-to-Road
SE | Sweden
SFF | Structured Finance Facility
SI | Slovenia
SK | Slovakia
TEN-T | Trans-European Transport Network
TEN-T EA | Trans-European Transport Network Executive Agency
Tkm | Tonne-kilometres
UK | United Kingdom
<table>
<thead>
<tr>
<th><strong>DEFINITION OF KEY TERMS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bottlenecks</strong></td>
</tr>
<tr>
<td><strong>COP crops</strong></td>
</tr>
<tr>
<td><strong>GIS</strong></td>
</tr>
<tr>
<td><strong>Logistical Infrastructure</strong></td>
</tr>
<tr>
<td><strong>Long-haul</strong></td>
</tr>
<tr>
<td><strong>NUTS regions</strong></td>
</tr>
<tr>
<td><strong>Short-haul</strong></td>
</tr>
<tr>
<td><strong>Storage</strong></td>
</tr>
<tr>
<td><strong>Storage capacity</strong></td>
</tr>
<tr>
<td><strong>Storage facilities</strong></td>
</tr>
<tr>
<td><strong>Trade Logistics</strong></td>
</tr>
<tr>
<td><strong>Transportation Network</strong></td>
</tr>
<tr>
<td><strong>Transportation hub</strong></td>
</tr>
</tbody>
</table>
INTRODUCTION

Context of the study

For more than twenty years the Common Agricultural Policy (CAP) of the EU has undergone successive reforms, aimed at increasing - among others - the market orientation of agricultural production. One part of the reforms was the revision of the public intervention system for cereals. In the past, public intervention was designed to support internal market prices through public purchases and intervention storage of cereals. Producers in some regions considered intervention as a market outlet for their products. CAP reforms gradually limited the scope of the intervention system, which became a safety net measure to be applied only when serious market disturbances occur.

As a result of CAP reforms, EU prices for cereals, oilseeds and protein crops have adjusted to world prices. This alignment with the world market has strengthened the EU’s position as a net exporter for certain cereals. However, the EU remains a net importer of maize and oilseeds. At the same time, EU agricultural commodity markets have been exposed to an increasing degree of market volatility. In a more market oriented CAP, producers have to manage the risks of increasing market volatility. Farmers in surplus Member States or regions have to transport their products to other regions in the EU, or export them to third countries. Storage and transport capacity, or the lack thereof, can hence be a decisive factor in the process of bringing cereals and oilseeds to the market at a profitable price. Furthermore, costs related to transportation and storage have become increasingly important factors for the pricing of agricultural commodities. Finally, adequate availability of storage capacity and logistical infrastructure can facilitate trade and, in particular, further promote the EU’s export competitiveness on the global cereals market. In a scenario of increasing EU import demand for oilseeds over the next decade to cover the EU’s protein deficit, a functioning logistical system is of paramount importance to provide a sufficient supply for the EU market at competitive prices.

It is therefore essential to have a clear picture of the current logistical infrastructure and storage capacity for cereals, the oilseed complex and protein crops (COP henceforth) in the EU. Possible bottlenecks in commodity flows hampering a smooth functioning of the market need to be identified, in order to assess in particular potential impacts on internal and external trade. The objectives of the study stemmed from such needs.

Objectives of the study

The study aims at providing an overview and mapping of the storage capacity and of the logistical infrastructure for COP in the EU, also analysing their evolution since 2005. The study also aims at identifying bottlenecks in storage capacity and logistical infrastructure for COP crops, at analysing their evolution since 2005, and at exploring their possible impact on intra and extra-EU trade in COP crops. Finally, the study aims at elaborating options for policy recommendations to overcome the identified bottlenecks, and at exploring opportunities for future investments in storage capacity and logistical infrastructure for COP crops in the EU.

Content of the study report

This report illustrates the outcomes of the analyses carried out for the purposes of the study, as well as the main conclusions drawn with respect to the three study themes. The three study themes and the related study questions are outlined hereunder.
An overview of the methodology applied for the mapping of storage capacity and of logistical infrastructure for COP in the EU, and for replying to the study questions under the three study themes, is provided at § 1.

The results of the overview and mapping of the storage capacity and of the logistical infrastructure for COP are illustrated at § 2.1 and 2.2, respectively.

The replies to study questions under theme 1 “storage capacity” are provided at § 3.1, whereas the replies to study questions under theme 2 “logistical infrastructure” are provided at § 3.2. The replies to study questions under theme 3 “bottlenecks” are provided at § 3.3, which also includes an illustration of the solutions to overcome the identified bottlenecks, and of the opportunities for future investments in storage capacity and logistical infrastructure.

The conclusions of the study, deriving from the most relevant findings of the analysis performed under the three study themes, are presented at § 4.
1 METHODOLOGY

1.1 Methodology for the mapping of storage capacity and logistical infrastructure

1.1.1 Methodology for the mapping of storage capacity

The *mapping of storage capacity* illustrated at § 2.1 is the result of a sequence of coordinated activities. The process started with an in-depth investigation on the storage system for COP in each Member State. The existing literature on the topic, previous studies and public/private surveys and enquiries were reviewed; public institutions, business organisations, researchers and consultants were also contacted to request access to the most complete and updated available data.

As expectable, the available information greatly varied in quantity and quality among the different Member States. Complete, well-organised and more or less updated databases were available in some Member States; by contrast, in the remaining Member States only very general information had already been recorded or, in some other cases, no research had ever been made on the topic.

The methodology for the mapping of storage capacity aimed at identifying storage facilities at all stages of the supply chain, at classifying them by typology and at knowing their individual storage capacity. A special effort was made to achieve the widest possible coverage in terms of observed capacity data for individual facilities (or at least, groups of individual facilities located in the same NUTS 2 or 3 region). This implied collecting such data directly from secondary or primary sources, through extraction from datasets, consultation of company websites, interviews with knowledgeable subjects and a very high number of direct enquiries to operators managing storage facilities. Wherever this proved unfeasible, a second-best approach was applied, aimed at indirect quantification of capacity data for individual facilities / groups of facilities. This was made through calculation, estimation or experts’ judgment on the basis of i) available relevant data and information (e.g. processing capacity, frequency of stock turnover, etc.) or ii) visual observation of images of the concerned storage facilities. Quantification of *aggregate storage capacity figures at NUTS 2 or 3 level* was applied for on-farm storage capacity in most Member States, because of the very low average dimension of the facilities and of the extremely great number of operators involved at this stage of the food supply chain. The estimation of *aggregate storage capacity* was only applied as a last resort option for the other stages of the supply chain. These different “components” were systematically combined, for each NUTS 2 or 3 region, into a single figure expressing the volume of existing storage capacity. Special attention was devoted to prevent the issue of double-counting of facilities. Interviews with national experts were mainly aimed at collecting useful elements for validation of total figures at Member State level.

The output of the above investigations was a *dataset* featuring all the relevant quantitative and qualitative information on the storage system for COP in all the NUTS 2 and 3 regions. This dataset formed the basis for the creation of a *set of GIS maps for storage capacity*, illustrating the situation of the storage system for COP in the EU-28 Member States in 2005 and at present, as well as the related evolution.

---

1 Through calculation, estimation or experts’ judgment on the basis of available relevant data and information.
1.1.2 Methodology for the mapping of logistical infrastructure

The following three activities were carried out in order to provide an overview and mapping of the logistical infrastructure for COP crops:

1. An analysis of transport modes for COP.
2. An assessment of the role, function and cost of transport.
3. The identification and illustration of the main EU transport corridors for COP and of the regional infrastructure for COP transportation.

The analysis of transport modes for COP was aimed at collecting a set of quantitative and qualitative information items illustrating how COP are currently transported in the EU. These included i) the distribution of COP transportation among the different modes (road, rail, inland waterways), ii) the geographical distribution of the transport modes at the appropriate NUTS level and iii) additional characteristics of transport modes (e.g. shipping distances, vehicle types, etc.), related to the role that each mode plays in COP transportation. Wherever possible, the significant data gaps emerged from the analysis were closed by interpolation or by reasonable estimates provided by interviewed experts.

The assessment of the role, function and cost of transport aimed at analysing why COP are transported in the aforementioned ways. To this end, a techno-economic analysis of transport processes and logistical concepts within the COP crop supply chain was performed, aimed at:

- describing representative COP transportation processes in terms of technical characteristics (e.g. truck, wagon and vessel capacities) and economic aspects (e.g. transport costs, contracts with transport service providers, etc.);
- analysing the role and function of COP transportation, focusing on the key elements defining the relevant logistical concepts (cost, lead time, flexibility), and on the required infrastructure.

Finally, the identification and illustration of the main EU transport corridors for COP transportation by road, rail and inland waterways, was aimed at analysing where COP are transported from origin to destination. The identification of the main EU transport corridors for COP was made on the basis of quantitative and qualitative elements sourced from i) official reports about the key EU transport corridors and ii) transportation statistics describing COP traffic flows between EU Member States/regions. The identified corridors were then illustrated in a set of GIS maps, together with the related transport infrastructure: road, rail, and inland waterways network, and the related interconnections and transhipment points (road-to-rail terminals; inland waterway ports; seaports). The analysis was carried out in a way that facilitated the identification of bottlenecks directly resulting from the structure of the transport corridors (e.g. missing or not yet built connections; tunnels; crossings), or arising from the interaction between long-haul and short-haul transportation and limited infrastructural and/or storage capacity.
1.2 Methodology for replying to study questions

1.2.1 Study questions under Theme 1 – Storage capacity

1.2.1.1 Question 1.1: Current need of storage capacity

The approach for replying to this study question was based on:

1. An analysis of the evolution of COP supply balance at EU and Member State level, with a special focus on the range of variation of relevant supply balance items - production, domestic use, imports and exports, stocks - in the 2005-2015 period. Such analysis was aimed at quantifying the needs of storage capacity on the basis of assumptions defining the extent of the security buffer with respect to the evolution of COP supply balance over the relevant period.

2. An analysis of the timing of COP production and use, in order to define intra-annual patterns and to identify the month in which the storage need peaks.

3. An analysis of the timing of peaks in COP exports and peaks in storage needs, in order to detect situations where lack of storage capacity in critical periods of the year may have put pressure on operators to “free up” storage space through increased/anticipated export sales.

Different approaches and sets of assumptions were applied to quantify the storage needs with different levels of security buffer. More specifically:

1. A base scenario was developed considering peaks in production for each crop and Member State over the 2005-2015 period. The base scenario allows a better appraisal of potential contingent shortages of storage capacity. Contingent shortages occur where storage capacity falls short of storage needs in exceptional circumstances, defined by peaks in COP production.

2. A first alternative scenario was based on average production for each crop and Member State over the same period, rather than on peaks in production. This scenario allows a better appraisal of potential structural shortages of storage capacity. Structural shortages occur where storage capacity falls systematically short of storage needs in ordinary conditions, defined by average COP production levels.

3. A second alternative scenario was derived from the base scenario by taking into account the net import/export position of each Member State2.

For each scenario, the maximum need of storage capacity was quantified through the following approach:

a. Peak production (in the base scenario and in the second alternative scenario) or average production (in the first alternative scenario) were considered for each crop and each Member State.

b. Actual monthly imports and exports of COP crops were used to build the storage patterns for the year in which the maximum production was recorded in the base scenario and in the second alternative scenario. For the first alternative scenario - based on average production levels - the average monthly imports and exports for each month were considered.

---

2 This scenario considered the different stock management models which can be applied in the two situations. Whereas the export of COP requires the availability of storage capacity in the period between harvest and actual export (whatever the length of such period), import flows usually can be managed in a more flexible way and be more tailored to the timing of consumption needs: with an accurate management of the timing of imports, a country can significantly reduce its storage needs in most years.
c. For all the combinations of COP products and Member States without domestic production, monthly trade data in the year when the peak in imports was recorded were used to build the storage patterns.
d. Within the limits of data availability for individual COP crops, the actual timing of production for individual COP crops was considered to determine the storage peak.
e. Beginning/ending stocks for individual COP crops were calculated as 20% of yearly consumption.

The formula used for the calculation of the maximum need of storage capacity is:

$$SN_{c/MS} = Max(P_x + I_x - E_x + S_x - AC_x)$$

Where:

- $SN_{c/MS}$ = Storage need for each crop/Member State (which corresponds to the maximum monthly ending stock)
- $P_x$ = Monthly production for each crop/Member State. Monthly production is equal to total production (production in the peak year for the base scenario and for the second alternative scenario; average 2005-2015 production for the first alternative scenario) for the main month of harvest; it is equal to zero in the other eleven months.
- $I_x$ = Monthly imports (actual imports in the month x in the peak year for the base scenario and for the second alternative scenario; average imports in the month x for the first alternative scenario)
- $E_x$ = Monthly exports (actual exports in the month x in the peak year for the base scenario and for the second alternative scenario; average exports in the month x for the first alternative scenario)
- $S_x$ = Beginning stock. In the main month of harvest, beginning stock = annual total (i.e. 20% of yearly consumption); in the following months, beginning stock = ending stock of the previous month
- $AC_x$ = Apparent monthly consumption = [(annual production) + (annual imports) – (annual exports)] / 12

The minimum need of storage capacity was instead quantified:

a. as the maximum observed production of cereals and oilseeds over the 2005-2015 period in the base scenario and in the second alternative scenario;
b. as the average production over the same period in the first alternative scenario.

Interviews with national experts provided additional qualitative elements for a thorough understanding of the different situations observed at Member State level.

1.2.1.2 Question 1.2: Evolution of storage capacity since 2005

The evolution of storage capacity was assessed through comparison between the current situation and the 2005 situation at Member State and individual NUTS 2 and 3 region level (data in absolute value), and analysed both in absolute value and as % variation.

Interviews with national experts provided additional qualitative elements for a better understanding of the overall trends behind the observed evolution.

1.2.1.3 Question 1.3: Factors influencing the evolution of storage capacity

To answer this study question, a quanti-qualitative assessment of relevant factors was performed, in order to understand the influence on the evolution of storage capacity of three main groups of factors:

---

3 Such assumption can be deemed as conservative. Actual stock-to-use ratios for all cereals have been closer to 15% in the EU in recent years, even though the ratio was above 20% at the beginning of the considered period. Furthermore, stock-to-use ratios for oilseeds tend to be much smaller than 20% of yearly consumption.
1. Factors specific to the functioning of COP supply chains, such as: the evolution of COP supply balance; the seasonal patterns of COP production; etc.
2. Factors related to the functioning of the agribusiness system as a whole, such as the evolution of non-crop specific support policies.
3. Other factors, such as competition for available space and storage facilities at transportation hubs.

The elements for the assessment were mainly drawn from interviews with EU and national experts, as well as from the available literature.

1.2.1.4 Question 1.4: Investments in storage capacity

The analysis of investments in storage capacity covered two main topics: prominent investors in storage capacity and available funding solutions. The operators which made the most significant investments in additional storage capacity over the relevant period were identified, classified and described under different “investor profiles”. The investigation on the available funding solutions covered internal resources, venture capital, EAFRD funding via specific Rural Development measures, and non-agricultural funding options at EU level (such as those offered through ESIF and EFSI).

The relevant evidence was collected through a combination of desk research and interviews with EU and national experts.

1.2.2 Study questions under Theme 2 – Logistical infrastructure

1.2.2.1 Question 2.1: Evolution of intra and extra-EU trade flows in COP crops by commodity since 2005

In general, the analysis of the evolution of trade in COP crops was performed through the elaboration of time series of annual data on COP trade covering the 2005-2015 period. These series were broken down by:

1. Origin (Member State) and destination: EU on aggregate and individual Member States for intra-EU flows; extra-EU on aggregate, individual macro-areas and individual main origin / destination countries for extra-EU flows.
2. Type of commodity: cereals / oilseed complex / feed protein crops.

1.2.2.2 Question 2.2: Evolution of logistical infrastructure for COP since 2005

The analysis of the evolution of logistical infrastructure for COP was differentiated according to the transport distance and the level of detail:

a. The main European transport corridors were analysed through:
   1. Review of implementation reports and corridor studies at EU level.
   2. Identification of major implementation steps and corresponding projects.

b. National and regional transport infrastructure was analysed through a set of statistical indicators (e.g. Logistics Performance Index\(^4\); modal split of freight transport; etc.).

---

\(^4\) The Logistics Performance Index (LPI) allows country comparisons on the basis of six indicators: 1) efficiency of the clearance process (i.e. speed, simplicity and predictability of formalities) by border control agencies, including customs; 2) quality of trade and transport related infrastructure (e.g. ports, railroads, roads, information technology); 3) ease of arranging competitively
The evidence base for the analysis of the evolution of logistical infrastructure for COP crops since 2005 was completed by (mainly qualitative) elements sourced through interviews with knowledgeable subjects.

1.2.2.3 Question 2.3: Factors influencing the evolution of logistical infrastructure

The analysis of the factors influencing the evolution of logistical infrastructure for COP was differentiated into:

a. An analysis of the factors influencing the evolution of the main European transport corridors in terms of implementation plans and development policies at EU level.

b. An investigation on factors influencing the evolution of the national and regional transport infrastructure, based on a quanti-qualitative assessment.

The evidence base for the analysis of factors influencing the evolution of logistical infrastructure was completed by (mainly qualitative) elements sourced through interviews with experts.

1.2.2.4 Question 2.4: Investments in logistical infrastructure

For the purposes of the analysis of the investments in logistical infrastructure at EU and Member State level, the leading investors in logistical infrastructure and the related investments were analysed and described in terms of:

1. Identification and description of investors in logistical infrastructure (EU funds, Member States, private investors).

2. Review of reports on the funding of logistical infrastructure and collection of statistics on the contribution of the identified investors.

3. Identification of notable investment projects for the development of logistical infrastructure financed by EU funds.

The investigation on the available funding solutions for investments in logistical infrastructure for COP was performed through:

1. the analysis of the importance of regional, national and EU level funding in the development of logistical infrastructure;

2. the identification of Infrastructure Development measures which are relevant for funding through relevant EU funds;

3. the identification of notable examples of Infrastructure Development programmes (national or regional ones) providing support to investments in logistical infrastructure;

4. the description and analysis of the selection of notable examples of funding via relevant EU funds.

Also in this case, the evidence base for the analysis of investments in logistical infrastructure for COP was completed by (mainly qualitative) elements sourced through interviews with knowledgeable subjects.
1.2.3 Study questions under Theme 3 – Bottlenecks

The approach to the assessment under Theme 3 moved from a comprehensive critical review of the outcomes of the analyses carried out for Themes 1 and 2. Additional qualitative and quantitative elements were also considered for answering the study questions.

Bottlenecks for storage capacity and logistical infrastructure for COP were identified, located and analysed, in order to provide an overview and mapping of bottlenecks at different stages of the COP supply chains. More specifically:

1. Bottlenecks were identified by comparing the demand for storage and infrastructure with the available capacity and quality.
2. Bottlenecks were located on the basis of the geographical information contained in the dataset which was built for the mapping of storage capacity (Theme 1) and logistical infrastructure (Theme 2).
3. A quanti-qualitative assessment was performed in order to analyse the bottlenecks.

Once the evolution of the identified bottlenecks and the reasons behind such evolution had been analysed, a quanti-qualitative assessment of the influence of such bottlenecks on EU internal and external trade in COP crops was performed.

The identification of solutions aimed at addressing and overcoming the bottlenecks focused on the reasons behind their evolution, which were identified and analysed with a view to removing / mitigating their influence. Future investments in storage capacity and logistical infrastructure play a role in this respect: the related opportunities - as defined by the existing funding solutions at EU, national and regional level - were hence investigated.

1.2.3.1 Question 3.1: Identification, location and analysis of bottlenecks for storage capacity and logistical infrastructure for COP crops

The key steps in the process of identification, location and analysis of bottlenecks were the following:

1. Identification of bottlenecks:
   a. gaps (if any) between available storage capacity and the estimated storage needs (according to the methodology explained at § 1.2.1.1) were quantified at Member State and NUTS 2 region level;
   b. bottlenecks (tunnels, crossings, missing links, etc.) within the logistical infrastructure of the main European transport corridors, as well as in Member States/regions with low quality of the overall logistical infrastructure, were then identified.

2. Location of bottlenecks through GIS mapping.
3. Analysis of bottlenecks through a quanti-qualitative assessment.

Qualitative elements for the assessment of the identified bottlenecks were drawn from a combination of desk research and interviews with EU and national experts.

1.2.3.2 Question 3.2: Evolution of bottlenecks since 2005

Analysis of the evolution of bottlenecks in storage capacity. The gaps (if any) between available storage capacity and the estimated storage needs (according to the methodology explained at § 1.2.1.1) were quantified at Member State and individual NUTS 2 region level for 2005 and 2015: a comparison between these gaps was then performed in order to assess their evolution over time.
Analysis of the evolution of bottlenecks in logistical infrastructure. The analysis was carried out through the identification and description of major implementation steps in the development of the main transport corridors which allowed to remove bottlenecks which were relevant for COP transportation. The elaboration and representation of time series of annual data for indicators on the overall quality of the logistical infrastructure, highlighting critical situations which could have negative implications for COP transportation, completed the analysis.

1.2.3.3 Question 3.3: Factors influencing the evolution of bottlenecks

The identification and assessment of factors influencing the evolution of bottlenecks was based on a critical review of the findings of the analyses under Themes 1 and 2, with a special focus on:

1. Factors specific to the structure and functioning of COP crops supply chains, such as: evolution of production vis-à-vis domestic use in terms of volume and/or geographical distribution; evolution of internal and external trade; changes (if any) in the technical requirements of COP storage and/or transportation; changes (if any) in the role played by collaborative structures in COP storage and/or logistics.

2. Factors related to the structure and functioning of the EU logistical network in general, such as implementation plans for the main transport corridors, and policies on transport infrastructure at EU and Member State level.

The evidence base for the analysis of factors influencing the evolution of bottlenecks was collected through both desk research and interviews with EU and national experts.

1.2.3.4 Question 3.4: Influence of bottlenecks on EU internal and external trade in COP crops

To answer this study question, a quanti-qualitative assessment of the influence of bottlenecks on EU trade in COP crops was performed.

The influence of bottlenecks for storage capacity and/or logistical infrastructure on the EU internal and external trade in COP crops was assessed in the light of:

1. the features of bottlenecks, as emerging from the replies to study questions 3.1 and 3.2;
2. the nature of the factors influencing the evolution of bottlenecks, as emerging from the reply to question 3.3;
3. the more general conditions applying in the EU agribusiness system and/or in the EU socio-economic context.

1.2.3.5 Question 3.5: Identification of solutions to overcome existing bottlenecks

Potential solutions to overcome existing bottlenecks were identified through a critical review of:

- The results of the assessments made under Themes 1, 2 and 3.
- The findings of previous research carried out in this field.
- Insights from interviews with independent experts.

Once identified, these solutions were classified according to their potential influence on trade (as assessed under study questions 3.1 and 3.4) and the time horizon of implementation (short/medium/long-term).
1.2.3.6 Question 3.6: Opportunities for future investments in storage capacity and logistical infrastructure

In order to reply to this study question, relevant funding options for the solutions to overcome existing bottlenecks identified at question 3.5 were selected among the funding options identified for storage capacity (question 1.4) and for logistical infrastructure (question 2.4).

The identification of funding options especially focused on solutions to overcome bottlenecks with high impact and strong influence on COP trade, in order to highlight the most important opportunities for future investments in storage capacity and logistical infrastructure.
2 OVERVIEW AND MAPPING UNDER THEMES 1 AND 2

2.1 Mapping of storage capacity (Theme 1)

The current total storage capacity for COP in the EU28 was quantified at around 359 million tonnes, up 20% from around 300 million tonnes in 2005. Over the same period, EU production of COP crops increased by 11%, from around 312 million tonnes to around 346 million tonnes. The increase in storage capacity was therefore greater than the increase in production, as some Member States fully or partially addressed the storage capacity shortages that they faced in 2005 (see § 3.3.2.1).

It is worth reminding that challenges deriving from limited availability of suitable data for the quantification of storage capacity in 2005 and 2015 had to be tackled through a combination of solutions, described at § 1.1.1. The different degree of completeness and precision ensured by these solutions suggests caution in the interpretation of the overview presented in this chapter. Even if figures for storage capacity at Member State, NUTS 2 and NUTS 3 region level were not “rounded”, they must in any case be interpreted as the most accurate approximation possible of the “actual” figures.

There are substantial differences in the availability of COP storage capacity at Member State level. Figure 2.1 reports the situation at national level by classes of capacity in 2015. France is by far the Member State with the largest storage capacity (around 91 million tonnes in 2015), followed by Germany (48 million tonnes) and Spain (30 million tonnes). Among the Eastern EU Member States, Poland (24 million tonnes), Romania (23 million tonnes) and Hungary (20 million tonnes) also stand out.

All 28 Member States increased their storage capacity over the observed period, albeit to a different extent. Figure 2.2 shows percentage increases at national level by size classes over the 2005-2015 period. With the only exception of Spain (which recorded a 33% increase), all the major increases were recorded in Eastern EU Member States. Bulgaria more than doubled its storage capacity, Poland increased it by around 57%, Latvia by 52%. Increases above 40% were also recorded in Greece, Sweden and Romania.

Figure 2.3 shows the distribution of storage capacity among the different NUTS2 regions in the EU28 by size class. The distribution of storage capacity in the different regions is not even. In France, Spain, Hungary and Romania most of the regions have substantial storage capacity. By contrast, the differences among regions are much more evident in Germany, Italy, Poland and the United Kingdom.

The mapping of storage capacity also allowed to identify the stages of the food supply chain at which the different facilities operate. The nearly 18 000 facilities mapped were classified to distinguish those pertaining to individual farms, those operated by farming cooperatives, those managed by operators processing COP into food/feed products, those managed by traders and wholesalers of grains and finally those operating at transportation hubs such as seaports, inland waterway ports, railway terminals and inland logistical hubs. Figure 2.4 reports the absolute value and the allocation among the above categories in the EU28, while Figures 2.5 to 2.7 detail the situation at Member State level.

Facilities at individual farm level currently account for the largest share of storage capacity in the EU (143 million tonnes / 40% of the EU total). Storage capacity at farming cooperatives is much more limited (38 million tonnes / 11% of EU total): its share on total capacity greatly varies among the different Member States, also according to the specific historical background of each of them.

---

5 The figure only refers to the storage facilities for which information on the exact location and on individual storage capacity in 2005 and 2015 was collected for the purposes of the study.
The processing industry manages around 31.5 million tonnes of storage capacity, equal to 9% of EU total. However, it should be noted that these facilities are usually the ones with the highest annual turnover of stocks, and can hence handle substantial quantities of COP crops with a relatively limited capacity.

The trading and wholesale sector was found to have a critical importance for COP storage, both in absolute terms (around 115.5 million tonnes of storage capacity) and for its share on EU total (32%). It should be noted that the annual turnover of stocks in storage facilities operated by traders and wholesalers is high (on average it is just slightly lower than in the processing stage). A substantial share of the EU production of COP and of COP imports from third countries is handled by storage facilities managed by traders/wholesalers.

Storage capacity at transportation hubs has a great strategic importance for COP trade. Such importance emerged from the replies to study questions under Theme 2 (see § 3.2), from the findings of case studies on Germany, Hungary and Romania, and was highlighted by a number of interviewed stakeholders. Although the total capacity of storage facilities at transportation hubs might seem relatively limited (around 31 million tonnes / 9% of EU total) in comparison with the other stages of the supply chain, also storage facilities at transportation hubs achieve fast turnover of stocks throughout the year. Most of the recent investments in such facilities focused not only on the expansion of storage capacity, but also on improvement of loading/unloading capacity and more in general on shortening “in transit” storage times, to achieve higher efficiency.

It is important to note that the availability of capacity for medium-long term storage in case of exceptional harvest volumes varies according to the stage of the supply chain. In other words, the pressure on the storage system from exceptional harvest volumes is not felt equally and at the same time by its different components. Most of the pressure on the storage system from exceptional harvest volumes is felt during the harvest season and in the following months. In these periods, the heaviest pressure falls on storage facilities managed by individual farms and by farming cooperatives, as these are usually the first to handle the bulk of harvested production. However, some vertically integrated agribusiness cooperatives operate mainly as processors and/or traders in a number of Member States (especially in France). These cooperatives manage significant storage capacity, including a number of storage facilities located at transportation hubs, such as ports. This storage capacity can ease some of the pressure felt by individual farmers and farming cooperatives in case of exceptional harvest volumes.

Findings from desk research, interviews with stakeholders and case studies highlighted that operators managing storage capacity in the processing and distribution stages (traders) have a strong focus on capacity utilisation and efficiency, which are achieved through fast turnover of stocks and through the use of flexible storage solutions (such as hiring multipurpose flat warehouses on an “as needed” basis). This applies even more to storage facilities located at transportation hubs (ports in particular). These facilities usually provide “transit storage” before processing or domestic and export trading: their availability to handle exceptional production volumes is therefore limited.

2.1.1 On-farm storage and storage by cooperative structures

The importance of on-farm storage by individual agricultural holdings varies remarkably among Member States (Figure 2.7). The share of on-farm storage is substantial in Finland (78% of total capacity), Greece (70%) and the United Kingdom (62%), and important in Germany (42 %). Most of these Member States have a higher presence of large agricultural holdings in the COP sector. On-farm storage capacity is also important in some Eastern EU Member States, such as Poland (67% of total capacity), Bulgaria (46%) and Romania (40%). The importance of on-farm storage is more limited in the Netherlands and especially in Italy, where the structure of the COP farming sector is more fragmented, with a prevalence of small/medium-sized holdings. On the other hand, COP storage capacity managed by farming cooperatives is rather important in these two Member States.
Farming cooperatives play an especially important role in COP storage in Austria (37% of total capacity), Germany (29%), Portugal (29%), Italy (27%) and Spain (25%). By contrast, their importance is generally very limited/negligible in most Eastern EU Member States, with the partial exception of Lithuania (34% of total capacity), Hungary, Estonia and Latvia. As for France, most cooperatives in this Member State actually operate mainly as traders/wholesalers and/or processors. The storage capacity managed by these French cooperatives was therefore counted under those categories. Part of this capacity is located at transportation hubs, and especially at some of the leading French ports handling COP traffic.

2.1.2 Storage at processing plants

In general, the share of COP storage capacity managed by processors tends to be rather limited in most Member States (Figure 2.7). It is especially limited in the Member States (e.g. France, Germany and the United Kingdom) where just-in-time (JIT) inventory management models have been implemented by leading processors (see also the reply to question 1.3 at § 3.1.3). COP storage at processing plants plays a more significant role in Member States like Belgium (29% of total capacity), Portugal (29%), the Netherlands (23%) and Italy (18%). This is mainly due to relatively limited availability of storage capacity in the agricultural sector, and/or to specificities in the structure and organisation of the COP supply chains and of procurement patterns.

2.1.3 Storage at transportation hubs and storage by traders

An important role of traders in providing storage capacity for COP (Figure 2.7) has emerged in Eastern EU Member States such as Bulgaria (49% of total capacity) and Romania (42%). It is worth observing that in these countries the former state-owned storage system has mostly been “inherited” by traders. COP storage by the trading sector is equally important in Western EU Member States such as France (56% of total capacity), Italy (32%), the Netherlands (32%) and Spain (24%).

Availability of storage capacity at transportation hubs was found to be especially important in Member States heavily relying on imports to meet internal demand (such as Spain, Portugal, Italy) and/or acting as transhipment areas (this is certainly the case of the Netherlands and of Belgium). The share of total storage capacity located at transportation hubs amounts to 30% in Portugal, 23% in Spain, and 17% in Italy; it amounts to 30% in Belgium and 27% in the Netherlands.

As already highlighted, agribusiness cooperatives operate also as traders in certain Member States (France in particular), and manage some large-scale storage facilities located at transportation hubs.

2.1.4 Graphic representation of current EU storage capacity and of its evolution

The following maps and graphs illustrate the distribution of storage capacity at national and NUTS 2 region level by size classes, and its allocation among the different stages of the supply chain.

---

6 Associations of COP producers managing storage capacity in Lithuania have been included in the “farming cooperatives” category.
7 For instance, the largest of the two grain terminals in the port of La Rochelle (the second most important French port for grain exports, behind Rouen) is operated by a French agribusiness cooperative.
8 In the case of Italy, findings from interviews highlighted that the greater importance of durum wheat milling translates into larger availability of storage capacity at milling sites. Italian durum wheat millers actually face remarkable price volatility (with increased need for strategic stock management), rely on substantial imports from third countries via marine transportation, and must implement segregation when storing durum wheat of different quality and/or origin.
Figure 2.1 – Current national storage capacity in the EU-28 Member States, by size classes

Source: Areté elaboration
Figure 2.2 – Percentage increases in national storage capacity in the EU-28 Member States, 2005-2015

- < 5%
- between 5% and 10%
- between 10% and 20%
- between 20% and 30%
- between 30% and 40%
- > 40%

Source: Areté elaboration
Figure 2.3 – Current regional storage capacity in the EU28 NUTS 2 regions, by size classes

Storage capacity (tonnes)

- No storage capacity
- < 120 000
- 120 000 – 600 000
- 600 000 – 1 200 000
- 1 200 000 – 2 000 000
- > 2 000 000

Source: Areté elaboration
Figure 2.4 – Current storage capacity at different stages of the COP supply chain and % composition

Source: Areté elaboration
Figure 2.5 – Current storage capacity for COP and allocation among the stages of the supply chain, by Member State

Source: Areté elaboration
Figure 2.6 – Storage capacity for COP and allocation among the stages of the supply chain, by Member State, 2005

Source: Areté elaboration
Figure 2.7 – Allocation of current and 2005 storage capacity for COP among the stages of the supply chain, by Member State (% shares of national total)

Current:

2005:

Source: Areté elaboration
2.2 Mapping of logistical infrastructure (Theme 2)

The mapping of logistical infrastructure for COP focuses on the European core transport infrastructure for road, rail and inland waterways (IWW). A GIS database to map the logistical infrastructure was created from data provided by DG MOVE-TENtec.

A complete EUROSTAT dataset for intermodal transportation of COP crops with the required specifications for the study - i.e. separation of COP crops into cereals, oilseed complex and protein crops; geographical detail at NUTS 2-3 level; time span 2005 – 2015 - is not available. The relevant evidence was hence collected from a combination of secondary data sources and sources of qualitative information. In addition, a dataset provided by the Joint Research Centre of the European Commission was used to map COP transport flows. However, the analysis was seriously constrained by the fact that the JRC dataset concerns the aggregate “products of agriculture, hunting, and forestry; fish and other fishing products”, in accordance to the NTS01 standard goods classification for transport statistics. This dataset hence lacks the product detail which would be needed to properly map COP transportation flows. In order to identify the relevant transport flows, additional secondary data (including import/export data) were also used.

2.2.1 Different modes of transport of COP crops and their interconnection

Transportation plays a fundamental role in the concept of logistics and constitutes one of the leading success factors in agribusiness systems by enabling a flow of agricultural goods - including COP – from agricultural holdings to final users/consumers. The terms “agricultural goods” and “agricultural products” are often used in the following sections, due to the missing distinction of data into cereals, oilseed complex and protein crops. The term COP crops and its derivatives are used where applicable.

Transportation of COP is performed by different types of transport modes: road, rail or inland waterways (IWW henceforth). In the EU, COP are usually transported in bulk via truck, rail wagon and inland vessel.

The term “bulk” refers to unpackaged goods of roughly uniform dimensions which are handled in large quantities. “Dry bulk goods” include a wide range of products, such as ores, coal and also COP. A diverse array of equipment for dry bulk handling is required, because the materials may require specialized grabs and cranes or conveyor-belt systems.

Inland waterways and railways handle almost all long-distance COP tonnage in the EU (60-70% for inland waterways, 30-40% for railways). Trucks play a marginal role in long-haul transportation of COP, and are only used in the few areas where railway and/or inland waterway networks are not very well developed, or as an emergency solution. The modal split in long-haul transportation of COP varies yearly depending on fairway conditions in IWWs. In case of low water levels, COP transportation is mostly shifted to railways in Eastern Europe (Danube River basin), while trucks can be used as an alternative in Central Europe (Rhine River basin) and wherever railway infrastructure is insufficient or lacking transport capacity.

The minimal level of service for IWW transportation requires a fairway depth of 2.5 m (low navigable water level) and a fairway width between 40 m and 80 m, depending on the curve radii.

For IWW bulk transportation of COP, compound formations of barges (“convoys”) account approximately for 60% of transported volume, pushed formations for 30%, and self-propelled barges for around 10%. Compound and pushed formations are mostly used on the Danube River, whereas self-propelled barges are most widespread on the Rhine River. As for railways, almost 100% of COP tonnage is transported via block trains, and less than 1% by wagonload freight. Transport by truck, trailer or farm tractor is solely used for short-distance transportation. The relevant modes and types of COP transportation are shown in Figure 2.8.
2.2.1.1 Road transportation

COP crop producers are usually not directly connected to the main transport infrastructures such as motorways, railways or navigable rivers/canals. For road transportation, tractors with trailers are used in the field, while on motorways COP are transported on trucks of varying capacity. The larger the capacity of the vehicle, the larger the likely economies of scale.

The numerous regulations and agreements that must be complied with while operating heavy goods vehicles in the different EU Member States (such as permissible maximum weight of vehicles, speed limitations, toll charging systems, driving time restrictions, etc.) all affect road transportation of COP.

Permissible maximum weights of trucks are applied for safety reasons and to avoid damaging roads, bridges and tunnels. Depending on the number of axles, country-specific maximum weights exist, as shown in Table 2.1.
Table 2.1 - Permissible maximum weights of trucks (tonnes) in Europe

<table>
<thead>
<tr>
<th>Country</th>
<th>Weight per non-drive axle</th>
<th>Weight per drive axle</th>
<th>Truck 2 axles</th>
<th>Truck 3 axles</th>
<th>Road train 4 axles</th>
<th>Road train 5 axles and +</th>
<th>Articulated vehicle 5 axles and +</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>26</td>
<td>36</td>
<td>40/44 (10)</td>
<td>40/44</td>
</tr>
<tr>
<td>BE</td>
<td>10</td>
<td>12</td>
<td>19</td>
<td>26</td>
<td>39</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>BG</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>26</td>
<td>36</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>HR</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>26</td>
<td>36</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>CZ</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>26</td>
<td>36</td>
<td>42/48</td>
<td>42/48</td>
</tr>
<tr>
<td>DK</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>26</td>
<td>38</td>
<td>42/56</td>
<td>42/56</td>
</tr>
<tr>
<td>EE</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>26</td>
<td>36</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>FI</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>26</td>
<td>38</td>
<td>44/76</td>
<td>42/48</td>
</tr>
<tr>
<td>FR</td>
<td>13 /12</td>
<td>13 /12</td>
<td>19</td>
<td>26</td>
<td>38</td>
<td>40/44</td>
<td>40/44</td>
</tr>
<tr>
<td>DE</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>26</td>
<td>36</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>EL</td>
<td>7/10</td>
<td>13</td>
<td>19</td>
<td>26</td>
<td>33/38</td>
<td>42</td>
<td>42/44</td>
</tr>
<tr>
<td>HU</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>25</td>
<td>36</td>
<td>40</td>
<td>40/44</td>
</tr>
<tr>
<td>IE</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>26</td>
<td>36</td>
<td>44/46</td>
<td>44/46</td>
</tr>
<tr>
<td>IT</td>
<td>12</td>
<td>12</td>
<td>18</td>
<td>26</td>
<td>36</td>
<td>40</td>
<td>40/44</td>
</tr>
<tr>
<td>LV</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>25/26</td>
<td>36</td>
<td>40</td>
<td>40/44</td>
</tr>
<tr>
<td>LT</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>26</td>
<td>36</td>
<td>40</td>
<td>40/44</td>
</tr>
<tr>
<td>LU</td>
<td>10</td>
<td>12</td>
<td>19</td>
<td>26</td>
<td>44</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>MT</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>25</td>
<td>36</td>
<td>40</td>
<td>40/44</td>
</tr>
<tr>
<td>NL</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>25</td>
<td>36</td>
<td>40</td>
<td>40/44</td>
</tr>
<tr>
<td>PL</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>26</td>
<td>36</td>
<td>40</td>
<td>40/44</td>
</tr>
<tr>
<td>PT</td>
<td>10/12</td>
<td>12</td>
<td>19</td>
<td>26</td>
<td>37</td>
<td>40/44/60</td>
<td>40/44</td>
</tr>
<tr>
<td>RO</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>25/26</td>
<td>36</td>
<td>40</td>
<td>40/44</td>
</tr>
<tr>
<td>SK</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>26</td>
<td>36</td>
<td>40</td>
<td>40/44</td>
</tr>
<tr>
<td>SI</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>25/26</td>
<td>36</td>
<td>40</td>
<td>40/44</td>
</tr>
<tr>
<td>ES</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>25/26</td>
<td>36</td>
<td>40</td>
<td>40/44</td>
</tr>
<tr>
<td>SE</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>26</td>
<td>38</td>
<td>46/64</td>
<td>48/64</td>
</tr>
<tr>
<td>UK</td>
<td>10</td>
<td>11.5</td>
<td>18</td>
<td>26</td>
<td>38</td>
<td>40/44</td>
<td>40/44</td>
</tr>
</tbody>
</table>

Source: itf-oecd.org

Each Member State has its own specifications regarding maximum loads, which result in 49 extra exceptions. The permissible weights are divergent especially for road trains, which have the highest capacities per vehicle.

One concept used for increasing efficiency of road transportation is the European Modular Systems (EMS) which uses existing loading units, the so called modules, to form longer and sometimes heavier vehicle combinations with the aim of aligning weight restrictions. These combinations can exceed the restrictions applying at Member State level. The profitability of road transportation improves with increased permitted loads. Heavier loads of up to 40 tonnes are favoured for distances of 500-700 km, while lower loads of up to 24 tonnes are most widespread for distances of 200-250 km. The EMS distinguishes heavy commercial vehicles into three classes: road class 1 with a length of 7.82 m; road class 2 with a length of 2 m x 7.82 m and 13.6 m; and road class 3 with a length of 7.82 m + 13.6 m. Class 3 vehicles, referred to as longer-heavier vehicles (LHV), and as “Eurocombi” in the EU, have a length of 25.25 m and are only allowed in Sweden and Finland. The application of the Eurocombi concept and its efficiency gains are under investigation in other EU Member States.

A typical truck-trailer combination for COP transportation is shown in Figure 2.9.
Next to permissible maximum weights of vehicles, further national restrictions apply, such as **speed limitations for trucks on motorways and highways**. Speed limitations vary within the EU, affecting cross-border transportation flows (see Table 2.2).

**Table 2.2 - Speed limitations for trucks on motorways and highways in EU Member States**

<table>
<thead>
<tr>
<th>Country</th>
<th>km/h</th>
<th>Country</th>
<th>km/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>80–100</td>
<td>Italy</td>
<td>80</td>
</tr>
<tr>
<td>Belgium</td>
<td>70–90</td>
<td>Latvia</td>
<td>80–90</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>100</td>
<td>Lithuania</td>
<td>90</td>
</tr>
<tr>
<td>Croatia</td>
<td>80</td>
<td>Luxembourg</td>
<td>90</td>
</tr>
<tr>
<td>Cyprus</td>
<td>100</td>
<td>Malta</td>
<td>60–80</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>80</td>
<td>Netherlands</td>
<td>80</td>
</tr>
<tr>
<td>Denmark</td>
<td>80</td>
<td>Poland</td>
<td>80</td>
</tr>
<tr>
<td>Estonia</td>
<td>90</td>
<td>Portugal</td>
<td>100</td>
</tr>
<tr>
<td>Finland</td>
<td>80</td>
<td>Romania</td>
<td>90</td>
</tr>
<tr>
<td>France</td>
<td>80–130</td>
<td>Slovakia</td>
<td>90</td>
</tr>
<tr>
<td>Germany</td>
<td>100</td>
<td>Slovenia</td>
<td>80</td>
</tr>
<tr>
<td>Greece</td>
<td>80</td>
<td>Spain</td>
<td>80–90</td>
</tr>
<tr>
<td>Hungary</td>
<td>80</td>
<td>Sweden</td>
<td>80</td>
</tr>
<tr>
<td>Ireland</td>
<td>80–100</td>
<td>United Kingdom</td>
<td>97–113</td>
</tr>
</tbody>
</table>

Source: transportsfriend.org

The operational implications of speed limitations for trucks must be assessed also taking into account the length of the road network per speed level class. Figure 2.10 illustrates the share of network length for three speed level classes: less than 50 km/h, between 80-100 km/h and more than 100 km/h.
Traffic congestion is a widely known phenomenon on European motorways, restricting transport flows and causing higher transportation costs. It is a key indicator for the capacity of transport systems in general, and a reason to shift freight transportation from road to rail and IWW. Table 2.3 shows the average delay per kilometre (in seconds) per Member State, for roads with a free flow speed of > 50 km/h, > 80 km/h and > 100 km/h, in three-hour moving averages.

<table>
<thead>
<tr>
<th>Country</th>
<th>&gt; 50 km/h</th>
<th>&gt; 80km/h</th>
<th>&gt; 100 km/h</th>
<th>Cost of congestion as % of GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>13.7</td>
<td>2.4</td>
<td>1.6</td>
<td>0.6%</td>
</tr>
<tr>
<td>Belgium</td>
<td>17.1</td>
<td>3.6</td>
<td>3.6</td>
<td>1.0%</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>11.5</td>
<td>2.4</td>
<td>1.9</td>
<td>0.6%</td>
</tr>
<tr>
<td>Germany</td>
<td>15.3</td>
<td>3.6</td>
<td>3.1</td>
<td>1.0%</td>
</tr>
<tr>
<td>Denmark</td>
<td>14.5</td>
<td>2.6</td>
<td>2.0</td>
<td>0.7%</td>
</tr>
<tr>
<td>Spain</td>
<td>10.4</td>
<td>2.2</td>
<td>2.2</td>
<td>0.5%</td>
</tr>
<tr>
<td>Estonia</td>
<td>12.5</td>
<td>1.3</td>
<td>1.8</td>
<td>0.8%</td>
</tr>
<tr>
<td>Finland</td>
<td>12.6</td>
<td>1.9</td>
<td>1.6</td>
<td>0.8%</td>
</tr>
<tr>
<td>France</td>
<td>13.1</td>
<td>2.3</td>
<td>1.9</td>
<td>0.9%</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>21.5</td>
<td>3.4</td>
<td>2.9</td>
<td>1.6%</td>
</tr>
<tr>
<td>Hungary</td>
<td>19.3</td>
<td>2.8</td>
<td>2.4</td>
<td>0.8%</td>
</tr>
<tr>
<td>Ireland</td>
<td>24.4</td>
<td>2.5</td>
<td>1.4</td>
<td>1.1%</td>
</tr>
<tr>
<td>Italy</td>
<td>12.8</td>
<td>2.3</td>
<td>1.7</td>
<td>1.0%</td>
</tr>
<tr>
<td>Lithuania</td>
<td>17.2</td>
<td>1.8</td>
<td>1.6</td>
<td>1.7%</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>14.1</td>
<td>4.4</td>
<td>5.1</td>
<td>0.7%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>15.6</td>
<td>4.3</td>
<td>4.5</td>
<td>0.8%</td>
</tr>
<tr>
<td>Poland</td>
<td>20.9</td>
<td>2.4</td>
<td>1.8</td>
<td>1.6%</td>
</tr>
<tr>
<td>Portugal</td>
<td>11.2</td>
<td>2.0</td>
<td>1.7</td>
<td>0.7%</td>
</tr>
<tr>
<td>Slovakia</td>
<td>15.3</td>
<td>2.8</td>
<td>2.3</td>
<td>0.5%</td>
</tr>
<tr>
<td>Sweden</td>
<td>13.9</td>
<td>1.9</td>
<td>1.6</td>
<td>0.9%</td>
</tr>
</tbody>
</table>

Source: ftp.jrc.es
For seven EU Member States (Belgium, Germany, Ireland, Italy, Lithuania, Poland and United Kingdom) traffic congestion results in costs of more than 1% of annual GDP.

Financial incentives such as toll charging systems are implemented to reduce road congestion and to promote a modal shift. Numerous Member States implement toll charging systems for road freight vehicles from 3.5 tonnes up to 40 tonnes (gross laden weight) to maintain an adequate road infrastructure. In general, either government authorities or private companies issue bonds that are later paid with the earned toll charges. Resources from bond issuing are used for the construction of roads. No road charges are required in Cyprus, Estonia, Finland, and Luxembourg. Two kinds of road pricing, usually involving an obligatory road tax, are applied in the EU: the time-based system (e.g. vignette) and the distance-based system (e.g. road toll). Road charging fees depend heavily on the route (special charges can be applied on certain sections), the emission class of the vehicle (based on EU emission standards), and type of toll charging system (time-based or distance-based). Figure 2.11 illustrates the different toll charging systems applied in the EU.

*Figure 2.11 - Different toll charging systems in the EU*

For cross-border freight transport within the EU, the logistics service providers need to consider the different toll charging systems. The related burden increases the underlying administrative effort for providing transportation services.
As for **driving time restrictions**, EU regulations (COM 561/2006) lay down rules on driving times, breaks and rest periods for drivers of trucks with a total mass exceeding 3.5 tonnes and with a maximum amount of daily driving time of 9 hours, that can be extended to 10 hours no more than twice a week. The regulations permit a maximum amount of weekly driving time of 56 hours; a maximum total accumulated driving time during any two consecutive weeks of 90 hours; a minimum daily rest of 11 hours, which can be reduced to 9 hours no more than 3 times a week. The regular weekly rest is a period of minimum 45 hours and a reduced weekly rest period of a minimum of 24 hours (COM 561/2006 Chapter II). With specific reference to COP transportation, it must be noted that **agricultural vehicles** carrying goods within a 100 km range are exempt from EU rules.

National **weekend driving restrictions** are also applied for trucks with certain load weights. These restrictions vary among countries and are also valid on public holidays and in certain periods of the year. Table 2.4 provides an overview of weekend driving restrictions per Member State and hour.

**Table 2.4 - Weekend driving restrictions per Member State and hour**

| AT | BE | BG | CY | CZ | DE | DK | EE | FI | FR | EL | HU | IE | IT | LV | LT | LU | MT | NL | NO | PL | PT | RO | SK | SI | ES | SE | UK |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 0  | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 0  | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |

Source: ajdor.co.uk

Specific exceptions covering agricultural vehicles apply, for instance, in France, Germany and the United Kingdom. These exceptions, however, are not permanent, and are implemented on a yearly basis.

In the light of the aforementioned **operational constraints** and of their **lower performance in terms of tonne-kilometres compared to freight trains and IWW vessels**, trucks are mainly used for **short-haul transportation of COP**. The economic distance also depends on the type of underlying supply chain. In the
case of international COP traffic, the economic distance for trucks greatly varies in the EU: it can reach 200 km in Central Europe and 400 km in Eastern Europe. Local COP transportation within a maximum distance of 30-50 km is often performed by farm tractors pulling trailers of different capacity. Farmers often cooperate and merge their orders and their quantities to reduce the cost of transportation of their products. Efficient long-haul transportation of large volumes of COP requires the use of transport modes with greater capacity, such as rail and inland waterway transportation.

2.2.1.2 Rail transportation

*Its better performance in terms of tonne-kilometres (Tkm) allows rail transportation to be more efficient than road transportation in long-haul moves.* Large quantities of COP crops are shipped by block trains or unit trains without being split up on route. These trains consist of numerous wagons with a volume of 80 m$^3$ each. A typical wagon used for COP transportation is the “TADS” type “covered hopper”. An example of “TADS” wagon is presented in Figure 2.12. Thousands of such rail wagons are used for transporting COP especially from Eastern Europe to the main ports in Central Europe for export. These wagons are generally rather old, amortised and only require maintenance efforts, resulting in low transport costs.

![Figure 2.12 - Typical agricultural transport wagon (“covered hopper”)](image)

Source: Own illustration

Rail transportation in Europe is characterized by its diversity of operational conditions at national and even regional or individual operator level, with both technical and infrastructural restrictions hindering interoperability. **Infrastructural restrictions** can derive from, for instance, limited availability of double track lines or different gauges. Europe inherited a diversity of gauges. Most railway systems in the EU use the standard gauge of 1 435 mm; therefore, gauge is not a concern for most trans-European railway traffic. However, some railway systems use broad gauge: this is the case in the Baltic States, which act as a crossover to the Russian railway system. In addition, extensive narrow-gauge railway networks still exist in Spain, Switzerland, Austria, Germany and Eastern Europe.

---

9 Single wagon transport solutions present serious operational (e.g. slow release of wagons at the point of loading) and economic (i.e. they are resource and cost intensive) drawbacks, and are hence rarely used for COP transportation. Roll-on/Roll-off (RoRo) transportation through rolling highway and/or combined transport is also seldom used for COP. Although the use of containers is widespread in freight transportation, their use for COP transportation in the EU is very limited. The main reasons are expensive handling from upright loading and the need to seal the container to prevent grains from spilling over. In the case of COP transportation, the bulk load and the substantial volumes to move favour the use of transport modes with large capacities.
Rail networks in Western and Central Europe are usually well developed and well maintained. In contrast, Eastern, Northern and Southern Europe rail networks often offer a more limited coverage and/or are affected by infrastructural problems. However, the Western and Central European railway infrastructure is already heavily used by freight transport, which also competes with heavy passenger traffic. Competition with higher priority freight and passenger traffic poses challenges to rail transportation of COP crops.

Moreover, legal restrictions such as the maximum permitted train length (as shown in Figure 2.13) also impede seamless transportation flows. The maximum permitted train length is an important factor in train interoperability, and has a significant impact on COP transportation by rail. In terms of general cost calculations, the longer the train, the larger the tonnage moved, and the lower the transportation cost per tonne. If, for instance, a complete train of COP crops is sent from Germany to Italy, either the train cannot operate with the maximum permitted length applying in Germany, or a transhipment of wagons on another train is required before crossing the national border between Austria and Italy. Transhipments due to different national regulations increase the overall transportation time and result in additional handling costs. If the maximum permitted length varies among Member States, there is a trade-off between avoided transhipment costs and relatively higher transportation costs from using shorter trains.

Figure 2.13 – Maximum permitted train length in EU Member States

Railway electrification systems differ within the EU on a regional level. Electrified railway networks in the EU operate with six different voltages, varying from 750 volts to 25 000 volts. If a locomotive does not support a
railway electrification system, it must be replaced by another with such capability\(^\text{10}\). Relatively short sections of non-electrified railway lines - the so called “diesel islands”, where electric locomotives cannot be used – also exist on a number of EU key rail routes. Also signalling and traffic management systems\(^\text{11}\) vary from country to country, further hindering cross-border traffic. There are more than 20 train control-command systems across the EU, but they are not interoperable. Each train must be provided with at least one functioning system to ensure safe driving. In order to standardise signalling and control systems, the European Rail Traffic Management System (ERTMS) has implemented the European Train Control System (ETCS), aimed at replacing the many incompatible safety systems currently used by European railways. Different electrification, signalling and traffic management systems, together with the presence of non-electrified sections, hinder interoperability, increase transportation times and generate additional costs because of the need for traction changes\(^\text{12}\).

In many EU Member States, large quantities of goods are transported by rail, which has the advantage of generally being cheaper than road transportation especially in long-haul moves. Nevertheless, a serious disadvantage of rail transportation are the often unavoidable moves by truck to the departure terminal, and from the destination terminal to the final customer. Road transportation, by contrast, provides a seamless door-to-door service. Rail transportation of agricultural goods - including COP - has disadvantages also vis-à-vis inland vessels. The most serious drawback of rail transportation are the aforementioned limitations in interoperability.

2.2.1.3 Inland waterways transportation

IWW transportation has the highest transport performance in terms of tonne-kilometres and the best relative energy efficiency compared to road and rail transportation. IWW vessels can be divided into three types according to the combination of their propulsion systems and cargo holds: the self-propelled vessels (motor cargo vessel), the tugs that pull multiple barges and the pushed convoys.

**Barges** are generally used for low-value bulk items, as the cost of hauling goods by barge is very low. However, load capacities can be fully exploited only where waterway depth is sufficient. The most common European barge measures 76.5 by 11.4 meters and can carry up to about 2 450 tonnes. The typical barge used for COP transportation can carry up to about 1 400 tonnes of cargo, i.e. the equivalent to 14 rail wagons (100 t) or 56 trucks (25 t).

**Dry cargo vessels** are used for transporting a wide variety of goods, including grains. Dry cargo vessels and self-propelled dry cargo vessels account for almost 75% of the European fleet. This type of vessel can carry between 1 000 and 2 000 tonnes of agricultural goods.

**Barge convoys** (pushed convoys, coupled formations and pushed-coupled convoys) are mostly used to transport agricultural goods on the Danube, while self-propelled cargo vessels only account for a small share of transport volume. On the Rhine, the ratio of convoys to self-propelled cargo vessels is almost reversed. About 75% of the European IWW fleet is under the flag of Member States crossed by the Rhine.

**Pushed convoys** consist of a pusher (motorized towboat used for pushing) and at least one pushed lighter or pushed barge that are firmly attached to the pushing unit. Pushed convoys have substantial bulk freight

\(^{10}\) The rail network in the South-East of France, for instance, has four different voltages. Locomotives travelling through this region are hence required to cope with multiple electrification systems, otherwise they must be changed.

\(^{11}\) Rail traffic management systems are aimed at enabling safe and efficient operation of trains on railway infrastructure.

\(^{12}\) For instance, a freight train travelling from Bulgaria to the Port of Antwerp in Belgium has to change the locomotive four times: the first and second time for transit at the borders of Serbia due to law restrictions (Serbia is not an EU Member State); the third change is at the border with Germany due to a different voltage and the fourth change at the border with Belgium, where the electric locomotive must be replaced by a diesel locomotive.
capacity\textsuperscript{13}, as shown in Figure 2.14, which provides an overview of the main features of the different IWW Vessel classes. Figure 2.15 shows a pushed convoy on the Danube River with a capacity of 10 000 tonnes.

Figure 2.14 - Classification of European IWW vessels and combinations according to Resolution NO 92/2 of the European Conference of Ministers of Transport

<table>
<thead>
<tr>
<th>Type of propelled</th>
<th>Designation</th>
<th>Maximum length (m)</th>
<th>Maximum beam (m)</th>
<th>Draught (m)</th>
<th>Tonnage (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Barge</td>
<td>38.5</td>
<td>5.05</td>
<td>1.80-2.0</td>
<td>250-400</td>
</tr>
<tr>
<td>II</td>
<td>Kampfner-Barge</td>
<td>50-55</td>
<td>6.6</td>
<td>2.50</td>
<td>400-650</td>
</tr>
<tr>
<td>III</td>
<td>Gustav Konigs</td>
<td>67-80</td>
<td>8.2</td>
<td>2.50</td>
<td>650-1 000</td>
</tr>
<tr>
<td>IV</td>
<td>Gross Finn</td>
<td>41</td>
<td>4.7</td>
<td>1.40</td>
<td>180</td>
</tr>
<tr>
<td>V</td>
<td>BM-500</td>
<td>57</td>
<td>7.5-9.0</td>
<td>1.60</td>
<td>500-630</td>
</tr>
<tr>
<td>VI</td>
<td>67-70</td>
<td>8.2-9.0</td>
<td>1.60-2.0</td>
<td>470-700</td>
<td></td>
</tr>
</tbody>
</table>

Source: EC Resolution NO 92/2

Figure 2.15 – Pushed convoy of barges with a capacity of 10 000 tonnes on the Danube River

Source: viadonau.org (published with permission)

\textsuperscript{13} For instance, a convoy formed by four (non-motorised) pushed lighters can transport between 9 600 and 18 000 tonnes of cargo on a waterway of Class IVc. A pushed convoy with four lighters can transport around 7 000 t of COP on the Danube from Passau on the German/Austrian border to the Black Sea. 280 trucks (each with a capacity of 25 net tonnes) or 175 rail wagons (each with a capacity of 40 net tonnes) would be needed to reach the same transport capacity. Even larger convoys of up to nine lighters can transport COP crops on the Central and Lower Danube. The most important rule for the formation of pushed convoys is to combine the pushed units in such a way to minimise water resistance when the convoy is in motion. Sufficient stop and manouevre conditions must also be ensured (e.g. when navigating downstream).
The advantage for IWW in long-haul bulk transportation of COP derives from a combination of factors: large loading capacity compared to trucks and railway wagons; absence of time restrictions (such as weekend driving bans, traffic jams, etc.); absence of costly transit permits in international transport, differently from rail transport; no need for complex route planning and infrastructure (signal lights, tunnels, bridges, etc.); all combined with a better environmental performance (Rudi et al. 2017).

2.2.2 Role, function and costs of transport of COP crops

COP crops harvested at farm level are either stored on site or transported to nearby storage facilities, mostly by truck or farm tractor and trailer. The COP logistic chain continues with the pre-haulage process via land transportation (predominantly by road) to a key logistical hub, where COP crops are transshipped on the transport mode used for main haulage. COP crops can be loaded onto a barge at an IWW port, or on a block train at a road-to-rail terminal. Trucks are generally preferred for direct short-haul moves from COP cultivation areas to local customers, whereas rail and/or IWW transportation are only relevant for long-haul moves. COP are a relatively low-value product which is transported in large amounts as bulk freight. The cheapest long-haul transport solutions for distances beyond 300 km are offered by IWW. In this distance range, IWW competes with rail, which is competitive with road for distances beyond 270 km. It should be noted that the break-even distance for modal choices varies from country to country: especially in Eastern EU Member States, long-haul transportation by truck can reach more than 500 km. The other transport modes can rarely compete with road transportation on distances of less than 100 km. In any case, the definition of break-even distances is case-specific rather than universal, and depends on individual business conditions and on the requirements of the shipper (Rudi et al. 2015). After the main haulage, COP are discharged and stored at a port or at a rail-to-road terminal. The post-haulage usually continues with road transportation to the final customer’s storage facilities. The COP transportation chain includes a number of operations and intermodal journeys, as well as several unloading/loading processes, as presented in Figure 2.16.

The main actors within the COP transportation chain are producers/processors, transport service companies such as 3rd party logistics providers (3PL), traders, freight forwarders, transportation administration units and authorities such as port operators (see Figure 2.17).
Figure 2.16 – Logistics of a classic agricultural supply chain in international trade

The transport system includes a number of operations:
1. sea/rail voyage; 8 movements to/from storage;
2. ship/train loading operation; 1 ship/rail discharge;
3. land journeys; 1 land loadings; 1 land unloadings

Objective 1: Use biggest vehicle possible
Objective 2: Use most efficient cargo handling
Objective 3: Make systems compatible
Objective 4: Keep stocks as small as possible

Source: Adapted from www.skuld.com – Transportation of Wheat

Figure 2.17 – Illustration of actors involved in the COP transportation chain
Seven **types of intermodal supply chains for COP** can be identified, with the two most prominent types applied in the EU for export to third countries highlighted in bold:

1. **Field-(Road)-Storage-(Road)-Railway-Port-Customer (international level)**
2. **Field-(Road)-Storage-(Road)-IWW-Port-Customer (international level)**
3. Field-Storage-Road-Port-Customer (regional level)
4. Field-Road-Port-Customer (regional level)
5. Field-Road-Customer (local level)
6. Field-Road-Rail-(Road)-Customer
7. Field-Road-IWW-(Road)-Customer

The first and the second type of intermodal supply chains are usually characterised by long distances and are found in international COP traffic connecting Eastern EU cultivation areas with the main EU seaports handling COP, such as the "ARA" ports (Amsterdam, Rotterdam and Antwerp).

Types 3 and 4 are characterised by a relatively short distance between cultivation areas and ports at regional level, whereas type 5 is applied at local level. Types 6 and 7 are comparable to Types 1 and 2 but lack in-transit storage processes.

Due to seasonality of COP crop production, the storage process is an essential component in COP trading, which takes place year-round. Besides the obvious influence of the seasonality of COP crop production, volatile conditions in the market of COP crops especially affect the transportation sector, leading to fluctuating transport service demand (this was confirmed by several interviews with agricultural transportation experts). Upon finalisation of the sale of a certain volume of COP crops, the parties usually agree also on the timing and conditions of the related logistical processes. Transport service providers are then reviewed and selected to transport the goods.

Four key aspects are considered in the **planning of transportation processes**:

1. **Transport route.** Transport service is defined by the transport route, which is the most important cost factor from the service provider’s perspective.
2. **Timing.** The demand for transportation services varies over time. As changes in demand translate into variations in the price of transportation services, traders must choose the right timing to sell or buy products, but also to arrange the related transportation processes.
3. **Size, capacity and location of storage facilities.** The technical features of each storage facility and of its loading/unloading machinery have an influence on the timing of handling processes. The location of the storage facility has an influence on its access to transportation infrastructure, and is hence a major factor in the choice of transport services.\(^\text{14}\)
4. **Shipment quantity.** Bulk freight such as COP is often subject to volume discount rates: the larger the quantity to be transported, the lower the related transportation costs.

Logistic costs for COP include tariffs for transportation, handling and storage costs and the margins of each actor in the logistic chain. Costs and rates depend on the type of COP crops, on the type of operation, on energy efficiency of transportation services, on transportation distance and on other factors.

**Tariffs for transportation**

- Tariffs for transportation depend on the distance to cover.
- Truck transportation of oilseeds is more expensive than that of cereals. Unlike cereals, oilseeds (especially sunflower seeds and soybeans) have a more heterogeneous shape and bigger size, which result in different requirements for truck transportation. The above features affect the bulk density,

\(^\text{14}\) For instance, many storage facilities in Eastern Europe tend to be scattered in rural areas. This implies that access to the core rail routes can only be achieved through secondary railway infrastructure.
which is lower for oilseeds than for cereals (empty spaces among seeds are wider), and results in higher transport costs per weight unit for oilseeds, as a wider space is needed (Kaltschmitt et al., 2016).

- COP producers and traders typically deal with truck carriers directly. Tariffs depend on travel distance, on transport volume, on the scale of carriers and on their relationship with shippers, etc. Large carriers tend to be less flexible in setting their tariffs, while smaller ones often offer reduced rates.
- COP producers and traders rarely deal directly with railway companies: railway freight forwarding companies usually act as intermediaries. Railway tariffs and other additional payments are included in the final rate, which varies with the distance.
- There is no fixed tariff for handling agricultural products at ports. All the related payments are integrated in a single rate.

Cost of handling services

- Various services are often provided at storage facilities and logistical hubs. These include unloading, cleaning, drying, storage, checking and loading for further transhipment and transportation processes.
- Loading and unloading as well as cleaning are relatively inexpensive operations, whereas pre-processing, drying and storage are the most expensive operations.
- Logistical cost structure depends on the type of intermodal supply chain and covers the following cost drivers:

<table>
<thead>
<tr>
<th>Direct cost drivers</th>
<th>Indirect cost drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm gate price</td>
<td>Staff costs</td>
</tr>
<tr>
<td>Transport from field to pre-processing facility (e.g. elevator)</td>
<td>Capital costs</td>
</tr>
<tr>
<td>Receiving at pre-processing facility</td>
<td>Insurance costs</td>
</tr>
<tr>
<td>Pre-processing (cleaning, drying, etc.)</td>
<td>Maintenance and repair costs</td>
</tr>
<tr>
<td>Storage</td>
<td></td>
</tr>
<tr>
<td>Unloading/loading</td>
<td></td>
</tr>
<tr>
<td>Certificates (quarantine and genetically modified (GM) content certificate, where relevant)</td>
<td></td>
</tr>
<tr>
<td>Freight forwarding</td>
<td></td>
</tr>
<tr>
<td>Transport to the port</td>
<td></td>
</tr>
<tr>
<td>Receiving at the port</td>
<td></td>
</tr>
<tr>
<td>Freight forwarding and shipping</td>
<td></td>
</tr>
<tr>
<td>Fumigation</td>
<td></td>
</tr>
<tr>
<td>Checking/surveying</td>
<td></td>
</tr>
<tr>
<td>Fuel costs</td>
<td></td>
</tr>
<tr>
<td>Charging of infrastructure utilization</td>
<td></td>
</tr>
</tbody>
</table>

Costs for transportation and handling services vary among EU Member States. The extent of the variation can be assessed by comparing hourly earnings in the transport sector (see Figure 2.18). Depending on the chosen transport mode and the overall transportation cost, the share of costs for personnel might differ among
Member States. Salaries in the transport sector vary to a great extent in the EU, and depend on requirements such as language speaking capabilities\(^\text{15}\).

\textbf{Figure 2.18 – Hourly earnings in the transport sector per EU MS in 2014}

\begin{table}[h]
\centering
\begin{tabular}{lcccccccccccccc}
\hline
\hline
\hline
\end{tabular}
\end{table}

\textit{Source: Eurostat: earn_ses14_13}

Terminal costs

A terminal is any location where freight (and passenger) traffic originates, terminates, or is handled in the transportation process. Terminals often require specific facilities and equipment to manage the traffic they handle. Terminals may also be points of interchange involving the same mode of transport. Besides facilities to manage ship, truck and train traffic, a very wide range of handling gear is needed at terminals. COP handling requires the availability of specific loading and unloading equipment at terminals. In most cases, storage is needed at least for a short period before and/or after loading. Terminals have hence to be equipped with storage facilities, which provide “in-transit” storage.

Terminal costs translate into fixed transportation costs - as they are independent of travel length - and are an important component of the total transportation cost. Terminal costs vary significantly among transportation modes. Terminal costs include:

- **Infrastructure costs**: building and operating costs of infrastructure such as piers, rails, parking areas, handling equipment, storage facilities, offices etc.
- **Transhipment costs**: costs of loading and unloading freight.
- **Administration costs**: costs incurred for managing the terminal.

As illustrated before, IWW vessels have a larger freight capacity than trains or trucks. As the loading and unloading of a vessel can even take days, the largest terminal costs are incurred in IWW transportation. By contrast, a truck can be loaded more quickly, and hence the terminal costs for road transportation are the lowest. Since terminal costs play an important role in determining the competitive position between transportation modes, IWW and rail are not suitable for short-haul transportation. The switch to fuel-efficient and higher-capacity vehicles, and/or to smaller train or vessel crews, is aimed at reducing transportation costs

\(^{15}\) For instance, a locomotive driver in Belgium must be able to speak three languages fluently, whereas in Eastern Europe no language requirements exist: this further disturbs communication in providing international rail transport services.
and at increasing the competitiveness of different transport modes. However, unless terminal costs are also reduced, the benefits would not be fully achieved. For instance, potential economies of scale in water transportation achieved by larger and more fuel-efficient vessels would be reduced if it took longer to load and unload these vessels.

### 2.2.3 Logistical infrastructure for COP crops

The analysis of the logistical infrastructure for COP crops is based on general information on the EU transport corridors and on the processing of GIS data to map the corridors which are relevant for COP crops. The analysis is aimed at identifying and describing the main corridors for COP transportation in the EU. The analysis of different modes for COP transportation was combined with the analysis of the main COP transport corridors in the EU to estimate the related transport flows with the highest possible detail. The level of detail is limited by the availability of suitable quantitative data on traffic flows and of relevant qualitative information in the reviewed literature.

**EU data on road and rail transportation of COP crops at NUTS-to-NUTS level are not available, as they are considered as confidential according to EU dissemination rules. Data for COP transportation at NUTS 2/3 level are available up to 2007 only. Data for road transportation according to standard goods classification for transport statistics NSTR24 – differentiating “01 Cereals” from “07 Oil seeds and oleaginous fruits and fats” - are available at NUTS 3 level up to 2007 only. Railway transportation data at NUTS 2 level cover all goods. In an attempt to map COP transportation flows by road and rail, a dataset provided by the Joint Research Centre (JRC) of the European Commission was used. However, the analysis of relevant traffic flows was seriously constrained by the fact that the JRC dataset concerns the aggregate “products of agriculture, hunting, and forestry; fish and other fishing products” (NTS01 standard goods classification for transport statistics). Further details on the JRC dataset and on the related limitations are provided in the illustration of the results of the analysis.**

**Identification and illustration of the main EU transport corridors**

The current state of road (§ 2.2.3.1), inland waterways (§ 2.2.3.2) and railway transportation (§ 2.2.3.3) is investigated to provide an overview of the core European logistical infrastructure used for COP transportation.

#### 2.2.3.1 Road transportation

There is no official classification for trucks used to transport COP. It is hence difficult to estimate the availability of road transport services for COP in the EU. The investigation mainly focused on structural aspects such as motorway density and distribution of rail-to-road (RR) terminals. Road traffic flows of agricultural goods (including COP) were also analysed.

The EU road transportation network has a higher density in Western Europe and a lower density in Eastern Europe. In order to increase network density, major thoroughfares are upgraded and/or new ones are constructed.

The GIS map at Figure 2.19 shows the core network of EU road transportation and the distribution of the 218 RR terminals.
The EU road network is under continuous development. Especially the Eastern EU Member States have increased motorway length in recent years. The four Member States with the highest increases in motorway length are Romania, Poland, Bulgaria and Hungary.

The construction of more than 1,000 km of additional motorways is planned in the EU in upcoming years. Figure 2.20 provides an overview of the length of planned motorways in EU Member States.

16 The longest planned routes can be found in Poland between Tarnow and Rzeszow (E040 / 136 km); in Romania between Simeria and Sebes (E068 / 46 km); in Croatia between Zagreb and Ivanic-Grad (46 km). Construction of several shorter stretches is planned in Slovakia.
To assess the road infrastructure at regional level, the motorway length must be compared to the land area in order to define the motorway density. The motorway density is an indicator allowing the identification of disproportions at regional level. NUTS 2 regions with the highest density of motorways are found in Central Europe (Table 2.5).

**Table 2.5 – NUTS 2 regions with the highest density of motorways**

<table>
<thead>
<tr>
<th>NUTS 2</th>
<th>Region</th>
<th>Area [km²]</th>
<th>km</th>
<th>Density [1000*km/km²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEA1</td>
<td>Düsseldorf</td>
<td>5 293</td>
<td>649</td>
<td>122.60</td>
</tr>
<tr>
<td>NL31</td>
<td>Utrecht</td>
<td>1 449</td>
<td>176</td>
<td>121.47</td>
</tr>
<tr>
<td>NL33</td>
<td>Zuid-Holland</td>
<td>3 237</td>
<td>361</td>
<td>111.54</td>
</tr>
<tr>
<td>NL41</td>
<td>Noord-Brabant</td>
<td>5 083</td>
<td>505</td>
<td>99.34</td>
</tr>
<tr>
<td>NL42</td>
<td>Limburg (NL)</td>
<td>2 212</td>
<td>212</td>
<td>95.84</td>
</tr>
</tbody>
</table>

Source: Eurostat: tran_r_net

NUTS 2 regions with the lowest density of motorways are mainly located in Eastern EU Member States (Table 2.6).

**Table 2.6 – NUTS 2 regions with the lowest density of motorways**

<table>
<thead>
<tr>
<th>NUTS 2</th>
<th>Region</th>
<th>Area [km²]</th>
<th>km</th>
<th>Density [1000*km/km²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR52</td>
<td>Bretagne</td>
<td>27 485</td>
<td>50</td>
<td>1.82</td>
</tr>
<tr>
<td>PL12</td>
<td>Mazowieckie</td>
<td>35 562</td>
<td>63</td>
<td>1.77</td>
</tr>
<tr>
<td>RO11</td>
<td>Nord-Vest</td>
<td>34 157</td>
<td>52</td>
<td>1.52</td>
</tr>
<tr>
<td>PL42</td>
<td>Zachodniopomorskie</td>
<td>22 451</td>
<td>25</td>
<td>1.11</td>
</tr>
<tr>
<td>BG31</td>
<td>Severozapaden</td>
<td>19 068</td>
<td>7</td>
<td>0.37</td>
</tr>
</tbody>
</table>

Source: Eurostat: tran_r_net

**Rail-to-Road (RR) terminals** enable the modal shift from rail to road and vice versa. The number of RR terminals in comparison with land area is presented by Member State in Figure 2.21. The high density of terminals in Germany - the Member State crossed by the most important transit traffic flows – stands out.
Figure 2.21 – Number of Rail-to-Road terminals in comparison to land area (km$^2$), by Member State

![Number of Rail-to-Road terminals in comparison to land area (km$^2$), by Member State](image)

Source: DG MOVE-TENtec. Eurostat

Road transportation of COP crops

Figure 2.22 illustrates the evolution of road transportation of dry bulk freight - which in most statistical databases also includes COP crops - in the top five EU Member States from 2005 until 2015.

Figure 2.22 – Road transportation of dry bulk freight (including COP) in the 5 Member States with the highest deviation, 2005 - 2015

![Road transportation of dry bulk freight (including COP) in the 5 Member States with the highest deviation, 2005 - 2015](image)

Source: Eurostat: road_go_ta_tcrg
A significant increase of dry bulk transportation by road is evident for Poland and Austria, whereas a decline is observed for Romania and Portugal.

Road transportation of agricultural products can be divided into two components:

- The first component is the initial transportation from the field to the first storage or pre-processing facility.
- The second component is the transportation from storage facilities to destination (either local customers or ports for export).

Transportation from fields to the first storage facility is done by truck only (usually in smaller trucks). Transportation from the first storage facility to the final destination can be done by rail and/or inland waterway and/or road (usually in larger trucks).

To observe the evolution of COP transportation by truck, national road transportation of cereals and oilseed complex by distance class for 2005 and 2015 is illustrated in Figures from 2.23 to 2.26. An overall decrease in the distance class “less than 50 km” and an increase in the distance class “from 50 to 149 km” can be observed between 2005 and 2015. The difference is particularly substantial in Spain. The shortest distance class is prominent in both reference years for France. In Eastern EU Member States, road transportation of cereals and oilseeds has increased significantly. A sharp increase in road transportation of oilseeds between 2005 and 2015 is evident in Germany, and can be explained by the policy of incentives to biodiesel production. Another significant increase for long-haul transportation of oilseeds can be observed in the United Kingdom.

GIS maps at Figures from 2.27 to 2.30 represent the difference between loaded and unloaded volumes of COP at NUTS 3 region level for road transportation. A negative value identifies the regions where COP are prevalently unloaded from trucks, whereas a positive value identifies the regions where COP are prevalently loaded on trucks. Prevalence of loading identifies regions which are mainly the origin of COP traffic flows, i.e. the main cultivation areas. Prevalence of unloading identifies regions which are mainly the destination of COP traffic flows, i.e. those with the highest density of COP processing facilities, and those where seaports are located. A more balanced loading/unloading ratio identifies regions where both COP cultivation and COP processing are present and/or regions where important inland transhipment hubs (road-to-rail or road-to-IWW terminals) for COP are located. To describe COP road traffic flows, however, a relationship between a defined origin and a defined destination must be established. This relationship is described at the end of this paragraph (see maps at Figures 2.31 and 2.32).

The regions highlighted by red shades in the maps are the main unloading areas. The Port of Le Havre in Northern France (FR232) stands out as an important unloading location for road transportation of cereals. The Port of La Rochelle in Western France (FR532) and the metropolitan region of Prague in the Czech Republic are key areas with a prevalence of oilseed unloading from trucks.

According to Eurostat data\(^\text{17}\), road transportation of agricultural products accounted for a 9% share of the total volume of road freight transportation in 2015. The smaller the distance, the larger the share of truck transportation of agricultural products. The economically viable distance of road delivery ranges between 100 km and 300 km, depending on fuel efficiency of vehicles. For journeys at longer distances (over 300 km), road transportation is increasingly substituted by more cost-efficient and environmentally friendly transportation modes such as rail or IWW, wherever the required infrastructure is available.

\(^{17}\) Except where otherwise noted, Eurostat data used in the study are referred to the aggregate “products of agriculture, hunting, and forestry; fish and other fishing products” according to NST07 standards goods classification GT01.
Figure 2.23 – National road transportation of cereals by distance class in 2005 (000 tonnes)

Source: Areté elaboration based on Eurostat: road_go_na_dctg; road_go_na7dctg

Figure 2.24 – National road transportation of cereals by distance class in 2015 (000 tonnes)

Source: Areté elaboration based on Eurostat: road_go_na_dctg; road_go_na7dctg
Figure 2.25 – National road transportation of oilseed complex by distance class in 2005 (000 tonnes)

Source: Areté elaboration based on Eurostat: road_go_na_dctg; road_go_na7dctg

Figure 2.26 – National road transportation of oilseed complex by distance class in 2015 (000 tonnes)

Source: Areté elaboration based on Eurostat: road_go_na_dctg; road_go_na7dctg
Figure 2.27 – National annual road transportation in terms of loading minus unloading quantities for cereals, by NUTS 3 regions, 2005 (000 tonnes)

Source: Areté elaboration based on Eurostat data: road_go_na_rl3g; road_go_na_ru3g
STUDY ON STORAGE CAPACITIES AND LOGISTICAL INFRASTRUCTURE FOR EU AGRICULTURAL COMMODITIES TRADE (with a special focus on Cereals, the Oilseed Complex and Protein Crops (COP))

Final Report

Figure 2.28 – National annual road transportation in terms of loading minus unloading quantities for cereals, by NUTS 3 regions, 2015 (000 tonnes)

Source: Areté elaboration based on Eurostat data: road_go_na_rl3g; road_go_na_ru3g
Figure 2.29 – National annual road transportation in terms of loading minus unloading quantities for oilseed complex, by NUTS 3 regions, 2005 (000 tonnes)

Source: Areté elaboration based on Eurostat data: road_go_na_rl3g; road_go_na_ru3g
Figure 2.30 – National annual road transportation in terms of loading minus unloading quantities for oilseed complex, by NUTS 3 regions, 2015 (000 tonnes)

Source: Areté elaboration based on Eurostat: road_go_na.rl3g; road_go_na_ru3g
In order to map the actual traffic flows of COP by road, a dataset provided by the Joint Research Centre of the European Commission was used. The dataset contained data on transport flows between origin and destination regions at NUTS 2 level, according to the standard goods classification for transport statistics NST01 “Products of agriculture, hunting, and forestry; fish and other fishing products” (referred to as “agricultural goods” henceforth for sake of conciseness). The reference to such a wide and composite aggregate of products posed significant limitations to the use of the dataset in the analysis of COP transportation flows. Substantial volumes of a large variety of agricultural goods other than COP (forestry products, liquid milk, fruits and vegetables for processing and for direct consumption, sugar beets, etc.) are actually transported by truck in both national and international traffic. The following considerations should hence be taken with caution. Wherever possible, qualitative elements based on the study team’s expertise are provided for a correct understanding of the traffic maps and of the underlying data.

In the traffic maps at Figures 2.31 and 2.32, flows are represented by lines connecting the origin and the destination regions: the direction of the flows is indicated by black arrows. The size of transported volumes is visually illustrated by the thickness of the lines. NUTS 2 regions that are primarily origins or destinations are highlighted by different colours, to distinguish them from regions with a more balanced split between inbound and outbound traffic. Traffic flows below a 10 000 tonnes per year volume threshold were not considered in the analysis.

Figure 2.31 shows the 25 main international road transportation flows of agricultural goods in the EU between NUTS 2 regions. The most prominent international road transportation flows of agricultural goods in the EU are related to moves to or from the regions hosting the ARA-Ports (ports of Antwerp, Rotterdam and Amsterdam). This is consistent with the role of Belgium and the Netherlands in intra- and extra-EU trade of COP (see the reply to Question 2.1 at § 3.2.1), albeit with the caveat that such flows are likely to concern a much wider variety of products.

Some international road transportation flows are rather short ranged (e.g. those in Eastern Europe, as well as some flows linking together a number of regions of Belgium, the Netherlands, North-Western Germany, and Northern France). With the caution suggested by the already underlined limitations, these short-range flows can in part be related to “feeder” moves towards large grain processing plants or COP transhipment terminals on inland waterways. Further flows originating from and/or terminating in the West-Vlaanderen region of Belgium and the Haute Normandie region of France can in part be related to COP transportation to and from the ports of Bruges-Zeebrugge and Gent (Belgium) and Rouen (France).

Also considering the results of the analysis of COP trade (see the reply to Question 2.1 at § 3.2.1), some important international road transportation flows of agricultural goods represented in Figure 2.31 are unlikely to concern significant volumes of COP. This is especially the case of traffic flows originating in Southern Spain, which are likely to include a substantial share of fruits and vegetables.

It is important to note that in road transportation of agricultural goods, the tonnage of international flows (and especially of long-range ones) is much smaller than the tonnage of national flows. This is consistent with the fact that long-haul transportation by truck is generally used for valuable and/or perishable goods (e.g., fresh fruit and vegetables, wine, olive oil, etc.), which require faster transit times and which can justify the higher transportation costs. As seen at § 2.2.1 and § 2.2.2, long-haul moves of COP crops by truck are not so common.

Even with its limitations, the analysis of international road transportation flows of agricultural goods highlights a number of routes characterised by heavy traffic, and hence provides useful information on potential bottlenecks in the concerned infrastructure, which may also affect COP transportation (see the reply to Question 3.1 at § 3.3.1). In particular, the concentration of traffic flows in the BeNeLux area (i.e. in the hinterland of ARA ports) and in Northern France (port of Dunkerque) already indicates potential infrastructural capacity bottlenecks.
National road transportation flows of agricultural goods are much more substantial than international ones (see Tables 2.7 and 2.8), and are likely to feature a larger share of COP tonnage. As underlined at § 2.2.1 and 2.2.2, short-haul transportation of COP crops by truck is much more common than international long-haul transportation. However, according to the origin and destination NUTS 2 regions concerned, inter-regional national road traffic may also concern substantial volumes of forestry products, milk, fruits and vegetables (for processing or for direct consumption), liquid milk and sugar beets.

The 100 largest national road transportation flows of agricultural goods are shown in Figure 2.32. The heaviest traffic is concentrated in Northern Italy, with flows reaching up to 3 million tonnes per year (Emilia-Romagna → Lombardia and Veneto). Road transportation of agricultural goods has historically prevailed in Northern Italy. The location and size of many COP processing plants in Northern Italy (several of them are located close to the borders between regions) contributes to determine the observed patterns of inter-regional road traffic among Piemonte, Lombardia, Veneto, Emilia Romagna, and Toscana regions. For Italy, it is likely that a large portion of tonnage travelling by truck from Puglia to Campania region consists of tomatoes for processing. Also durum wheat for milling travels on that route.

Heavy inter-regional road traffic of agricultural goods can also be observed in North-Western France. A rather clear pattern of flows towards the main centre of consumption (Ile de France → Paris) and towards the deep sea ports in the Nord Pass de Calais, Haute Normandie and Bretagne regions emerges.

In Germany, the inter-regional road traffic flows of agricultural goods converging towards Saxony-Anhalt from Thüringen, Braunschweig, Brandenburg, and Leipzig regions are surely constituted also by COP tonnage destined to processing plants located in the region.

Heavy inter-regional road traffic of agricultural goods between some regions of Finland and Sweden mainly concerns forestry products.
Figure 2.31 – Top 25 international road transportation flows of agricultural goods in 2015

- Top 25 road transport flows
- Transport flow direction
- Destination NUTS 2 regions
- Origin NUTS 2 regions
- Destination and origin NUTS 2 regions
- Below threshold of 10 000 tonnes

Source: Areté elaboration based on EC JRC data
## Table 2.7 – Top 25 international road transportation flows of agricultural goods in 2015

<table>
<thead>
<tr>
<th>No.</th>
<th>Origin</th>
<th>NUTS 2 region</th>
<th>Destination</th>
<th>NUTS 2 region</th>
<th>Quantity in tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NL33</td>
<td>Zuid-Holland</td>
<td>DE21 Oberbayern</td>
<td></td>
<td>295 448</td>
</tr>
<tr>
<td>2</td>
<td>BE21</td>
<td>Prov. Antwerpen</td>
<td>NL34 Zeeland</td>
<td></td>
<td>244 607</td>
</tr>
<tr>
<td>3</td>
<td>NL34</td>
<td>Zeeland</td>
<td>DK03 Syddanmark</td>
<td></td>
<td>200 050</td>
</tr>
<tr>
<td>4</td>
<td>BE25</td>
<td>Prov. West-Vlaanderen</td>
<td>FR22 Picardie</td>
<td></td>
<td>172 377</td>
</tr>
<tr>
<td>5</td>
<td>FR42</td>
<td>Alsace</td>
<td>LU00 Luxembourg (Grand-Duché)</td>
<td></td>
<td>167 822</td>
</tr>
<tr>
<td>6</td>
<td>FR21</td>
<td>Champagne-Ardenne</td>
<td>BE25 Prov. West-Vlaanderen</td>
<td></td>
<td>149 238</td>
</tr>
<tr>
<td>7</td>
<td>DEA1</td>
<td>Düsseldorf</td>
<td>TH3 Veneto</td>
<td></td>
<td>143 294</td>
</tr>
<tr>
<td>8</td>
<td>HU33</td>
<td>Del-Alfold</td>
<td>RO42 West</td>
<td></td>
<td>141 418</td>
</tr>
<tr>
<td>9</td>
<td>NL33</td>
<td>Zuid-Holland</td>
<td>DE13 Freiburg</td>
<td></td>
<td>139 846</td>
</tr>
<tr>
<td>10</td>
<td>FR22</td>
<td>Picardie</td>
<td>NL42 Limburg (NL)</td>
<td></td>
<td>139 078</td>
</tr>
<tr>
<td>11</td>
<td>LU00</td>
<td>Luxembourg</td>
<td>BE22 Prov. Limburg (B)</td>
<td></td>
<td>133 355</td>
</tr>
<tr>
<td>12</td>
<td>NL34</td>
<td>Zeeland</td>
<td>DEA4 Detmold</td>
<td></td>
<td>125 489</td>
</tr>
<tr>
<td>13</td>
<td>NL33</td>
<td>Zuid-Holland</td>
<td>LU00 Luxembourg (Grand-Duché)</td>
<td></td>
<td>121 176</td>
</tr>
<tr>
<td>14</td>
<td>NL41</td>
<td>Noord-Brabant</td>
<td>DE94 Weser-Ems</td>
<td></td>
<td>116 847</td>
</tr>
<tr>
<td>15</td>
<td>BE32</td>
<td>Prov. Hainaut</td>
<td>NL34 Zeeland</td>
<td></td>
<td>109 872</td>
</tr>
<tr>
<td>16</td>
<td>NL34</td>
<td>Zeeland</td>
<td>FR41 Lorraine</td>
<td></td>
<td>104 373</td>
</tr>
<tr>
<td>17</td>
<td>ES62</td>
<td>Región de Murcia</td>
<td>FR61 Aquitaine</td>
<td></td>
<td>102 917</td>
</tr>
<tr>
<td>18</td>
<td>FR23</td>
<td>Haute-Normandie</td>
<td>ES51 Cataluña</td>
<td></td>
<td>100 597</td>
</tr>
<tr>
<td>19</td>
<td>DEE0</td>
<td>Saxony-Anhalt</td>
<td>NL42 Limburg (NL)</td>
<td></td>
<td>87 187</td>
</tr>
<tr>
<td>20</td>
<td>ES52</td>
<td>Comunidad Valenciana</td>
<td>NL42 Limburg (NL)</td>
<td></td>
<td>86 966</td>
</tr>
<tr>
<td>21</td>
<td>SK04</td>
<td>Eastern Slovakia</td>
<td>C206 Jihovýchod</td>
<td></td>
<td>86 547</td>
</tr>
<tr>
<td>22</td>
<td>ES62</td>
<td>Región de Murcia</td>
<td>FR22 Picardie</td>
<td></td>
<td>86 262</td>
</tr>
<tr>
<td>23</td>
<td>C203</td>
<td>Jihozapad</td>
<td>AT12 Niederösterreich</td>
<td></td>
<td>86 022</td>
</tr>
<tr>
<td>24</td>
<td>ES62</td>
<td>Región de Murcia</td>
<td>NL41 Noord-Brabant</td>
<td></td>
<td>84 361</td>
</tr>
<tr>
<td>25</td>
<td>FR42</td>
<td>Alsace</td>
<td>BE32 Prov. Hainaut</td>
<td></td>
<td>77 517</td>
</tr>
</tbody>
</table>

Source: Areté elaboration based on EC JRC data
Figure 2.32 – Top 100 national road transportation flows of agricultural goods in 2015

- Top 100 road transport flows
- Transport flow direction
- Destination NUTS 2 regions
- Origin NUTS 2 regions
- Destination and origin NUTS 2 regions
- Below threshold of 10 000 tonnes

Source: Areté elaboration based on EC JRC data
### Table 2.8 – Top 100 national road transportation flows of agricultural goods in 2015

<table>
<thead>
<tr>
<th>No.</th>
<th>Origin</th>
<th>NUTS2 name</th>
<th>Destination</th>
<th>NUTS2 name</th>
<th>Quantity in tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Emilia-Romagna</td>
<td>ITF4</td>
<td>Lombardia</td>
<td>DEE0</td>
<td>3 004 700</td>
</tr>
<tr>
<td>2</td>
<td>Emilia-Romagna</td>
<td>PL52</td>
<td>Veneto</td>
<td>ITF3</td>
<td>2 996 699</td>
</tr>
<tr>
<td>3</td>
<td>Pohjois</td>
<td>FI1C</td>
<td>Etelä-Suomi</td>
<td>FI1C</td>
<td>2 528 814</td>
</tr>
<tr>
<td>4</td>
<td>Lombardia</td>
<td>FI4C</td>
<td>Emilia-Romagna</td>
<td>TH3</td>
<td>2 093 240</td>
</tr>
<tr>
<td>5</td>
<td>Veneto</td>
<td>FI5C</td>
<td>Emilia-Romagna</td>
<td>TH3</td>
<td>2 038 697</td>
</tr>
<tr>
<td>6</td>
<td>Lombardia</td>
<td>FI6C</td>
<td>Veneto</td>
<td>TH3</td>
<td>1 931 158</td>
</tr>
<tr>
<td>7</td>
<td>Piemonte</td>
<td>FI7C</td>
<td>Lombardia</td>
<td>TH4</td>
<td>1 930 638</td>
</tr>
<tr>
<td>8</td>
<td>Veneto</td>
<td>FI8C</td>
<td>Lombardia</td>
<td>TH4</td>
<td>1 871 884</td>
</tr>
<tr>
<td>9</td>
<td>Syddanmark</td>
<td>DK03</td>
<td>Middtylland</td>
<td>DK04</td>
<td>1 856 525</td>
</tr>
<tr>
<td>10</td>
<td>Middtylland</td>
<td>DK03</td>
<td>Syddanmark</td>
<td>DK04</td>
<td>1 808 379</td>
</tr>
<tr>
<td>11</td>
<td>Peloponnisos</td>
<td>EL65</td>
<td>Attiki</td>
<td>EL30</td>
<td>1 649 394</td>
</tr>
<tr>
<td>12</td>
<td>Centre</td>
<td>FR24</td>
<td>Île de France</td>
<td>FR10</td>
<td>1 548 850</td>
</tr>
<tr>
<td>13</td>
<td>Toscana</td>
<td>FI11</td>
<td>Emilia-Romagna</td>
<td>TH5</td>
<td>1 436 178</td>
</tr>
<tr>
<td>14</td>
<td>Emilia-Romagna</td>
<td>FI12</td>
<td>Toscana</td>
<td>IT11</td>
<td>1 412 139</td>
</tr>
<tr>
<td>15</td>
<td>Lincolnshire</td>
<td>UKF3</td>
<td>East Anglia</td>
<td>UKH1</td>
<td>1 398 405</td>
</tr>
<tr>
<td>16</td>
<td>East Anglia</td>
<td>UKH1</td>
<td>Lincolnshire</td>
<td>UKF3</td>
<td>1 396 311</td>
</tr>
<tr>
<td>17</td>
<td>Etelä-Suomi</td>
<td>FI13</td>
<td>Länsi-Suomi</td>
<td>FI19</td>
<td>1 349 515</td>
</tr>
<tr>
<td>18</td>
<td>Picardie</td>
<td>FR23</td>
<td>Île de France</td>
<td>FR10</td>
<td>1 346 752</td>
</tr>
<tr>
<td>19</td>
<td>Lisboa</td>
<td>PT17</td>
<td>Centro (P)</td>
<td>PT16</td>
<td>1 330 731</td>
</tr>
<tr>
<td>20</td>
<td>Picardie</td>
<td>FR25</td>
<td>Nord - Pas-de-Calais</td>
<td>FR30</td>
<td>1 324 375</td>
</tr>
<tr>
<td>21</td>
<td>Mazowieckie</td>
<td>PL12</td>
<td>Łódzkie</td>
<td>PL11</td>
<td>1 311 266</td>
</tr>
<tr>
<td>22</td>
<td>Nord - Pas-de-Calais</td>
<td>FR30</td>
<td>Picardie</td>
<td>FR22</td>
<td>1 306 109</td>
</tr>
<tr>
<td>23</td>
<td>Pays de la Loire</td>
<td>FR51</td>
<td>Bretagne</td>
<td>FR52</td>
<td>1 260 958</td>
</tr>
<tr>
<td>24</td>
<td>Picardie</td>
<td>FR28</td>
<td>Haute-Normandie</td>
<td>FR23</td>
<td>1 220 799</td>
</tr>
<tr>
<td>25</td>
<td>Castilla-La Mancha</td>
<td>ES42</td>
<td>Comunidad de Madrid</td>
<td>ES30</td>
<td>1 199 873</td>
</tr>
<tr>
<td>26</td>
<td>Midi-Pyrénées</td>
<td>FR62</td>
<td>Aquitaine</td>
<td>FR61</td>
<td>1 173 350</td>
</tr>
<tr>
<td>27</td>
<td>Essex</td>
<td>UKH3</td>
<td>East Anglia</td>
<td>UKH1</td>
<td>1 167 895</td>
</tr>
<tr>
<td>28</td>
<td>Aragón</td>
<td>ES54</td>
<td>Cataluña</td>
<td>ES51</td>
<td>1 126 245</td>
</tr>
<tr>
<td>29</td>
<td>Centre</td>
<td>FR42</td>
<td>Pays de la Loire</td>
<td>FR51</td>
<td>1 113 089</td>
</tr>
<tr>
<td>30</td>
<td>Región de Murcia</td>
<td>ES62</td>
<td>Comunidad Valenciana</td>
<td>ES52</td>
<td>1 092 425</td>
</tr>
<tr>
<td>31</td>
<td>Lincolnshire</td>
<td>UKF3</td>
<td>E-Riding, N-Lincolnshire</td>
<td>UKE1</td>
<td>1 074 493</td>
</tr>
<tr>
<td>32</td>
<td>Aquitaine</td>
<td>FR61</td>
<td>Midi-Pyrénées</td>
<td>FR62</td>
<td>1 067 914</td>
</tr>
<tr>
<td>33</td>
<td>Zachodniopomorskie</td>
<td>PL42</td>
<td>Wielkopolskie</td>
<td>PL41</td>
<td>1 063 180</td>
</tr>
<tr>
<td>34</td>
<td>Ostrá Mellansverige</td>
<td>SE12</td>
<td>Småland med öarna</td>
<td>SE21</td>
<td>1 017 330</td>
</tr>
<tr>
<td>35</td>
<td>Île de France</td>
<td>FR10</td>
<td>Haute-Normandie</td>
<td>FR23</td>
<td>1 011 119</td>
</tr>
<tr>
<td>36</td>
<td>Schleswig-Holstein</td>
<td>DEF0</td>
<td>Hamburg</td>
<td>DE60</td>
<td>1 001 424</td>
</tr>
<tr>
<td>37</td>
<td>Basse-Normandie</td>
<td>FR25</td>
<td>Pays de la Loire</td>
<td>FR51</td>
<td>925 534</td>
</tr>
<tr>
<td>38</td>
<td>Nordjylland</td>
<td>DK03</td>
<td>Middtylland</td>
<td>DK04</td>
<td>923 540</td>
</tr>
<tr>
<td>39</td>
<td>Middtylland</td>
<td>DK04</td>
<td>Nordjylland</td>
<td>DK05</td>
<td>923 404</td>
</tr>
<tr>
<td>40</td>
<td>North Yorkshire</td>
<td>UKE2</td>
<td>E-Riding, N-Lincolnshire</td>
<td>UKE1</td>
<td>922 164</td>
</tr>
<tr>
<td>41</td>
<td>Moravskoslezsko</td>
<td>CZ08</td>
<td>Stredni Morava</td>
<td>CZ07</td>
<td>917 605</td>
</tr>
<tr>
<td>42</td>
<td>East Anglia</td>
<td>UKH3</td>
<td>Essex</td>
<td>UKH3</td>
<td>917 419</td>
</tr>
<tr>
<td>43</td>
<td>Zuid-Holland</td>
<td>NL33</td>
<td>Noord-Brabant</td>
<td>NL41</td>
<td>915 405</td>
</tr>
<tr>
<td>44</td>
<td>Sjælland</td>
<td>DK04</td>
<td>Middtylland</td>
<td>DK04</td>
<td>912 561</td>
</tr>
<tr>
<td>45</td>
<td>Sydsverige</td>
<td>SE22</td>
<td>Småland med öarna</td>
<td>SE21</td>
<td>907 260</td>
</tr>
<tr>
<td>46</td>
<td>Champagne-Ardenne</td>
<td>FR21</td>
<td>Nord - Pas-de-Calais</td>
<td>FR30</td>
<td>900 795</td>
</tr>
<tr>
<td>47</td>
<td>Basse-Normandie</td>
<td>FR25</td>
<td>Haute-Normandie</td>
<td>FR23</td>
<td>893 241</td>
</tr>
<tr>
<td>48</td>
<td>Thüringen</td>
<td>DEG0</td>
<td>Saxony-Anhalt</td>
<td>DEE0</td>
<td>892 815</td>
</tr>
<tr>
<td>49</td>
<td>Opolskie</td>
<td>PL52</td>
<td>Słaskie</td>
<td>PL22</td>
<td>888 561</td>
</tr>
<tr>
<td>50</td>
<td>Puglia</td>
<td>ITF4</td>
<td>Campania</td>
<td>ITF3</td>
<td>888 343</td>
</tr>
<tr>
<td>No.</td>
<td>Origin</td>
<td>NUTS 2 region</td>
<td>Destination</td>
<td>NUTS 2 region</td>
<td>Quantity in tonnes</td>
</tr>
<tr>
<td>-----</td>
<td>--------</td>
<td>---------------</td>
<td>-------------</td>
<td>---------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>51</td>
<td>FR21</td>
<td>Champagne-Ardenne</td>
<td>FR41</td>
<td>Lorraine</td>
<td>876 722</td>
</tr>
<tr>
<td>52</td>
<td>UKK1</td>
<td>Gloucestershire, etc.</td>
<td>UKK2</td>
<td>Dorset and Somerset</td>
<td>875 939</td>
</tr>
<tr>
<td>53</td>
<td>UKF3</td>
<td>Lincolnshire</td>
<td>UKF1</td>
<td>Derbyshire and Nottinghamshire</td>
<td>868 494</td>
</tr>
<tr>
<td>54</td>
<td>ITC4</td>
<td>Lombardia</td>
<td>ITC1</td>
<td>Piemonte</td>
<td>851 135</td>
</tr>
<tr>
<td>55</td>
<td>FI1D</td>
<td>Pohjois</td>
<td>FI19</td>
<td>Länsi-Suomi</td>
<td>850 763</td>
</tr>
<tr>
<td>56</td>
<td>SE33</td>
<td>Ovre Norrland</td>
<td>SE32</td>
<td>Mellersta Norrland</td>
<td>845 939</td>
</tr>
<tr>
<td>57</td>
<td>UKK2</td>
<td>Dorset and Somerset</td>
<td>UKK4</td>
<td>Devon</td>
<td>843 476</td>
</tr>
<tr>
<td>58</td>
<td>DK03</td>
<td>Syddanmark</td>
<td>DK02</td>
<td>Sjælland</td>
<td>829 989</td>
</tr>
<tr>
<td>59</td>
<td>PL62</td>
<td>Warminsko-Mazurskie</td>
<td>PL12</td>
<td>Mazowieckie</td>
<td>826 436</td>
</tr>
<tr>
<td>60</td>
<td>DE91</td>
<td>Braunschweig</td>
<td>DE90</td>
<td>Saxony-Anhalt</td>
<td>815 846</td>
</tr>
<tr>
<td>61</td>
<td>UKM2</td>
<td>Eastern Scotland</td>
<td>UKM3</td>
<td>South Western Scotland</td>
<td>814 043</td>
</tr>
<tr>
<td>62</td>
<td>DK02</td>
<td>Sjælland</td>
<td>DK03</td>
<td>Syddanmark</td>
<td>811 711</td>
</tr>
<tr>
<td>63</td>
<td>SE12</td>
<td>Östra Mellansverige</td>
<td>SE31</td>
<td>Norra Mellansverige</td>
<td>808 772</td>
</tr>
<tr>
<td>64</td>
<td>ES41</td>
<td>Castilla y León</td>
<td>ES30</td>
<td>Comunidad de Madrid</td>
<td>807 292</td>
</tr>
<tr>
<td>65</td>
<td>FR10</td>
<td>Île de France</td>
<td>FR22</td>
<td>Picardie</td>
<td>806 482</td>
</tr>
<tr>
<td>66</td>
<td>CZ07</td>
<td>Strední Morava</td>
<td>CZ08</td>
<td>Moravskoslezsko</td>
<td>806 166</td>
</tr>
<tr>
<td>67</td>
<td>FR24</td>
<td>Centre</td>
<td>FR23</td>
<td>Haute-Normandie</td>
<td>802 950</td>
</tr>
<tr>
<td>68</td>
<td>SE23</td>
<td>Västsverige</td>
<td>SE31</td>
<td>Norra Mellansverige</td>
<td>789 719</td>
</tr>
<tr>
<td>69</td>
<td>FR51</td>
<td>Pays de la Loire</td>
<td>FR53</td>
<td>Poitou-Charentes</td>
<td>769 742</td>
</tr>
<tr>
<td>70</td>
<td>PL52</td>
<td>Opolskie</td>
<td>PL51</td>
<td>Dolnoslaskie</td>
<td>767 617</td>
</tr>
<tr>
<td>71</td>
<td>PL61</td>
<td>Kujawsko-Pomorskie</td>
<td>PL41</td>
<td>Wielkopolskie</td>
<td>767 549</td>
</tr>
<tr>
<td>72</td>
<td>PL12</td>
<td>Mazowieckie</td>
<td>PL31</td>
<td>Lubelskie</td>
<td>763 089</td>
</tr>
<tr>
<td>73</td>
<td>SE21</td>
<td>Småland med öarna</td>
<td>SE23</td>
<td>Västsverige</td>
<td>754 542</td>
</tr>
<tr>
<td>74</td>
<td>UKH1</td>
<td>East Anglia</td>
<td>UKF2</td>
<td>Leicestershire, etc.</td>
<td>752 003</td>
</tr>
<tr>
<td>75</td>
<td>PL12</td>
<td>Mazowieckie</td>
<td>PL62</td>
<td>Warminsko-Mazurskie</td>
<td>745 228</td>
</tr>
<tr>
<td>76</td>
<td>PL34</td>
<td>Podlaskie</td>
<td>PL12</td>
<td>Mazowieckie</td>
<td>733 437</td>
</tr>
<tr>
<td>77</td>
<td>DE92</td>
<td>Hannover</td>
<td>DE94</td>
<td>Weser-Ems</td>
<td>725 205</td>
</tr>
<tr>
<td>78</td>
<td>DE40</td>
<td>Brandenburg</td>
<td>DE90</td>
<td>Saxony-Anhalt</td>
<td>724 559</td>
</tr>
<tr>
<td>79</td>
<td>DE91</td>
<td>Braunschweig</td>
<td>DE92</td>
<td>Hannover</td>
<td>717 595</td>
</tr>
<tr>
<td>80</td>
<td>FR22</td>
<td>Picardie</td>
<td>FR21</td>
<td>Champagne-Ardenne</td>
<td>705 937</td>
</tr>
<tr>
<td>81</td>
<td>DE50</td>
<td>Bremen</td>
<td>DE94</td>
<td>Weser-Ems</td>
<td>701 991</td>
</tr>
<tr>
<td>82</td>
<td>NL33</td>
<td>Zuid-Holland</td>
<td>NL32</td>
<td>Noord-Holland</td>
<td>701 604</td>
</tr>
<tr>
<td>83</td>
<td>PT18</td>
<td>Alentejo</td>
<td>PT16</td>
<td>Centro (P)</td>
<td>693 665</td>
</tr>
<tr>
<td>84</td>
<td>UKE2</td>
<td>North Yorkshire</td>
<td>UKC1</td>
<td>Tees Valley and Durham</td>
<td>688 027</td>
</tr>
<tr>
<td>85</td>
<td>SE31</td>
<td>Norra Mellansverige</td>
<td>SE12</td>
<td>Östra Mellansverige</td>
<td>685 982</td>
</tr>
<tr>
<td>86</td>
<td>DE93</td>
<td>Lüneburg</td>
<td>DE60</td>
<td>Hamburg</td>
<td>678 463</td>
</tr>
<tr>
<td>87</td>
<td>FR10</td>
<td>Île de France</td>
<td>FR21</td>
<td>Champagne-Ardenne</td>
<td>656 949</td>
</tr>
<tr>
<td>88</td>
<td>SE23</td>
<td>Västsverige</td>
<td>SE21</td>
<td>Småland med öarna</td>
<td>650 824</td>
</tr>
<tr>
<td>89</td>
<td>FR30</td>
<td>Nord - Pas-de-Calais</td>
<td>FR23</td>
<td>Haute-Normandie</td>
<td>646 880</td>
</tr>
<tr>
<td>90</td>
<td>FR10</td>
<td>Île de France</td>
<td>FR24</td>
<td>Centre</td>
<td>644 176</td>
</tr>
<tr>
<td>91</td>
<td>UKK4</td>
<td>Devon</td>
<td>UKK2</td>
<td>Dorset and Somerset</td>
<td>640 809</td>
</tr>
<tr>
<td>92</td>
<td>PL51</td>
<td>Dolnoslaskie</td>
<td>PL41</td>
<td>Wielkopolskie</td>
<td>639 466</td>
</tr>
<tr>
<td>93</td>
<td>UKF2</td>
<td>Leicestershire, etc.</td>
<td>UKH1</td>
<td>East Anglia</td>
<td>636 743</td>
</tr>
<tr>
<td>94</td>
<td>FR52</td>
<td>Bretagne</td>
<td>FR51</td>
<td>Pays de la Loire</td>
<td>631 247</td>
</tr>
<tr>
<td>95</td>
<td>SE21</td>
<td>Småland med öarna</td>
<td>SE12</td>
<td>Östra Mellansverige</td>
<td>626 830</td>
</tr>
<tr>
<td>96</td>
<td>UKE1</td>
<td>E-Riding, N-Lincolnshire</td>
<td>UKE2</td>
<td>North Yorkshire</td>
<td>616 168</td>
</tr>
<tr>
<td>97</td>
<td>DED5</td>
<td>Leipzig</td>
<td>DEE0</td>
<td>Saxony-Anhalt</td>
<td>607 788</td>
</tr>
<tr>
<td>98</td>
<td>UKF3</td>
<td>Lincolnshire</td>
<td>UKF2</td>
<td>Leicestershire, etc.</td>
<td>603 365</td>
</tr>
<tr>
<td>99</td>
<td>PL12</td>
<td>Mazowieckie</td>
<td>PL34</td>
<td>Podlaskie</td>
<td>600 675</td>
</tr>
</tbody>
</table>

Source: Areté elaboration based on EC JRC data
2.2.3.2 Inland waterway transportation

The European inland waterway network (Figure 2.33) fulfils a valuable function as a transportation mode for agricultural commodities. The Danube River, with a share of almost 10% of EU traffic volume, has not yet been able to fully exploit the potential of its corridor connecting Western, Central, and South-Eastern Europe. This paragraph first illustrates the key features of the logistical infrastructure for COP transportation via IWW, and then investigates the main IWW routes for COP shipping.

Figure 2.33 – European inland waterway core network and main COP crop ports

The role of IWWs as the prominent COP transportation mode is tightly linked to the harvest outcomes and to market price fluctuations. Bad weather conditions, for instance, negatively affect IWW traffic volumes,
whereas high market prices for COP crops lead to peaks in demand of IWW transportation, highlighting the situations of insufficient infrastructural capacity. In case of poor fairway conditions (i.e. low water levels), IWW transportation is usually replaced by rail transportation.

**Main IWW traffic axes**

The main traffic axes for inland navigation are the following: a) Rhine, b) Moselle, c) North-South axis, d) East-West axis, and e) Danube. An outline of these traffic axes is provided in the following sections.

a) **Rhine**

The Rhine axis connects Switzerland, Germany, France and Benelux and accounts for approximately 2/3 of EU IWW freight transportation. Almost 200 million tonnes of goods are shipped yearly through this axis. The flow of agricultural products through the axis has experienced a slight decline in recent years. Around 5-7% of the freight traffic volume currently carried on the Rhine consists of agricultural and food products (10-15 million tonnes / year). However, a forecast by the Central Commission for Rhine navigation foresees increased transportation of agricultural products along the river in the short- and medium-term.

The Rhine axis is the busiest waterway in Europe. It contains 8 seaports, 22 inland ports and 20 Rail-Road Terminals, as well as 4 river inflows. The main tributaries of the Rhine are the Neckar, the Main, the Moselle and the Meuse. Ports of major traffic (> 5 million tonnes / year) on the Rhine are Basel, Strasbourg, Karlsruhe, Mannheim, Ludwigshafen, Köln, Düsseldorf, Duisburg, Liège. The major seaports served by the Rhine are the ARA ports (Antwerp, Rotterdam, Amsterdam), each handling a traffic volume above 50 million tonnes / year. The port of Rotterdam is the leading one for COP traffic on the corridor.

The Rhine axis links the largest seaports of Europe to their hinterland and to many intermodal hubs. The axis is hence a crucial one for inland navigation in Europe. The Rhine axis is also characterized by its high density of population and economic activity, representing the main part of the so called “Blue Banana”\(^\text{18}\). Duisburg is the biggest inland port of the corridor, handling over 50 million tonnes of freight per year (most of it related to the steel industry). The ports of Liège, Cologne, Strasbourg and Ludwigshafen are ranked second to fifth in terms of traffic volume. The largest seaport on the corridor is Rotterdam, followed by Amsterdam and Antwerp.

The main sector of activity on the Rhine is dry bulk shipping. More than half of the IWW fleet on the Rhine is under the Dutch flag; Germany accounts for around 1/4 of the fleet. Although a decline in terms of total number of vessels has been observed on the Rhine in recent years, the available loading capacity has increased by 20% in total and by 13% in the dry bulk sector, reaching 10 million tonnes in 2016\(^\text{19}\).

\(^{18}\) The Blue Banana is a densely populated area with more than 111 million inhabitants stretching from the Mediterranean to the Irish Sea, also referred to as megalopolis or megaregion. The Blue Banana includes England with London, the Rhine plain and the Rhine-Ruhr region, Benelux with Randstad and Northern Italy. Almost all of the European Union’s central institutions, as well as twenty of its largest cities, are located in this area.


b) **Moselle**

The Moselle links Germany, France and Luxembourg and is mainly used by Belgian and Dutch vessels. Agricultural products are usually transported downstream, and used to account for around half of the volumes shipped on the river. However, low water levels in recent years caused traffic volumes in 2015 to drop by nearly 1/3 in comparison to 2010.

The biggest inland ports on the Moselle are Metz (one of the main inland ports handling COP in France), Thionville and Trier. On the Moselle, upstream traffic comes almost exclusively from the Rhine, and downstream traffic transits almost exclusively via the Rhine. The main locks on the Moselle are located in Koblenz and Apach.

c) **North-South axis**

The North-South axis connects the Netherlands, Belgium and northern France, and is the second most important IWW shipping axis in Europe, next to the Rhine. Freight volumes are shipped on a dense network of natural and artificial inland waterways. Agricultural products are primarily shipped from northern France to either seaports or agribusiness customers. A sharp increase (+23%) in exports of agricultural products from the Nord-Pas-de-Calais region was recorded in 2015, with cereals accounting for an 80% share. The average volume of agricultural products transported by IWW in France, Belgium and the Netherlands amounts to 3-6% of total traffic volume. Around 2 million tonnes of cereals are transported along the North-South axis via the Rhine and its tributaries.

Canals, rivers and river deltas in the Netherlands, Belgium and Northern France connect several large North Sea ports with their hinterland regions. The already substantial traffic on this axis is going to be further increased by the completion of the Seine-Scheldt transit link. The Seine/Scheldt/Meuse axis is relevant for several corridors of the EU-wide TEN-T network, including the Atlantic, North Sea-Mediterranean and North Sea-Baltic corridors. With a traffic of more than 20 million tonnes / year for Paris and 13 million tonnes / year for Liège, these two inland ports are the most important ones on the corridor. Paris handles important COP traffic. Rotterdam is the largest seaport of the corridor, followed by Le Havre and Antwerp (each with about
60 million tonnes / year of traffic) and by Amsterdam and Ghent. The port of Rotterdam is also the leading one for COP traffic on the corridor.

Figure 2.35 – Domestic IWW transport of agricultural and food products - French pavilion (for own account or reward, in Tkm)

![Graph showing domestic IWW transport of agricultural and food products](source: bdm.insee.fr)

d) East-West axis

The Mittelland Canal connects the Rhine region, the Ruhr region, the Berlin area, the Oder river and integrates the Havel, the Dortmund-Ems and the Rhine-Herne Canal. With 321 km of length, it is the longest canal in Germany, providing an average traffic volume of 22 million tonnes of freight for the years from 2005 to 2015. Traffic of agricultural products on the canal nearly doubled in volume over the last ten years. In combination with the Elbe, Weser and Ems rivers, the Mittelland Canal forms an essential part of the IWW network in Europe, and is included in the EU-wide TEN-T network. The canal provides a hinterland connection for seaports on the North Sea and the Baltic Sea. While important traffic already takes place on the canals in the Ruhr region and on the Lower Elbe, navigation on the Middle and Upper Elbe still has considerable development potential.

e) Danube

Transportation of agricultural products represents the most important market segment on the Danube, and is particularly important in the middle Danube region, from which COP are exported via the seaports on the Black Sea (Constanta in particular). More than 14 million tonnes of cereals are transported annually on the Danube river.

The Danube is divided into three sections:

- Upper Danube, which connects Germany, Austria, Slovakia and Hungary.
- Middle Danube, which connects Hungary, Croatia and Serbia.
- Lower Danube, which connects Serbia, Romania, Bulgaria, Moldova and Ukraine.

The share of the total volume of freight carried on the Danube in 2015 was less than 10% of the total of the main European IWW shipping routes, and showed a declining trend. However, the quantities of COP shipped downstream on the Danube increased sharply in 2015. Traffic of agricultural products is increasing constantly.
especially on the Middle Danube. Traffic of agricultural products along the Lower Danube has always been substantial. Traffic of agricultural products on the river exceeds 0.9 million tonnes in the spring, due to large COP volumes bound for the Black Sea. The Upper Danube flows through Germany, Austria and Slovakia: agricultural products account for a 15-20% share of total traffic on this section.

*Figure 2.36 – Agricultural products shipped on the Upper Danube (Austria)*

Traffic flows on the Danube see Romania in a leading position (around 21% of total traffic), followed by Bulgaria (15%), Croatia (6%), Austria (5%), Hungary (4%) and Slovakia (3%).

Demand for IWW transportation of COP on the Danube - mostly deriving from demand for COP in the Rhine and Danube areas, as well as by the growing demand for cereals in the Mediterranean countries (Greece, North Africa, Near East) - has been stable over the past five years. The export of large volumes of cereals (the most important exporters are Hungary and Serbia) is seasonally driven, and takes place mainly from September to December. Cereal exports from Hungary via the Danube and the Romanian seaport of Constanta have steadily increased in recent years, reaching a volume of over 1.2 million tonnes. West of Regensburg (Germany) there is a three to one structural quantitative predominance of westbound traffic (primarily agricultural and food products from the Middle Danube region) over eastbound traffic.

Dry bulk traffic on the Danube is characterised by high volatility, due to the peculiarities of water level fluctuations. The recent traffic increase mainly derives from catch-up effects, after the sharp decline experienced in low water periods in 2015. COP traffic on the Danube is also volatile and highly dependent on harvest quantities. Decreases in COP traffic on the river generally correspond to decreases in harvested quantities.\(^{20}\)

The Danube connects agricultural production and consumption markets of key importance at EU level. Besides strengthening the transport network in its namesake region, the Danube also connects it with the rest of the world via seaports on the North Sea and Black Sea. IWW ports on the Danube are also important transhipment points and logistical hubs. They are also linked with the North Adriatic ports via direct rail connections.

\(^{20}\) For instance, the bad grain harvest in Western Europe in 2016 kept having a negative impact on grain traffic on the Middle Danube until the beginning of 2017. By contrast, the good grain harvest in the Lower Danube region in 2016 had a positive impact on grain transportation on that part of the river.
The Romanian fleet accounts for almost half of the total size of the Danube fleet. Similarly to what happened in the Member States along the Rhine, the number of operating vessels on the Danube has decreased in recent years. However, by contrast to the increased loading capacity on the Rhine, the loading capacity declined together with the number of operating vessels on the Danube. The current average payload on the Danube amounts to 1 000 tonnes per vessel.

The use of large capacity vessels or barge convoys improves the ratio between revenues and costs, and hence the overall competitiveness of IWW transportation. Since there is a direct relationship between fairway conditions and the load factor of vessels, the competitiveness of IWW transportation is highly dependent on these conditions. Minimum fairway conditions cannot be currently guaranteed on some sections of the Danube. This is in part due to poor planning, in part to the lack of adequate maintenance equipment, and finally to the lack of funding for rehabilitation work. Waterway maintenance and ensuring reliable fairway depths are all-important tasks for all the countries along the Danube, to allow IWW transportation to fully exploit its key strengths.

f) Main-Danube Canal

This canal runs on a distance of about 171 km in Germany, from Bamberg (where it connects with the Main river) via Nuremberg to Kelheim (where it connects with the Danube). The river Main itself serves as a tributary to the Rhine: the (Rhine-)Main-Danube Canal is hence part of the Rhine-Danube Corridor, and serves as a transit area to the seaports in the Netherlands. The canal was built from 1960 to 1992: it is therefore the youngest German IWW. The completion of the canal provided the missing link to create a seamless European inland waterway from Constanta on the Black Sea to the North Sea ports, known as Europe Canal.

The canal is about 4 metres deep, and allows the transit of fully loaded ships. A maximum vessel length of 110 metres and a maximum width of 11.40 metres are allowed on the canal, but pushed convoys are allowed to exceed the maximum length.

Ports

The ports which are relevant for the analysis of waterway infrastructure in the EU can be divided into seaports and inland ports.

The three leading seaports in Europe are: 1) Rotterdam, which also handles around 100 000 inland vessels; 2) Hamburg, which also handles around 20 000 inland vessels; 3) Antwerp, which also handles around 58 000 inland vessels.

1) Port of Rotterdam. More than 10 million tonnes of cereals and ligno-cellulosic products are annually traded, stored and transhipped in the port.

---

22 The Main-Danube Canal has sixteen locks that are needed to regulate height differences. From Bamberg to the crest of the canal the height difference amounts to 175 metres, and is regulated through eleven locks. The crest of the canal, between Hilpoltstein and Bachhausen, is 406 metres above sea level and constitutes the highest location in the European waterway network. Five locks regulate the height difference of about 68 metres from the crest of the canal to the Danube. All locks have a dimension of 190 x 12 metres. Similar times are needed for transit through each lock, in spite of height differences: this ensures that no bottlenecks from different lock transit times occur.
Figure 2.37 – Inland waterway traffic in the seaport of Rotterdam (million tonnes, all goods)

Source: www.inland-navigation-market.org

2) The dry cargo traffic in the port of Hamburg reaches a volume of 20 million tonnes, of which around 5.7 million tonnes are cereals, feedstuffs and oilseeds. Except for fertilizers, most exported dry bulk cargo reaches the port by truck or IWW.

Figure 2.38 – Inland waterway traffic in the seaport of Hamburg (million tonnes, all goods)

Source: www.inland-navigation-market.org

3) The port of Antwerp handles around 1.2 million tonnes of cereals annually.
Although the biggest inland ports are Duisburg (dominated by the steel industry, providing almost 70% of total cargo) and 4) Paris, the leading port for COP export in the EU is the inland port of 5) Rouen.

4) The port of Paris is among the three leading inland ports in Europe. Cereals account for a substantial share of the 20 million tonnes of yearly traffic. Agricultural goods in general represent the second largest segment by transhipped volume. The port of Paris is integrated into the Seine/Scheldt/Meuse axis, which is a main IWW axis in Western Europe. The canals, rivers and river deltas in Northern France, Belgium and the Netherlands provide a dense network of hinterland connections for several large North Sea ports, as well as links between them.

5) The cereals harvested in Ile-de-France, Normandy and Picardy regions are often exported via the inland port of Rouen primarily to Spain, North Africa and China. The port is located on the Seine river, but can handle oceangoing vessels.

Rouen is the EU leading port for the export of cereals and, together with Paris and Le Havre, is organised within a port network. The IWW network between Rouen, Paris and Le Havre is a key transportation infrastructure for the shipment of cereals. With around 9 million tonnes of grains exported yearly, the Port of Rouen represents a key terminal, transshipment and consolidation point for COP traffic in West and Central Europe. Wheat accounts for the highest share of traffic with up to 6.5 million tonnes per year, followed by barley with 2.4 million tonnes and by other cereals with approximately 20 000 tonnes. Protein crops - mainly consisting of dry peas - account for 183 000 tonnes, and rapeseed for 93 000 tonnes. Around 400 grain vessels are handled annually at the Port of Rouen. Operators at the port of Rouen are focused on further development of mass grain transportation to the port via rail or river.

Other key ports for the transhipment of COP are 6) Metz, 7) Marseille and 8) the Danube ports:

6) The French inland port of Metz is another key transhipment terminal for cereals and other agricultural products, which account for a 92% share of total traffic. The annual quantity of grains and

---

24 The port is located 120 km upstream from the mouth of the Seine River. It has two grain terminals with a combined daily loading capacity of 100 000 tonnes, and 1.2 million tonnes of total grain storage capacity. The maximum draught at piers (10.30 metres) does not allow handling of fully loaded Panamax vessels at the port of Rouen. Panamax vessels range from 60 000 to 80 000 DWT (Dead Weight Tonnage) and are compatible with the dimensions of Panama canal’s lock chambers (32.26 metres wide, 320.0 metres long, and 25.9 metres deep).
other agricultural products transhipped at the port ranges between 2 and 4 million tonnes and is heavily dependent on harvest volumes.

7) The "Tellines Port" terminal at the French seaport of Marseille serves the primary purpose of exporting cereals from the Rhone-Alps and Burgundy regions via the country's inland waterways. The terminal can handle and store a wide range of solid bulk cargoes including cereals. The terminal has one deep-water station with maximum authorized draught of 12.8 meters.

8) Almost all Danube ports are involved in the transhipment of large volumes of agricultural products, and especially of cereals. The biggest export volumes of agricultural products originate from ports in Serbia and Hungary, as well as Bulgaria and Romania. Agricultural products account for 80-85% of transhipment traffic volume.

The main port on the Danube is the Romanian seaport of Constanta. Traffic of agricultural products from Central Europe for export to Southern Europe and Northern Africa transits through the port of Constanta into the Black Sea. The port is gaining further importance, with Romania turning into a leading EU grain exporter together with France and Germany. The port of Constanta handled 19.61 million tonnes of grains in 2015 and 20.4 million tonnes in 2016. Cereals account for a share of around 35% of total traffic handled at Constanta.

Illustration of main IWW transport flows of COP crops

Inland waterways handle from 60% to 70% of long-distance COP traffic volume in the EU.

The main IWW corridor for COP transportation is the Rhine-Danube corridor (Figure 2.40). This corridor provides the main East–West link between the export ports in Western and Central Europe and COP cultivation areas of Eastern Europe. Although the overall modal split of the corridor is 58% for road, 28% for rail and 14% for IWW, agricultural products are primarily transported via IWW. IWW accounts for 60-70% of total agricultural traffic on the corridor, and rail for the remaining 30-40%, depending on water depth conditions on the rivers.

More than 14 million tonnes of cereals are transported annually on the Danube river. Around 50-70% of cereals are shipped downstream on the Central and Lower Danube towards the Black Sea, and 30-50% are shipped upstream on the Upper Danube towards the ARA Ports using the Rhine-Alpine corridor. The volume of cereals transported downstream on the Danube to the Region Sud-Est in Romania (which includes the port of Constanta) amounted to 8 million tonnes in 2015 (see Figure 2.41).

The ten largest quantities per NUTS 2 region shipped on the Rhine-Danube corridor towards the port of Constanta are reported in Table 2.9.

---

25 The many facilities for the handling and storage of dry cereals in the Port of Constanta are served by 14 specialized berths, with water depths ranging between 7 and 13 metres. The port has a total grain storage capacity of 350 000 tonnes. High-capacity oceangoing vessels are handled at a sea buoy with water depth of 16 metres, allowing direct transhipment from/to IWW vessels. The most important shippers of agricultural bulk products at the Port of Constanta are TTS Operator, North Star Shipping, United Shipping Agency, Silotrans, Chimpex and Socep.
More than 1.3 million tonnes of cereals are transported on the Rhine-Danube corridor to the ARA Ports. Around 2 million tonnes of cereals are transported along the North-South river axis via the Rhine and its tributaries, as illustrated in Figure 2.42.

The ten largest quantities per NUTS 2 regions shipped on the Rhine-Danube corridor to the Port of Rotterdam are reported in Table 2.10.

### Table 2.9 – IWW traffic volume of cereals towards the port of Constanța in 2015 (tonnes)

<table>
<thead>
<tr>
<th>From/To</th>
<th>RO22 (Sud-Est)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BG31 (Severozapaden)</td>
<td>1 178 000 t</td>
</tr>
<tr>
<td>HU23 (Del-Dunantul)</td>
<td>1 848 000 t</td>
</tr>
<tr>
<td>HU33 (Del-Alfold)</td>
<td>273 000 t</td>
</tr>
<tr>
<td>RO42 (Vest)</td>
<td>286 000 t</td>
</tr>
<tr>
<td>BG32 (Severen tsentralen)</td>
<td>397 000 t</td>
</tr>
<tr>
<td>HU22 (Nyugat-Dunantul)</td>
<td>406 000 t</td>
</tr>
<tr>
<td>RO22 (Sud-Est)</td>
<td>680 000 t</td>
</tr>
<tr>
<td>RO31 (Sud-Muntenia)</td>
<td>718 000 t</td>
</tr>
<tr>
<td>HU21 (Kozep-Dunantul)</td>
<td>883 000 t</td>
</tr>
<tr>
<td>RO41 (Sud-Vest Oltenia)</td>
<td>996 000 t</td>
</tr>
</tbody>
</table>

Source: Eurostat: iww_go_atygofl

### Table 2.10 – IWW traffic volume of cereals towards the Port of Rotterdam in 2015 (tonnes)

<table>
<thead>
<tr>
<th>From/To</th>
<th>NL33 (Zuid-Holland)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR42 (Alsace)</td>
<td>692 000 t</td>
</tr>
<tr>
<td>DE23 (Oberpfalz)</td>
<td>142 000 t</td>
</tr>
<tr>
<td>DE22 (Niederbayern)</td>
<td>84 000 t</td>
</tr>
<tr>
<td>DE26 (Unterfranken)</td>
<td>82 000 t</td>
</tr>
<tr>
<td>AT12 (Niederösterreich)</td>
<td>39 000 t</td>
</tr>
<tr>
<td>SK02 (Western Slovakia)</td>
<td>39 000 t</td>
</tr>
<tr>
<td>SK01 (Bratislava region)</td>
<td>34 000 t</td>
</tr>
<tr>
<td>DE13 (Freiburg)</td>
<td>31 000 t</td>
</tr>
<tr>
<td>DE24 (Oberfranken)</td>
<td>29 000 t</td>
</tr>
<tr>
<td>AT13 (Vienna)</td>
<td>28 000 t</td>
</tr>
</tbody>
</table>

Source: Eurostat: iww_go_atygofl
Figure 2.40 – Rhine-Danube corridor

Source: DG MOVE-TENtec
Figure 2.41 – IWW transportation of cereals on the Danube river in 2015 by NUTS 2 region

Source: own calculations based on Eurostat: iww_go_atygofl
2.2.3.3 Railway transportation

Europe has a generally dense rail network (Figure 2.43), but there are significant differences in network density among regions. High-speed railways are most widespread in Central Europe, and conventional railways in Eastern Europe.

The overview at Table 2.11 shows the main railway infrastructure owners and some characteristics of the railway infrastructure by Member State.
Figure 2.43 – European core railway network

Source: DG MOVE-TENtec
Table 2.11 – Characterization of railway infrastructure by EU Member States

<table>
<thead>
<tr>
<th>Name of the main infrastructure owner</th>
<th>Total line-km</th>
<th>Share of multiple track lines</th>
<th>Share of electrified lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Infrabel</td>
<td>3 578</td>
<td>77%</td>
<td>84%</td>
</tr>
<tr>
<td>BG NRIC</td>
<td>4 098</td>
<td>23%</td>
<td>68%</td>
</tr>
<tr>
<td>CZ SZDC</td>
<td>9 469</td>
<td>20%</td>
<td>34%</td>
</tr>
<tr>
<td>DK Banedanmark</td>
<td>2 131</td>
<td>44%</td>
<td>29%</td>
</tr>
<tr>
<td>DE DB Netz</td>
<td>33 708</td>
<td>54%</td>
<td>59%</td>
</tr>
<tr>
<td>EE EVR</td>
<td>787</td>
<td>11%</td>
<td>17%</td>
</tr>
<tr>
<td>ES Adif</td>
<td>15 317</td>
<td>34%</td>
<td>59%</td>
</tr>
<tr>
<td>FR RFF</td>
<td>33 608</td>
<td>57%</td>
<td>50%</td>
</tr>
<tr>
<td>IE Irish Rail</td>
<td>1 919</td>
<td>26%</td>
<td>3%</td>
</tr>
<tr>
<td>IT RFI</td>
<td>18 011</td>
<td>47%</td>
<td>73%</td>
</tr>
<tr>
<td>LV LDz</td>
<td>1 897</td>
<td>17%</td>
<td>14%</td>
</tr>
<tr>
<td>LT JSC</td>
<td>1 767</td>
<td>22%</td>
<td>7%</td>
</tr>
<tr>
<td>LU ACF</td>
<td>275</td>
<td>53%</td>
<td>95%</td>
</tr>
<tr>
<td>HU MAV</td>
<td>7 893</td>
<td>17%</td>
<td>37%</td>
</tr>
<tr>
<td>NL ProRail</td>
<td>3 016</td>
<td>66%</td>
<td>70%</td>
</tr>
<tr>
<td>AT ÖBB Netz</td>
<td>5 066</td>
<td>38%</td>
<td>67%</td>
</tr>
<tr>
<td>PL PLK</td>
<td>19 702</td>
<td>44%</td>
<td>60%</td>
</tr>
<tr>
<td>PT REFER</td>
<td>2 843</td>
<td>21%</td>
<td>52%</td>
</tr>
<tr>
<td>RO CFR</td>
<td>10 777</td>
<td>27%</td>
<td>37%</td>
</tr>
<tr>
<td>SI SŽ</td>
<td>1 228</td>
<td>27%</td>
<td>41%</td>
</tr>
<tr>
<td>SK ZSR</td>
<td>3 587</td>
<td>28%</td>
<td>44%</td>
</tr>
<tr>
<td>FI Liikennevirasto</td>
<td>5 919</td>
<td>10%</td>
<td>52%</td>
</tr>
<tr>
<td>SE Trafikverket</td>
<td>9 957</td>
<td>18%</td>
<td>79%</td>
</tr>
<tr>
<td>UK Network Rail</td>
<td>31 471</td>
<td>63%</td>
<td>40%</td>
</tr>
</tbody>
</table>

Source: FLAVIA (2013) Freight and Logistics Advancement in Central Europe - Validation of processes, Improvements, Application of co-operation. Reports of the EU-funded FLAVIA project

In order to connect the entire EU territory via railway network, new routes are planned and/or existing ones are upgraded. A notable example in this respect is provided by the “Betuweroute” Project no. 5 of the TEN-T network. The Betuwe rail line is a double track freight railway connecting the port of Rotterdam with the “Ruhrgebiet” area of Germany and with the leading inland port of Duisburg via Arnhem and Oberhausen. With 60 freight trains and 16 long-distance trains each way and a capacity of 700 trains per day, the Betuwe line is of critical importance for freight traffic and is listed as a priority project of the TEN-T network. A three/four-track upgrade is under development on the line, aimed at opening up new freight transportation opportunities between the North Sea ports and their European hinterland.

**Railways play an important role in long-distance COP transportation in the EU, with a share of 30 to 40% of total long-haul COP traffic.** Traditional COP traffic flows via IWW from Eastern EU Member States to the North-Western EU markets are slowly shifting to railways mainly due to uncertain fairway conditions on the Danube. The key destinations for COP international rail traffic are the ARA Ports and the German seaports.

The same dataset by JRC used at § 2.2.3.1 to map road traffic of COP was also used to map rail traffic of these products. The dataset contains data on transport flows between origin and destination regions at NUTS 2 level. Reference to product group NST01 “Products of agriculture, hunting, and forestry; fish and other fishing

---

26 Service costs in rail transportation are distance-dependent and amount to approximately EUR 3 per train kilometre. The tariff charged to train operators for transit on the Betuwe rail line is calculated according to the travelled distance on the line, whereas on other rail routes the tariff is calculated according to train weight. The tariff applied on the Betuwe line has increased progressively from EUR 1.41 per train kilometre to EUR 2.33 per train kilometre between 2008 and 2011.
products” (referred to as “agricultural goods” henceforth for sake of conciseness) in the JRC dataset posed significant limitations also for the mapping of COP rail traffic. Substantial volumes of products other than COP (e.g. forestry products and liquid milk in tank containers) are actually transported by train in both national and international traffic, especially on long-haul moves. The following considerations should hence be taken with caution. Wherever possible, qualitative elements based on the study team’s expertise are provided for a correct understanding of the traffic maps and of the underlying data.

In the traffic maps at Figures 2.44 and 2.45, flows are represented by lines connecting the origin and the destination regions: the direction of the flows is indicated by black arrows. The size of transported volumes is visually illustrated by the thickness of the lines. NUTS 2 regions that are primarily origins or destinations are highlighted by different colours, to distinguish them from regions with a more balanced split between inbound and outbound traffic. Traffic flows below a 10 000 tonnes per year volume threshold were not considered in the analysis.

The top-25 international rail traffic flows of agricultural goods are illustrated in the map at Figure 2.44. The underlying data are reported in Table 2.12.

Traffic flows originating from a number of German and Austrian regions towards regions in Northern Italy (Piemonte, Lombardia, Veneto, Emilia Romagna, Friuli Venezia Giulia) are likely to consist in part of COP unit trains, in part of milk container trains, plus forestry products traffic. Flows originating from the Antwerp region are likely to include extra-EU COP (especially soybeans and soymeal) imported through the namesake port. In the light of the results of the analysis of COP trade (see the reply to Question 2.1 at § 3.2.1), part of the substantial rail traffic from Latvia and Lithuania to Estonia should consist of COP. Also international rail traffic flows between Spain and Portugal are likely to involve some COP tonnage.

It appears that international rail transport flows of agricultural goods towards Northern Italy are rather important: this can have implications for the underlying logistical infrastructure. This element is taken into account in the analysis of logistical bottlenecks presented at § 3.3.1.2.

Inter-regional rail traffic flows of agricultural goods at national level are roughly comparable to international transports flows in terms of tonnage. Figure 2.45 presents the top-100 national rail transport flows. The underlying data are reported in Table 2.13.

In France, the analysis identified a clear pattern of rail traffic heading towards the regions where the main seaports in the North-West of France are located: Bretagne (Brest and Saint Malo); Nord – Pas de Calais (Dunkerque); Haute-Normandie (Rouen and Le Havre); Pays de la Loire (Nantes); Poitou-Charentes (La Rochelle). A substantial part of this traffic should consist of COP tonnage moving to these ports for export. Similar considerations can be made for rail traffic flows heading towards Provence-Alpes-Cote d’Azur region, where the port of Marseille is located. Significant COP tonnage should also be present in traffic flows heading towards Alsace, including traffic to transhipment terminals at Rhine ports for further transportation via IWW vessels.

Other significant rail traffic flows were identified in Germany. These should include COP tonnage moving from the South-East and from the Central regions towards the Northern ports of Hamburg and Bremen for export. A dense network of substantial rail flows of agricultural goods criss-crossing Austria without an evident directional pattern emerged from the analysis. It should be noted that Austria is a major transit country also for COP traffic. This implies that the observed national transport flows might affect international transit flows due to limited railway network capacity. This element is taken into account in the analysis of logistical bottlenecks presented at § 3.3.1.2.

A pattern of rail transport flows towards the Sud-Est region, where the port of Constanta is located, clearly emerged in Romania: COP tonnage should be substantial in this case.

Substantial volumes of inter-regional rail traffic of agricultural goods in Sweden and Finland should mainly be related to forestry products.
Figure 2.44 – Top 25 international rail transportation flows of agricultural goods in 2015

- Top 25 rail transport flows
- Transport flow direction
- Destination NUTS 2 regions
- Origin NUTS 2 regions
- Destination and origin NUTS 2 regions
- Below threshold of 10,000 tonnes

Source: Areté elaboration based on EC JRC data
Table 2.12 – Top 25 international rail transport flows of agricultural goods in 2015

<table>
<thead>
<tr>
<th>No.</th>
<th>Origin NUTS 2 region</th>
<th>Destination NUTS 2 region</th>
<th>Quantity in tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LV00 Latvija EE00 Eesti</td>
<td>1 221 798</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>AT33 Tirol TH2 Trento</td>
<td>677 982</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>DE80 Mecklenburg-Vorpommern TH3 Veneto</td>
<td>524 328</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>ES51 Cataluña PT16 Centro (P)</td>
<td>506 330</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>DE13 Freiburg TC1 Piemonte</td>
<td>424 190</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>TH2 Trento DE23 Oberpfalz</td>
<td>420 286</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>DE23 Oberpfalz TH2 Trento</td>
<td>390 142</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>LT00 Lithuania EE00 Eesti</td>
<td>342 459</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>PT16 Centro (P) ES51 Cataluña</td>
<td>226 591</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>DE13 Freiburg TC4 Lombardia</td>
<td>196 872</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>AT22 Steiermark DEA1 Düsseldorf</td>
<td>185 364</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>TH2 Trento AT33 Tirol</td>
<td>180 469</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>DEA1 Düsseldorf AT22 Steiermark</td>
<td>176 424</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>DEB1 Koblenz TH5 Emilia-Romagna</td>
<td>172 946</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>DED4 Chemnitz PL43 Lubuskie</td>
<td>164 252</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>BE21 Prov. Antwerpen TC4 Lombardia</td>
<td>162 610</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>AT32 Salzburg TH4 Friuli-Venezia Giulia</td>
<td>158 173</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>DEA2 Köln TC4 Lombardia</td>
<td>150 808</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>DE22 Niederbayern AT31 Oberösterreich</td>
<td>149 784</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>AT21 Kärnten TH4 Friuli-Venezia Giulia</td>
<td>131 251</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>DEB3 Rheinhessen-Pfalz TC4 Lombardia</td>
<td>124 527</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>SK01 Bratislava region AT22 Steiermark</td>
<td>124 475</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>DEA1 Düsseldorf AT31 Oberösterreich</td>
<td>115 966</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>AT21 Kärnten DE13 Freiburg</td>
<td>90 857</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>DEA1 Düsseldorf TC4 Lombardia</td>
<td>90 744</td>
<td></td>
</tr>
</tbody>
</table>

Source: Areté elaboration based on EC JRC data
Figure 2.45 – Top 100 national rail transportation flows of agricultural goods in 2015

- Top 100 rail transport flows
- Transport flow direction
- Destination NUTS 2 regions
- Origin NUTS 2 regions
- Destination and origin NUTS 2 regions
- Below threshold of 10 000 tonnes

Source: Areté elaboration based on EC JRC data
### Table 2.13 – Top 100 national rail transport flows of agricultural goods in 2015

<table>
<thead>
<tr>
<th>No.</th>
<th>Origin</th>
<th>NUTS2 name</th>
<th>Destination</th>
<th>NUTS2 name</th>
<th>Quantity in tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FI1D</td>
<td>Pohjois</td>
<td>FI19</td>
<td>Läänä-Suomi</td>
<td>983 645</td>
</tr>
<tr>
<td>2</td>
<td>FI19</td>
<td>Läänä-Suomi</td>
<td>FI1B</td>
<td>Jusimaa</td>
<td>921 606</td>
</tr>
<tr>
<td>3</td>
<td>FR24</td>
<td>Centre</td>
<td>FR52</td>
<td>Bretagne</td>
<td>782 078</td>
</tr>
<tr>
<td>4</td>
<td>AT12</td>
<td>Niederösterreich</td>
<td>AT22</td>
<td>Steiermark</td>
<td>699 771</td>
</tr>
<tr>
<td>5</td>
<td>FR22</td>
<td>Picardie</td>
<td>FR30</td>
<td>Nord - Pas-de-Calais</td>
<td>683 140</td>
</tr>
<tr>
<td>6</td>
<td>FR24</td>
<td>Centre</td>
<td>FR30</td>
<td>Nord - Pas-de-Calais</td>
<td>588 937</td>
</tr>
<tr>
<td>7</td>
<td>SE33</td>
<td>Övre Norrland</td>
<td>SE32</td>
<td>Mellersta Norrland</td>
<td>575 036</td>
</tr>
<tr>
<td>8</td>
<td>AT12</td>
<td>Niederösterreich</td>
<td>AT31</td>
<td>Oberösterreich</td>
<td>563 244</td>
</tr>
<tr>
<td>9</td>
<td>AT21</td>
<td>Kärnten</td>
<td>AT22</td>
<td>Steiermark</td>
<td>539 587</td>
</tr>
<tr>
<td>10</td>
<td>FR21</td>
<td>Champagne-Ardenne</td>
<td>FR30</td>
<td>Nord - Pas-de-Calais</td>
<td>476 105</td>
</tr>
<tr>
<td>11</td>
<td>FR24</td>
<td>Centre</td>
<td>FR23</td>
<td>Haute-Normandie</td>
<td>438 147</td>
</tr>
<tr>
<td>12</td>
<td>AT12</td>
<td>Niederösterreich</td>
<td>AT21</td>
<td>Kärnten</td>
<td>426 685</td>
</tr>
<tr>
<td>13</td>
<td>FR24</td>
<td>Centre</td>
<td>FR51</td>
<td>Pays de la Loire</td>
<td>411 533</td>
</tr>
<tr>
<td>14</td>
<td>FR24</td>
<td>Centre</td>
<td>FR53</td>
<td>Poitou-Charentes</td>
<td>393 271</td>
</tr>
<tr>
<td>15</td>
<td>AT31</td>
<td>Oberösterreich</td>
<td>AT12</td>
<td>Niederösterreich</td>
<td>375 495</td>
</tr>
<tr>
<td>16</td>
<td>AT13</td>
<td>Vienna</td>
<td>AT22</td>
<td>Steiermark</td>
<td>348 744</td>
</tr>
<tr>
<td>17</td>
<td>FR21</td>
<td>Champagne-Ardenne</td>
<td>FR42</td>
<td>Alsace</td>
<td>326 082</td>
</tr>
<tr>
<td>18</td>
<td>AT13</td>
<td>Vienna</td>
<td>AT11</td>
<td>Burgenland</td>
<td>321 788</td>
</tr>
<tr>
<td>19</td>
<td>FR26</td>
<td>Bourgogne</td>
<td>FR82</td>
<td>Provence-Alpes-Côte d’Azur</td>
<td>319 078</td>
</tr>
<tr>
<td>20</td>
<td>AT21</td>
<td>Kärnten</td>
<td>AT32</td>
<td>Salzburg</td>
<td>309 671</td>
</tr>
<tr>
<td>21</td>
<td>RO31</td>
<td>Sul- Muntenia</td>
<td>RO22</td>
<td>Sud-Est</td>
<td>298 065</td>
</tr>
<tr>
<td>22</td>
<td>AT22</td>
<td>Steiermark</td>
<td>AT12</td>
<td>Niederösterreich</td>
<td>293 191</td>
</tr>
<tr>
<td>23</td>
<td>AT22</td>
<td>Steiermark</td>
<td>AT31</td>
<td>Oberösterreich</td>
<td>281 244</td>
</tr>
<tr>
<td>24</td>
<td>FI1B</td>
<td>Jusimaa</td>
<td>FI19</td>
<td>Läänä-Suomi</td>
<td>267 827</td>
</tr>
<tr>
<td>25</td>
<td>AT31</td>
<td>Oberösterreich</td>
<td>AT22</td>
<td>Steiermark</td>
<td>256 203</td>
</tr>
<tr>
<td>26</td>
<td>DE40</td>
<td>Brandenburg</td>
<td>DE00</td>
<td>Saxony-Anhalt</td>
<td>251 087</td>
</tr>
<tr>
<td>27</td>
<td>AT22</td>
<td>Steiermark</td>
<td>AT21</td>
<td>Kärnten</td>
<td>247 172</td>
</tr>
<tr>
<td>28</td>
<td>FR24</td>
<td>Centre</td>
<td>FR81</td>
<td>Languedoc-Roussillon</td>
<td>235 252</td>
</tr>
<tr>
<td>29</td>
<td>AT13</td>
<td>Vienna</td>
<td>AT31</td>
<td>Oberösterreich</td>
<td>226 583</td>
</tr>
<tr>
<td>30</td>
<td>PT17</td>
<td>Lisboa</td>
<td>PT11</td>
<td>Norte</td>
<td>202 259</td>
</tr>
<tr>
<td>31</td>
<td>FR62</td>
<td>Midi-Pyrénées</td>
<td>FR82</td>
<td>Provence-Alpes-Côte d’Azur</td>
<td>202 016</td>
</tr>
<tr>
<td>32</td>
<td>FR21</td>
<td>Champagne-Ardenne</td>
<td>FR22</td>
<td>Picardie</td>
<td>191 945</td>
</tr>
<tr>
<td>33</td>
<td>FR43</td>
<td>Franche-Comté</td>
<td>FR42</td>
<td>Alsace</td>
<td>188 399</td>
</tr>
<tr>
<td>34</td>
<td>FR53</td>
<td>Poitou-Charentes</td>
<td>FR61</td>
<td>Aquitaine</td>
<td>178 780</td>
</tr>
<tr>
<td>35</td>
<td>FI1B</td>
<td>Jusimaa</td>
<td>FI1D</td>
<td>Pohjois</td>
<td>177 919</td>
</tr>
<tr>
<td>36</td>
<td>SE12</td>
<td>Ostra Mellansverige</td>
<td>SE31</td>
<td>Norra Mellansverige</td>
<td>171 724</td>
</tr>
<tr>
<td>37</td>
<td>AT12</td>
<td>Niederösterreich</td>
<td>AT13</td>
<td>Vienna</td>
<td>160 140</td>
</tr>
<tr>
<td>38</td>
<td>AT31</td>
<td>Oberösterreich</td>
<td>AT21</td>
<td>Kärnten</td>
<td>153 881</td>
</tr>
<tr>
<td>39</td>
<td>SE12</td>
<td>Ostra Mellansverige</td>
<td>SE21</td>
<td>Småländ med öarna</td>
<td>148 991</td>
</tr>
<tr>
<td>40</td>
<td>AT21</td>
<td>Kärnten</td>
<td>AT33</td>
<td>Tirol</td>
<td>147 724</td>
</tr>
<tr>
<td>41</td>
<td>AT21</td>
<td>Kärnten</td>
<td>AT31</td>
<td>Oberösterreich</td>
<td>145 319</td>
</tr>
<tr>
<td>42</td>
<td>FR26</td>
<td>Bourgogne</td>
<td>FR42</td>
<td>Alsace</td>
<td>138 370</td>
</tr>
<tr>
<td>43</td>
<td>AT13</td>
<td>Vienna</td>
<td>AT21</td>
<td>Kärnten</td>
<td>136 550</td>
</tr>
<tr>
<td>44</td>
<td>SE32</td>
<td>Mellersta Norrland</td>
<td>SE33</td>
<td>Övre Norrland</td>
<td>131 788</td>
</tr>
<tr>
<td>45</td>
<td>SE33</td>
<td>Övre Norrland</td>
<td>SE31</td>
<td>Norra Mellansverige</td>
<td>127 173</td>
</tr>
<tr>
<td>46</td>
<td>FR10</td>
<td>Île de France</td>
<td>FR30</td>
<td>Nord - Pas-de-Calais</td>
<td>121 018</td>
</tr>
<tr>
<td>47</td>
<td>RO42</td>
<td>Vest</td>
<td>RO22</td>
<td>Sud-Est</td>
<td>118 772</td>
</tr>
<tr>
<td>48</td>
<td>ES41</td>
<td>Castilla y León</td>
<td>ES51</td>
<td>Cataluña</td>
<td>116 407</td>
</tr>
<tr>
<td>49</td>
<td>SE32</td>
<td>Mellersta Norrland</td>
<td>SE31</td>
<td>Norra Mellansverige</td>
<td>114 874</td>
</tr>
<tr>
<td>50</td>
<td>FI1D</td>
<td>Pohjois</td>
<td>FI1B</td>
<td>Jusimaa</td>
<td>112 441</td>
</tr>
<tr>
<td>No.</td>
<td>Origin NUTS 2 region</td>
<td>Destination NUTS 2 region</td>
<td>Quantity in tonnes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>----------------------</td>
<td>---------------------------</td>
<td>-------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>AT12 Niederösterreich</td>
<td>AT32 Salzburg</td>
<td>111,856</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>AT13 Vienna</td>
<td>AT32 Salzburg</td>
<td>109,130</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>AT31 Oberösterreich</td>
<td>AT32 Salzburg</td>
<td>108,795</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>FR26 Bourgogne</td>
<td>FR23 Haute-Normandie</td>
<td>106,317</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>AT21 Kärnten</td>
<td>AT12 Niederösterreich</td>
<td>104,243</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>AT22 Steiermark</td>
<td>AT33 Tirol</td>
<td>102,783</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>FR81 Languedoc-Roussillon</td>
<td>FR10 Île de France</td>
<td>101,498</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>DEA3 Münster</td>
<td>DEA1 Düsseldorf</td>
<td>101,216</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>AT13 Vienna</td>
<td>AT12 Niederösterreich</td>
<td>98,750</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>FR71 Rhône-Alpes</td>
<td>FR30 Nord - Pas-de-Calais</td>
<td>96,633</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>RO42 Vest</td>
<td>RO41 Sud-Vest Oltenia</td>
<td>95,102</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>ES24 Aragón</td>
<td>ES51 Cataluña</td>
<td>91,580</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>ES51 Cataluña</td>
<td>ES24 Aragón</td>
<td>89,811</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>DE60 Hamburg</td>
<td>DE91 Braunschweig</td>
<td>87,991</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>ES21 País Vasco</td>
<td>ES52 Comunidad Valenciana</td>
<td>82,536</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>SE32 Mellersta Norland</td>
<td>SE12 Östra Mellansverige</td>
<td>82,283</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>AT31 Oberösterreich</td>
<td>AT13 Vienna</td>
<td>81,787</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>FR21 Champagne-Ardenne</td>
<td>FR23 Haute-Normandie</td>
<td>80,365</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>SE21 Småland med darna</td>
<td>SE31 Norra Mellansverige</td>
<td>79,798</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>DE11 Stuttgart</td>
<td>DE50 Bremen</td>
<td>79,719</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>FR10 Île de France</td>
<td>FR23 Haute-Normandie</td>
<td>78,452</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>AT12 Niederösterreich</td>
<td>AT33 Tirol</td>
<td>78,409</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>DE73 Kassel</td>
<td>DE60 Hamburg</td>
<td>78,299</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>FR72 Auvergne</td>
<td>FR82 Provence-Alpes-Côte d'Azur</td>
<td>76,769</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>FI19 Länsi-Suomi</td>
<td>FI1D Pohjois</td>
<td>74,392</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>SE21 Småland med darna</td>
<td>SE12 Östra Mellansverige</td>
<td>70,370</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>RO41 Sud-Vest Oltenia</td>
<td>RO22 Sud-Est</td>
<td>69,682</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>DE60 Saxony-Anhalt</td>
<td>DE60 Hamburg</td>
<td>68,251</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>DEA3 Münster</td>
<td>DEAS Arnsberg</td>
<td>66,229</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>DE91 Braunschweig</td>
<td>DE94 Weser-Ems</td>
<td>65,276</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>DE94 Weser-Ems</td>
<td>DE94 Detmold</td>
<td>65,227</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>FR51 Pays de la Loire</td>
<td>FR52 Bretagne</td>
<td>63,637</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>AT22 Steiermark</td>
<td>AT13 Vienna</td>
<td>62,743</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>ES61 Andalucia</td>
<td>ES63 Ciudad Autónoma de Ceuta</td>
<td>62,496</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>RO31 Sud - Muntenia</td>
<td>RO11 Nord-Vest</td>
<td>62,483</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>ITC3 Liguria</td>
<td>ITC1 Piemonte</td>
<td>60,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>DE21 Oberbayern</td>
<td>DE60 Hamburg</td>
<td>61,689</td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>FR22 Picardie</td>
<td>FR23 Haute-Normandie</td>
<td>61,039</td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>ES61 Andalucia</td>
<td>ES62 Región de Murcia</td>
<td>60,122</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>RO31 Sud - Muntenia</td>
<td>RO42 Vest</td>
<td>57,580</td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>DE80 Mecklenburg-Vorpommern</td>
<td>DE13 Freiburg</td>
<td>56,835</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>FR26 Bourgogne</td>
<td>FR30 Nord - Pas-de-Calais</td>
<td>55,936</td>
<td></td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>DE40 Brandenburg</td>
<td>DE60 Hamburg</td>
<td>55,557</td>
<td></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>RO41 Sud-Vest Oltenia</td>
<td>RO42 Vest</td>
<td>55,283</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>SE12 Ostra Mellansverige</td>
<td>SE11 Stockholm</td>
<td>54,274</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>AT12 Niederösterreich</td>
<td>AT11 Burgenland</td>
<td>52,005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>AT22 Steiermark</td>
<td>AT32 Salzburg</td>
<td>51,250</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>RO21 Nord-Est</td>
<td>RO22 Sud-Est</td>
<td>50,491</td>
<td></td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>DE40 Brandenburg</td>
<td>DE62 Dresden</td>
<td>49,390</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>AT32 Salzburg</td>
<td>AT22 Steiermark</td>
<td>49,274</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Areté elaboration based on EC JRC data
3 REPLIES TO STUDY QUESTIONS UNDER THEMES 1, 2 AND 3

3.1 Replies to study questions under Theme 1 (storage capacity)

3.1.1 Question 1.1: Current need of storage capacity

The current need of storage capacity at Member State level was quantified, according to the methodology explained at § 1.2.1.1, on the basis of several scenarios: each scenario implies a wider or narrower security buffer. The extent of storage needs is therefore heavily influenced by the assumptions made for the estimation: if the storage need estimate is based on peak production, no ample security buffer is needed. However, an estimate of storage needs based on peak production is particularly prudent: the available storage capacity at Member State level is hence more likely to fall short of the estimated needs.

The needs were estimated in three scenarios. A base scenario referred to peaks in COP production over the 2005-2015 period, which defines the upper limit of the estimate of storage needs to address contingent situations, i.e. exceptional harvest volumes. Two alternative scenarios were also developed for a better estimate of the structural storage needs, i.e. those occurring in ordinary conditions: a first one, based on average COP supply balance conditions over the 2005-2015 period; and a second one, derived from the base scenario by taking into account the net import/export position of each Member State.

Table 3.1 reports the results of the analysis made under the base scenario, which compares the available storage capacity for each Member State with:

1. the maximum theoretically needed storage capacity calculated for each Member State;
2. the minimum need of storage capacity.

Such comparative analysis allowed to conclude that:

- The most serious potential shortages of storage capacity (i.e. the situations where total capacity falls short of both the maximum and the minimum need) affect four Member States: Germany, Lithuania, Poland and the United Kingdom. The shortages which emerged for Denmark, Estonia, Greece, Ireland, Latvia, Luxembourg and Sweden seem less critical, as the extent of the capacity gap to cover is smaller.
- In other eight Member States (Austria, Belgium, Croatia, Italy, Netherlands, Portugal, Slovenia and Spain), total storage capacity falls short of the maximum storage need only.

27 This allowed to consider the different stock management models which can be applied in the two situations. Storage facilities mainly handling COP imports can focus on accurate planning of inbound and outbound flows to optimise the use of storage capacity through faster turnover of stocks. In contrast, storage facilities in export-oriented countries (and especially those operating at farming level) need to have enough storage capacity to handle also exceptional production volumes during the harvest period and in the following months, to reduce the pressure to free up storage capacity through sales of products at unfavourable price conditions.
Table 3.1 – Available storage capacity at Member State level vs. storage needs (minimum/maximum).

<table>
<thead>
<tr>
<th>Member States</th>
<th>2005 mapped storage capacities (tonnes)</th>
<th>Current mapped storage capacities / total current s.c. (tonnes)</th>
<th>Minimum needed storage capacity (tonnes)</th>
<th>Maximum needed storage capacity (tonnes)</th>
<th>Shortage situations vs. the expected total capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>4,420,949</td>
<td>5,065,549</td>
<td>3,887,000</td>
<td>6,275,000</td>
<td>✗</td>
</tr>
<tr>
<td>Belgium</td>
<td>3,636,202</td>
<td>3,820,630</td>
<td>2,674,000</td>
<td>4,954,000</td>
<td>✗</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>7,291,367</td>
<td>14,032,575</td>
<td>8,573,000</td>
<td>9,230,000</td>
<td>✗</td>
</tr>
<tr>
<td>Croatia</td>
<td>2,276,926</td>
<td>2,504,676</td>
<td>1,854,000</td>
<td>4,054,000</td>
<td>✗</td>
</tr>
<tr>
<td>Cyprus</td>
<td>95,019</td>
<td>311,292</td>
<td>104,000</td>
<td>248,000</td>
<td>✗</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>10,436,297</td>
<td>11,427,481</td>
<td>9,982,000</td>
<td>10,635,000</td>
<td>✗</td>
</tr>
<tr>
<td>Denmark</td>
<td>8,938,900</td>
<td>9,954,900</td>
<td>12,141,000</td>
<td>13,006,000</td>
<td>✗ ✗</td>
</tr>
<tr>
<td>Estonia</td>
<td>1,054,613</td>
<td>1,470,806</td>
<td>1,753,000</td>
<td>1,826,000</td>
<td>✗ ✗</td>
</tr>
<tr>
<td>Finland</td>
<td>6,540,400</td>
<td>7,559,500</td>
<td>4,767,000</td>
<td>4,900,000</td>
<td>✗</td>
</tr>
<tr>
<td>France</td>
<td>82,685,986</td>
<td>90,870,486</td>
<td>67,320,000</td>
<td>76,930,000</td>
<td>✗</td>
</tr>
<tr>
<td>Germany</td>
<td>46,520,775</td>
<td>48,104,734</td>
<td>55,087,000</td>
<td>60,705,000</td>
<td>✗ ✗ ✗</td>
</tr>
<tr>
<td>Greece</td>
<td>2,165,980</td>
<td>3,144,337</td>
<td>3,281,000</td>
<td>5,803,000</td>
<td>✗ ✗ ✗</td>
</tr>
<tr>
<td>Hungary</td>
<td>14,714,427</td>
<td>20,144,534</td>
<td>10,460,000</td>
<td>18,196,000</td>
<td>✗</td>
</tr>
<tr>
<td>Ireland</td>
<td>1,993,367</td>
<td>2,593,903</td>
<td>2,989,000</td>
<td>3,503,000</td>
<td>✗ ✗</td>
</tr>
<tr>
<td>Italy</td>
<td>14,649,689</td>
<td>15,683,826</td>
<td>12,219,000</td>
<td>24,270,000</td>
<td>✗</td>
</tr>
<tr>
<td>Latvia</td>
<td>1,569,028</td>
<td>2,377,920</td>
<td>3,377,000</td>
<td>3,435,000</td>
<td>✗ ✗</td>
</tr>
<tr>
<td>Lithuania</td>
<td>4,815,009</td>
<td>5,615,498</td>
<td>6,892,000</td>
<td>7,027,000</td>
<td>✗ ✗ ✗</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>56,210</td>
<td>170,655</td>
<td>216,000</td>
<td>240,000</td>
<td>✗ ✗ ✗</td>
</tr>
<tr>
<td>Malta</td>
<td>0</td>
<td>88,000</td>
<td>0</td>
<td>64,000</td>
<td>✗</td>
</tr>
<tr>
<td>Netherlands</td>
<td>2,164,970</td>
<td>2,275,630</td>
<td>1,768,000</td>
<td>4,925,000</td>
<td>✗</td>
</tr>
<tr>
<td>Poland</td>
<td>15,494,236</td>
<td>24,368,366</td>
<td>29,670,000</td>
<td>32,313,000</td>
<td>✗ ✗ ✗</td>
</tr>
<tr>
<td>Portugal</td>
<td>1,755,100</td>
<td>1,913,580</td>
<td>556,000</td>
<td>2,531,000</td>
<td>✗</td>
</tr>
<tr>
<td>Romania</td>
<td>16,138,355</td>
<td>23,377,236</td>
<td>13,995,000</td>
<td>22,232,000</td>
<td>✗</td>
</tr>
<tr>
<td>Slovakia</td>
<td>5,698,412</td>
<td>5,875,219</td>
<td>3,968,000</td>
<td>5,414,000</td>
<td>✗</td>
</tr>
<tr>
<td>Slovenia</td>
<td>573,385</td>
<td>609,635</td>
<td>342,000</td>
<td>755,000</td>
<td>✗</td>
</tr>
<tr>
<td>Spain</td>
<td>22,464,548</td>
<td>29,905,814</td>
<td>23,858,000</td>
<td>29,985,000</td>
<td>✗</td>
</tr>
<tr>
<td>Sweden</td>
<td>4,384,580</td>
<td>6,496,430</td>
<td>6,984,000</td>
<td>7,221,000</td>
<td>✗ ✗ ✗</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>17,098,723</td>
<td>19,517,051</td>
<td>28,487,000</td>
<td>31,288,000</td>
<td>✗</td>
</tr>
<tr>
<td>EU 28</td>
<td>299,633,454</td>
<td>359,282,264</td>
<td>317,204,000</td>
<td>391,965,000</td>
<td>✗</td>
</tr>
</tbody>
</table>

Source: Areté elaboration on own data and data provided by DG AGRI

Under the base scenario, the maximum and the minimum storage needs are quantified with respect to the peaks in production recorded for each Member State and each individual COP crop over the 2005-2015 period: for this reason, the situation represented in Table 3.1 is likely to overestimate the presence and extent
of storage capacity shortages. The base scenario is in fact more suitable for detecting potential contingent shortages, which might emerge in case of simultaneous production peaks of different COP crops, i.e. in rather exceptional conditions. By contrast, a structural shortage would emerge only in case a Member State faces storage capacity shortages in most of the years. In this context, additional elements should be taken into account when comparing the results of the above exercise with the actual situation of individual Member States:

1. Generally speaking, investments in storage capacity are more likely to be determined by average production levels plus a security buffer (e.g. +20%). Operators actually tend to avoid creating storage capacity which would not be utilised most of the time.

2. Findings from interviews at EU and national level suggest that no Member State currently suffers from serious structural shortage of storage capacity for COP.

3. A number of storage solutions fell out of the scope of the mapping of permanent storage facilities carried out for the study, including:
   a. Silobags, used for temporary (from a few weeks to a few months) storage of grains. Their use is rather widespread in some Member States/Regions (e.g. in Germany and in the Tuscany region of Italy).
   b. Flat storage facilities with or without roof which are normally used for other purposes (and therefore fall outside the scope of the study). These facilities can also be used as "emergency solution" for the storage of COP28.
   c. In some Member States, temporary storage capacity is also granted by floating barges and/or ships moored at ports. Operators in the Netherlands especially rely on such solution, which accounts for a significant portion of the available storage capacity at ports and logistical hubs on inland waterways in the country.

4. The mapping carried out for the present study does not take into account the frequency of yearly stock turnover of storage facilities; this element is of particular importance for all those Member States where just-in-time inventory management models have become more and more common. This is mostly the case in the United Kingdom and Germany, where permanent and temporary storage capacity at farming level is increasingly used to reduce as much as possible the size of storage facilities in the processing stage, which only apparently seem undersized with respect to their needs.

5. A certain volume of COP crops has direct on-farm uses (as feed, as feedstock for the production of renewable energies, etc.) which need temporary storage only.

For the above reasons, two alternative scenarios were developed to allow a better appraisal of structural (rather than contingent) storage capacity shortages.

The first alternative scenario adopts the same methodology for the estimation of storage needs described above, with the difference that the average production over the 2005-2015 period is considered for each crop and each Member State, rather than the peak in production over the same period. Similarly, import and export flows were calculated as monthly average over the observed period, rather than referred to a specific year.

The second alternative scenario considers the same storage needs at Table 3.1, but focuses on the distinction between net importer and net exporter Member States. This is made under the assumption that net

28 This is especially the case in the United Kingdom, where an ample buffer of non-specialised storage capacity may be used to store grains - especially at farm level – in case of exceptional harvest volumes.
exporters of COP need storage capacity in the period between harvest and actual export (whatever the length of such period); in contrast, net importers of COP can usually manage inbound and outbound flows in a more flexible way and adjust them to the timing of their consumption needs. A net importer can significantly reduce its storage needs in most years through a timely management of its imports.

The results of the analysis performed under the first and second alternative scenarios are illustrated in Box 1 and 2, respectively.

**Box 1 – Storage need scenario using average production and trade flows (first alternative scenario)**

Table 3.2 reports the shortages/surpluses of each Member State in the first alternative scenario.

As it can be observed, considering average production and average trade flows drastically reduces the national storage needs and therefore the occurrence and seriousness of shortage situations vis-à-vis the base scenario. Similarly to the base scenario, the minimum need is quantified on the basis of production only, while the maximum need takes into account also trade flows, expected beginning/ending stocks and consumption. The difference between current storage capacity and the average need (i.e. the average between the minimum and maximum need) is reported in the last column of Table 3.2.

In the first alternative scenario, only the United Kingdom and Luxembourg result to have serious shortages, meaning a storage capacity below the minimum need. Eleven Member States – Belgium, Croatia, Denmark, Germany, Greece, Ireland, Italy, the Netherlands, Poland, Portugal and Slovenia - have a storage capacity between the minimum and maximum need.
<table>
<thead>
<tr>
<th>Member States</th>
<th>Current mapped storage capacities / total current s.c. (tonnes)</th>
<th>Minimum needed storage capacity (tonnes)</th>
<th>Maximum needed storage capacity (tonnes)</th>
<th>Shortage situations vs. the expected total capacity</th>
<th>Average needed storage capacity (tonnes)</th>
<th>2015 (Shortage)/Surplus (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>5,065,549</td>
<td>3,034,000</td>
<td>4,950,000</td>
<td>x</td>
<td>3,992,000</td>
<td>1,073,549</td>
</tr>
<tr>
<td>Belgium</td>
<td>3,820,630</td>
<td>2,355,000</td>
<td>4,490,000</td>
<td>x</td>
<td>3,422,500</td>
<td>398,130</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>14,032,575</td>
<td>6,734,000</td>
<td>6,858,000</td>
<td></td>
<td>6,796,000</td>
<td>7,236,575</td>
</tr>
<tr>
<td>Croatia</td>
<td>2,504,676</td>
<td>1,384,000</td>
<td>3,191,000</td>
<td>x</td>
<td>2,287,500</td>
<td>217,176</td>
</tr>
<tr>
<td>Cyprus</td>
<td>311,292</td>
<td>58,000</td>
<td>211,000</td>
<td></td>
<td>134,500</td>
<td>176,792</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>11,427,481</td>
<td>8,015,000</td>
<td>8,402,000</td>
<td></td>
<td>8,208,500</td>
<td>3,218,981</td>
</tr>
<tr>
<td>Denmark</td>
<td>9,954,900</td>
<td>9,726,000</td>
<td>10,615,000</td>
<td>x</td>
<td>10,170,500</td>
<td>-215,600</td>
</tr>
<tr>
<td>Estonia</td>
<td>1,470,806</td>
<td>1,054,000</td>
<td>1,103,000</td>
<td></td>
<td>1,078,500</td>
<td>392,306</td>
</tr>
<tr>
<td>Finland</td>
<td>7,559,500</td>
<td>3,936,000</td>
<td>3,990,000</td>
<td></td>
<td>3,963,000</td>
<td>3,596,500</td>
</tr>
<tr>
<td>France</td>
<td>90,870,486</td>
<td>57,787,000</td>
<td>64,494,000</td>
<td></td>
<td>61,140,500</td>
<td>29,729,986</td>
</tr>
<tr>
<td>Germany</td>
<td>48,104,734</td>
<td>47,136,000</td>
<td>52,992,000</td>
<td>x</td>
<td>50,064,000</td>
<td>-1,959,266</td>
</tr>
<tr>
<td>Greece</td>
<td>3,144,337</td>
<td>2,311,000</td>
<td>4,532,000</td>
<td>x</td>
<td>3,421,500</td>
<td>-277,163</td>
</tr>
<tr>
<td>Hungary</td>
<td>20,144,534</td>
<td>8,341,000</td>
<td>13,783,000</td>
<td>x</td>
<td>11,062,000</td>
<td>9,082,534</td>
</tr>
<tr>
<td>Ireland</td>
<td>2,593,903</td>
<td>2,293,000</td>
<td>2,730,000</td>
<td>x</td>
<td>2,511,500</td>
<td>82,403</td>
</tr>
<tr>
<td>Italy</td>
<td>15,683,826</td>
<td>9,582,000</td>
<td>21,142,000</td>
<td>x</td>
<td>15,362,000</td>
<td>321,826</td>
</tr>
<tr>
<td>Latvia</td>
<td>2,377,920</td>
<td>1,968,000</td>
<td>2,099,000</td>
<td></td>
<td>1,988,500</td>
<td>389,420</td>
</tr>
<tr>
<td>Lithuania</td>
<td>5,615,498</td>
<td>4,045,000</td>
<td>4,121,000</td>
<td></td>
<td>4,083,000</td>
<td>1,532,498</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>170,655</td>
<td>180,000</td>
<td>193,000</td>
<td>x x</td>
<td>186,500</td>
<td>-15,845</td>
</tr>
<tr>
<td>Malta</td>
<td>88,000</td>
<td>0</td>
<td>26,000</td>
<td></td>
<td>13,000</td>
<td>75,000</td>
</tr>
<tr>
<td>Netherlands</td>
<td>2,275,630</td>
<td>1,553,000</td>
<td>4,699,000</td>
<td>x</td>
<td>3,126,000</td>
<td>-850,370</td>
</tr>
<tr>
<td>Poland</td>
<td>24,368,366</td>
<td>23,931,000</td>
<td>26,085,000</td>
<td>x</td>
<td>25,008,000</td>
<td>-639,634</td>
</tr>
<tr>
<td>Portugal</td>
<td>1,913,580</td>
<td>286,000</td>
<td>2,036,000</td>
<td>x</td>
<td>1,161,000</td>
<td>752,580</td>
</tr>
<tr>
<td>Romania</td>
<td>23,377,236</td>
<td>10,275,000</td>
<td>16,629,000</td>
<td></td>
<td>13,452,000</td>
<td>9,925,236</td>
</tr>
<tr>
<td>Slovakia</td>
<td>5,875,219</td>
<td>2,895,000</td>
<td>3,652,000</td>
<td></td>
<td>3,273,500</td>
<td>2,601,719</td>
</tr>
<tr>
<td>Slovenia</td>
<td>609,635</td>
<td>263,000</td>
<td>681,000</td>
<td>x</td>
<td>472,000</td>
<td>137,635</td>
</tr>
<tr>
<td>Spain</td>
<td>29,905,814</td>
<td>16,462,000</td>
<td>21,999,000</td>
<td></td>
<td>19,230,500</td>
<td>10,675,314</td>
</tr>
<tr>
<td>Sweden</td>
<td>6,498,430</td>
<td>5,269,000</td>
<td>5,451,000</td>
<td></td>
<td>5,360,000</td>
<td>1,138,430</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>19,517,051</td>
<td>23,850,000</td>
<td>26,270,000</td>
<td>x x</td>
<td>25,060,000</td>
<td>-5,542,949</td>
</tr>
<tr>
<td><strong>EU 28</strong></td>
<td><strong>359,282,264</strong></td>
<td><strong>254,723,000</strong></td>
<td><strong>317,334,000</strong></td>
<td><strong>xx</strong></td>
<td><strong>286,028,500</strong></td>
<td><strong>73,253,764</strong></td>
</tr>
</tbody>
</table>

Source: Areté elaboration on own data and data provided by DG AGRI
The analysis focuses on the shortage situations highlighted in Table 3.1 which are more relevant both in absolute and relative terms; for this purpose, a double screening was performed in order to analyse only:

1. Member States with a shortage of at least 500,000 tonnes (absolute value threshold).
2. Member States whose storage capacity is less than 75% of their average\(^{29}\) storage need (relative threshold).

Table 3.3 summarises the result of the analysis.

Considering the two thresholds described above and the net trade position of the different Member States\(^{30}\), the only situation of serious potential concern was identified in Latvia. A shortage was already identified for Latvia in the base scenario, while no shortage emerged for this country in the first alternative scenario at Box 1.

Table 3.3 – Situations of serious potential concern considering absolute and relative thresholds and net trade position

---

\(^{29}\) In this analysis, consistently with the approach adopted at § 3.3, the average need is calculated for each Member State as the simple average between the minimum and the maximum storage need in the base scenario.

\(^{30}\) For the calculation of the net trade position of each Member State, the average import and export volumes over the 2013-2015 period were considered.
An analysis of the **timing of peaks in COP exports and peaks in storage needs** was also made. This allowed the detection of situations where lack of storage capacity in critical periods of the year may have put pressure on operators to “free up” storage space through increased/anticipated export sales.

Figure 3.1 illustrates the main monthly peaks of COP exports (i.e. those above an 800 000 tonnes threshold) over the 2005-2015 period. The analysis of the timing of peaks in COP exports revealed that:
Eight Member States recorded their export peak in March: Hungary in 2009; Italy in 2011; Czech Republic, Germany, Denmark, France, Poland and Slovak Republic in 2015.

Four Member States recorded their export peak in September: Cyprus in 2008; Estonia, Lithuania and Latvia in 2015.

Three Member States recorded their export peak in August, and other three Member States in November.

The export peak at EU28 level was recorded in October 2014.

Table 3.4 reports for eight leading EU COP exporters the results of a comparison between i) the month when the largest average monthly exports were recorded over the 2005-15 period and ii) the month when the largest storage needs were quantified for each Member State.

<table>
<thead>
<tr>
<th>Month with the biggest average monthly exports</th>
<th>BG</th>
<th>DE</th>
<th>FR</th>
<th>HU</th>
<th>LT</th>
<th>NL</th>
<th>PL</th>
<th>RO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly storage needs</td>
<td>Aug</td>
<td>Oct</td>
<td>Mar</td>
<td>Mar</td>
<td>Sep</td>
<td>May</td>
<td>Aug</td>
<td>Aug</td>
</tr>
</tbody>
</table>

Conditions highlighting potential pressure to release storage capacity - which occur wherever monthly exports peak in the same month when storage needs peak, or in the following month – were identified in Lithuania and in Poland only.

The year when the peak in monthly COP exports was recorded, and the year of maximum COP production over the 2005-2015 period were also compared for the same eight Member States. Table 3.5 reports the results of the comparison.

<table>
<thead>
<tr>
<th>Year of max monthly export</th>
<th>BG</th>
<th>DE</th>
<th>FR</th>
<th>HU</th>
<th>LT</th>
<th>NL</th>
<th>PL</th>
<th>RO</th>
</tr>
</thead>
</table>

No clear relationship was found between i) the year of maximum monthly exports and ii) the year of maximum production over the observed period. This suggests that for most of the Member States covered by the above analyses, these two variables are only partially correlated, and that the influence of other factors - such as the dynamics of re-exports of imported COP volumes, domestic consumption, intra and extra-EU demand - can be significant.

In conclusion, elements suggesting that lack of storage capacity in critical periods of the year may have put pressure on operators to “free up” storage capacity through increased/anticipated export sales emerged for Lithuania and Poland only. No issues in this respect were identified for the other six leading EU COP exporters.

The analysis of the availability of storage capacity vis-à-vis the estimated storage needs is developed further in the reply to Question 3.1 (see § 3.3.1.1), where the implications of the identified capacity gaps are assessed from a strategic and operational viewpoint.
Figure 3.1 - Monthly peaks* of COP exports at Member State level over the 2005-2015 period

* only peaks above 800,000 tonnes are shown

Source: Areté elaboration on raw Eurostat data provided by DG AGRI
3.1.2 Question 1.2: Evolution of storage capacity since 2005

Total available storage capacity for COP has increased in all 28 Member States over the observed period. The increase was substantial in some Eastern EU Member States, such as Bulgaria, Poland and Romania, but also in some Western EU ones, such as Spain. For most of the remaining Member States, storage capacity has increased by a limited or negligible extent.

The results of a comparative analysis between the overall storage capacity available in 2005 and 2015 for each Member State are reported in Figure 3.2.

Figure 3.2 - Evolution of the available storage capacity in selected Member States: 2005 vs. 2015.

Looking at the recorded evolution at NUTS2 region level, 18 regions increased their storage capacity by more than 1 million tonnes between 2005 and 2015: out of these, 12 regions are located in Eastern EU Member States (Romania, Bulgaria, Hungary and Poland) while the remaining six are Spanish, French and German regions. Figure 3.3 reports the most significant increases at regional level over the observed period.

Even if no Member State recorded a decrease in its national storage capacity over the observed period, in some NUTS 2 regions the rationalisation process resulted in the closure or abandonment of older facilities, which determined a decrease in total storage capacity. Only five NUTS 2 regions recorded capacity decreases of over 200 000 tonnes: among them, four regions are located in Western EU Member States (Germany and Spain) and one in the Czech Republic. The German region of Thuringen is the only one recording a decrease of more than 1 million tonnes over the observed period, as shown in Figure 3.4 below.
Figure 3.3 – NUTS 2 regions with the highest increase of storage capacity between 2005 and 2015.

Source: Areté elaboration

Figure 3.4 – NUTS 2 regions with the highest decrease of storage capacity between 2005 and 2015.

Source: Areté elaboration

An analysis on the evolution of storage capacity by level of the supply chain revealed that the most substantial investments were made at farm level (+34 million tonnes, +32%) and at wholesale/trade level (+12.5 million tonnes, +12%); significant growth in relative terms was also recorded at transportation hubs, with a +22% increase between 2005 and 2015, as shown in Figure 3.5 below.
A more in-depth analysis of the Member States with the highest increases in storage capacity (see Figure 3.6 below) confirmed that the most substantial investments were made in on-farm facilities. In France and Hungary, however, important investments in additional storage capacity were also made at the wholesale/trade level of the supply chain. France also rationalised its storage capacity at ports and transportation hubs, which decreased by 35% over the observed period. Spain, one of the Western EU Member States experiencing the largest growth in storage capacity, mostly concentrated its investments in the downstream stages of the supply chain, with substantial increases at processing level and at transportation hubs.

Figure 3.6 – Member States with the highest 2005-15 increase in storage capacity by level of the supply chain
Both the available literature\(^{31}\) and interviews with stakeholders suggest that the most significant investment projects, with special respect to construction of new storage facilities, have been concentrated in a number of Eastern EU Member States: Czech Republic, Slovakia, Hungary, Poland, Romania and Bulgaria. These Member States experienced an increase in COP production over the 2005-2015 period, which also fuelled a growth in exports (see the reply to question 2.1 at § 3.2.1). Investments in storage capacity in Western EU Member States have been more focused on rationalisation, expansion and/or technological upgrade of existing storage facilities\(^{32}\). In certain Member States, especially concentrated in Southern Europe\(^{33}\), storage facilities are mostly of small/medium size and are getting increasingly obsolete\(^{34}\). Among the Western EU Member States, Spain and Greece recorded the most significant increases in storage capacity over the observed period.

Table 3.6 reports key facts about the most notable investment projects in storage capacity for COP crops completed in the 2005-2016 period in the EU, covering both construction of new facilities and expansion of existing facilities.

**Table 3.6 - Key facts on selected investment projects in storage capacity for COP crops completed in the 2005-2016 period in the EU**

<table>
<thead>
<tr>
<th>Member State</th>
<th>Main investments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bulgaria</strong></td>
<td>Rosa, ADM, BMF Port Burgas and Agria all invested in new storage facilities or in acquisition of existing ones in recent years.</td>
</tr>
<tr>
<td><strong>Denmark</strong></td>
<td>Sokup invested in around 30 000 tonnes of storage capacity in 2014; additional investments might be limited to trading and processing companies because of the increasing need of animal feed.</td>
</tr>
<tr>
<td><strong>Estonia</strong></td>
<td>Because of the constantly growing yields, new on-farm investments are expected, mainly thanks to the Rural Development Program.</td>
</tr>
<tr>
<td><strong>Finland</strong></td>
<td>Most investments made in the last seven years were by farming companies, whose storage capacity increased by around 20% between 2011 and 2015.</td>
</tr>
<tr>
<td><strong>France</strong></td>
<td>Centre Grains, Unéal, Carré Group and CAPA invested in a total of 136 000 tonnes of additional storage capacity between 2012 and 2014; there is a growing interest of cooperatives in investments in Eastern EU Member States (especially Romania and Bulgaria).</td>
</tr>
<tr>
<td><strong>Germany</strong></td>
<td>Investments by J. Müller, Agrofert, Getreide AG, Jäckering Mühlen &amp; Nährmittelwerke, Versis DE Verband and Villarta de San Juan added more than 100 000 tonnes of storage capacity in the last three years.</td>
</tr>
<tr>
<td><strong>Hungary</strong></td>
<td>A notable investment project was completed in 2014 by Cordos Lucian Interprindere Individuala, which renewed its drying equipment and brought its storage capacity to around 14 000 tonnes.</td>
</tr>
<tr>
<td><strong>Italy</strong></td>
<td>The Barilla Group, Terremerse consortium and the Savona port terminal all invested in storage capacity and in the connection of storage facilities with core logistical infrastructure.</td>
</tr>
<tr>
<td><strong>Latvia</strong></td>
<td>Major investments in storage capacity were completed by Agrokoncernas, DLA Group and Linas Agro in the last seven years.</td>
</tr>
</tbody>
</table>


\(^{32}\) Interviews with stakeholders in some Member States (e.g. Belgium and France) also reported that some storage facilities located in metropolitan areas were demolished to make room for urban development, and were replaced by new facilities in more convenient locations.

\(^{33}\) According to the Rabobank / COPA-COGECA study (2014).

\(^{34}\) This is for instance the case of Italy, where according to the 2014 survey by ISMeA / MiPAAF most of the storage facilities have an individual capacity below 10 000 tonnes, a single receiving bin, and were built between 1960 and 1990.
### Member State | Main Investments
---|---
Lithuania | Similarly to Latvia, the main companies investing in storage facilities have been DLA Group and Linas Agro.

Netherlands | Vopak, Stolt-Nielsen, Port of Rotterdam, OBA Group and HES Beheer invested in the acquisition of new storage facilities and in the expansion of existing ones in the last four years.

Poland | ADM, Cefetra and Elewarr invested in new storage facilities and in the acquisition of companies with storage capacity for a total of approximately 1 million tonnes between 2011 and 2014.

Romania | Investments by Cargill, Nidera, Axeral, Comuna Independenta and Aholt increased the overall storage capacity by over 100,000 tonnes in the last three years.

Spain | Cooperative The Sarda, Sevitrade, Aceites Abril, Harinalia Canarias and Portillo all invested in construction of new storage facilities or in the modernization of existing ones between 2012 and 2014. Additional investments are expected for on-farm storage.

UK | Wessex Grain, Europort, Weals Granary and Peel Ports Group invested in storage capacity for a total of approximately 150,000 tonnes in the 2011-2015 period.

Source: Web search on companies’ websites, press releases, sector magazines, World Grains, annual reports.

### 3.1.3 Question 1.3: Factors influencing the evolution of storage capacity

#### 3.1.3.1 Factors specific to the functioning of COP supply chains

The elements allowing the identification of the main factors influencing the evolution of storage capacity for COP in the EU28 emerged from interviews with EU and national stakeholders, as well as from the literature on the topic.

The combined effect of growth in COP yields and production and increasing exports of COP, which generally resulted in increased storage needs, emerged as a key driver behind the expansion of storage capacity for COP. This was the case in the Eastern EU Member States which recorded the best export performances over the observed period, i.e. Romania, Bulgaria, Poland, Hungary, Czech Republic, Lithuania and Latvia, and also in France and Germany, which recorded significant increases in both production and exports.

Increased volatility of domestic and international prices for COP crops has further encouraged the use of strategic stock management, which requires the availability of surplus storage capacity. According to DG AGRI’s internal assessment (2016), COP prices on the EU market have become more volatile as a result of their increased interconnection with the dynamics of international prices after the reduction of the level of tariff protection and of the scope for intervention purchases. In combination with the increased importance of the EU as a global COP exporter (especially of cereals), more volatile price dynamics can imply the need for longer storage periods in the wait for favourable market conditions for both sellers and buyers, and hence the need for increased availability of storage capacity for COP. The importance of price volatility as a factor influencing the evolution of storage capacity was emphasised by stakeholders operating in sectors which are especially affected by such phenomenon, such as durum wheat milling. The limited size of the global market of durum wheat amplifies the pressure on prices coming from variations in world production and/or from demanding quality requirements in the downstream stages.

---

b\textsuperscript{35} Basically limited to the Rabobank/COPA-COGECA study (2014) and to DG AGRI’s internal assessment (2016).
Another important factor shaping the evolution of the EU storage system for COP was identified in the **switch to just-in-time (JIT) inventory management models** by an increasing number of millers, oilseed crushers and producers of compound feed. This trend emerged especially in the United Kingdom, in the Netherlands and in Scandinavian countries, but it was also reported as significant in Belgium, France and Poland. In JIT supply systems, existing storage facilities at the concerned processing plants are used only in part\(^{36}\), mothballed\(^{37}\) or disposed of. The storage function is transferred for the most part from the processing stage to the upstream stages of the COP supply chains, and especially to the farming stage. The switch to JIT supply systems therefore requires an increased availability of storage capacity in the upstream stages of the supply chains. At EU level, the combined share of total capacity of individual on-farm facilities and farming cooperatives has actually increased from 48% to 51% between 2005 and 2015, whereas the share of processing facilities has remained stable at 9%.

Some stakeholders also highlighted the **need to ensure segregation of products with different quality features or origins** as a significant factor promoting investments in additional COP storage capacity in the EU.

Also the **implementation of plans aimed at expanding/upgrading storage capacity for COP** has played a role in some Member States. The “Plan Silo” implemented in France since 2011 is a notable example in this respect. The plan – developed by stakeholders, supported by the Ministry of Agriculture, and implemented by FranceAgriMer – aimed at increasing storage capacity by 5 million tonnes in 5 years. In Spain, the Ministry of Agriculture has sold to private operators or transferred to agribusiness cooperatives several unused storage facilities. These facilities, with a cumulated storage capacity close to one million tonnes, were once managed by the National Agency for Market Intervention. In this way, a part of this unused storage capacity has become operational again.

### 3.1.3.2 Factors related to the functioning of the agribusiness system as a whole

The **specific needs** in terms of availability of storage capacity experienced by large-scale, multinational and multi-commodity agribusiness companies emerged as a significant factor shaping the evolution of storage capacity. These operators must address rather complex combinations of geographical and chronological factors in their storage needs, mainly related to the different timing of harvest peaks and demand peaks in the different areas where they operate. These operational conditions suggest, wherever this is possible, the use of flexible storage solutions as a cost-saving measure. In such conditions, expensive investments in proprietary storage facilities would actually risk underutilisation in certain periods of the year. Temporary availability of non-specialised storage capacity for hire, especially at transportation hubs (ports and rail terminals), was found to be often exploited by these operators as a flexible solution to their storage needs (see also § 3.1.3.3).

**Public policies and support** (see also the reply to question 1.4 at § 2.1.4) as well as the **privatisation of the former state-owned agribusiness system** have played a critical role in determining the evolution of the COP storage system in some Eastern EU Member States: Hungary, Poland and Romania represent notable examples in this respect. The cases of Poland and Romania offer some interesting elements on the role played by the privatisation of state-owned companies. Most of the current COP storage capacity of the Polish processing sector (cereal milling, oilseed crushing and feed production) has been “inherited” through the privatisation of former state-owned companies (PZZs), or their conversion into stock companies with the Polish government as main shareholder. These were located in every province and had an average storage capacity of around 50 000 tonnes per unit. Up to 1996, the total Romanian grain storage capacity amounted

---

\(^{36}\) Storage facilities in these processing plants are generally used to store “emergency” stocks - sufficient for 1-6 weeks of operation - to cover possible temporary disruptions in the JIT supply system.

\(^{37}\) The term “mothballing” refers to the preservation of a facility which is not used anymore. A mothballed facility is kept in working order so that operations may be restored quickly if needed.
to 10.6 million tonnes: such capacity was entirely owned by the State company *Romcereal*. In 1996, *Romcereal* was split in two other companies: *Cerealcom* (storage capacity for 3.5 million tonnes / 100% state capital) and *Comcereal* (storage capacity for 6.9 million tonnes / 40% private capital and 60% state capital). Over time, the Romanian government sold its shares in these companies to investments funds, completing the process of privatization of the former public storage system.

### 3.1.3.3 Other factors

Constraints in the availability of space for the expansion of storage capacity in certain locations, with special respect to transportation hubs (ports and rail terminals) often result in greater availability of non-specialised, multi-purpose storage facilities at those locations (i.e. flat warehouses rather than specialised vertical silos). These non-specialised facilities can offer flexible and temporary storage solutions to agribusiness operators, with special respect to large-scale, multinational and multi-commodity companies (see § 3.1.3.2). These non-specialised facilities are actually hired to multiple agribusiness companies every year, with each operator storing a certain volume of COP for a certain period. In the periods when no COP are stored, these warehouses can store a wide range of non-agricultural products, including products not stored in bulk (e.g. motor vehicles, manufactured goods packed in boxes, etc.). The use of such storage solutions was found to be rather widespread in Italy, the Netherlands and Spain. According to interviews, other temporary storage solutions available at ports, such as barges, play an important role especially in the Netherlands.

**External factors may also pose constraints to the expansion of storage capacity.** Difficulties in getting building permits in the framework of urban planning, for instance, were reported by some stakeholders as a limiting factor in the implementation of the “Plan Silo” in France. A difficulty in purchasing building plots in suitable locations (transportation hubs, industrial parks) at reasonable prices was highlighted by a Belgian stakeholder.

### 3.1.4 Question 1.4: Investments in storage capacity

#### 3.1.4.1 Prominent investors in storage capacity

As already highlighted in the reply to question 1.2 (see § 3.1.2), the bulk of investments in storage capacity in the EU derived from a number of notable projects completed in both Eastern EU Member States (where the focus has especially been on increasing the available storage capacity, through expansion of existing facilities or through construction of new ones) and Western EU ones (where the focus has been more on rationalisation, expansion and technological upgrade of existing facilities). Box 3 defines selected “prominent investor profiles”, describing their key features.
Box 3 – Prominent investor profiles

Agribusiness cooperatives

This typology of investors in storage capacity is particularly important in Western EU Member States, and especially in France, Germany, Spain and Italy. The focus of its investment strategy has mainly been on technological upgrading and rationalisation of existing facilities (capacity expansion at the most conveniently located facilities, and closure of small-scale / obsolete ones), but construction of new facilities has also occurred. Differently from the other typologies of investors, agribusiness cooperatives have easier access to public funding, mainly in the form of EAFRD funds made available via Rural Development Plans (see § 3.1.4.2).

Operators in the processing stage

This typology of investors has been active in most EU Member States. Its investment strategy combines rationalisation and expansion of existing storage capacity, often as a consequence of restructuring in multi-plant agribusiness companies. Construction of new storage facilities at processing plants has mainly occurred in Eastern EU Member States, especially in recent years. The investment strategy of this typology of operators is mainly funded through own resources or credit.

Export-oriented traders operating at transportation hubs

This typology of investors has been particularly active over the observed period, and has completed the largest individual capacity expansion projects, especially at ports, both in Western EU Member States (notable projects were completed in Italy, the Netherlands and the United Kingdom) and in Eastern EU ones (important investments were made in Bulgaria, Hungary and Romania). Own resources or credit have constituted the main funding solutions also for this typology of investors.

3.1.4.2 Available funding solutions

The investigation focused on the following typologies of available funding solutions:

1. internal resources and venture capital;
2. funding through EAFRD via specific measures in Rural Development Programmes;
3. non-agricultural funding options at EU level offered through ESIF and EFSI.

Findings from interviews with stakeholders suggest that:

- Internal resources and venture capital are solutions which have been adopted especially by large-scale operators in the downstream stages of the COP supply chains (processors and traders).
- Funding through EAFRD via Rural Development Programmes (RDPs) has mainly played a role for investments in storage capacity at the farming level, including those by agribusiness cooperatives. In the 2007-2013 programming period, the measures including COP storage facilities among the investment typologies eligible for funding have mainly been measure 121 (for on-farm storage) and measure 123 (especially for storage at agribusiness cooperatives).
- Non-agricultural funding options at EU level seem to have played a more limited role, and have not been available in all Member States.

It is worth underlining that one of the most ambitious plans for expanding storage capacity, the French “Plan Silo”, has mainly been aimed at raising awareness on the need for additional/upgraded storage capacity in the country, and does not rely on public funding for the related investments. According to the interviewed stakeholders, most of the investments in storage capacity completed in France over the 2005-2015 period, and especially investments made in the downstream stages of the supply chain, have been privately funded. In contrast, the role played by EAFRD funding via RDPs has been rather limited.
The prevailing importance of private funding for off-farm capacity expansion projects (especially large-scale ones) has also emerged from interviews with Belgian, Dutch, German, Italian and Polish stakeholders. No public funding has been available in these Member States in the last years for major investments in storage capacity by operators in the downstream stages of the supply chain (processors, traders).

Public funding – mainly co-financed by EAFRD via RDPs – has mainly been available for small/mid-sized projects, especially in the farming stage. It has played a significant role especially in some Eastern EU Member States (e.g. Hungary and Poland). Hungary constitutes a notable example in this respect. Already within the pre-accession agricultural support program SAPARD, about 1,4 billion Forints (5,5 million Euros) were allocated for investments into storage facilities. Hungary joined the EU with about 10 million tonnes of COP storage capacity with often outdated technology. Back-to-back exceptional harvests in 2004 and 2005, combined with low world market prices, resulted in the offering of huge quantities of cereals for intervention. MVH – the Hungarian paying agency at the time – faced great difficulties with ensuring adequate storage capacity. Within the 2004-2006 RDP, about 20 billion Forints (80 million euros) of support were allocated to 460 farmers for building modern steel silos and flat storage facilities, for a cumulated capacity of around 2.5 million tonnes of grains. In addition, around 400 000 tonnes of storage capacity were renewed through EU-funded support. Farmers were also investing into storage facilities financed by own resources (including credit). According to experts' estimations, about 14-15 million tonnes of COP storage capacity were in operation in Hungary by 2008. Storage capacity added from 2008 onwards has mostly been financed through own resources or credit, as the 2007-2013 RDP allocated only limited resources for investments in storage facilities and drying equipment. The current Hungarian RDP (2014-2020) allocates again around 20 billion Forints (65 million Euros) for investments in “small scale storage facilities (max 5 000 tonnes) and dryers”.
3.2 Replies to study questions under Theme 2 (logistical infrastructure)

3.2.1 Question 2.1: Evolution of intra and extra-EU trade flows in COP crops since 2005

The analysis of the overall geographical structure of EU COP trade, based on average figures for the 2005-2015 period, is the preliminary step for studying the evolution of intra and extra-EU trade flows in COP crops since 2005.

The average annual COP imports in the EU in the 2005-2015 period (Figure 3.7) amounted to around 125 million tonnes, with around 42% of imports coming from extra-EU countries and 58% from intra-EU trade. The average annual COP exports over the same period (Figure 3.8) amounted to around 107 million tonnes, with around 30% going to third countries; the remaining 70% consists of intra-EU exports.

The leading importers of COP over the observed period (Figure 3.7) have been the Netherlands, Germany, Spain, Italy and Belgium. France, the United Kingdom and Portugal have also imported significant volumes of COP between 2005 and 2015. Spanish and French COP imports have mostly come from third countries, whereas the combination between intra and extra-EU imports has been more balanced in the Netherlands, Italy and the United Kingdom. Germany and Belgium have mostly been importing COP crops by other Member States.

France is the leading COP exporter in the EU, followed by Germany. Also the Netherlands, Hungary and Romania have exported significant volumes over the observed period (Figure 3.8). Whereas exports to third countries have been particularly important for France, Germany and Romania, the Netherlands and Hungary have mostly exported COP to other Member States.
Figure 3.7 – Annual COP imports by Member State: EU vs. non-EU origins (average 2005-15)

Source: Areté elaboration on raw Eurostat data provided by DG AGRI

Figure 3.8 – Annual COP exports by Member State: EU vs. non-EU destinations (average 2005-15)

Source: Areté elaboration on raw Eurostat data provided by DG AGRI
Spain and the Netherlands have been the leading COP importers from third countries, followed at a certain distance by Italy, Germany and France (Figure 3.9).

**Figure 3.9 – Top 10 EU importers of COP from extra-EU countries (average 2005-15)**

France has been the leading COP exporter to extra-EU destinations over the observed period, followed at a great distance by Germany and Romania (Figure 3.10).

**Figure 3.10 – Top 10 EU exporters of COP to extra-EU countries (average 2005-15)**

Figure 3.11 highlights the main macro-areas from which EU COP imports originate. South America accounts for over 60% of EU imports, followed by North America and non-EU European countries, each with a share of around 17% of total imports. Imports from South America mainly consist of soymeal and soybeans, whereas imports from North America mainly consist of soybeans and wheat (both soft and durum); maize accounts for nearly half of imports from non-EU European countries.

Figure 3.12 highlights the macro-areas which constitute the main destinations for EU COP exports. Africa and Asia account on aggregate for more than 80% of extra-EU exports. EU COP exports to Africa mainly consist of soft wheat, while soft wheat and barley account for the majority of exports to Asia.
The previous findings suggest a role of the Netherlands as logistical hub for extra-EU inward flows, which are re-distributed mainly to EU destinations. Belgium plays a similar role for outward flows from other Member States, which are re-exported to both EU and third country destinations.

The origin/destination matrices for COP imports (Table 3.7) and exports (Table 3.8) highlight a number of key intra-EU trade flows, such as:

- From France to Belgium, the Netherlands, Spain, Germany and Italy.
- From Germany to the Netherlands and vice versa.
- From Belgium to the Netherlands and vice versa.
- From Hungary to Italy.
- From the Czech Republic to Germany.

The analysis of intra-EU COP trade reveals that Germany, the Netherlands, Belgium, Spain and Italy (in decreasing order of importance) have been the top-5 COP importers from other Member States over the observed period. The Netherlands and Belgium mainly act as re-exporters of COP both inside and outside the EU. By contrast, Italy and Spain mainly import COP to meet domestic consumption needs.

France has been the leading COP exporter to other EU destinations, followed by Germany, the Netherlands and Hungary, with the United Kingdom as a distant fifth. France has been a key COP supplier to the Netherlands, Belgium (part of these exports have been re-exported), Spain, Germany and Italy.
Figure 3.11 – Main extra-EU COP imports by macro-areas (average 2005-15)

Source: Areté elaboration on raw Eurostat data provided by DG AGRI
Figure 3.12 – Main extra-EU COP exports by macro-areas (average 2005-15)

Source: Areté elaboration on raw Eurostat data provided by DG AGRI
STUDY ON STORAGE CAPACITIES AND LOGISTICAL INFRASTRUCTURE FOR EU AGRICULTURAL COMMODITIES TRADE (with a special focus on Cereals, the Oilseed Complex and
Protein Crops (COP))
Final Report

Table 3.7 – Origin-destination matrix for COP imports
Average 05-15
Partner
('000 tonnes)
Reporter
AT
BE
BG
CY
CZ
DE
DK
EE
EL
ES
FI
FR
HR
HU
IE
IT
LT
LU
LV
MT
NL
PL
PT
RO
SE
SI
SK
UK
Intra EU28

AT

BE

BG

6
11
4
72
19
0
0
0
66
42
2
0
302
390
71
3
4
2
0
0
0
11
7
320
19
3
718
0
7
9
4
715
120
11
0
4
40
8
2
0
6
17
929
17
293
1
1
1
0
19
0
0
1
0
0
1
6
18 1,240 160
17
21
6
0
1
175
25
1
491
2
6
4
68
0
0
22
3
1
2
48
65
1,540 2,509 2,615

CY

CZ

DE

DK

EE

EL

ES

FI

FR

HR

HU

IE

IT

LT

LU

LV

MT

0
0
0

271
18
1
0

475
1,414
4
4
498

2
44
0
1
1
663

0
4
0
2
0
43
15

0
3
20
37
0
0
1
0

0
18
0
21
0
13
0
0
18

0
36
0
2
0
192
21
29
0
43

10
5,182
4
92
10
2,986
55
1
204
3,829
5

6
0
0
3
0
8
0
0
11
10
0
2

679
58
40
29
31
815
0
5
255
113
0
29
71

0
7
0
0
0
11
1
0
0
0
0
5
0
0

226
24
1
7
2
156
46
0
30
40
0
85
13
56
2

1
56
0
0
0
147
72
28
0
181
28
13
0
0
2
7

2
47
0
0
0
42
5
0
0
0
0
48
0
0
0
0
0

0
22
0
0
0
115
73
52
0
94
37
10
0
0
5
15
83
0

1
0
0
0
0
4
1
0
1
0
0
0
0
0
0
12
0
0
0

0
0
0
0
33
7
0
0
0
1
0
2
0
0
0
0
0
1
3
0
0
0
0
48

1,899
0
554
0
8
12
0
94
1
10
478
202
0
64
19
1
702
13
3
1
0
22
77
0
3
29
20
59
805
11
1
14
24
0
27
0
0
27
27
0
5
1
9
3,069 109
511
486
94
0
180
43
25
21
1
0
89
96
13
15
0
92
33
0
8
509
115
2,947 9,681 1,498

0
40
60
4
0
0
4
5
7
0
28
2
7
4
6
1
9
0
0
16
256

27
0
0
0
0
0
222
0
0
0
3
0
1
2
7
0
0
0
3
327

0
268
1
0
3
131
0
1
0
15
10
8
634
2
13
0
0
58
1,215

1
0
0
6
6
8
0
2
0
27
11
3
0
25
0
0
33
445

5
16
216
2,563
1
59
1
38
4,583
33
1,008
13
29
2
6
1,065
22,017

8
0
145
9
0
0
6
2
0
3
8
0
34
0
0
245

0
1,423
9
0
0
14
531
232
23
843
3
270
221
3
5,700

0
0
0
0
0
2
1
1
0
0
0
0
292
320

0
1
0
9
19
6
3
22
9
35
7
36
834

0
312
0
73
63
10
0
42
0
0
19
1,054

1
0
18
0
0
0
1
0
0
0
164

3
30
8
13
0
14
0
0
19
592

1
0
0
0
0
0
0
1
22

NL

PL

175
6
1,494 37
1
0
9
0
33
71
3,726 1,725
132
43
16
1
22
2
79
191
60
16
256
23
0
0
276
6
35
49
67
13
81
38
19
0
39
2
0
1
102
269
36
17
15
1
42
20
0
0
37
26
484
66
7,404 2,457

PT

RO

SE

SI

SK

UK

0
0
1
1
0
0
0
0
1
236
0
1
0
0
0
1
0
0
0
0
0
0

25
166
129
95
4
127
0
0
144
574
0
185
1
111
14
383
0
0
0
10
410
5
132

0
33
0
2
0
177
172
1
0
162
7
6
0
0
12
1
6
0
2
0
67
29
11
0

22
1
1
1
0
2
0
0
6
0
0
0
8
171
0
482
0
0
0
2
0
0
0
5
0

392
3
6
0
201
187
5
0
4
23
0
0
4
181
0
107
0
0
0
0
44
357
2
56
0
10

0
266
0
6
1
310
52
0
14
895
3
85
0
0
608
40
1
0
1
2
553
47
287
1
16
0
0

1
0
0
0
3
245

0
1
3
82
2,597

0
0
38
725

5
0
722

3
1,587 3,189

Intra
EU28

Extra
EU28

Total
import

2,309
9,008
227
381
898
14,111
1,257
152
1,178
7,978
316
2,574
123
974
1,032
7,741
277
126
443
118
11,085
2,211
2,590
1,542
421
462
458
2,966
72,958

36
2,313
77
242
14
4,625
1,567
13
1,124
10,722
80
4,005
159
77
531
6,650
143
0
96
35
10,257
1,669
2,379
529
239
1,010
5
3,197
51,793

2,344
11,321
304
623
913
18,736
2,824
165
2,301
18,700
397
6,580
282
1,051
1,562
14,390
420
126
540
153
21,342
3,880
4,968
2,071
660
1,472
462
6,162
124,751

Source: Areté elaboration on raw Eurostat data provided by DG AGRI

111


### Table 3.8 - Origin-destination matrix for COP exports

#### Average 05-15 (1,000 tonnes)

| Partner | AT | BE | BG | CY | CZ | DE | DK | EE | EL | ES | FI | FR | HR | HU | IE | IT | LT | LU | MT | NL | PL | PT | RO | SE | SI | SK | UK | Intra EU28 | Extra EU28 | Total export |
|---------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| AT 4 16 0 41 289 3 0 8 1 1 12 13 46 1 831 1 0 0 1 13 15 0 24 5 76 21 2 1,422 121 1,543 |
| BE 12 0 0 1 504 14 0 7 8 8 820 0 10 5 20 7 12 1 0 1,577 20 2 1 13 0 4 76 3,123 1,568 4,711 |
| BG 14 63 74 1 80 8 0 361 842 10 127 4 7 15 330 1 0 0 6 167 8 178 544 6 0 1 44 2,889 1,424 4,323 |
| CY 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 29 500 0 24 0 13 136 21 2 2,809 156 2,965 |
| CZ 229 0 0 0 0 1,777 1 0 0 1 0 2 3 24 3 45 1 0 0 0 29 500 0 24 0 13 136 21 2 2,809 156 2,965 |
| DE 416 1,076 3 9 494 560 5 45 450 61 740 2 59 51 686 8 25 23 3 3,258 406 123 12 87 13 34 516 5,164 5,667 10,831 |
| DK 1 27 0 0 0 745 15 0 139 22 62 0 0 37 12 15 2 18 0 225 85 23 0 87 0 1 77 1,595 485 2,079 |
| EE 0 2 0 2 0 48 25 0 0 23 62 3 0 9 2 12 0 30 3 30 1 1 10 0 0 6 0 272 140 413 |
| EL 1 5 35 40 0 1 1 0 0 32 0 0 0 0 0 0 0 0 0 0 0 3 5 0 2 8 0 0 0 0 11 385 149 534 |
| ES 1 18 0 18 0 23 1 0 12 0 0 0 0 0 0 0 0 0 0 0 0 2 138 0 1 0 17 6 2 511 1 9 0 0 46 1,109 458 1,567 |
| FI 0 32 0 1 0 167 25 36 0 50 2 0 0 0 5 6 7 7 0 1 0 75 7 4 0 37 0 0 49 504 265 769 |
| FR 15 4,734 4 105 10 2,966 61 1 202 3,730 3 5 17 382 2,631 2 75 1 36 4,582 34 1,025 12 29 2 9 1,050 21,720 2,942 34,662 |
| HR 6 1 0 3 0 8 0 0 10 10 0 5 0 8 0 158 0 0 0 0 7 2 0 2 12 0 18 0 0 249 234 483 |
| HU 763 48 41 44 44 876 1 6 262 108 1 43 77 1 1,537 7 0 1 6 744 208 5 1,063 4 255 294 3 6,442 569 7,011 |
| IE 0 10 0 0 0 15 0 0 0 0 0 2 0 1 1 0 0 0 0 0 1 0 15 2 0 0 1 0 136 183 10 193 |
| IT 113 19 1 6 2 122 43 0 25 24 0 83 11 25 5 0 1 0 8 25 5 2 24 9 23 3 38 616 450 1,066 |
| LT 1 63 0 0 0 143 70 29 0 153 30 23 0 0 6 6 0 0 296 0 119 70 16 0 48 0 0 19 1,093 1,008 2,101 |
| LU 0 49 0 0 0 28 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 24 0 0 0 0 0 0 0 120 0 120 |
| LV 0 19 0 0 0 172 116 58 0 122 33 32 0 0 4 12 111 0 0 16 73 22 9 0 27 0 0 10 836 596 1,432 |
| MT 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 5 3 9 |
| NL 186 1,160 2 7 16 1,825 148 23 11 133 63 258 0 154 52 14 95 21 29 0 212 19 20 44 0 31 516 7,239 503 7,742 |
| PL 5 44 0 0 72 1,673 69 2 1 167 15 17 8 82 62 9 34 0 2 0 90 22 1 32 0 30 55 2,407 833 3,240 |
| PT 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 293 46 329 |
| RO 31 186 107 82 8 134 5 0 153 730 0 186 1 189 29 437 0 0 0 10 458 3 168 0 0 13 47 2,979 1,336 6,515 |
| SE 0 29 0 1 0 199 237 2 1 156 7 31 0 0 12 1 6 0 2 0 83 31 15 0 0 0 0 37 849 486 1,335 |
| SI 66 1 1 0 0 1 5 0 0 4 0 0 1 12 295 0 676 0 0 0 2 0 7 0 0 22 0 1,112 58 1,171 |
| SK 148 1 6 9 183 158 4 0 3 15 0 5 5 230 0 78 1 0 0 2 48 308 0 49 0 6 0 3 1,524 77 1,600 |
| UK 0 240 0 6 1 319 38 0 10 963 3 171 0 0 542 43 0 0 2 2 589 23 329 1 29 0 0 3,311 618 3,929 |

| Source: Areté elaboration on raw Eurostat data provided by DG AGRI |  |

112
3.2.1.1 Evolution of EU COP imports

EU COP imports have grown by 21% over the observed period, mainly thanks to the increase of intra-EU trade (+30%). The vast majority of the main importers (e.g. the Netherlands, Germany, Italy, Belgium, the United Kingdom) increased their import volumes from other Member States. The only notable exception was Spain, whose total imports decreased by around -6% over the observed period.

The key trends emerged from the analysis of the evolution of COP imports in terms of Compound Annual Growth Rate (CAGR) over the observed period are the following (Figure 3.1):

- Most of the leading importers have recorded CAGRs falling between 0% and 10%; Slovenia, Austria and Romania have recorded higher CAGRs, albeit for relatively limited overall volumes.
- The growth of imports in Spain and Portugal has mainly come from extra-EU origins; by contrast, it has mainly come from EU origins for France and Denmark. The growth of COP imports has been roughly balanced between EU and non-EU origins for most of the other leading EU importers.

Among the leading COP importers, Germany and the Netherlands have experienced the most substantial increases in terms of absolute variation of COP import volumes between 2005 and 2015 (Figure 3.14). Belgium and Italy have also recorded significant increases, whereas Spanish imports have slightly decreased.

---

38 The compound annual growth rate (CAGR) is the mean annual growth rate of a quantity over a specified period longer than one year. It is expressed by the formula: \( \text{CAGR}(t_0, t_n) = \left( \frac{V(t_n)}{V(t_0)} \right)^{\frac{1}{t_n - t_0}} - 1 \)
Figure 3.13 – Key trends in the evolution of COP imports for the leading EU importers, 2005-2015

Source: Areté elaboration on raw Eurostat data provided by DG AGRI
Figure 3.14 – Absolute variation of COP import volumes (2005 vs. 2015*)

Source: Areté elaboration on raw Eurostat data provided by DG AGRI

*2005 data calculated as 2004-06 average; 2015 data calculated as 2013-15 average
A comparative analysis of COP imports from non-EU macro-areas was also performed (Figure 3.15). The volume of total COP imports from non-EU origins remained stable over the observed period, albeit with substantial shifts among the different macro-areas. The sharp decrease in COP imports from South America (-32%) was compensated by increases in imports from the rest of Europe (+237%) and from North America (+26%). The most important suppliers of COP to the EU over the observed period have been Brazil, Argentina and Ukraine.

Figure 3.15 – Comparative analysis of COP imports from non-EU macro-areas (2004-06 vs. 2013-15)

3.2.1.2 Evolution of EU COP exports

Compared to imports, export volumes showed a sharper increase over the observed period, growing by around 42 million tonnes (+50%). The largest part of the increase came from exports to third countries, which recorded a growth of around +111%. The sharpest increases were all recorded by Eastern EU Member States: Romania (+750%), Poland (+412%), Bulgaria (+219%), Hungary (+49%). Both Western and Eastern EU Member States recorded higher growth rates in extra-EU trade than in intra-EU trade.

The key trends emerged from the analysis of the evolution of EU COP exports in terms of CAGRs over the 2005-2015 period are the following (Figure 3.16):

- Most of the growth recorded by France, Germany and the United Kingdom has derived from exports to third countries, since exports from these Member States to EU destinations have been flat or declining. Exports from Belgium and the Netherlands (including re-exports) have remained stable or have declined.
- Among the emerging exporters recording higher CAGRs over the observed period, Hungary and Bulgaria have mostly increased their exports to EU destinations, whereas Romania and Poland have experienced a more balanced growth between EU and non-EU destinations.

The most substantial increases in export volumes among the leading EU exporters have been recorded in Romania and Poland (albeit starting from rather limited volumes in 2005), as well as in Hungary (Figure 3.17).
Also France and Germany have recorded significant increases, since the growth of exports to third countries has more than compensated the decline in exports to other Member States.

The best export performances at Member State level have not always coincided with a comparable expansion of domestic COP production over the 2005-2015 period (see also § 3.2.1.1). Among the Member States which recorded the greatest increases in COP exports, Poland and France significantly increased their COP production (+16% and +13%, respectively), Germany and Romania recorded more limited increases (+6% and +5%, respectively), while Hungary experienced a slight contraction (-2%).
Figure 3.16 – Key trends in the evolution of COP exports for the leading EU exporters, 2005-2015

Source: Areté elaboration on raw Eurostat data provided by DG AGRI
Figure 3.17 – Absolute variation of COP export volumes (2005 vs 2015*)

Source: Areté elaboration on raw Eurostat data provided by DG AGRI

*2005 data calculated as 2004-06 average; 2015 data calculated as 2013-15 average
A comparative analysis of COP exports to non-EU macro-areas was also performed (Figure 3.18). Except for a decrease in the (traditionally limited) COP exports to South America, EU COP exports to all the remaining macro-areas have increased over the observed period. The increase of EU COP exports to Africa (+86%) and Asia (+192%) has been especially important. Romania in particular increased its COP exports to extra-EU destinations in Northern Africa and the Middle East. Algeria, Saudi Arabia and Morocco have been the leading importers of EU COP over the observed period.

Figure 3.18 - Comparative analysis of COP exports to non-EU macro-areas (2004-06 vs. 2013-15)

Source: Areté elaboration on raw Eurostat data provided by DG AGRI

3.2.1.3 Evolution of COP net trade and production

The evolution of the net trade position for COP of the 28 Member States over the observed period was analysed through a comparison of three-year averages (2004-2006 vs. 2013-2015). Figure 3.19 reports the average net import/export position for COP of the 28 Member States in the aforementioned three-year periods. It is worth reminding that some Western EU Member States (especially Italy and Spain) mainly import COP to cover domestic demand, while other Member States (Belgium and the Netherlands in particular) also play an important role in redistributing COP trade flows both within and outside the EU, hence acting as logistical hubs for a number of final destinations.

In this framework, the strategy of individual Member States with respect to COP storage and trade is mainly determined by their net trade position.

Operators managing storage capacity in Member States which import COP mainly to satisfy domestic demand can handle inbound flows in a more flexible way. The apparent shortage of storage capacity in those Member States can be addressed through accurate planning of import flows and through faster turnover of stocks, which allow improved efficiency in the use of the available storage capacity.

By contrast, operators managing COP storage capacity in Member States which are net exporters of COP have much less flexibility in handling inbound and outbound flows. In these Member States, the availability of surplus storage capacity to handle exceptional volumes of domestic COP production is of paramount

39 For instance, the port of Rotterdam also handles substantial volumes of inbound and outbound COP traffic which do not terminate in, or originate from, the Netherlands. A similar role is played by the port of Antwerp in Belgium, as well as by the inland waterway and railroad network in Belgium and the Netherlands.
importance from a strategic standpoint. The availability of surplus storage capacity reduces the pressure to free up storage capacity in the harvest period and in the following months. It also allows the implementation of strategic stock management in the wait of more favourable market conditions.

The above considerations are mostly valid also for operators managing storage capacity in Member States which act as logistical hub for re-exports.

*Figure 3.19 – Average net trade position for COP by Member State (2004-06 vs. 2013-15).*

It is interesting to read the evolution of the net trade position of Member States together with the *evolution of domestic COP production* (Figure 3.20), also analysed through a comparison of three-year averages (2004-2006 vs. 2013-2015).

*Figure 3.20 – Average COP production by Member State (2004-06 vs. 2013-15).*

Source: Areté elaboration on raw Eurostat data provided by DG AGRI
In several Eastern EU Member States - Bulgaria, Czech Republic, Estonia, Lithuania, Latvia - the increase in domestic COP production boosted exports. Thanks to a massive increase in domestic COP production, Poland moved from a position of net importer to a position of net exporter of COP, and was hence forced to rethink its overall strategy in terms of storage capacity use. Also Romania experienced an impressive growth in its net exports of COP: if such an export performance can be maintained, Romania might challenge the position of France as leading net exporter of COP in the future.

Among net importers, Spain satisfied at least part of its domestic demand through an increase in domestic COP production, which resulted in lower net imports at the end of the observed period. Italy, by contrast, experienced a decrease in domestic COP production which resulted in an increase of its net imports. For both Spain and Italy, the importance of sufficient storage capacity is mainly limited to the optimisation of operations at import terminals located in ports and other logistical hubs, rather than directly impacting their international competitiveness.

In Germany the moderate increase in COP domestic production has not been sufficient to cover an increasing demand: as a result, the country significantly increased its net imports of COP. Similar dynamics were experienced in Belgium, the Netherlands and the United Kingdom.

Finally, France maintained its status of leading net exporter of COP in the EU thanks to a substantial increase in domestic production, which supported the growth of exports.

### 3.2.2 Question 2.2: Evolution of logistical infrastructure for COP crops since 2005

The analysis of the evolution of logistical infrastructure for COP crops required a differentiation based on transport distance and the level of detail. This means that:

**a. Main European transport corridors** were analysed through:
   1. Evaluation of implementation reports and corridor studies at EU level.
   2. Identification of major implementation steps and corresponding projects.
   3. GIS mapping of development steps.

**b. National and regional transport infrastructure** were analysed through identification of statistical items (e.g. railway kilometres) characterising the national and regional transport infrastructure.

The elaboration and representation of time series of annual data covering the 2005-2015 (2016 if available) period was broken down by:
   1. Relevant statistical items for each mode of transport.
   2. Geographical region (Member State).

The evidence for the analysis of the evolution of logistical infrastructure for COP crops since 2005 was completed by (mainly qualitative) findings from interviews.

#### 3.2.2.1 Evolution of the main European transport corridors

The main European transport corridors are defined by the European Commission as the nine “Trans-European Transport Network” (TEN-T) corridors, as shown in Figure 3.21.
Figure 3.21 – European TEN-T corridor network

The TEN-T corridors have been defined mainly on the basis of overall traffic volumes. The TEN-T network comprises roads, railway lines, inland waterways, inland and maritime ports, airports and rail-to-road terminals throughout the EU. This characteristic is a key factor for the network's efficient, safe and secure operation, with a view to providing seamless transport chains for freight and passengers. The TEN-T network builds on existing and planned infrastructure which has been identified on the basis of a single methodology and which has to comply with common requirements/standards. The TEN-T network is designed in two planning layers, and consists of a “core network” and of a “comprehensive network”. The core network is scheduled to be completed by 2030 and the comprehensive network by 2050\(^40\).

\(^{40}\) Source: [www.ec.europa.eu/transport](http://www.ec.europa.eu/transport)
1. The "comprehensive network" is a multi-modal network of relatively high density which provides all European regions with accessibility to transportation infrastructure that supports their further economic, social and territorial development as well as the mobility of their citizens. Its planning has been based on some common criteria (e.g. traffic volume thresholds for terminals or accessibility needs). The total length of the comprehensive network amounts to:
   - 138,072 km of railway lines
   - 136,706 km of roads
   - 23,506 km of IWWs

2. The "core network" is a part of the comprehensive network distinguished by its strategic importance for major European and global transport flows. It was defined by the European Commission and is subject to broad consultation among the Member States and other stakeholders. The total length of the core network amounts to:
   - 50,762 km of railway lines
   - 34,401 km of roads
   - 12,880 km of IWWs

The GIS maps of the TEN-T network featured in the study report display existing infrastructure as well as infrastructure to be built or upgraded for the different transport modes, i.e.:
- IWWs, inland ports and seaports
- (Freight) railways
- Roads and motorways
- Rail-to-road (RR) terminals

Four of the core corridors connect the main Eastern European COP crop production areas with the main Central European COP crop demand areas (Figure 3.22). These were identified as the core corridors for long-distance transportation of COP crops: Baltic-Adriatic, North Sea-Baltic, Rhine-Alpine and Rhine-Danube corridors.

The GIS map of these four main corridors for COP transportation shows the concentration of the logistical infrastructure towards the ARA ports (Antwerp, Rotterdam, Amsterdam). Whereas the core corridor network in South-Eastern Europe consists mainly of IWW infrastructure (Danube river), the core corridor network in North-Eastern Europe solely consists of road and rail routes.
The current infrastructure of the four TEN-T corridors is relevant for the development of the COP transportation chain. The key indicators to assess corridor development by transport mode are: corridor length; load capacity; total number of relevant freight vehicles. The evolution of these indicators is analysed for each transportation mode (road, IWW, railway) in the sections that follow.
Evolution of corridor length by transport mode

The length of corridors by transport mode is a key indicator measuring the evolution of the European logistical infrastructure (Table 3.9).

**Table 3.9 – Evolution of corridor length excluding planned routes and routes under construction**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A – Baltic-Adriatic</td>
<td>Road</td>
<td>2 110 km</td>
<td>2 416 km</td>
<td>13%</td>
</tr>
<tr>
<td></td>
<td>Railway</td>
<td>2 960 km</td>
<td>3 038 km</td>
<td>3%</td>
</tr>
<tr>
<td>B - North Sea-Baltic</td>
<td>Road</td>
<td>2 112 km</td>
<td>2 200 km</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td>Railway</td>
<td>3 920 km</td>
<td>4 601 km</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>IWW</td>
<td>2 088 km</td>
<td>2 088 km</td>
<td>0%</td>
</tr>
<tr>
<td>F - Rhine-Alpine</td>
<td>Road</td>
<td>1 035 km</td>
<td>1 050 km</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>Railway</td>
<td>1 825 km</td>
<td>1 825 km</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>IWW</td>
<td>1 762 km</td>
<td>1 762 km</td>
<td>0%</td>
</tr>
<tr>
<td>I – Rhine-Danube</td>
<td>Road</td>
<td>2 653 km</td>
<td>2 870 km</td>
<td>8%</td>
</tr>
<tr>
<td></td>
<td>Railway</td>
<td>3 652 km</td>
<td>5 146 km</td>
<td>29%</td>
</tr>
<tr>
<td></td>
<td>IWW</td>
<td>1 624 km</td>
<td>3 918 km</td>
<td>59%</td>
</tr>
</tbody>
</table>

Source: DG MOVE-TENtec

The growth in the length of the four core TEN-T corridors relevant for COP transportation over the 2005-2015 period greatly varied according to the corridor and the transport mode considered. Very limited expansion concerned the Rhine-Alpine corridor, whereas more significant developments took place on the Baltic-Adriatic corridor (especially for roads), on the North Sea-Baltic corridor (especially for railways) and above all on the Rhine-Danube corridor, with significant expansion in network length for all transport modes, and especially for railways and inland waterways.

Evolution of road transportation infrastructure

The main indicator for illustrating the evolution of road infrastructure is the length of motorways. The motorway length is expressed in kilometres, whereas the motorway density is expressed in kilometres of motorway per square kilometre of land area. The analysis of the evolution of motorway length mainly focused on Eastern EU Member States, due to their historical drawbacks in terms of adequate motorway network in comparison to Central EU Member States. Albeit not specific to COP transportation, all the following metrics define the key features and trends of road freight transportation in the EU. The development and adequateness of the road network, together with the key trends in the evolution of the truck fleet, have important implications for COP transportation: this is mainly performed by truck in the early stages of the logistical process, which usually have a local/regional geographical dimension (see § 2.2.2).

Evolution of motorway length in selected Eastern EU Member States

Substantial increases in motorway length between 2005 and 2015 were recorded in Romania (+228%), Poland (+182%) and Bulgaria (+122%) (Figures 3.23 and 3.24).
Evolution of motorway density in Eastern EU Member States by NUTS 2 region

The evolution of motorway density in Eastern EU Member States is presented in Figures 3.25 and 3.26.
Figure 3.25 – Motorway length in comparison to land area [km/1000 square km] in Eastern Europe for 2005

Figure 3.26 – Motorway length in comparison to land area [km/1000 square km] in Eastern Europe for 2015

Source: Eurostat: tran_r_net
Motorway density in Eastern EU Member States has increased substantially between 2005 and 2015. Regions surrounding the metropolitan areas and capital cities have recorded the highest increases. The top 10 NUTS 2 regions with the highest motorway density growth are presented in Figure 3.27. Except for two regions in Ireland, the most significant increases have been concentrated in Eastern Europe.

Figure 3.27 – Evolution of top 10 regions with highest motorway growth (2005-2015)

An indirect indicator of the development of the road network is the evolution of the load capacity in tonne-kilometres (Tkm), which is allowed by improvements in the quality of infrastructure. The use of higher capacity trucks has increased in recent years, as shown in Figure 3.28.

Figure 3.28 – Evolution of load capacity in the EU, 2005 vs. 2015

Load capacity of road freight transportation

Small freight vehicles (loading capacity below 3.5 tonnes) and vehicles registered in third countries are not covered by the related Eurostat dataset.

IE02: Southern and Eastern; HU23: Del-Dunantul; BG34: Yugoiztochen; IE01: Border, Midland and Western; PL11: Lodzkie; HU32: ; PL22: Slaskie; SK04: Eastern Slovakia; RO22: Sud-Est; CZ07: Stredni Morava.
Load capacity tends to increase with a view to exploiting economies of scale (it is less costly to operate larger vehicles than smaller ones) and to handling increased traffic volumes. The increase of load capacities of vehicles has important operational implications for storage facilities and logistical infrastructure for COP transportation, since higher capacity vehicles require adequate handling capacity and infrastructural standards.

Evolution of the stock of road tractor vehicles by NUTS 2 regions

The analysis of the evolution of the stock of road tractor vehicles by NUTS 2 regions highlights an increase in some regions of Poland and Romania, whereas a decrease can be observed in some regions of France (Figure 3.29).

Figure 3.29 – Top 10 NUTS 2 regions⁴³ for increase/decrease (+/-) of road tractor stock

![Graph showing the evolution of road tractor vehicles by NUTS 2 regions]

Source: Eurostat: tran_r_vehst

Annual road freight transportation of cereals (except rice), leguminous crops and oilseeds

The analysis of the evolution of annual road freight transportation related to cultivation of cereals (except rice), leguminous crops and oilseeds highlights a decrease of journeys until 2010 (Figure 3.30). The rapid decline of journeys in the Czech Republic stands out. Data for the remaining EU Member States are not available at Eurostat.

Evolution of IWW transportation infrastructure

IWW transportation plays an important role in long-distance COP transportation in the EU (see § 2.2.1 and § 2.2.3.2). According to information from the European Commission, 21 out of the 28 Member States have inland waterways; inland waterway networks are found in 13 out of these 21 countries. In comparison to other transport modes, IWW transportation shows higher reliability. Congestion issues and capacity problems are less severe in IWW transportation, which also has better energy efficiency and shows potential for further capacity increases. IWW provides a competitive alternative to road and rail transportation especially for bulk commodities such as COP.

The European IWW infrastructure has basically remained the same over the last decade. The EU enlargement process, through the accession of Romania, Bulgaria and Croatia, has also enlarged the EU IWW network. Some developments have been recorded at regional level in terms of expansion of the network of navigable rivers and canals. An overview of regional developments for navigable rivers is provided at Figure 3.31.

---

44 With only 17% of the energy consumption per km/tonne needed for road transportation, and 50% of the energy consumption per km/tonne needed for rail transportation, IWW transportation can be considered as an environmentally-friendly transport mode. It also has relatively low noise emissions.
The most significant expansion in the navigable river network took place in the South of Finland (FI1C) and the West of Finland (FI19) as well as in the German regions of Mecklenburg-Vorpommern (DE80) and Schleswig-Holstein (DEF0) and in Estonia (EE00). Other significant increases in the length of the navigable river network can be observed in some Hungarian regions and in the Kontinentalna Hrvatska region (HR04) of Croatia.

The main developments in navigable canals took place in the German regions of Schleswig-Holstein (DEF0) and Brandenburg/Berlin (DE30), and derived from the completion of construction works to connect the Mittelland Canal with the Elbe-Havel and the Havel-Oder-canals.

**Fairway depth**

Fairway depth is a crucial parameter affecting IWW transportation. On the Rhine and the Danube river, fairway conditions vary daily, disturbing traffic flows and causing long waiting times for vessels. The recommended fairway depth of 2.5 meters was often not achieved in recent years.

The evolution of fairway depth from 2012 to 2015 is illustrated in Figure 3.32. Fairway conditions vary significantly, mainly depending on water levels and implemented maintenance measures. The gap between the available water levels and the required fairway depths is clearly illustrated by the grey bars in the graph. The sections showing the most serious gaps over the years are those most in need of maintenance and/or rehabilitation work. The sections with the most critical fairway conditions can be identified east of Vienna, on the Hungarian Danube, and in the areas of Milka/Belene/Coundur (BG) and Cochirleni (RO).

45 FI1C: South; FI19: Länsi-Suomi; DE80: Mecklenburg-Vorpommern; EE00: Eesti; HR04: Kontinentalna Hrvatska; HU21: Kozep-Dunantul; HU22: Nyugat-Dunantul; HU23: Del-Dunantul; DEF0: Schleswig-Holstein; HU10: Kozep-Magyarorszag. It is likely that changes in the data collection method after 2010 lead to the divergent increase of IWW infrastructure for Finland and Germany.

46 Water levels are traditionally measured at static gauging stations. This implies that adequate fairway depth cannot be ensured automatically, because the morphology of the riverbed can vary due to the dynamics of a free-flowing river.
According to the Fairway Rehabilitation and Maintenance Master Plan (2016) the fairway width of the Danube River ranges between 40 m and 80 m in Austria, between 60 m and 100 m in Slovakia and in the Slovakian-Hungarian border section, between 80 m and 120 m in Hungary and below 80 m in Croatia, Serbia, Romania and Bulgaria (including border sections).

Figure 3.32 – Availability of fairway depth on the Danube from 2012 until 2015

Source: Fairway Rehabilitation and Maintenance Master Plan for the Danube and its navigable tributaries

**Evolution of railway transportation infrastructure**

As underlined at § 2.2.1, railways have an important role in long-distance COP transportation. The EU rail infrastructure requires improvements in terms of interoperability and regional accessibility, given the current state of rail network coverage. Central Europe has a dense rail network, a large number of freight wagons as well as a developed transport service market. Eastern Europe, by contrast, has inherited a well-established railway network which nevertheless requires improvements in terms of quality and regional accessibility.

Figures from 3.33 to 3.35 illustrate the evolution in the length of total railway lines, railway lines with multiple tracks and electrified railway lines at NUTS2 region level.

In general, no significant developments in railway infrastructure were identified, except for those related to the enlargement process of the EU.
Figure 3.33 – Evolution in the length of total railway lines by NUTS 2 regions\(^{47}\) (kilometres)

![Graph showing the evolution in the length of total railway lines by NUTS 2 regions](image)

Source: Eurostat: tran_r_net

Figure 3.34 – Evolution in the length of railway lines with multiple tracks by NUTS 2 regions\(^{48}\) (kilometres)

![Graph showing the evolution in the length of railway lines with multiple tracks by NUTS 2 regions](image)

Source: Eurostat: tran_r_net

---


3.2.2.2 Evolution of national and regional transport infrastructure

In order to illustrate the evolution of national and regional transport infrastructure, a set of GIS maps is used. Each map illustrates the main road, rail and IWW infrastructure, the main ports and Rail-to-Road terminals, and the relevant TEN-T corridors. In combination with factsheets, the GIS maps highlight country-specific information, allowing an analysis at Member State level. A combination of GIS maps of the logistical infrastructure and GIS maps of COP storage capacity is used at § 3.3.1.2.2 to identify potential bottlenecks.

GIS maps of the logistical infrastructure in all EU28 MS are provided in the Annexes of the report.

3.2.3 Question 2.3: Factors influencing the evolution of logistical infrastructure

To analyse which factors influence the evolution of logistical infrastructure - both in general terms, and with specific reference to infrastructure used for COP transportation - the possible types of evolution must be defined. Infrastructural development can be divided into the construction of new infrastructure or the maintenance and improvement of existing infrastructure. A distinction between quantity and quality of logistical infrastructure can hence be made. This implies that the influencing factors to be identified must affect one or both of these dimensions.

For a correct understanding of the reply to this question, it is important to keep in mind that COP transportation usually takes place on infrastructure (roads, railways, inland waterways) which is also used for the transportation of other goods, and often also for passenger traffic. In other words, there is little (if any) transport infrastructure which is exclusively used for COP transportation. Also terminals handling exclusively

---


50 Factsheets feature a set of key general and transportation-specific data, such as: employment growth; activity branches; Logistical Performance Indexes; modal split of freight transportation; characteristics of the leading logistics operators; etc.
(or mainly) grains are often located at transportation hubs (road-to-rail terminals, inland ports, seaports) where also terminals handling other types of freight are located. This implies that the factors influencing the evolution of logistical infrastructure in general are also the relevant ones for COP transportation.

Strategical governmental actions are an important influencing factor for the evolution of logistical infrastructure. Interests might be on a national or European basis, but the political strategies are in any case designed to follow consistent long-term goals. To date, no true research exists that determines how governmental processes and the related framework should be laid out to achieve these long-term goals. A review\textsuperscript{51} of national transport strategies of developed countries was conducted in 2006; researchers were able to identify similar attributes among nations that have to be addressed to reinforce effective national transport strategies. Examples of these attributes are:

- integration and consensus of key stakeholders through participation;
- understanding of the role of all modes of transport as well as their interdependencies;
- recognition of the interdependencies between national and international links/issues.

Although governments and political strategies have an unquestioned influence on the evolution of logistical infrastructure, this can hardly be measured as a factor with quantitative methods.

Planning and approval procedures for infrastructural projects are another important influencing factor on new construction or improvement of infrastructure, and primarily determine the implementation process. Depending on the speed of approval, the timing of infrastructural development may be influenced. Approval processes might accelerate if competences and responsibilities are standardised. Planning and approval procedures vary across EU Member States and highly depend on the planned infrastructure project itself. The higher the number of partners involved a project, the longer the possible approval time, especially if the allocation of responsibilities is not clearly defined.

Although public funding usually finances infrastructural projects, private financing might also influence their evolution. It is typically assumed that (additional) private financing will contribute to the growth or quality of infrastructure. Whilst in some Member States private road infrastructure, such as motorways, barely exist, in other Member States (e.g. France) the involvement of private corporations in maintaining and upgrading road infrastructure is common.

“Public Private Partnerships” (PPP) are an option for long-term cooperative management between public and private actors. In Germany, only a few PPP have been applied so far to improve the quality and capacity of road infrastructure. A notable example is offered by projects for the construction of new motorway lanes between Munich and Augsburg in Bavaria. Since 2007 the Autobahnplus A8 GmbH\textsuperscript{52} is concession partner over 52 km of the A8 motorway for the next 30 years. The concession agreement included the construction of additional lanes for a length of 37 km. The construction was finished in 44 months: this can be considered as four years faster than usual. An analysis by the Federal Ministry of Digital Infrastructure also reported an above average construction quality\textsuperscript{53}. This may derive from the fact that the concession taker is not just responsible for construction, but has a specific interest in meeting high quality standards, which may result in lower costs for maintenance and repair in the future. In the case of the connection between Munich and Augsburg, the concession holder receives license fee resources or parts of them.

Next to private capital, user financing (e.g. through toll charges) is another widespread factor influencing the evolution of transportation infrastructure in the EU. Toll charges can contribute to a better quality of roads if

\textsuperscript{51} Hazel & Hazel (2006); A Review of National Transport Strategies Across Developed Countries in Europe and Elsewhere.

\textsuperscript{52} \url{http://www.autobahnplus.de/} (15.06.2017)

\textsuperscript{53} Bundesministerium für Verkehr, Bau und Stadtentwicklung (2010); Bundesautobahn A 8 Augsburg – München ÖPP-Betreibermodell.
the collected money is reinvested; they can also be used as a tool to implement transportation policies, since other transport modes may become relatively cheaper (see § 2.2.1). While user financing contributes to the quality of infrastructure, it also has operational implications for road freight transportation, and may also hinder smooth traffic flows along the EU corridors.

The above illustrated influencing factors aim at improving the physical dimension of logistical infrastructure. However, the evolution of logistical infrastructure might also be promoted through technological innovation. **Research & development (R & D)** has been one of the most prominent factors behind the evolution of logistical infrastructure. To understand which aspects of the logistical infrastructure can be affected by technological evolution, an overview of current R & D areas for traffic infrastructure is needed. The case of Austria is illustrated here by way of example.

The Austrian transportation infrastructure is modern, well-developed and efficient. R & D is primarily used to respond to future challenges, such as obtaining a more efficient, safer and socially and environmentally friendly transport system. In 2015, the Austrian Ministry for Transport, Innovation and Technology was financially involved with EUR 18.04 million in R & D projects whose total budget amounted to around EUR 54 million. With EUR 24.14 million, transnational networks accounted for the largest share of the total budget; national partners contributed the remaining share.

All approved R & D projects in Austria can be classified into the following areas: mobility and ITS (intelligent transport systems); environment, energy and resources; construction and operation; safety (see Figure 3.36). The largest share (36%) of R & D projects focuses on the construction and operation of traffic infrastructure: this category can be considered as “traditional” and covers bridges, driveways, tunnels, asset management and maintenance. The "mobility and ITS" and "environment, energy and resources" areas account for 27% and 36% shares respectively, and might lead to a more efficient use of transportation infrastructure.

**Figure 3.36 – Subject areas of R & D projects (in terms of number of projects) in Austria**

![Figure 3.36](http://www.bmvi.de)

Austrian R & D projects mainly focus on national and transnational roads; only 16 projects (9%) focus on road-rail interconnection issues (Figure 3.37). It is important to note that the funded projects have different

---

54 Bmvit (2015); Verkehrsinfrastruktur – Forschung und Entwicklung in Österreich.
Technology Readiness Levels: some deal with the development of new technology, some are already in a pre-commercial status. Networking among the project partners is promoted in R & D activities. The majority of participants in projects of national relevance are companies (61%): in most cases, these are small to medium-sized firms, such as companies of the transport sector.

*Figure 3.37 – Researched infrastructure in R&D projects in Austria (2015)*

Source: Bundesministerium für Verkehr, Innovation und Technologie - [http://www.bmv.i.de](http://www.bmv.i.de) (2015)

### 3.2.4 Question 2.4: Investments in logistical infrastructure

For a correct understanding of the reply to this question, it is important to keep in mind the same considerations made at § 3.2.3 for question 2.3. The transportation of COP crops usually takes place on infrastructure which is also used for the transportation of other goods, and often also for passenger traffic. This implies that most investments in logistical infrastructure for freight transportation are directly or indirectly relevant also for COP transportation. Investments in infrastructure for passenger transportation (e.g. dedicated high speed/high capacity rail lines) can also be indirectly relevant for COP transportation, especially where these investments address congestion issues, freeing capacity for freight transportation (including COP transportation).

#### 3.2.4.1 Leading investors in logistical infrastructure and related investments

The main investor in logistical infrastructure is the EU itself. The Trans-European Transport Network Executive Agency (TEN-T EA) technically and financially manages expansion and upgrading on the Trans-European Transport Networks (TEN-T). The EU works to promote network development through a combination of leadership, coordination, issuance of guidelines, funding and implementation of EU-wide projects.

The TEN-T/CEF Projects (Figure 3.38) aim at linking major cities and economic areas throughout the EU. A large number of infrastructure improvement projects have been identified for the TEN-T corridors. They are part of the EU’s development strategy. These high-profile projects are meant to better coordinate international and national network development and to improve cross-border transportation. The projects include improvement to transportation infrastructure of Central, Eastern and South-Eastern Member States. Progress in the implementation of TEN-T corridors and of the related infrastructure projects differs significantly among regions and Member States.
The main role of the TEN-T program is to grant EU funding to projects of common interest. These are mainly to be found among 30 priority projects. These projects are expected to enhance the cohesion, interconnection and interoperability of the trans-European transport network, as well as to improve access to that network. The completion of the logistical network will contribute to improved competitiveness and sustainability of transportation in the EU.

55 The illustration includes transport and energy-related projects.
An overview of some TEN-T priority projects (including information on the year(s) of funding) is presented below.

- High-speed railway axis east (2007)
- Betuwelijn (2007)
- Motorway axis Igoumenitsa/Patra-Athina-Sofia-Budapest (2006-2008)
- Multimodal axis Portugal/Spain-rest of Europe (2001-2015)
- Railway axis Cork-Dublin-Belfast-Straanraer (2001)
- Malpensa (completed 2001)
- Öresund fixed link (completed 2000)
- UK/Ireland/Benelux road axis (2010)
- West coast main line (2007)
- Galileo (2008)
- Motorways of the sea (2010)

- Rhine/Meuse-Main-Danube inland waterway axis (2011-2019)
- Fehmarn Belt railway axis (2015)
- Motorway axis Gdansk-Brno/Bratislava-Wien (2009-2010)
- "Rail Baltica" axis Warsaw-Kaunas-Riga-Tallinn-Helsinki (2010-2016)
- "Europaclip" on the Brussels-Luxembourg-Strasbourg railway axis (2012)
- Railway axis of the Ionian/Adriatic intermodal corridor (2012-2014-2016)
The TEN-T programme aims at improving the logistical network by providing financial aid.

- In 2005 the total investment of EUR 51.3 billion in the TEN-T network in the EU-27 focused on railways (57%), followed by roads (27%), airports (9%), ports (5%) and IWW (2%).
- By 2009, the rail sector had received EUR 4.4 billion in funding, representing more than half of the overall budget so far; an amount of EUR 640 million was committed to inland waterways.
- A budget of EUR 500 million was allocated to the TEN-T program in 2009, following the financial crisis of 2008.
- An amount of EUR 8 billion to support research which contributes to the TEN-T programme objectives was allocated by the EU in the 2007-2013 programming period.
- A new TEN-T infrastructure policy was established in 2013, with a budget of over EUR 30.4 billion up to 2020. Such policy aims at leveraging funding from the public and the private sectors and at speeding up investment in the field of trans-European networks.
- The funding of transport projects for the 2014-2020 programming period has nearly tripled compared to the previous programming period, reaching EUR 22.4 billion. The focus of EU funding is the core transport network and selected elements of the comprehensive network that create the highest EU added value. Almost half of the total EU funding for transport infrastructure (EUR 11.3 billion) is allocated to cohesion countries.

According to estimations, the completion of the TEN-T network will require a total investment of EUR 500 billion until 2020, with EUR 270 billion allocated to priority projects. Another goal of the TEN-T program is to encourage the involvement of the private sector in the financing of European logistical infrastructure.

### 3.2.4.2 Available funding solutions

As announced by the European Commission on February 2nd, 2017, EUR 1 billion of grants shall boost the European transport infrastructure. These grants shall be financed from public financial institutions, the private sector or from the European Fund for Strategic Investments.

A wide range of public funding solutions is available to finance investments in the EU logistical network. EU funding opportunities are rather diverse. An overview and an explanation of EU funding for transportation and mobility is provided in the following sections.

#### Funding solutions under the EU Cohesion Policy:

- European Structural and Investment Funds (ESI Funds)
- JASPERS
- INTERREG
- URBACT III
- Innovative actions in sustainable urban development

#### Funding solutions under the European Investment Bank: (EIB)

- Loans and guarantees
- ELENA
- JESSICA
- European Energy Efficiency Fund

#### Other funding solutions:

- LIFE
According to the Transport Council, many different funding options at EU level exist to improve the transport infrastructure. Funds are made available especially through the European Structural and Investment Funds (ESI Funds), European Fund for Strategic Investment (EFSI) and the Connecting Europe Facility (CEF), as well as through the European Regional Development Fund (ERDF).

A general overview of available funding solutions is provided in Figure 3.40.

**Figure 3.40 – Overview of possible funding options for infrastructural projects**

### Traditional funding schemes

Grants given by TEN-T funds and by ERDF/CF are the main sources of EU funding. While the policy framework for allocation of funds is set by DG MOVE, technical management is performed by the TEN-T EA. The maximum TEN-T co-funding rates are set at 50% for studies/plans, 10-30% for works, 50% for ERTMS and 20% for traffic management systems. The maximum rate for ERDF/CF co-funding is set at 85%. 73% of the projects were co-financed at 10-30% by the investment budget, while 27% of the projects enjoyed co-financing up to
50%. The majority of EIB co-financing consists of commercial long-term loans which are in general granted after successful project appraisal by the bank. The maximum co-funding rate is normally set at 50%; in exceptional cases, it may reach 75%.

**Cohesion Fund**

Member States whose Gross National Income (GNI) per inhabitant is less than 90% of the EU average can apply for aid from the Cohesion Fund. This fund promotes sustainable development by reducing economic and social disparities. For the 2014-2020 programming period, the Cohesion Fund concerns Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia and Slovenia. The Cohesion Fund allocates a total of EUR 63.4 billion to activities under the following categories:

- Trans-European transport networks: funding is aimed at supporting infrastructural projects under the Connecting Europe Facility.
- Environment: projects related to energy or transport can be funded only if they provide environmental benefits. This includes for instance the use of renewable energy, developing rail transportation, supporting intermodal transportation, strengthening public transport.

**European long-term investment funds (ELTIFs)**

The European long-term investment fund (ELTIF) is a pan-European regime for Alternative Investment Funds (AIF) which guides venture capital towards European long-term investments in the real economy. To be eligible for funding under the ELTIF, investments have to be in line with the EU objective of smart, sustainable and inclusive growth.

**Connecting Europe Facility (CEF)**

The CEF has been developed as a main financial instrument for the 2014-2020 programming period aimed at supporting investment programmes under the proposed TEN-T guidelines. According to Regulation (EU) No 1316/2013 of the European Parliament and of the Council, the CEF provides funding solutions that encourage participation by private sector investors and by financial institutions. The CEF is based on the experience of other financial instruments, such as the Loan Guarantee Instrument for Trans-European Transport Network projects (LGTT).

CEF offers grants which are issued usually after a public announcement (‘call for proposals’) and are used to finance or subsidise specific projects in relation to EU policies. According to the goal of achieving a Digital Single Market to enhance Europe’s position as a world leader in the digital economy, the CEF supports trans-European networks and infrastructures in the sectors of transport, telecommunications and energy. CEF funding is hence allocated to the energy, telecommunication and transport sectors.

The available budget for transport under the CEF amounts to EUR 23.4 billion for the 2014-2020 programming period. It is aimed at co-funding TEN-T projects in EU Member States. 83% of the overall budget has been allocated following the calls for proposals issued in 2014 and 2015. EUR 11.3 billion were allocated to Member States that can benefit from the cohesion fund, and EUR 12.1 billion were allocated to projects of general interest. Agreements have been signed for 452 projects that were selected out of 1 087 proposals received under the 2014-2015 calls for proposals.

CEF transport funding can be further divided into building cross-border infrastructure, implementing sustainable and efficient transportation and combining transport modes and IT. EUR 17 billion were allocated to building of cross-border infrastructure with the breakdown illustrated in Figure 3.41. Around EUR 15.1 billion were allocated to the Core Network Corridors.
Figure 3.41 – CEF funding for building of cross-border infrastructure (2014-2015 calls for proposals)

Flagship projects (Figure 3.42) have been funded with EUR 10.1 billion. The largest project is Seine-Escaut, which involves France and Belgium. The Seine-Nord Europe Canal is an inland waterway project that is expected to link the Oise River at Compiègne with the Canal Dunkerque-Escaut, east of Arleux (France). The completion of this priority project would strengthen the North-Sea Mediterranean Corridor and the Atlantic Corridor. The project includes nine different studies and works within France and Belgium. The expected impact after completion is a change in modal split, less congestion and more interoperability. The overall competitive position of the concerned regions would hence be improved.
In June 2017, the European Commission proposed to invest EUR 2.7 billion of CEF funding in 152 energy and transport projects that support competitive, clean and interconnected mobility within the EU, selected in the call for proposals issued in 2016. These proposed investments are in line with the overall Investment Plan for Europe’s connectivity.

The selected projects are contributing to one or more of the following goals:

- Modernising rail lines
- Removing bottlenecks
- Improving cross-border connections
- Implementing innovative traffic management solutions

Projects are either works/construction in existing or new infrastructure for transport and energy, studies to investigate possible investments, or a combination of both. The recommended funding by type of investment for the 2016 CEF call for proposals is illustrated in Figure 3.43. Projects in Poland account for the largest share of funds, with EUR 818 million contributed for investment in works/construction. In other Member States (e.g. Lithuania) the majority of funding is allocated to mixed projects.

Transport projects are normally assigned to one or more of the nine Core Network Corridors. In the 2016 call for proposals the recommended funding contributes quite evenly to the different corridors, as shown in Figure 3.44. The Mediterranean and the Orient/East-Mediterranean Corridors include the largest number of projects. Looking at individual Member States, Austrian projects are relevant for 3.5 corridors on average (one or more corridors can be assigned to each project).

The investments can also be grouped according to the different priorities. A priority is assigned to projects or actions that help creating or expanding a corridor of the core network. Recommended CEF funding by priority for the 2016 call for proposals is illustrated in Figure 3.45.
Figure 3.43 – Recommended CEF funding by type of investment for the 2016 call for proposals (million Euros)

Source: Elaboration based on INEA (2017c)

Figure 3.44 – Relevant Corridors for projects of the 2016 call for proposals

Source: Elaboration based on INEA (2017c)
Figure 3.45 – Recommended CEF funding by priority for the 2016 call for proposals (million Euros)

Selected projects of the 2016 call for proposals are illustrated in Table 3.10. Within a wide variety of projects, a special focus on infrastructure upgrading can be especially found in Eastern Europe and in Mediterranean countries such as Spain. Nevertheless, investments in IT solutions and digitalization or in data use are also part of the projects.
Table 3.10 – CEF: selected projects of the 2016 call for proposals

<table>
<thead>
<tr>
<th>Corridor / Title / Country</th>
<th>Description</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baltic-Adriatic Core Network</td>
<td>The action/project concerns work on the Kędzierzyn Koźle–Opole Zachodnie section of the E30 railway line, with modernisation of 44.5 km of railway line.</td>
<td>Contribution to establish a good connection between the Eastern part of the EU through Poland to the Czech border.</td>
</tr>
<tr>
<td>Poland</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhine-Danube and Baltic-Adriatic Corridors</td>
<td>The action aims at upgrading selected sections of the Přerov railway junction. It consists of five activities: (i) land acquisition (ii) railway substructure and superstructure (iii) footbridges and overpasses (iv) interlocking and signalling (v) engineering supervision</td>
<td>Increased capacity, improved safety and interoperability of the railway line.</td>
</tr>
<tr>
<td>Přerov junction - 2nd construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Czech Republic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baltic-Adriatic Corridor</td>
<td>The project will implement Intelligent Truck Parking and Real-Time Traffic Information for trucks in 4 parking areas of the motorway.</td>
<td>High-quality and reliable freight transport information, with concrete benefits to almost 2,000 road operators and 25,000 vehicles operating in domestic and international traffic.</td>
</tr>
<tr>
<td>URSA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Czech Republic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhine-Alpine Core Network Corridor</td>
<td>The Action will develop software to enable electronic exchange of information on the estimated time of arrival of trains at terminals and at hand-over points in the logistic chain</td>
<td>Development of conditions to make rail freight transportation more attractive for shippers and to improve the use of train services, reducing the environmental footprint of freight transport</td>
</tr>
<tr>
<td>Sharing of train tracking &amp; ETA information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: INEA (2017b)

“Innovative” funding solutions

The European Commission has considered four financial instruments as innovative:

1. The Structured Finance Facility (SFF): established in 2001 to support priority projects with higher risk profile instruments (EIB loans granted to Member States).
2. The Loan Guarantee Instrument for TEN-T Network (LGTT): established in 2008 to attract private venture capital. It provides risk guarantee for the first years after project opening for revenue-generating projects.
3. EU Project Bonds: this initiative, started with a pilot phase in 2012-2013, tries to attract private capital from institutional investors like insurance companies and pension funds. Project Bonds are
intended to increase the credit rating to at least A-level. As with the CEF, a multiplier effect of 15-20 is expected.

4. The Marguerite Fund: an equity fund established in 2008 by six founders including the EIB and KfW. Used for TEN-E (energy, e.g. renewables) until now, it is in principle suitable also for TEN-T funding.

Concession Finance and Public-Private Partnerships (PPP)

Motorways are managed and financed by concession companies in several EU Member States according to different organisation principles. Concession companies finance investments through loans, equity capital and the capital of concessionaries. Public companies in countries with a high investment grade enjoy similar credit conditions to the Owner State. Re-financing is done through user charges or shadow charges paid by the state.

National budgets for the development of infrastructure

The total budget by Member State for the development of infrastructure in transport and energy (Figure 3.46) shows a substantial allocation to Poland, followed by Romania, Czech Republic and Slovakia. The share of CF and ERDF varies among the Member States, but on average results in a 45% share for CF and in a 55% share for ERDF.

Figure 3.46 – Total budget for the development of infrastructure in transport and energy, by Member State
3.3 replies to study questions under Theme 3 (bottlenecks)

3.3.1 Question 3.1: Identification, location and analysis of bottlenecks for storage capacity and logistical infrastructures for COP crops

3.3.1.1 Bottlenecks for storage capacity

The current storage capacity of each Member State was compared to the estimated average storage need in order to identify possible bottlenecks for storage capacity.

It is worth reminding that the storage needs quantified in the base scenario for replying to Question 1.1 (see § 3.1.1) are more suitable for the identification of contingent shortages of storage capacity rather than of structural ones. It should also be noted that the extent of the shortages/surpluses of storage capacity in absolute terms is important to assess their strategic implications: the larger the capacity gap, the larger the investment in additional storage capacity required to address the situation. The relative measure of the extent of shortages/surpluses of storage capacity versus the average storage needs allows instead an assessment of their current operational implications. The smaller the share of average needs covered by the available storage capacity, the greater the pressure to free up storage capacity during the harvest period and in the following months, and the greater the difficulties for implementing strategic stock management.

Table 3.11 ranks Member States according to the seriousness of their bottlenecks for storage capacity. Member States with shortages of storage capacity, i.e. with a negative difference between available storage capacity and storage needs, can be found at the top of the table. Member States with no bottlenecks for storage capacity, i.e. with a surplus of storage capacity vis-à-vis storage needs, can be found at the bottom of the table.

Surpluses of storage capacity also have strategic and operational implications. The larger the surplus in absolute terms, the larger the storage capacity buffer available to handle exceptional harvest volumes and/or expansive trends in COP production and/or trade in the future. Capacity to needs ratios above 100% highlight the possibility to implement strategic stock management (medium/long-term storage) aimed at exploiting more favourable conditions in COP markets occurring also several months after harvest, or even on longer time spans.

The Member States affected by the most critical bottlenecks in storage capacity are those combining a position of net exporters for COP crops (which would require a surplus of storage capacity to allow strategic stock management) with substantial shortages in storage capacity in both absolute and relative terms.

---

56 The assessment of bottlenecks for storage capacity was based on the average storage need in the base scenario (set on peaks of COP production and trade), calculated as simple average between the maximum and the minimum storage need (see § 3.1.1).
57 Contingent shortages occur where storage capacity falls short of storage needs in exceptional circumstances, defined by peaks in COP production. Structural shortages occur where storage capacity falls systematically short of storage needs in ordinary conditions, defined by average COP production levels.
58 Difference between available storage capacity and storage needs, expressed in absolute value.
59 Storage capacity / storage needs expressed as % ratio.
Table 3.11 – Comparison between current storage capacity and estimated storage needs, by Member State

<table>
<thead>
<tr>
<th>Member State</th>
<th>2015 (shortage) / surplus (000 tonnes)</th>
<th>2015 capacity / average need (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>United Kingdom</td>
<td>-10,370</td>
<td>65%</td>
</tr>
<tr>
<td>Germany</td>
<td>-9,791</td>
<td>83%</td>
</tr>
<tr>
<td>Poland</td>
<td>-6,623</td>
<td>79%</td>
</tr>
<tr>
<td>Denmark</td>
<td>-2,619</td>
<td>79%</td>
</tr>
<tr>
<td>Italy</td>
<td>-2,561</td>
<td>86%</td>
</tr>
<tr>
<td>Greece</td>
<td>-1,398</td>
<td>69%</td>
</tr>
<tr>
<td>Lithuania</td>
<td>-1,344</td>
<td>81%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>-1,071</td>
<td>68%</td>
</tr>
<tr>
<td>Latvia</td>
<td>-1,028</td>
<td>70%</td>
</tr>
<tr>
<td>Ireland</td>
<td>-652</td>
<td>80%</td>
</tr>
<tr>
<td>Sweden</td>
<td>-604</td>
<td>91%</td>
</tr>
<tr>
<td>Croatia</td>
<td>-449</td>
<td>85%</td>
</tr>
<tr>
<td>Estonia</td>
<td>-319</td>
<td>82%</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>-57</td>
<td>75%</td>
</tr>
<tr>
<td>Austria</td>
<td>-15</td>
<td>100%</td>
</tr>
<tr>
<td>Belgium</td>
<td>7</td>
<td>100%</td>
</tr>
<tr>
<td>Malta</td>
<td>56</td>
<td>275%</td>
</tr>
<tr>
<td>Slovenia</td>
<td>61</td>
<td>111%</td>
</tr>
<tr>
<td>Cyprus</td>
<td>135</td>
<td>177%</td>
</tr>
<tr>
<td>Portugal</td>
<td>370</td>
<td>124%</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>1,119</td>
<td>111%</td>
</tr>
<tr>
<td>Slovakia</td>
<td>1,184</td>
<td>125%</td>
</tr>
<tr>
<td>Finland</td>
<td>2,726</td>
<td>156%</td>
</tr>
<tr>
<td>Spain</td>
<td>2,984</td>
<td>111%</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>5,131</td>
<td>158%</td>
</tr>
<tr>
<td>Romania</td>
<td>5,264</td>
<td>129%</td>
</tr>
<tr>
<td>Hungary</td>
<td>5,817</td>
<td>141%</td>
</tr>
<tr>
<td>France</td>
<td>18,745</td>
<td>126%</td>
</tr>
<tr>
<td><strong>EU 28</strong></td>
<td><strong>4,698</strong></td>
<td><strong>101%</strong></td>
</tr>
</tbody>
</table>

Source: Areté elaboration

With around 10 million tonnes of gap between capacity and storage needs, United Kingdom stood out as the Member State with the largest storage capacity shortage in absolute terms; it was followed by Germany (around 9.8 million tonnes), Poland (6.6 million) and Denmark (2.6 million). In relative terms, i.e. comparing the ratios between national storage capacity and storage needs, the most critical situation was again identified in the United Kingdom, where the current capacity only covers 65% of the average storage needs. Other significant shortages in relative terms were identified in the Netherlands (68%), Greece (69%) and Latvia (70%).

It is worth reminding that findings from both literature and interviews highlighted how the storage facilities are differently managed according to their function in the supply chain and also to specific conditions applying at Member State level, including net trade position.

United Kingdom and Germany are both net importers of COP crops. Just-in-time inventory management models have increasingly been implemented by processors in both Member States. The use of temporary
storage solutions (such as silobags, which are widely used in Germany, or open air storage, which is often used in the United Kingdom) is also widespread in both Member States. These elements suggest that storage capacity gaps in Germany and the United Kingdom should have a less serious impact on the actual ability of these countries to cover their storage needs throughout the year. Similarly, storage capacity gaps in net importing countries like Italy, Greece and the Netherlands appear to be less critical than those identified in net exporting countries. The situation of Poland appears to be especially critical, as it combines a substantial gap in absolute terms (6.6 million tonnes) with a rather low capacity/needs ratio for a net exporting country (79%); on a smaller scale, also Lithuania and Latvia combine significant gaps in absolute terms (above 1 million tonnes) with rather low capacity/needs ratios (81% and 70%, respectively).

France emerged as the Member State with the largest surplus of storage capacity in both absolute value (18.7 million tonnes) and relative terms (storage capacity/storage need ratio equal to 126%). France was followed by Hungary (around 5.8 million tonnes / 141% ratio), Romania (around 5.3 million tonnes / 129% ratio) and Bulgaria (5.1 million tonnes / 158% ratio). Bulgaria – together with Malta and Cyprus – is the Member State with the highest ratio between storage capacity and storage needs.

The upward trend in COP production observed in most of the Eastern EU Member States, and the consequent increase of their COP exports, might lead in the near future to the need of investments in additional storage capacity. This consideration especially applies to net exporting countries such as Poland, Lithuania and Latvia, which are already affected by sub-optimal availability of storage capacity. Investments in additional storage capacity would be especially needed in the farming stage of the supply chain, as the achievement of greater efficiency in the use of available storage capacity through faster turnover of stocks is unfeasible at this stage. Additional considerations in this respect are made in the reply to Question 3.4 (see § 3.3.4).

Figure 3.47 – Member States with the most serious shortages in 2015

![Graph showing storage capacity and shortage in Member States in 2015](image)

Source: Areté elaboration

The assessment of bottlenecks for storage capacity was also carried out on individual NUTS 2 regions, in order to identify the regions where the available storage capacity was substantially below regional storage needs.²⁶

Figure 3.48 below reports the EU regions with capacity gaps above 1 million tonnes, also indicating the respective capacity to need ratios.

²⁶ For such purpose, storage needs were allocated according the regional distribution of the UAA (in hectares) under COP crops, based on Eurostat data. No data on COP production volumes at NUTS 2 level are available from Eurostat.
Germany is by far the Member State with the highest number of serious regional capacity bottlenecks, with five regions affected by storage capacity gaps of more than 1 million tonnes. Three regions with serious storage capacity gaps were also identified in France, the top-ranked Member State in terms of current COP storage capacity.

In relative terms, the region affected by the most serious bottleneck is Groningen in the Netherlands, with a storage capacity of just around 190 000 tonnes against a storage need of 1.5 million tonnes (12% ratio). The Oberbayern region of Germany and Piemonte region of Italy also showed substantial capacity gaps versus regional storage needs (34% and 44% ratios, respectively).

**Figure 3.48 – NUTS 2 regions with the most serious storage capacity shortages in 2015**

Source: Areté elaboration

### 3.3.1.2 Bottlenecks for logistical infrastructure

Bottlenecks on the main routes for COP transportation are identified for the relevant TEN-T corridors as well as on national and regional level. Member States and regions are analysed in terms of low quality of logistical networks and services. The analysis is based on the mapping of logistical infrastructure and of the allocation of COP storage capacity illustrated at § 2.

The focus of the identification, location and analysis of bottlenecks is defined by the cause of bottleneck:

---

61 The analysis of bottlenecks at EU level is primarily based on the corridor work plans that are issued by the European Coordinators assigned to each TEN-T corridor.
• Interoperability, i.e. technical and administrative obstacles (as shown in Figure 3.49).
• Transport network capacity.
• Terminal and cross-border point capacity.
• Liner service shortages.
• Location of transportation hubs and terminals.
• Terminal and transportation hub shortages.

As already underlined at § 3.2.3 (reply to question 2.3) and at § 3.2.4 (reply to question 2.4), for a correct understanding of the analysis of bottlenecks for logistical infrastructure it is essential to consider the “shared” nature of most transport infrastructure. COP transportation actually takes place on the same network (roads, railways, inland waterways) used for transportation of other types of freight, and often also for passenger traffic. As a consequence, “general” bottlenecks along the routes which have a critical importance for transportation have to be regarded as relevant ones for the purposes of the analysis, as they directly or indirectly affect COP traffic flows along these routes.

In principle, EU-level bottlenecks on the main TEN-T corridors have mainly an impact on long-haul international COP traffic. However, these bottlenecks can also affect national (inter-regional) COP traffic. By contrast, bottlenecks at national or regional level firstly affect short-haul COP transportation: however, these bottlenecks usually have an impact also on long-haul international traffic, as the related transportation process always starts in COP production areas.

3.3.1.2.1 Bottlenecks at EU level

The second longest trans-European corridor, the Rhine-Danube corridor, runs for 2 860 km and connects the Eastern part of the EU (Black Sea, Budapest, Bratislava and Vienna) with the central part (Southern Germany, Frankfurt and Strasbourg). The corridor incorporates the Main and Danube waterways as its backbone, with an important branch from Munich to Prague, Zilina, Kosice and the Ukrainian border. The corridor includes sections of Priority Projects 7, 17, 18 and 22, with the aim of providing the main East–West link between continental EU Member States by improving (high speed) rail and IWW interconnections. Interconnections between Germany and its neighbouring countries (France, Austria and Czech Republic) have to be strengthened and extended to develop a cross-border rail network. Bottlenecks in Slovakia, Hungary, Romania and Bulgaria, as well as between Austria and Slovakia, need to be removed. While navigation on the Rhine River and on the Rhine-Main-Danube canal is not hampered by the presence of major bottlenecks, the navigability of the Danube must be improved in order to offer a real modal choice for COP transportation. A high number of locations with critical fairway conditions has been identified along the Danube. Moving eastwards, locations with critical fairway conditions along the Danube can be found in Germany (1 location), Austria (2 locations), Slovakia (3 locations), Hungary (5 locations), Bulgaria (3 locations) and Romania (4 locations). The Western Balkans sections of the corridor show some missing links, and have to be further developed to ensure the functioning of the corridor. Freight transportation is concentrated on the Western end of the corridor, with 82% of traffic volume recorded between Slovakia, Czech Republic, Germany and Austria. The modal split of freight traffic on the Rhine-Danube corridor is as follows: 14% by IWW; 28% by rail; 58% by road.

IWWs plays an important role on the Rhine-Alpine corridor. The corridor runs for 1 577 km and passes through Switzerland, France, Germany and the Netherlands, connecting the North Sea ports of Rotterdam and Antwerp to the Mediterranean basin in Genoa, via Switzerland and some of the major economic centres in the Rhine-Ruhr and Rhine-Main-Neckar regions, and the agglomeration of Milan in Northern Italy. The main IWWs are the Rhine, the Moselle and the Neckar. The cargo shipped on this corridor reaches around 200 million tonnes.
Figure 3.49 – Illustration of administrative railway interoperability in European cross-border transport

- **End-to-end, driver of any nationality, on any EU lorry, under mandatory driving times and rest periods**
  - Same driver, same lorry

- **Mostly End-to-end, conductor of any nationality, on any EU vessel, under mandatory rest periods**
  - Same captain, same vessel

- **Country of origin**
  - For the formation of the train, different operating regulations of all the involved countries must be considered: braking rules, length and weight
  - The standard is the lowest length/weight of train of any of the involved countries
  - The locomotive must be equipped with the national train control system

- **Border Station**
  - Change of locomotive and driver (e.g.,
    - Locomotive has admission for neighbouring country and is equipped with national train control system of that country
    - Hand-over of responsibilities may result in technical inspection

- **Transit country**
  - Driver must have knowledge of official language of that country
  - Driver must have knowledge of operational procedures of that country

- **Border Station**
  - “Same procedure as for previous border station”

- **Country of destination**
  - “Same procedure as for previous transit country”

Source: Own illustration.
The modal share of IWWs between Germany and the Netherlands is around 47%, and 33% between the Netherlands and Belgium. The Rhine-Alpine corridor is one of the most utilized freight routes in Europe. It is basically a North–South connection, integrated into Priority Projects 5 and 24, ERTMS Corridor A, and Rail Freight Corridor 1. Due to intensive use of the corridor, capacity upgrades are required in Germany and Italy to resolve bottlenecks. The interconnections between the Belgian, Dutch and German networks also have to be reinforced. A critical missing link can be found in the section between Emmerich and Oberhausen, where construction work is already ongoing. The access routes to the Swiss tunnels in Germany and Italy (Karlsruhe-Basel and Switzerland-Milano/Novara) need to show rapid progress in the next years to ensure smooth and ecological freight transportation on the corridor. Ports have to be upgraded, and multimodal connections have to be ensured.

The **Baltic-Adriatic corridor** is one of the most significant trans-European road and railway axes. It connects the Baltic Sea with the Adriatic Sea, and the industrialised regions in between. These essential economic areas are located in Southern Poland (Upper Silesia), around Vienna and Bratislava, in the Eastern Alpine region and in Northern Italy. The key railway projects of the corridor, aimed at ensuring smooth transportation flows, are the Semmering base tunnel and Koralm railway in Austria. Cross-border sections between Poland, the Czech Republic, Austria, Slovakia and Slovenia also demand attention to ensure the overall quality of freight transportation on the corridor. The further development of this corridor will allow countries with no or limited access to seaports (e.g. Austria, Poland, the Czech Republic) to strengthen their intermodal international transport network. Completion of Priority Projects 23 and 25 and of the Rail Freight Corridor 5 (Gdansk-Ravenna) can contribute to this evolution.

The longest trans-European corridor is the **North Sea-Baltic corridor**, with a total length of 3,200 km. The corridor spans across Finland, Estonia, Latvia, Lithuania, Poland, Germany, Belgium and the Netherlands, and connects the most important North Sea ports with Central Europe and the Baltic States. The main navigable waterway within the corridor is the Mittelland Canal in northern Germany. The average IWW modal share of the corridor is 10%. Substantial freight traffic flows emerge in the Western section of the corridor (spanning across Germany, Belgium and the Netherlands), where all transportation modes are present. The corridor comprises different rail gauges, which cause transhipment costs for international rail freight. "Break-of-gauge" locations pose problems for both freight and passenger traffic. Rail sections along the corridor are mostly electrified, except for a small section in Germany (where construction is ongoing to close the gap) and for a 100 km stretch at the Polish-Lithuanian border. Cross-border traffic between the Baltic States and Poland currently runs with diesel traction only. Besides that, there are different voltage systems along the corridor (see § 2.2.1.2): the resulting interoperability issues can be solved if locomotives are equipped with converters.

ERTMS is implemented on about 8% of the corridor, while it will be installed in the Baltic States - together with the extension of the standard gauge - by the mid-2020s. Bottlenecks might occur for IWW transportation - in the light of the expected increase in demand -- as the network is not fully compliant with current requirements. Not all bridges spanning IWWs on the corridor meet the agreed European standards, as some have a height of less than 5.25 m. IWW infrastructure on the corridor, such as locks or canal draught, needs to be continually updated: an example is the upgrading of the Beatrix lock, which is the largest monumental IWW lock in the Netherlands.

As for the **coverage of national COP transportation flows through TEN-T corridors**, it is important to note that whereas the main IWW infrastructure for COP transportation is integrated in the European TEN-T corridors, the main road and rail COP traffic flows, as identified in § 2.2.3, are not completely covered by the TEN-T network. Especially national road and rail COP traffic flows towards the main seaports in North-Western France (see Figures 2.32 and 2.45 at § 2.2.3) are not covered by the TEN-T corridors. The Northern region of Italy is characterised by substantial road COP traffic flows: differently from France, however, the concerned road infrastructure is well integrated in the TEN-T network, with four of nine corridors encompassing the region. Similar considerations apply for COP traffic flows headed for the region of Saxony-
Anhalt (Eastern Germany), which are covered by three TEN-T corridors. The substantial COP traffic flows originating from and terminating in the ARA Ports are covered by five of the nine TEN-T corridors. Also COP traffic flows among the Baltic States, including traffic headed for Russia, should already benefit from improvements in the North Sea-Baltic corridor.

In the light of the aforementioned potential bottlenecks, the situation of France is assessed in detail in the following subchapter on bottlenecks at national level. The heavy use of rail for inter-regional COP transportation in Austria, together with the critical importance of the country’s infrastructure for transit traffic, also suggest a detailed assessment of bottlenecks at national level for Austria. Finally, although the Romanian rail network is part of the Orient/East-Mediterranean corridor, COP traffic flows towards the Port of Constanta are affected by limitations in hinterland accessibility: this suggests a detailed assessment of bottlenecks at national level also for Romania.

In general, the EU transportation network requires an adequate amount of investments in new infrastructure, modernisation and refurbishment of the existing infrastructure, and increased coordination of cross-border infrastructural projects. Besides implementation of the relevant TEN-T corridors, the key objective for some Member States in Central Europe is to upgrade and maintain the existing infrastructure. By contrast, the key objective for Member States in Eastern Europe is to develop and expand the existing infrastructure. The common challenge for all Member States is the renovation and upgrading of the railway network and the construction of interconnections at borders, as well as the provision of adequate equipment for traffic management.

3.3.1.2.2 Bottlenecks at national level

Bottlenecks at national and regional level are investigated by comparing the results of COP storage capacity mapping (see § 2.1) and the underlying logistical infrastructure, as well as the identified transport flows (see § 2.2). Depending on the type of bottleneck, a separation by transportation mode is required in this assessment. The assessment mainly focused on a selection of Member States hosting important COP production/consumption areas and/or critical sections of the TEN-T corridors and/or some of the main seaports for COP exports.

As shown in § 2.2.3, the Danube river represents the major route for COP transportation in Eastern Europe. For this reason, the analysis of bottlenecks at national level focused on a selection of Member States (Germany, Austria, Slovakia, Czech Republic, Hungary, Romania and Bulgaria) which are directly or indirectly served by this important transportation route. Freight traffic on the Danube is hampered by capacity limitations caused by low water levels and insufficient fairway conditions. Due to the intense dynamics in the free-flowing river sections of the Danube, the morphology of the riverbed and thus fairway depth and/or width may change rapidly affecting the transport flow. The localisation of critical fairway conditions is essential to identify bottlenecks in the IWW transport network. Critical sections are defined in terms of number of days with a water level below 2.5 m.

Next to the Danube, also the Rhine river is of crucial importance for COP traffic towards the ARA Ports: this reinforces the need to include Germany in the selection of Member States covered by the assessment of bottlenecks at national level.

The selection of Member States covered by the assessment also includes France and Poland, mainly on the grounds of their importance as producers and exporters of COP, and of actual or potential issues on routes concerned by heavy road and rail traffic of COP, as identified at § 2.2.3.1 and 2.2.3.3.

3.3.1.2.2.1 Austria
Relevant information on Austria’s economy, the transport sector and its logistical infrastructure is provided in the related Factsheet.

**Characteristics of Austrian freight transportation**

The Austrian logistics market was impacted by dynamic changes over the last decades. The Austrian economy has embraced modern business concepts such as JIT and a global planning perspective. These factors, along with policy incentives, determine the relative competitiveness of the different transportation modes in Austria. The country has a very high quality of infrastructure for freight rail, road and inland waterways. Road is the most used transport mode with a 63% share of total freight traffic. IWW holds a 25% share, and rail a 12% share.

Transportation infrastructure is state of the art, but it has to adapt to the latest trends and needs of the logistics market. Prices charged by operators for logistical services are often high: this may lead to less competitive service compared to foreign operators. An internalization of external costs would be needed.

- **Biggest logistics operators**: Rail Cargo Austria AG; Schenker & Co AG; LKW Walter Internationale Transport organisation AG; Gebrüder Weiss GmbH; Gartner Transport Holding GmbH; Multi Transport & Logistik Holding AG (Cargo Partner Group); Kühne + Nagel GmbH; Logwin Holding Austria GmbH.
- **Shippers** need innovative ideas and the implementation of competitive products in intermodal transportation.
- **Operators** need a harmonised national terminal network and a liberalization of access to rail infrastructure to avoid any kind of discrimination and easy, fast, and cheap transhipment processes between road and rail. The service quality provided by Austrian operators is set at a very high level in every aspect, also in comparison to other Member States.
- **Terminals**. The biggest terminal operator is Rail Cargo Austria AG (RCA), which runs at least half of the terminals in the country. The allocation of terminals on the Austrian territory depends on the importance of traffic flows and of economic regions. A neutral access to terminals is needed in Austria. The offer of intermodal services is limited by the high investment costs for specialised equipment. Time losses at borders due to different rail electrification systems pose significant issues. Specialisation of terminals results in specialisation on transportation of certain types of freight, such as bulk products or containers. Cooperation among terminal operators is not widespread. Implementation of a harmonised terminal network strategy should be considered to improve the efficiency and capacity of terminals.

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Transport routes are relatively short to all other neighbouring countries.</td>
<td>• Austria suffers from the high volume of transit freight traffic, which combines with heavy inter-regional traffic, causing capacity problems.</td>
</tr>
<tr>
<td>• Multimodal transport connections are in place.</td>
<td>• Many trade flows cross Austria from North to South and from West to East or vice versa. Transportation infrastructure is heavily used. As a result, permanent maintenance and infrastructural development are needed to handle the increasing traffic flows in the future. The gained road tolls should cover such investments, but the tolls are uncommitted.</td>
</tr>
<tr>
<td>• High quality standards of technical infrastructure.</td>
<td>• Because of the additional costs caused by transhipment processes and by their higher complexity, multimodal services lack too often the ability to compete.</td>
</tr>
<tr>
<td>• High education level of staff.</td>
<td>• Austria lacks a general transport concept and policy.</td>
</tr>
<tr>
<td>• High and competitive quality of services.</td>
<td></td>
</tr>
<tr>
<td>• Dense railway infrastructure.</td>
<td></td>
</tr>
<tr>
<td>• Austria as a transit country gains toll from crossing shippers.</td>
<td></td>
</tr>
</tbody>
</table>
Identified bottlenecks in Austria’s logistical infrastructure

IWW transportation is supported by policy making, but suffers from system features like roundtrip time, geographical bottlenecks etc. The state-owned ÖBB still dominates the railway market; Rail Cargo Austria (RCA) is the leading operator, accompanied by small private railway companies which focus on niche markets. The infrastructure is owned by ÖBB IS Betrieb AG, which allows access to all market operators according to defined rules. Railway transportation is often non-competitive compared to road transportation.

IWW

The Danube River is the most important IWW in Austria. Poor fairway conditions on the Danube are a major bottleneck for waterway navigation. Critical sections of the Danube exist East of Vienna and at the Port of Krems in Central Austria (see Figure 3.50).

Identified bottlenecks in Austrian IWW infrastructure:

- Limited fairway depth in shallow sections to the East of Vienna
- Optimisation of the shallow section at Petronell – Witzelsdorf is needed
- Maintaining water level measurements with strategic and operational plans
- Establishment of back-up energy supply systems for automatic measuring stations
- Equipping most important water measuring stations with batteries and solar panels to keep measurement running also during extreme weather events
- Maintaining technical equipment of measuring stations to avoid data errors and gaps
- Staff for weekly or even daily on-site checks
- Support opening-up of the currently limited market for dredging activities
- Set up of multi-annual framework contract for dredging services with contractors
- Preparation and implementation of river engineering works
- Proper and up-to-date user information on available fairway depths in critical segments
- Display of recent surveying results of shallow sections in a differentiated manner
- Designation and display of “deep navigation channel” within the existing fairway and integration in published maps

Rail

The Austrian railway system struggles with capacity problems on essential cross-border tracks to the Czech Republic, Slovakia, Hungary. This concerns the main transit routes across the Alps and the routes for hinterland transportation. Many standard routes for COP unit trains reach capacity limits because of increasing freight traffic, as well as operation conflicts with passenger traffic (see critical bottleneck region in Figure 3.50). The relatively dense railway network theoretically allows operating many alternative routes for COP transportation, and is effectively connecting the main hub (Vienna) with intermodal terminals (in the areas of Salzburg, Graz and Wels). However, the conditions on the concerned secondary tracks are often not adequate for COP transportation. The customer is not willing to operate on alternative routes as long as its transportation requirements cannot be met, because of insufficient infrastructure and/or service level. Rail COP traffic uses heavily utilized routes along the West-East and North-South directions. In addition to transit flows, heavy inter-regional rail traffic of agricultural goods (with volumes reaching up to 5 million tonnes per year, as identified at § 2.2.3.3) also affects the rail network capacity significantly. Although most of the rail routes are well equipped, they are constantly operating at full capacity, due to competition with passenger traffic. COP traffic needs to be allocated more efficiently on alternative routes which can cope with the related transport volumes. Alternative routes must also enable interoperability and should be well equipped (i.e. electrified and double-tracked). Finally, COP transportation services within the main hubs have to be modernized in terms of both infrastructure and IT-support. Capacity expansion (e.g. additional tracks, loading/unloading equipment at terminals, etc.) would also be needed.
Factsheet on Austria

Basic data

Population 8 711 770 ('16) (Growth rate: 0.55%)
Urban population 66% of total population ('15)
Land use
- agricultural land: 38.4%
  - arable land: 16.5%
  - permanent crops: 0.8%
  - permanent pasture: 21.1%
- Forest: 47.2%
- Other: 14.4%
- Irrigated land: 1.17/0 sq km

GDP - per capita (PPP) € 43 300 ('16)
GDP - composition, by sector of origin
- agriculture: 1.3%
- industry: 28.1%
- services: 70.6%
Labor force by occupation
- agriculture: 0.7%
- industry: 25.3%
- services: 74%
Unemployment rate 6.1% ('16)
Agriculture – products
- grains, potatoes, wine, fruit; dairy products, cattle, pigs, poultry; lumber and other forestry products

Transport network data

Roadways total: 133 597 km (includes 2 207 km of expressways) ('16)
Railways total: 5 268 km standard gauge: 5 268 km 1,435-m gauge (3 556 km electrified) ('14)
Waterways 358 km ('11)
Major river port(s) Enns, Krems, Linz, Vienna (Danube)
Figure 3.50 – Illustration of bottlenecks in Austrian infrastructure

Source: Own illustration based on DG MOVE data
Bulgaria

Relevant information on Bulgaria’s economy, the transport sector and its logistical infrastructure is provided in the related Factsheet.

Characteristics of Bulgarian freight transportation

- **The biggest logistics operators are:** BDZ EAD; FT EOOD; BDZ AD; Bulmarket Rail; Cargo EOOD; DB Cargo Bulgaria; EOOD; Bulgaria AD; Port Rail OOD; Bulgaria EOOD.

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Favourable geographical location.</td>
<td>• Deterioration of operational performance and quality of services due to the advanced age of vehicles.</td>
</tr>
<tr>
<td>• High degree of completion and density of the existing transport infrastructure.</td>
<td>• Lack of bypasses around urban areas.</td>
</tr>
<tr>
<td>• Available transportation links between the railway network and the national road infrastructure.</td>
<td>• Lack of legislation to stimulate the development of intermodal transportation.</td>
</tr>
</tbody>
</table>

Identified bottlenecks in Bulgarian logistical infrastructure

By comparing COP storage capacity with the available logistical infrastructure, the region of Dobrich (BG332) emerges as a critical bottleneck, as shown in Figure 3.51. Dobrich has substantial COP storage capacity and is located by the Black Sea, but a major terminal or port is missing in the region. The nearest port is in Varna, but no adequate logistical infrastructure exists to enable an efficient connection.

Road

The total road network length has increased from 19,425 km to 19,853 km (a 428 km expansion) since the EU membership. The major sources of funding are subsidies and transfers from national budget, revenue from fees for the use of road infrastructure as well as EU funds. A major share of the revenues used for road infrastructure maintenance comes from vignette fees for the use of road infrastructure, which are collected by the national road infrastructure agency. However, the budget required for maintaining the condition of the road network considerably exceeds the current funding.

The age structure of the fleet shows that 70% of vehicles exceed the age of 15 years. Road transportation plays an important role in the shipment of COP in Bulgaria; the aging truck fleet represents a major concern in the COP transportation process.

IWW

A major share of the turnover of Bulgarian ports comes from bulk freight transport, mainly due to large exports of grains to the Russian Federation, Turkey, Romania, and Ukraine. The demand for cereals, which are the main agricultural products exported from Bulgaria by IWW, is growing. Nevertheless, low water levels of the Danube River restrict downstream COP traffic to the Black Sea ports. Critical fairway locations are shown in Figure 3.51.

For both the port of Lom/Vidin and the port of Ruse, bulk shipping of cereals may become an important factor for the increase of the overall freight throughput.

Varna is the biggest Bulgarian port for the export of bulk agricultural products, although investments were also made in the port of Burgas, which has increased its market share in the last years. Intermodal terminals are also developed through PPP (this is the case of, for instance, the Ruse terminal).
Identified bottlenecks in Bulgarian IWW infrastructure:

- Existing port infrastructure such as quay and transhipment handling and storage facilities often do not comply with the characteristics of IWW vehicles, types of freight and technological requirements in their processing and storage.
- Water depth at the quays of many ports/terminals is insufficient and limits the draught/size of ships entering these ports.
- For some older ports with regional significance, the technical features of individual port areas - storage, transhipment, and road links - as well as their layout are not compatible with vessel sizes that are typical for commercial ports.
- Several publicly owned port terminals lack the required logistical infrastructure.
- The specialization in ports and terminals is insufficient and does not provide the needed conditions for transhipment and storage and/or adequate capacity.

Further IWW transportation issues exist in Bulgaria, but incentives to address them are already provided, such as CEF funding for the update of old and insufficient waterway measuring equipment. In addition, training for personnel to operate the equipment will be performed. In order to improve monitoring procedures, data quality and analysis projects are planned (FAIRway Danube).

**Rail**

The conventional railway network does not allow significant service quality improvements of freight transportation in Bulgaria. The average commercial speed is one of the lowest in the EU. Although the designed speed is 120-130 km/h, the predominant speed range is between 60 and 80 km/h for around 40% of mainline rail network, and below 60 km/h for around 17% of the same.

The increased frequency of track repairs carried out in sections of the railway network, and the extended periods of interruption of train traffic, seriously affect the quality of rail transport service. Another key factor behind the poor quality of rail transport service is the poor condition of rolling stock. A significant part of the fleet does not meet EU standards for maintenance and repair.

Another problem is represented by outdated technologies and a lack of rail information systems, which restricts interoperability and leads to the inability to implement modern information technologies in transport planning and in the management of the transportation process.

There are insufficient links to seaports and IWW ports within the national railway network, which constrain the development potential of intermodal COP transportation. In general, the national railway network is not efficiently integrated into the European rail system; its large capacity is partly unused.
Factsheet on Bulgaria

**Basic data**

- Population: 7 144 653 ('16) (Growth rate: -0.6%)
- Urban population: 74% of total population ('15)
- Land use:
  - Agricultural land: 46.9%
  - Arable land: 29.9%
  - Permanent crops: 1.5%
  - Permanent pasture: 15.5%
- Forest: 36.7%
- Other: 16.4%
- Irrigated land: 1.020 sq km
- GDP - per capita (PPP): € 18 200 ('16)
- GDP - composition, by sector of origin:
  - Agriculture: 5.1%
  - Industry: 27.3%
  - Services: 67.5%
- Labor force by occupation:
  - Agriculture: 7%
  - Industry: 30.1%
  - Services: 62.9% ('14)
- Unemployment rate: 8.9% ('16)
- Agriculture - products: vegetables, fruits, tobacco, wine, wheat, barley, sunflowers, sugar beets, livestock

**Transport network data**

- Roadways: total: 19,512 km
  - Paved: 29,235 km (incl. 438 km of expressways)
  - Unpaved: 277 km
- Railways: total: 5,114 km
  - Standard gauge: 4,989 km
  - 1,435-m gauge (2,880 km electrified)
  - Narrow gauge: 1,256 km (760-mm gauge) ('14)
- Waterways: 470 km ('99)
- Major seaport(s): Burgas, Varna (Black Sea)
Figure 3.51 – Illustration of bottlenecks in Bulgaria’s infrastructure

Source: Own illustration based on DG MOVE data
Czech Republic

Relevant information on the Czech Republic’s economy, the transport sector and the logistical infrastructure is provided in the related Factsheet.

Characteristics of the Czech Republic’s freight transportation

- **Biggest logistics operators in the Czech Republic**: A.W.T.; ČD Cargo, a.s.; ČSAD Hodonín, a.s.; Dachser Czech Republic, a.s.
- **The Czech logistics market** used to be eastward-oriented, with a strong position in railroad transport; a husky network of marshalling yards had been built. The situation changed after the revolution in 1989, when new markets were opened up for Czech suppliers and haulers. The eastward-oriented railroad network was not able to sustain the development of westward traffic. Road traffic volumes were growing at the expense of rail traffic. In the present situation, railroads are used for long-haul COP traffic in shuttle trains. The current share of railroads in freight traffic is 21%, with a 79.5% share for road transport and a 0.5% share for IWWs.

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Location in Central Europe (transport bridge between Western and Eastern</td>
<td>• Transit traffic brings low added value.</td>
</tr>
<tr>
<td>Europe)</td>
<td>• Congestion on roads and railways.</td>
</tr>
<tr>
<td>• Borders with many neighbouring countries.</td>
<td>• Heavy burden on road infrastructure.</td>
</tr>
<tr>
<td>• High density of road and railroad network.</td>
<td>• Limited funds for maintenance and new investments in infrastructure resulting from current</td>
</tr>
<tr>
<td>• Main transport flows are implemented by road transport and by shuttle</td>
<td>toll system for highways and 1st class roads.</td>
</tr>
<tr>
<td>intermodal trains.</td>
<td>• Long-term strategies for logistics and infrastructures are not available.</td>
</tr>
<tr>
<td>• Favourable prices for road and railroad transport.</td>
<td>• Limited use of IWW transportation</td>
</tr>
<tr>
<td></td>
<td>• Inadequate implementation of rail interoperability.</td>
</tr>
</tbody>
</table>

Identified bottlenecks in the Czech Republic’s logistical infrastructure

The quality of transportation infrastructure is improving; however, growing transportation demand requires additional expansion of the related logistical infrastructure. Connections between terminals handling COP and the transport network are especially missing. Bottlenecks in the Czech Republic’s logistical infrastructure mainly concern rail transportation.

The South-Eastern region CZ064 (Jihomoravsky kraj) has a substantial amount of COP storage capacity, but lacks the required infrastructure to enable transport flows to regions in the Eastern and North-Western parts of the country. Furthermore, the centralized structure of the logistical infrastructure towards the city of Prague affects traffic flows, and results in bottlenecks in the metropolitan area of the city.

Road

The density of the road network and the quality of road infrastructure are sufficient, and the cost of road transportation services is competitive. Nevertheless, road vehicles and transhipment equipment require modernization. A critical issue of road infrastructure is the lack of alternatives to the highway D1 (Prague – Brno – Ostrava), which is the busiest road connection in the Czech Republic. This highway, among others, needs a major overhaul.

IWW

Waterway terminals are a major problem in the Czech Republic. They are situated just on the Labe (Elbe) river in the North of the country. The use of IWW for freight transportation is limited, due to the low capacity of the Labe river.
Rail
Although the Czech rail network has one of the highest densities in Europe, technical barriers on many routes make the implementation of modern logistic chains impossible. Only a few rail connections are competitive to road transportation in speed and service quality. A long-term issue in COP rail transportation is the lack of specialized equipment: service requirements cannot hence be completely satisfied. Long-haul rail traffic is constrained by inadequate track capacity. Especially rail connections from the South-East to the North-West are intensively used by passenger traffic, which competes with freight traffic. In addition, single track lines on critical rail connections – such as the one from the South to the South-East - also pose capacity limits (see Figure 3.52).

Another problem affecting freight rail transportation in the Czech Republic is the inadequate level of interoperability. Pilot projects to improve interoperability of multimodal transportation are integrated in the European ETCS (European Train Control System) corridor E: Dresden – Prague – Brno – Vienna – Budapest – Bucharest – Constanta.

Lack of investments in logistical infrastructure is a major issue in the Czech Republic. Systematic support for intermodal transportation and public logistic centres is missing. The liberalization of the rail market has not yet been completed. As a consequence, the most used transportation mode for COP in the Czech Republic is still road transportation.
Factsheet on Czech Republic

Basic data
Population 10 644 842(’16) (Growth rate: 0.14%)
Urban population 73% of total population (’15)
Land use
- agricultural land: 54.8%
  - arable land: 41%
  - permanent crops: 1%
  - permanent pasture: 12.8%
- Forest: 34.4%
- Other: 10.8%
- Irrigated land: 320 sq km

GDP - per capita (PPP) € 30 000 (’16)
GDP - composition, by sector of origin
  - agriculture: 2.5%
  - industry: 37.5%
  - services: 60%
Labor force by occupation
  - agriculture: 2.6%
  - industry: 37.4%
  - services: 60% (’12)
Unemployment rate 5.6% (’16)
Agriculture – products
  - wheat, potatoes, sugar beets, hops, fruit;
  - pigs, poultry

Transport network data
Roadways total: 120 661 km (includes 730 km of expressways) (’11)
Railways
  - standard gauge: 9 519 km, 1,435-m gauge (3 240 km electrified)
  - narrow gauge: 102 km 0,760-m gauge (’14)
Waterways 664 km (principally on Elbe, Vltava, Oder, and other navigable rivers, lakes, and canals) (’10)
River port(s)
  - Prague (Vltava); Decin, Usti nad Labem (Elbe)

Employment growth and activity branches - annual averages

Logistics Performance Index (LPI) and modal split of freight transport

Inland waterways
Roads
Railways
LPI Infrastructure
Figure 3.52 – Illustration of bottlenecks in the Czech Republic’s infrastructure

Bottlenecks
- Critical bottleneck region
- Critical bottleneck section

Road
- Motorway Completed
- Motorway to be upgraded
- Road Completed
- Road to be upgraded

Rail
- High speed Planned
- Conventional Completed
- Conventional to be upgraded

Inland waterway
- Completed
- To be upgraded

Rail-Road terminal

Port

Port & RR-terminal

Corridors
- A – Baltic-Adriatic
- D – Orient/East-Med.
- I – Rhine-Danube

Storage capacity (tonnes)
- No storage capacity
- < 120,000
- 120,000 – 600,000
- 600,000 – 1,200,000
- 1,200,000 – 2,000,000
- > 2,000,000

Source: Own illustration based on DG MOVE data
3.3.1.2.2.4  France

Relevant information on the French economy, the transport sector and the logistical infrastructure is provided in the related Factsheet.

Characteristics of the French freight transportation

The French logistical infrastructure has a centralized structure converging towards its capital, the city of Paris. The logistical network is very dense around Paris and gets less dense at the edge of the country. Despite the high density of the network around Paris, congestion is still a concern in this area.

- **Biggest logistics operators in France**: SNCF Logistics; Geodis Logistics; Darque Logistics France SAS; DB Schenker.
- France has excellent LPIs for its road, rail, and IWW infrastructure. In addition, France has significantly improved the timeliness of shipments between 2005 and 2015. As regards the TEN-T corridors, France has almost fully completed its conventional road and rail Core Network, and 75% of the IWW Core Network.

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The central position of France in the EU offers relatively short routes to neighbouring Member States.</td>
<td>• The centralized structure of the logistical network, converging towards Paris, results in a higher risk of failure due to the bottlenecks in and around the city.</td>
</tr>
<tr>
<td>• France has one of the best logistical infrastructures worldwide (it ranks eighth in the world for its overall quality).</td>
<td>• In order to sustain the high quality level of the logistical infrastructure, permanent maintenance and infrastructural development are necessary.</td>
</tr>
<tr>
<td>• France has access to the Atlantic Ocean and the Mediterranean Sea. French seaports are important transhipment points for inward and outward global trade flows.</td>
<td></td>
</tr>
<tr>
<td>• France invests more in its domestic transportation infrastructure than its closest European neighbours.</td>
<td></td>
</tr>
</tbody>
</table>

Identified bottlenecks in French logistical infrastructure

No serious infrastructural issues can be identified in France. Compared to other EU Member States, the French logistical network is state of the art.

Road

The national road infrastructure of France has a good quality and the network capacity is sufficient for freight transportation, including COP. However, bilateral or multilateral agreements at border crossings are missing.

COP transportation flows in the Northern area of France are all integrated in the TEN-T network and do not pose any concerns for potential bottlenecks. Network sections in the North-West of France, which are not part of the TEN-T, were found to handle significant COP traffic moving to seaports in the area, but the concerned infrastructure is sufficient to provide the required services. However, increasing transport volumes might pose challenges in the future. The North-West region was hence identified as a potential bottleneck region for road transportation, due to heavy road freight traffic and missing TEN-T integration (see Figure 3.53).

---

62 For instance, 44-tonne trucks are the standard for domestic traffic in the BeNeLux Member States and in France, but border crossing is only allowed with 40-tonne trucks. This results in inefficient loading of trucks used in international traffic, and causes road congestion on cross-border routes.
Rail
Cross-border issues are an important aspect in the French rail transport services due to an insufficient level of interoperability.63

Furthermore, the centralized structure of the rail network around Paris, with many important routes converging towards the city, is critical in terms of potential risk of failure, also due to missing alternative railway links around Paris, which could make it possible for transit traffic to bypass this congested area. Such rail network structure poses a high risk of failure and may represent a potential bottleneck in the future (see Figure 3.53).

According to a study carried out by the European Parliament,64 “the rail network, which connects ports to their hinterland, is generally in poor condition, with very low door-to-door speeds in some cases”. For instance, the average rail transport speed between the large COP ports of Le Havre, Rouen, and Paris amounts to only 6 km/h. Rail freight transportation to the seven biggest French ports only reaches a modal share of 15%. An unused transport capacity appears to exist for COP shipping by rail in France.

The quality of railway freight service in France is affected by the poor maintenance of some freight railway lines. Around 76 % of lines are subject to temporary speed limitations. The closure of a significant number of secondary but anyway important railway lines affects COP transportation in the North-West of France.

There is lack of standards for communication and information exchange, a lack of transparency of freight flow information in combination with limited ICT facilities, as well as a lack of real-time traffic information and forecasts about the traffic on the multimodal transport network. All these drawbacks have a negative impact on the efficiency and reliability of multimodal COP transportation services.

IWW
Due to its geographical position, metropolitan France - with a coastline of nearly 3 500 km - has a competitive advantage in seaborne COP traffic. In 2008 France enacted a Port Reform Act to strengthen the position of the following seven significant ports: Bordeaux, Dunkerque, Le Havre, La Rochelle, Rouen, Nantes-Saint Nazaire and Marseille. These ports are collectively known today as "Grands Ports Maritimes" (GPM). Like the other French ports, they remain under public authority, but each port had to evolve a strategy including main orientation, a business plan and a financial plan. The reform initially included planned investments for EUR 2.5 billion from 2009 to 2013 (of which EUR 174 million from national funds), and came into force in 2010-2011.

While primarily focusing on the development of container traffic, the investment also reinforced the logistical infrastructure for COP traffic, wherever the selected ports also handled agricultural goods and opted for a bulk traffic orientation.

Investments in logistical infrastructure that followed the reform act included better multimodal hinterland connections. One priority was the railway network for freight transportation to develop a better quality and efficiency as well as reliability, hence strengthening the position of local railway operators. The reform act was also part of the foundation for a better connection between ports and port grain terminals located along the River Seine, namely Le Havre, Rouen, and Paris. As a consequence, IWW COP transportation services were also reinforced by the related investments.

The HAROPA joint venture of the Seine ports (Le Havre, Rouen and Paris) was established in 2012, thus creating the most extensive French port system, ranking on the fifth position in Europe. HAROPA is part of the

---

63 Differences in the maximum length of trains (for instance, trains may be 740 m long in France, while trains of up to 450 m of length only are allowed in Spain) significantly reduce the competitiveness of freight rail transportation. In addition, even within France, different electrification and/or signalling systems are used, and this disturbs a smooth flow of rail traffic.

TEN-T core network. Over EUR 100 million in funds were made available in 2015 to improve land and sea access. The HAROPA network exceeds the three ports due to partnerships, such as the one with the “Ports Normands Associés” (Caen-Ouistreham and Cherbourg). The logistics operators and shippers using HAROPA ports benefit from a multimodal transport service offer (IWW, rail, road, short- and deep sea transport, cross-channel) connecting the metropolitan region of Paris, which is the second largest European consumer market.

The port of Rouen has reported increasing grain traffic volumes for several consecutive years with a focus on export to Algeria (3.5 million tonnes), Morocco (2.1 million tonnes) and China (1.2 million tonnes) in the 2015-2016 season. The port of Rouen is affected by a serious operational limitation, as it cannot handle fully loaded Panamax dry bulk cargo vessels because of limited draught. However, deep sea ports at Dunkerque and La Rochelle can handle fully loaded Panamax and Post-Panamax vessels, thus providing valuable alternatives to shippers making use of these vessels.

Inland navigation activity in France strongly relies on transport of agricultural products, which accounts for a share of 25% of IWW overall freight traffic in the country.

---

65 Vessels ranging from 60 000 to 80 000 DWT (dead weight tonnage), whose movement is restricted by the dimensions of the Panama canal’s lock chambers (32.26 metres in width, 320.0 metres long, and 25.9 metres deep).
Factsheet on France

<table>
<thead>
<tr>
<th>Basic data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
</tr>
<tr>
<td>Urban population</td>
</tr>
<tr>
<td>Land use</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>GDP - per capita (PPP)</td>
</tr>
<tr>
<td>GDP - composition, by sector of origin</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Labor force by occupation</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Unemployment rate</td>
</tr>
<tr>
<td>Agriculture – products</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transport network data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadways</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Railways</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Waterways</td>
</tr>
<tr>
<td>Major seaport(s)</td>
</tr>
<tr>
<td>River port(s)</td>
</tr>
<tr>
<td>Container port(s)</td>
</tr>
<tr>
<td>Cruise/ferry port(s)</td>
</tr>
<tr>
<td>LNG terminal(s) (import)</td>
</tr>
</tbody>
</table>

Employment growth and activity branches - annual averages

Logistics Performance Index (LPI) and modal split of freight transport
Figure 3.53 – Illustration of bottlenecks in French infrastructure

Source: Own illustration based on DG MOVE data
3.3.1.2.5 Germany

Relevant information on the Germany’s economy, the transport sector and the logistical infrastructure is provided in the related Factsheet.

Characteristics of German freight transportation

The German logistics market can be considered as the largest in Europe.

- **Important market players** are: Deutsche Bahn Group AG; Deutsche Post (DHL); Kühne + Nagel; Dachser; Rhenus.
- German operators can count on state-of-the-art rolling stock and transhipment equipment. However, there is a problem in the terminal network which, according to many operators, is not dense enough. Another problem derives from the fact that a large share of transport flows circumvents Eastern Germany. This happens because most of the operators use the established transport routes across Western Germany (in the so-called “blue banana” area). This increases the presence of bottlenecks along the European North-South transport axis (Rhine-Danube corridor).
- The intermodal transportation market in Germany is partly dominated by the container ship operators located at the seaports. These operators determine service requirements for container traffic and handling: other shippers/operators and inland terminals have to adapt to such requirements.
- Operators require a clear institutional separation between ownership of infrastructure and management of operations, and access to infrastructure free from discrimination.

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany is located in Central Europe. Transport routes are relatively short to all other neighbouring countries.</td>
<td>Because of the central position in Europe, Germany is a transit country. Obviously not every transport chain starts or ends in Germany: this implies that many traffic flows cross Germany from North to South and West to East, or vice versa, and transport infrastructure is heavily utilised.</td>
</tr>
<tr>
<td>Germany has access to the sea. German seaports are important transhipment points for inward and outward global trade flows.</td>
<td>Permanent maintenance and infrastructural development are necessary to overcome the increasing transport flows in the future. The gained road toll should cover such investments, but the toll is uncommitted.</td>
</tr>
<tr>
<td>The dense inland waterway network with numerous channels connects Germany to neighbouring countries.</td>
<td></td>
</tr>
<tr>
<td>Germany has the densest railway infrastructure in the EU.</td>
<td></td>
</tr>
<tr>
<td>Germany as a transit country gains tolls from crossing shippers.</td>
<td></td>
</tr>
</tbody>
</table>

**Identified bottlenecks in German logistical infrastructure**

No serious infrastructural issues can be identified in Germany. Compared to other EU Member States, the German logistical network is state of the art. Although huge national investments have been allocated to infrastructure improvements, the transportation network has to be continuously expanded and modernized to cope with the growing traffic flows.

**Road**

Road transportation holds an 80% share of total freight traffic, followed by rail transportation with 20%. The share of the road freight transportation increased by more than 20% over the last 30 years, at the expense of the other transportation modes. Since 2005 a road toll is raised for trucks (≥ 12 t) on the German highways. As a negative side effect, some truckers switched to federal roads. This “toll sidestep traffic” (Mautausweichverkehr) poses a heavy burden on federal roads. Substantial road traffic flows of agricultural
products (including COP) were identified (see § 2.2.3.1) towards the region of Saxony-Anhalt (around 5 million tonnes per year), the Weser-Ems Canal (around 1.5 million tonnes) and the Port of Hamburg (around 2 million tonnes): however, no significant bottlenecks in the concerned road network were identified.

**IWW**

The overall condition of navigable waterways in Germany is good. However, one concern is the aging of locks. Most locks have already exceeded their lifetime and must be replaced. Furthermore, information on water levels can be improved by implementing a push information system. Dredging activities are undertaken widely in several waterway sections in Germany. On the one hand, this improves fairway conditions in the long run. On the other hand, operation during dredging is prohibited, and this disturbs traffic flows.

Low water levels are a major concern for non-regulated waterways (main rivers, canals, etc.) such as the Rhine, the Danube and the Elbe. Critical sections with poor fairway conditions are presented in Figure 3.54. Low water levels not only restrict the load capacity of IWW vessels and demand low water surcharges: in the worst cases, the cargo must be transhipped onto alternative and costlier transportation modes such as trucks.

**Rail**

The German railway system struggles with capacity problems. This concerns especially port hinterland routes starting at the seaports of Bremen and Hamburg. The standard routes for freight trains reached their capacity limits, due to increasing rail freight traffic as well as to operation conflicts with passenger traffic (see critical segments in Figure 3.54). The relatively dense railway network potentially allows operating many alternative routes for COP transportation by rail, but often the conditions on these secondary tracks are not good enough for heavy freight traffic. This applies especially to non-electrified tracks and single-track sections.

National transport flows of agricultural goods (including COP crops) by rail amount to around 2 million tonnes, with the main flows originating from Central Germany towards the Northern Ports and Southern Germany (see § 2.2.3.3). These inter-regional transportation flows, as well as the international (Germany ↔ Italy) and transit (Belgium and Netherlands ↔ Austria and Italy) COP flows are affected by the aforementioned capacity problems of the German railway network.

Deutsche Bahn AG holds a strong market position in Germany. The company is private, but the German Federal Government holds 100% of the shares. Additionally, most of the rail infrastructure is in the hands of DB Netz. DB Netz is controlled and regulated by the Bundesnetzagentur. It is evident that rail infrastructure and rail operations should be separated more clearly in Germany.

Intermodal transportation is often hindered by rail passenger traffic. The time slots for handling intermodal traffic are constrained by the regular interval timetables of rail passenger traffic. Another problem concerns prices (and especially low fuel prices) and subsidies, which favour road transportation and limit the competitiveness of rail transportation services. For instance, the share of transport costs for using the rail infrastructure is between 30-40% of total transport costs, whereas the share of costs for using the road infrastructure is significantly lower (only road toll and transit costs).
**Factsheet on Germany**

### Basic data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>80,722,792 (16)</td>
</tr>
<tr>
<td>Urban population</td>
<td>75.3% of total population (15)</td>
</tr>
<tr>
<td>Land use</td>
<td></td>
</tr>
<tr>
<td>- Agricultural land</td>
<td>48%</td>
</tr>
<tr>
<td>- Arable land</td>
<td>34.1%</td>
</tr>
<tr>
<td>- Permanent crops</td>
<td>0.6%</td>
</tr>
<tr>
<td>Forest</td>
<td>31.8%</td>
</tr>
<tr>
<td>Other</td>
<td>20.2%</td>
</tr>
<tr>
<td>Irrigated land</td>
<td>500 sq km</td>
</tr>
<tr>
<td>GDP - per capita (PPP)</td>
<td>€ 42,600 (16)</td>
</tr>
<tr>
<td>GDP - composition, by sector of origin</td>
<td></td>
</tr>
<tr>
<td>- Agriculture</td>
<td>0.6%</td>
</tr>
<tr>
<td>- Industry</td>
<td>30.3%</td>
</tr>
<tr>
<td>- Services</td>
<td>69.1%</td>
</tr>
<tr>
<td>Labor force by occupation</td>
<td></td>
</tr>
<tr>
<td>(45.3 Mio. '16 est.)</td>
<td></td>
</tr>
<tr>
<td>- Agriculture</td>
<td>1.6%</td>
</tr>
<tr>
<td>- Industry</td>
<td>24.6%</td>
</tr>
<tr>
<td>- Services</td>
<td>73.8% (11)</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>4.3% (16)</td>
</tr>
<tr>
<td>Agriculture - products</td>
<td></td>
</tr>
<tr>
<td>- Potatoes, wheat, barley, sugar beets, fruit, cabbages, milk products, cattle, pigs, poultry</td>
<td></td>
</tr>
</tbody>
</table>

### Transport network data

<table>
<thead>
<tr>
<th>Network</th>
<th>Total / Paved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadways</td>
<td>645,000 km / 645,000 km (incl. 12,800 km of expressways)</td>
</tr>
<tr>
<td>Railways</td>
<td>43,468.3 km / standard gauge: 43,093 km, 1,435-m gauge (19,973 km electrified); narrow gauge: 220 km, 1,000-m gauge (79 km electrified); 15 km, 900-m gauge; 24 km, 5,750-m gauge (14)</td>
</tr>
<tr>
<td>Waterways</td>
<td>7,467 km (12)</td>
</tr>
<tr>
<td>Major seaport(s) [Baltic]</td>
<td>Rostock</td>
</tr>
<tr>
<td>Major seaport(s) [North]</td>
<td>Wilhelmshaven</td>
</tr>
<tr>
<td>River port(s)</td>
<td>Bremen (Weser); Bremerhaven (Geeste); Duisburg, Karlsruhe, Neuss-Dusseldorf (Rhine); Brunsbuttel, Hamburg (Elbe); Lubeck (Wakenitz)</td>
</tr>
<tr>
<td>Oil terminal(s)</td>
<td>Brunssbuttel Canal terminals</td>
</tr>
<tr>
<td>Container port(s) [TEUs]</td>
<td>Bremen/Bremerhaven (5,915,487); Hamburg (9,014,165) (11)</td>
</tr>
<tr>
<td>LNG terminal(s)</td>
<td>Hamburg</td>
</tr>
</tbody>
</table>

---

**Employment growth and activity branches - annual averages**

- Agriculture in % of total employment
- Industry in % of total employment
- Services in % of total employment
- Total employment (ESA - domestic concept)

**Logistics Performance Index (LPI) and modal split of freight transport**

- Inland waterways
- Roads
- Railways
- LPI Infrastructure
Figure 3.54 – Illustration of Bottlenecks in Germany’s infrastructure

Source: Own illustration based on DG MOVE data
3.3.1.2.2.6 Hungary

Relevant information on the Hungarian economy, the transport sector and the logistical infrastructure is provided in the related Factsheet.

Characteristics of Hungarian freight transportation

The Hungarian logistics market is an evolving one, although it remains relatively small. The share of providers of integrated logistics services in the GDP is only 5%, compared to the EU average of 14%. Hungary is characterised by a high participation of small and medium-sized enterprise (SME) in the logistics market (30 000 companies with 160 000 employees), but European global logistics players are also present in the country (Dachser, DB Schenker, Rhenus, Hoyer, Wincanton, Kühne+Nagel etc.).

- The biggest logistics operators are: Posta Zrt.; Budapest Airport Zrt.; MÁV Magyar Államvasutak Zrt., Rail Cargo Hungaria Árufuvarozási Zrt.; Állami Autópálya Kezelő Zrt.; WABERER’S INTERNATIONAL Szállítmányozó és Fuvarozó Zrt.; E. ON Földgáz Storage Földgázüzem Zrt.; MASPED Első Maqyar Általános Szállítmányozási Zrt.; Magyar Közút Nonprofit Zrt.

- The two rail infrastructure managers in Hungary are MÁV Hungarian State Railways Co. (MÁV) and Győr-Sopron-Ebenfurth Railway Co. (GYSEV/Raaberbahn, owned by the Hungarian and the Austrian state in majority). The railway network is mainly operated by MÁV, whereas GYSEV is responsible for 504 km of lines. The TEN-T lines consist of 2 800 km out of the 7 800 km long network.

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>- The geographical location of Hungary makes it the doorway to the East and Far East.</td>
<td>- Hungary is a transit country, but the road toll does not cover the damages caused by intense traffic of heavy trucks.</td>
</tr>
<tr>
<td>- Relatively dense railway infrastructure.</td>
<td>- The Danube inland waterway can be navigated only 5 months a year due to a lack of locks.</td>
</tr>
<tr>
<td>- Hungary as a transit country gains toll from crossing shippers.</td>
<td>- No access to the seas; sea imports and exports require long-haul transport from/to ARA Ports.</td>
</tr>
<tr>
<td>- The efforts and achievements in electronic customs speed up border crossing.</td>
<td>- Adriatic seaports as Trieste or Venice or the Black Sea ports (Constanța) are not sufficiently integrated in the logistics chain.</td>
</tr>
</tbody>
</table>

In the ranking of World Bank Logistics Performance Index (LPI) Hungary is in the middle field. Hungary has a relatively large railway network and a higher share of rail freight transportation than the EU average. Although the share of rail freight transportation increased up to 20% over the last decades, road freight transportation grew to a much larger extent: its share increased up to 75% over the last decades. IWW transportation on the Danube was only able to increase slightly to a 5% share, due to the average navigable period of only about 5 months per year.

Identified bottlenecks in Hungarian logistical infrastructure

By comparing the distribution of COP storage capacity with the availability of logistical infrastructure, the region of Fejer (HU211) appears to be a critical one. The Fejer region has substantial storage capacity and is located in the centre of Hungary. However, because of the proximity to the metropolitan region of Budapest and of the centralized logistical infrastructure of Hungary, COP traffic flows are constrained (see critical bottleneck region in Figure 3.55).

Road

A road toll was introduced for trucks (≥ 3,5 t) on the Hungarian highways and main roads in 2005, with the effect of shifting truck traffic to inadequate rural roads. The main problem of the Hungarian infrastructure is
the centralized logistical network: all highways, roads and railways go through Budapest, which increases traffic congestion and leads to critical bottlenecks. The transhipment between road and rail is slow and requires a better organisation and control. COP transportation by road occurs only to neighbouring countries such as Austria, in order to transship COP at terminals onto IWW. The transportation service is typically performed by small businesses, because COP transportation is not profitable for multinational shipping companies. The Hungarian truck fleet is outdated and requires replacement.

IWW

IWW is the main mode for COP transportation in Hungary, with a share of almost 60%; it is followed by road with a 30% share, and by rail with a 10% share. The Danube is the only navigable waterway handling heavy COP traffic. Transport destinations are either the ARA ports (via the Danube-Rhine corridor) or the Port of Constanta in Romania. COP shipments upstream the Danube towards Western Europe are mostly carried out by barges, whereas downstream shipments are carried out by dry cargo vessels and pushed convoys. Fairway width on the Danube ranges between 60 and 100 m, which enables the use of 9-unit convoys. However, the most critical section in terms of fairway width (60 m) is located East of Budapest. Low-water periods on the Danube in Hungary – which last from June until December - are in line with the ones found in the other EU Member States scattered along the river. The most critical fairway locations are highlighted in Figure 3.55. Low water level sections are located East of Budapest at Solt and Kisapostag as well North of Budapest at locations Göd, Dömös and Nyergesujfalu.

Identified bottlenecks in Hungarian IWW infrastructure:

- Level of detail of monitoring fairway data is unsatisfactory.
- Old monitoring equipment and fleet (related to fairway marking).

Improvements in IWW transportation, in terms of developing Danube ports and the underlying navigation managements systems and of improving inadequate fairway conditions, are ongoing.

Rail

The liberalized Hungarian railway network is mainly over-aged and consists of heterogeneous subsystems, which need refurbishment and replacement. Because of the centralized structure of the infrastructure network, all freight traffic is running via Budapest, which increases the risk of traffic congestion. Especially transit freight traffic is affected by highly prioritized suburban passenger traffic around Budapest. The most critical bottleneck sections, characterised by high capacity utilization, are shown in Figure 3.55. Furthermore, the commercial speed for freight on the rail network is very low: this implies that freight traffic on the most important rail lines is suspended in daylight. Rail projects to allow freight traffic to bypass the overloaded area of Budapest are under development.

Identified bottlenecks in Hungarian rail infrastructure:

- **Number of tracks**: only 15,5% of the entire Hungarian rail network is double-track, compared to an EU average of 41,2%.
- **Electrification**: The share of electrified lines is 34%, compared to an EU average of 46,4%. 60% of the catenary network requires reconstruction, and some main lines also electrification.
- **Speed**: Transport speed is low due to speed limits because of the low quality of rail infrastructure.
- **Density of terminals**: The density of terminals is relatively high compared to the European average.
- **Level crossing**: There are around 6 000 level crossings on the network, which is the second worst situation in the EU.
- **Engineering works**: The number of bridges crossing the main rivers (Danube, Tisza) is low, and bridges are in poor conditions. Rail bridges are often 40-50 years-old.
- **Signalling and control command systems**: Hungary has a significant shortage in modern control command systems. Only 65% of the rail network is equipped with signalling systems, which are also in
poor condition. There is a lack of interoperable signalling and control command systems.

- **Outdated practises:** Transhipment at RR terminals is slow (long loading/unloading times).
- **Missing transhipment hubs:** The number of loading stations for grains along the Hungarian railway network is decreasing.
- **Telematics systems:** The telematics systems functionally are not satisfactory; the analogue systems are outdated.
Factsheet on Hungary

Basic data

Population: 9,874,784 (16) (Growth rate: -0.24%)  
Urban population: 71.2% of total population (15)  
Land use:  
- Agricultural land: 58.9%  
  - Arable land: 48.5%  
  - Permanent crops: 2%  
  - Permanent pasture: 8.4%  
- Forest: 22.5%  
Other: 18.6%  
Irrigated land: 1,771 sq km

GDP - per capita (PPP): €24,600 (16)  
GDP - composition, by sector of origin:  
- Agriculture: 3.5%  
- Industry: 31.8%  
- Services: 64.7%  
Labor force by occupation:  
- Agriculture: 7.1%  
- Industry: 29.7%  
- Services: 63.2% (11)  
Unemployment rate: 6.6% (16)  
Agriculture - products: wheat, corn, sunflower seed, potatoes, sugar beets, pigs, cattle, poultry, dairy products

Transport network data

Roadways: total: 203,601 km  
  - Paved: 77,078 km (incl. 1,582 km of expressways)  
  - Unpaved: 126,514 km (14)  
Railways: total: 8,049 km  
  - Broad gauge: 36 km (1,524-m gauge)  
  - Standard gauge: 7,794 km (1,435-m gauge)  
    - 2,889 km electrified  
  - Narrow gauge: 219 km (0.760-m gauge) (14)  
Waterways: 1,622 km (most on Danube River) (2011)  
River ports: Baja, Csepel (Budapest), Dunaujvaros, Győr, Gönyű, Mohács (Danube)
Figure 3.55 – Illustration of bottlenecks in Hungary’s infrastructure

Source: Own illustration based on DG MOVE data
3.3.1.2.7 Poland

Relevant information on Poland’s economy, the transport sector and the logistical infrastructure is provided in the related Factsheet.

**Characteristics of Polish freight transportation**

The main corridor connecting the Baltic States with Central Europe is the North Sea-Baltic corridor, and the most important country enabling the infrastructural linkage is Poland. The average length of road transportation increased mainly because of an increase in international transportation. Still, Poland faces several challenges in the transport sector, which include some of the remaining drawbacks in its road and rail infrastructure. The current modal share of railroad transportation is 17%; road transportation holds a share of 83%. IWW transportation is almost non-existent and will therefore not be evaluated.

- **Biggest logistics operators:** PKP Cargo S.A.; DB Schenker Poland Sp. Z o.o.; Raben Group Sp. Z o.o.; FM Logistics; PCC Rail; Kuehne Nagel

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
</table>
| • Poland is located in Central Europe and is important for the transit between Western and Eastern parts of Europe.  
• Poland has access to the sea. The seaports are increasingly important transhipment points for inward and outward global trade flows. | • Lack of high quality roads (motorways and expressways).  
• Shortage of river ports.  
• Poor quality of rail infrastructure (low average speed for freight).  
• Rolling stock is very old and also carrier equipment used in IWW is old.  
• Low users’ awareness about possibility of using intermodal transport.  
• Lack of one common strategy to terminals network development.  
• Serious competition with passenger traffic on important railway routes for COP crop transportation |

**Identified bottlenecks in Polish logistical infrastructure**

Figure 3.63 illustrates the identified bottlenecks in Polish rail infrastructure, highlighting four sections with capacity use beyond 90% (including one affecting traffic on an important route linking Southern Poland with Ukraine) and the hinterland connectivity of the Port of Gdansk as crucial ones.

**Road**

The main problem of Poland’s transportation infrastructure is its poor maintenance quality. This relates to the relatively extensive road and rail networks, which require considerable financial costs for maintenance. Another problem is the insufficient capacity of existing networks and poor connections to neighbouring countries. Shippers report problems at road connections with terminals. There are competition issues stemming from lack of market liberalization and from unsatisfactory access to railroad infrastructure and inland waterways. Furthermore, the age of freight vehicles is often stretched far beyond operational life.

Terminals mostly function as standalone facilities, without a connection to the existing network of warehouses and logistics centres. Most of the terminals must be modernised to increase handling capacity. Size and capacity of terminals can be the major technical bottleneck for the international COP logistics chain originating from or terminating in Poland.
The main problem for intermodal transportation in Poland is missing public support. There is an enormous burden on road infrastructure, and this creates bottlenecks. Another problem is the accessibility of terminals due to private ownership. Access to the railway infrastructure is also limited.

**Rail**

The Polish railway system struggles with capacity problems. This concerns especially the routes of the port hinterland starting at the seaports of Gdynia/Gdańsk. The standard routes for freight trains are operated at their capacity limits. This is due to reduced speed by unsatisfactory track conditions. Modernisation of these lines is hence required. Moreover, adequate management of daily freight operations which conflict with passenger traffic must be implemented.

The relatively dense railway network potentially allows operating some alternative routes for freight transport, but often the conditions on these secondary tracks are not adequate (lack of electrification, reduced speed from unsatisfactory track conditions, longer distance, etc.). A serious problem also exists in the “Upper Silesian industrial area”, where alternative rail routes are not available. In this area, freight trains seriously conflict with passenger traffic, and there are many sections with reduced speed because of low quality of tracks (see Figure 3.56). Another critical issue is the advanced age of rolling stock.
Factsheet on Poland

**Basic data**
- Population: 38,523,261 ('16) (Growth rate: -0.11%)
- Urban population: 60.5% of total population ('15)
- Land use:
  - Agricultural land: 48.2%
  - Arable land: 36.2%
  - Permanent crops: 1.3%
  - Permanent pasture: 10.7%
  - Forest: 30.6%
  - Other: 21.2%
  - Irrigated land: 970 sq km
- GDP - per capita (PPP): €25,000 ('16)
- GDP - composition, by sector of origin:
  - Agriculture: 2.7%
  - Industry: 38.5%
  - Services: 58.9%
- Labor force by occupation:
  - Agriculture: 12.6%
  - Industry: 30.4%
  - Services: 57.0% ('12)
- Unemployment rate: 9.6% ('16)
- Agriculture - products: potatoes, fruits, vegetables, wheat, poultry, eggs, pork, dairy

**Transport network data**
- Roadways: total: 412,035 km
  - Paved: 280,719 km (incl. 2,418 km of expressways)
  - Unpaved: 131,316 km ('12)
- Railways: total: 19,837 km
  - Broad gauge: 395 km, 1,524-m gauge
  - Standard gauge: 19,442 km, 1,435-m gauge
  - (11,889 km electrified) ('14)
- Waterways: 3,997 km ('09)
- Major seaports: Gdansk, Gdynia, Swinoujscie
- River ports: Szczecin (River Oder)
- LNG terminal(s) (import): Swinoujscie

---

Employment growth and activity branches - annual averages

Logistics Performance Index (LPI) and modal split of freight transport

---

186
Figure 3.56 – Bottlenecks in Poland’s infrastructure

Source: Own illustration based on DG MOVE data
3.3.1.2.2.8 Romania

Relevant information on Romania’s economy, the transport sector and the logistical infrastructure is provided in the related Factsheet.

The development of the logistics market in Romania is characterised by the access to the Black Sea, linking the Danube IWW with the Middle East and allowing transit traffic. The fact that Romania is located at the intersection of numerous routes connecting Western and Eastern Europe and Northern and Southern Europe, as well as on the transit axes between Europe and Asia, highlights the importance of adequate transportation infrastructure for the country. The access offered by Romania to the Black Sea and the Danube is an opportunity for COP exports and a reason to enhance IWW transportation, considering the low cost of such mode vis-à-vis ground transportation. However, fairway conditions must be improved to expand freight traffic on navigable rivers: hence, investments in IWW infrastructure are required in Romania.

Characteristics of Romanian freight transportation

- Biggest logistics operators: Sntfm CFR Marfa SA; Grup Feroviar Roman; DB Schenker Romtrans; Navrom; Ceta; Wim Bosman; Servtrans Invest
- Norms and standards for intermodal transportation are needed. Emission allowance trading system (ETS) along with upgrading of intermodal terminals and the implementation of ITS and ICT solutions, are leading towards a greater importance of railways in freight transportation, especially for long-haul moves.
- Terminals: Romanian transport terminals are old, but well positioned and accessible. The quality of terminal equipment is low and inadequate for quick loading/unloading or modal changes. Terminals with new operating systems and modern equipment are needed to increase service quality.

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ideal geographical position between Western and Eastern Europe, Northern and Southern Europe and Europe and Asia.</td>
<td>Undeveloped infrastructure, limited capacity and poor commercial speed.</td>
</tr>
<tr>
<td></td>
<td>Lack of liberalization of the railway market and heavily subsidised road transportation.</td>
</tr>
<tr>
<td></td>
<td>Missing support and standards for intermodal transportation.</td>
</tr>
<tr>
<td></td>
<td>Increased traffic, aging truck fleet and rolling stock.</td>
</tr>
</tbody>
</table>

Identified bottlenecks in Romanian logistical infrastructure

The illustration of identified bottlenecks in Romanian IWW infrastructure highlights four locations of critical fairway depth with a water level below 2.5 m for more than 25% of days per year. Also, two critical bottleneck regions are highlighted in Figure 3.57.

Substantial COP storage capacity is located in the West and South-East of Romania, with the main IWW COP traffic heading towards the Black Sea through the Port of Constanta, and additional flows heading towards the North-Western EU markets via rail, and towards nearby Member States via road. Road is also used to transport COP from the fields to the storage facilities. During harvest periods, a lack of sufficient transportation means occurs.

Road

Road is the most used transportation mode in Romania with a share of around 60%, followed by rail and IWW, each with a share of 20%. The liberalisation of the railway transport sector did not provide the needed improvements, and rail transportation cannot compete with road transportation, which is heavily subsidised.
From the point of view of many transport operators, road infrastructure is overwhelmed by the number of vehicles: many national roads should be extended from one lane to two lanes. However, the number of trucks during harvest peaks is insufficient, especially in the main COP cultivation regions.

Although the motorway connectivity to the Port of Constanta has improved (see § 2.2.3), COP transportation by truck from West to East is not an option, due to the distance of around 800 km to the Port of Constanta. It can take more than 20 hours for a truck leaving Timisoara to reach the Port of Constanta, due to the poor quality of roads, which increases delays en-route. Delays are also often registered at the Port of Constanta, due to congestion and poor quality infrastructure in the hinterland. The main challenge facing transportation services is the poor quality of roads for both international and local traffic. Railway transportation is hence the only option for COP long-haul transportation, if navigable rivers and canals are not accessible.

IWW
The waterway network is developed only in the South and Southeast of the country, and offers access to the Danube River and the Black Sea. However, low water levels are often a cause for bottlenecks. Critical fairway locations with a water level below 2.5 m on more than 25% of days per year are located in Bechet, Corabia, Turcescu and Cichirieni. The NUTS 3 region of Timis (RO424) represents a critical bottleneck region: it has substantial COP storage capacity, but lacks adequate infrastructural connectivity. The region of Timis has no access to IWW infrastructure: only road and rail infrastructure is available for COP transportation. Road infrastructure, however, does not provide a connection to the nearest Danube port in Moldova Veche. For that reason, only conventional rail transportation is available. COP must hence be transhipped onto rail wagons at the RR terminal of Timisoara. The closest IWW port which can be reached from Timisoara by rail is located in Drobeta Turnu Severin (200 km).

Another critical bottleneck is related to the poor hinterland connectivity of the Port of Constanta. The port is rather small in terms of regional extension, but represents the main port for COP export in Eastern Europe, and requires a critical view on its handling capacity and logistical performance. Also the rather heavy COP rail traffic moving towards the port (as identified at § 2.2.3.3) requires attention, as it could cause congestion in the port hinterland, thus affecting the port’s logistical performance.

Further infrastructural bottlenecks were identified in the Romanian IWW infrastructure. These are summarised below.

**Identified bottlenecks in Romanian IWW infrastructure:**
- Insufficient number of sounding vessels
- Insufficient number of automatic gauging stations
- Lack of dredging equipment, specialized personnel and deficiency of investments in river regulation
- Inefficient procedures. The documentation to draw up a contract for dredging is time-consuming
- Lack of efficient vessels and special equipment for marking
- Insufficient number of buoys and position monitoring equipment
- Unavailable automated system for the transmission of information on the buoys. The dissemination of information could be improved
- Unavailable forecast for water levels
- Information could be provided in a customer-friendly way by using established river information portals
- Unavailable digital terrain models for shallow sections
- Insufficient number and quality of weather stations
- Missing interconnection with databases of other waterway administrations to exchange data

**Rail**
During the last years, there has been some entry by new, non-integrated freight train operating companies. New competitors on the market might lead to decreasing prices for COP transportation. These lower prices,
near marginal transport costs, might change market structure and behaviour. New entrants, and especially shippers directly transporting their own products, might opt for operating “block train” traffic only, thereby skimming the relatively high margins of this service. Less profitable transportation of smaller “wagonload” traffic would remain for the other operators: these might even choose not to offer such service anymore, due to excessively low prices. A shift to road transportation for smaller COP volumes might be the final outcome of this process. This issue calls attention to the importance of fixed infrastructural costs in the freight rail sector, as well as to issues regarding access pricing and price discrimination. Conflicts between freight operators and CFR, the biggest transport service provider, further complicate the picture. These conflicts are negatively affecting the quality of services.

Rolling stock and transhipment equipment for COP is generally outdated and overused. Also rail infrastructure is old and does not allow adequate commercial speed. With an average commercial speed of just 30 km/h, rail freight transportation is very slow in Romania66.

The Romanian railway network has a good density and connectivity and also a lot of potential to ensure adequate transportation capacity; however, modernised rail transport solutions are required. The main problem of the Romanian railway network is the lack of significant and coherent investments for its infrastructure. The old age of the infrastructure imposes speed limitations on many sections, which limit capacity and cause congestion. Single track sections and outdated signalling systems are also a cause of reduced capacity. As already noted, rather heavy COP rail traffic towards the port of Constanta represents a challenge for the concerned routes.

66 Romania yields a commercial speed of 40 km/h on roads and of 15 km/h on inland waterways.
Factsheet on Romania

**Basic data**
- Population: 21,599,736 (16) (Growth rate: 0.32%)
- Urban population: 54.6% of total population (15)
- Land use:
  - agricultural land: 60.7%
  - arable land: 39.1%
  - permanent crops: 1.9%
  - permanent pasture: 19.7%
  - Forest: 28.7%
  - Other: 10.6%
- Irrigated land: 3,490 sq km
- GDP - per capita (PPP): €20,160 (16)
- GDP - composition, by sector of origin:
  - Agriculture: 3.3%
  - Industry: 35.4%
  - Services: 61.3%
- Labor force by occupation (9,133 Mio. '16 est.):
  - Agriculture: 28.3%
  - Industry: 28.9%
  - Services: 43.8% (14)
- Unemployment rate: 6.7% (16)
- Agriculture - products: wheat, corn, barley, sugar beets, sunflower seed, potatoes, grapes, eggs, sheep

**Transport network data**
- Roadways: total: 84,185 km
  - paved: 49,873 km (incl. 337 km of expressways)
  - unpaved: 34,312 km (12)
- Railways: total: 11,268 km
  - broad gauge: 60 km 1,525-m gauge
  - standard gauge: 10,781 km 1,435-m gauge
  (1,252 km electrified)
  - narrow gauge: 427 km 0,760-m gauge (14)
- Waterways: 1,731 km (10)
- Major seaport(s): Constanta, Midia
- River port(s): Braila, Galati (Galata), Mancanului (Giurgiu), Tulcea (Danube River)
Figure 3.57 – Illustration of bottlenecks in Romanian infrastructure 2015

Source: DG Move, Danube Fairway Masterplan, own calculations
3.3.1.2.9 Slovakia

Relevant information on the Slovakian economy, the transport sector and the logistical infrastructure is provided in the related Factsheet.

After the opening of the Western market in 1989, a re-orientation of traffic flows took place, and resulted in the development of road transportation and also of IWW transportation on the Danube River. Road transportation holds a share of 76% of overall freight traffic. Railway transportation holds a share of 22%, and IWW transportation holds a share of 2%.

Characteristics of Slovakian freight transportation

- **Biggest logistics operators:** Eustream, a.s., Bratislava; Železnice SR, Bratislava; Železničná spoločnosť Cargo Slovakia, a.s., Bratislava; Slovenská pošta, a.s., Banská Bystrica; Express Slovakia "Medzinárodná preprava", a.s., Bratislava; Budamar Logistics, a.s., Bratislava.

- **Shippers:** Removal of barriers affecting competitiveness of transportation services is of paramount importance. This includes strategic location of intermodal terminals. Railway transportation suffers from problems in the handling of cross-border trains at transit and transhipment terminals.

- **Operators:** Operators need a fair pricing for the use of the transportation network. An adequate approach in national regulation of the transport sector is missing.

- **Terminals:** Intermodal terminals exist mainly along the Danube River. A critical terminal is located at Čierna nad Tisou, at the Hungarian-Ukrainian border: it is the main transhipment terminal towards the Eastern railway network, allowing the shift from normal to wide-gauge track. For terminal owners, increased public promotion of intermodal transportation is of great importance.

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Location: the region of Bratislava is crossed by three TEN-T corridors.</td>
<td>• Low Infrastructure quality.</td>
</tr>
<tr>
<td>• Operators need a fair pricing for the use of the transportation network.</td>
<td>• Relatively high fees for use of rail network.</td>
</tr>
</tbody>
</table>

Legislative conditions on the Slovakian transport market are not fully harmonised with EU regulation. Prices for use of transport infrastructure are not split equally on all users.

**Identified bottlenecks in Slovakian logistical infrastructure**

**Road**

The improvement and development of road infrastructure is the main target of governmental support.

**IWW**

The Danube River stretch in Slovakia is divided into four surface water bodies: two of them have been designated as “heavily modified water bodies” and two as “natural water bodies”; three of these water bodies are transboundary ones.

In terms of fairway depth, the most critical seasons are late summer and early autumn. Fairway depths regularly fall short of the required depth of 2.5m during these periods. The most critical section is the last segment of the Danube River located on the Slovakia-Hungary stretch (see Figure 3.58 for critical fairway locations). The main reason for not meeting the needed fairway depth is the stony riverbed, which cannot be removed because of the high investments needed and of limited dredging possibilities. The Slovakian section of the Danube contains 16 water gauge stations: of these, 5 are main ones (Devin, Bratislava, Medvedov, Komárno, Štúrovo).
Identified bottlenecks in Slovakian IWW infrastructure:

- Lack of multi-beam sounding vessels
- Overaged information technology and missing database for monitoring data
- Insufficient skilled staff to monitor fairway conditions (available staff is reaching retirement)
- Missing central database for monitoring fairway conditions
- Inefficient information and data exchange process
- Old dredging and marking fleet and equipment
- Lack of flexibility in case of traffic priority problems related to dredging activities (because of lack of staff)

Rail

A major concern in Slovakia is the quality of the railway infrastructure. The railway network requires extensive upgrading and modernisation. In contrast to other Member States, an effective support for intermodal transportation is missing. The lack of financial support for operators to invest into new vehicles and equipment results in an increased age of rolling stock, often stretched far beyond operational life.

Furthermore, two railway sections are heavily utilized, and especially the section between Bratislava and Štúrovo, one of the busiest rail sections in Slovakia (see Figure 3.58 for critical bottleneck sections). This section serves the two regions with the greatest amount of COP storage capacity in Slovakia (SK021 Trnavský kraj and SK023 Nitriansky kraj).

ZSSK CARGO is the biggest rail freight transport operator in Slovakia, with a share of 95% of total transportation capacity. The Slovakian railway network is only partially electrified and requires further upgrades.
Factsheet on Slovakia

Basic data
- Population: 5,445,802 (16) (Growth rate: 0.01%)
- Urban population: 53.6% of total population (15)
- Land use:
  - Agricultural land: 40.1%
  - Arable land: 28.3%
  - Permanent crops: 0.4%
  - Permanent pasture: 10.8%
- Forest: 40.2%
- Other: 19.7%
- Irrigated land: 869 sq km
- GDP - per capita (PPP): € 28,200 (16)
- GDP - composition, by sector of origin:
  - Agriculture: 3.8%
  - Industry: 31.6%
  - Services: 64.8%
- Labor force by occupation:
  - Agriculture: 4.2%
  - Industry: 22.6%
  - Services: 73.2% (15)
- Unemployment rate: 9.8% (16)
- Agriculture - products: grains, potatoes, sugar beets, hops, fruit, pigs, cattle, poultry, forest products

Transport network data
- Roadways: total: 54,869 km (includes local roads, national roads, and 420 km of highways) (12)
- Railways:
  - Total: 3,624 km
  - Broad gauge: 99 km, 1.520 gauge
  - Standard gauge: 3,475 km, 1.435-m gauge
  - (1,616 km electrified)
- Narrow gauge: 50 km, 1,000-m or 0,750-m gauge (17,4)
- Waterways: 172 km (on the Danube River) (12)
- River port(s): Bratislava, Komarno (Danube)

Employment growth and activity branches - annual averages
- Agriculture in % of total employment
- Industry in % of total employment
- Services in % of total employment
- Total employment (ESA - domestic concept)

Logistics Performance Index (LPI) and modal split of freight transport
- Inland waterways
- Roads
- Railways
- LPI Infrastructure
Figure 3.58 – Illustration of bottlenecks in Slovakia’s infrastructure

**Figure 3.58 – Illustration of bottlenecks in Slovakia’s infrastructure**

- **Road**
- Motorway Completed
- Motorway to be upgraded
- Motorway New construction
- Road Completed
- Road to be upgraded

- **Rail**
- Conventional Completed
- Conventional to be upgraded

- **Inland waterway**
- Completed

- **Corridors**
- A – Baltic-Adriatic
- D – Orient/East-Med.
- I – Rhine-Danube

- **Storage capacity (tonnes)**

Source: Own illustration based on DG MOVE data
3.3.2 Question 3.2: Evolution of bottlenecks since 2005

3.3.2.1 Evolution of bottlenecks for storage capacity

The evolution of bottlenecks for storage capacity for the different Member States was assessed through i) the quantification of the storage needs at the beginning and at the end of the observed period; ii) the quantification of the national shortages and surpluses of storage capacity for 2005 and 2015; iii) a comparison between the resulting values. The results of the assessment at Member State level are illustrated in Figure 3.59.

The evolution of bottlenecks in storage capacity over the 2005-2015 period emerged as being balanced between Member States which improved their situation (13) and Member States where the situation worsened (15).

The area where the most significant improvements were recorded was Eastern EU. It is worth reminding that increases in storage capacity were recorded in all 28 Member States, albeit to a different degree (see the reply to question 1.2 at § 3.1.2). Among the Eastern EU Member States which improved their situation, Romania switched from an initial shortage of storage capacity to a surplus of 5.3 million tonnes, and Poland managed to reduce its shortage by 3.9 million tonnes. In addition, Bulgaria and Hungary increased by 3.9 million tonnes and 4.8 million tonnes, respectively, the surpluses of storage capacity they already had. In Western EU, only Spain managed to achieve a substantial surplus of storage capacity (3 million tonnes), starting from a situation of balance between capacity and needs.

Among the Member States where the situation worsened, Lithuania and Latvia moved from a surplus of storage capacity to a shortage of 1.3 million tonnes and 1 million tonnes, respectively. Six Member States experienced further aggravation of existing shortages of storage capacity, with Denmark, the United Kingdom and Germany being the most affected.
Figure 3.59 – Storage capacity shortages/surpluses at Member State level: evolution over the observed period

Source: Areté elaboration
The same analysis was performed at NUTS2 level in order to identify the most significant cases of negative and positive evolution. The evolution experienced in the regions recording the most substantial variations of storage capacity over the observed period (i.e. those above a 1 million tonnes threshold) is illustrated in Figures 3.60, 3.61 and 3.62.

Fourteen of these regions improved their situation over the observed period. Four regions partially reduced their initial shortages: Zachodniopomorskie (Poland), Centre (France), Sachsen-Anhalt and Mecklenburg-Vorpommern (Germany). Three regions switched from a shortage of storage capacity to a surplus: Sud-Muntenia and Sud (Romania), and Andalucia (Spain). The remaining seven regions further increased their initial surpluses of storage capacity.

The situation worsened in seven of these regions between 2005 and 2015. Initial shortages were further aggravated in two regions: Türingen (Germany) and Castilla-la-Mancha (Spain). The Picardie region of France experienced a reduction of its initial surplus. The remaining four regions switched from a situation of surplus to a situation of shortage: Lithuania, Latvia, Braunschweig (Germany) and Castilla y León (Spain).

It is worth noting that regions which managed to substantially improve their situation are prevalent in Romania, Bulgaria and Hungary. These three Member States made substantial investments in additional storage capacity over the observed period. In Spain, France and Germany, by contrast, the increase in national storage needs was unevenly tackled among the different regions: whereas substantial improvements where recorded in some regions, the situation remarkably worsened in other regions.
Figure 3.60 – Evolution experienced in the regions recording the most substantial positive variations in available storage capacity (2005-2015)

Source: Areté elaboration
Figure 3.61 – Evolution experienced in the regions recording the most substantial negative variations in available storage capacity (2005-2015)

Source: Areté elaboration
Figure 3.62 – Largest positive and negative variations in available storage capacity at regional level (2005-2015)

Source: Areté elaboration
3.3.2.2 Evolution of bottlenecks for logistical infrastructure

3.3.2.2.1 Evolution of bottlenecks for logistical infrastructure at EU level

The evolution of bottlenecks on selected TEN-T corridors is analysed considering the restriction that comparable methods to measure such evolution have been established in 2013. To give a more detailed view of implementation steps, selected funded projects are illustrated in more detail in a second step of the analysis. The elaboration and representation of time series of annual data for indicators of the overall quality of the logistical infrastructure, highlighting critical situations which could have negative implications for COP transportation, completes the analysis.

Main transport corridors

Since 2013 a framework for the development of the EU transport infrastructure was established, together with guidelines for the development of the trans-European transport network (Regulation (EU) NO 1315/2013, also called “TEN-T Regulation”). The progress of the development in terms of benchmark technical standards is measured through key performance indicators (KPI). A selection of KPIs used to measure the technical maturity of the corridors is given in Table 3.12. To analyse the evolution of bottlenecks in core transport corridors, reference to selected and mostly not yet met KPIs of the TEN-T Regulation is made.

Table 3.12 - Selected KPIs to measure technical implementation of TEN-T network and related calculation method

<table>
<thead>
<tr>
<th>Mode</th>
<th>Indicator</th>
<th>Unit</th>
<th>Calculation method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail</td>
<td>Electrification</td>
<td>%</td>
<td>Electrified rail network as a share of relevant rail network.</td>
</tr>
<tr>
<td>Rail</td>
<td>Track gauge 1 435 mm</td>
<td>%</td>
<td>Standard track gauge as a share of relevant rail network.</td>
</tr>
<tr>
<td>Rail</td>
<td>ERTMS implementation</td>
<td>%</td>
<td>Length of permanent operation of both ERTMS and GSM-R67 on rail network, as a share of relevant rail network.</td>
</tr>
<tr>
<td>Rail</td>
<td>Line speed (≥ 100 km/h)</td>
<td>%</td>
<td>Length of freight and combined line allowing for a maximum operating speed greater than or equal to 100 km/h, as a share of relevant rail network.</td>
</tr>
<tr>
<td>Rail</td>
<td>Axle load (≥ 22.5t)</td>
<td>%</td>
<td>Length of freight and combined line with a permitted axle load greater than or equal to 22.5 tonnes, as a share of relevant rail network.</td>
</tr>
<tr>
<td>Rail</td>
<td>Train length (≥ 740 m)</td>
<td>%</td>
<td>Length of freight and combined line with a permitted train length ≥ 740 m, as a share of relevant rail network.</td>
</tr>
<tr>
<td>Road</td>
<td>Express road/motorway</td>
<td>%</td>
<td>Road network classified as motorway or express road, as a share of relevant road network.</td>
</tr>
<tr>
<td>Road</td>
<td>Availability of clean fuels</td>
<td>N</td>
<td>Number of fuel stations offering plugin electricity, hydrogen, liquid biofuels, LNG/CNG, bio-methane or LPG along road sections or within 10 km from its junctions (units in absolute number)</td>
</tr>
<tr>
<td>IWW</td>
<td>CEMT requirement for class IV IWW</td>
<td>%</td>
<td>Length of inland waterways classified as at least CEMT class IV, as a share of waterway network.</td>
</tr>
<tr>
<td>IWW</td>
<td>Permissible Draught (min. 2.5 m)</td>
<td>%</td>
<td>Inland waterway network with permissible draught of at least 2.5 m, as a share of waterway network.</td>
</tr>
<tr>
<td>IWW</td>
<td>Permissible Height under bridges (min. 5.25 m)</td>
<td>%</td>
<td>Inland waterway network with vertical clearance of at least 5.25 m under bridges, as a share of waterway network.</td>
</tr>
<tr>
<td>IWW</td>
<td>River Information System (RIS) implementation</td>
<td>%</td>
<td>Inland waterway network on which the minimum technical requirements of the RIS directive are met, as a share of waterway network.</td>
</tr>
</tbody>
</table>


67 Global system for mobile communication (GSM) for railways
According to the analysis at § 2.2.3, the Rhine-Danube corridor is the most important corridor of the core network in terms of COP transportation. This corridor is generally well developed. The evolution of infrastructural bottlenecks can be measured mainly in terms of improvement of the existing infrastructure.

Railway projects on the Rhine-Danube corridor have aimed at enhancing capacity and increasing the permitted speed in Austria and the Czech Republic since 2013. Because these projects took place at sections that were already compliant with the relevant regulations, they had no influence in increasing such railway KPIs as “line speed ≥ 100 km/h”, although they contributed to faster transport flows. The KPI “electrification”, that is not at 100% for the Rhine-Danube corridor, was influenced by one project at the border between Germany and the Czech Republic.

The static key performance indicators for the inland waterway network did not change with the progress in the implementation of projects on the corridor. The dynamic KPI “permissible draught” varies annually according to hydrological and infrastructural conditions. Several projects (including the needed building permits) have already started to improve fairway conditions and to stabilise the KPI “permissible draught”. So far, only very slight changes can be measured by the KPIs of the corridor, but the Rhine-Danube corridor shows already a high performance on the essential KPIs.

With the opening of the Gotthard Base Tunnel in 2016, one major implementation step of the Rhine-Alpine corridor was accomplished. The next step will be the completion of the “railway link through the Alps” programme. The “Betuwe Line” links the Rotterdam harbour to the German border and is crucial for the transit of COP to and from the port. It was fully put into service in June 2007. Mainly thanks to the completion of the “Massvlakte 2” project in the harbour of Rotterdam, a significant increase of freight traffic has been observed on the Betuwe Line. In comparison to the Rhine-Danube corridor, no major missing links exist on the corridor. The evolution of bottlenecks will depend on the development of future traffic flows.

The North-Sea-Baltic corridor can be divided into three parts: the North-Eastern part (Finland, Estonia, Latvia, Lithuania), the central part (Germany, Poland) and the Western part (Netherlands, Belgium). The North-Sea-Baltic corridor has an unique modal split that varies among Member States (see Figure 3.63). Especially in Poland and the Baltic countries, such as Latvia, improvements in roads and the upgrading of gauges have been completed in the past years, but there are still many ongoing projects. Several road projects in the Netherlands have been finished as well. Inland waterways are only relevant in Germany and the Western part of the corridor, whereas in the North-Eastern part short sea shipping is the dominant transport mode.

---

69 Short sea shipping refers to seaborne freight transportation on relatively short routes.
Improvements on the Baltic-Adriatic corridor have been achieved by fostering the cross-border sections of the corridor. This corridor still faces several bottlenecks in the railway network. Construction to close two missing links in the Alps is in progress at the Koralm Tunnel (to be in operation by 2023) and at the Semmering Base Tunnel. In the context of the supply-side KPIs, the corridor shows improvements for several indicators. The KPI “train length ≥ 740 m” increased from 16% to 29%. Also some ERTMS implementation took place, leading to an increase from 0% to 18%. Nevertheless, the way to reach the target value of 100% for the KPIs seems to be a very long one.

As KPIs have just been established to measure the performance of corridors in 2013, the evolution of bottlenecks along these corridors cannot be properly measured by these KPIs alone. A selection of important EU funded projects that removed relevant bottlenecks along the core corridors for COP transportation is therefore illustrated in the next section.

Implementation of EU funded projects

All investments in infrastructure projects bear challenges and risks due to the long-term planning horizon. Many risks that might influence the implementation are due to changes in the legal, financial and political framework or the high complexity of coordination, especially in cross-border projects. Diverse impacts can multiply and lead to changing conditions such as delays, higher costs or in the worst case the cancellation of the project. A few examples of EU funded projects are described, and the impacts of their implementation on the core transport corridors for COP crops is analysed. Due to the long overall duration of construction sites for logistical infrastructure, projects from the funding period 2007-2013 only are examined. Projects that are financed under the 2014-2020 CEF-funding period are currently in the implementation phase: a mid-term evaluation is expected to be completed by the fourth quarter of 2017. For the 2007-2013 funding period, this review was published in 2010.
One of the 30 appointed priority projects for the 2007-2013 period covers the waterway axis Rhine/Meuse-Main-Danube. In 2007 the project “Construction of a 225 x 25 m chamber navigation lock, [...] on the Albert Canal, [...]” (2007-BE-18070-P) was selected for EU funding. The new lock was constructed to further connect maritime and inland ports along the Rhine-Main-Danube corridor and the Seine-Scheldt (from Le Havre to Antwerp). The lock constitutes an essential point of passage for the European IWW network, with the crossroad of the Meuse and Albert Canal and the Belgian and Dutch border (see Figure 3.64).

**Figure 3.64 – The crossroad of Meuse and Albert Canal**

![Diagram of the crossroad of Meuse and Albert Canal](image)

Source: EIB (2015)

In Lanaye (Ternaaien) the existing three locks were not sufficient to handle the cargo flow of over 11.5 million tonnes (about 21 000 ships). The three water gates consist of two locks with a dimension of 55 m x 7.5 m which have capacity limits for vessels of up to 600 tonnes, and one lock with a dimension of 136 m x 16 m (max. capacity 2 000 tonnes).

Before the (fourth) lock was constructed, congestion and delays were common at the crossroad of the Albert Canal and the Meuse that is located at the border between Belgium and the Netherlands. The crossroad was therefore known as “Stop van Ternaaien”. To address the bottleneck the project included the construction of a fourth lock with the dimension of 225 m x 25 m. The lock is located close to the Liège Trilogiport, the largest tri-modular (road-rail-IWW) platform in the region of Wallonia. Besides the lock, the project also included a pumping station to offset the increase in water consumption and to capitalise the available fall of water, and a hydroelectric power plant.

The project consisted of a study part, including an environmental study, and of construction. By the mid-term evaluation, the project was delayed by 15 months because an environmental study took longer than anticipated. Construction started in 2011, and was completed in August 2015. The total project costs summed up to about EUR 150 million. While about EUR 28 million were financed by the EU, the Netherlands financed EUR 10 million, and the remaining balance was financed by the SOFICO (Société de Financement Complémentaire des infrastructures) with a loan from the EIB. Originally, the costs were anticipated to amount to EUR 89.8 million. Assuming that the expected and realized budget that was reported covers the same content, the investment turned out to be about 60% higher than planned.

With the inauguration of the fourth lock, ships of up to 9 000 tonnes can transit from the ports of Rotterdam and Antwerp to Liege and Namur. It is now possible to manoeuvre up to four smaller-sized river barges through the lock at any time, significantly increasing the locks' capacity and speeding up traffic. Up to 50 000 vessels can now enter the crossroad in a year (compared to 21 000 vessels before capacity increase).
The construction of the lock in Lanaye was part of an investment program in the inland waterways and roads in the region of Wallonia. Besides the described lock, another water gate with the same dimensions was built in Ivoz-Ramot. The Walloon Region’s IWW network is one of the densest in Europe and is used for the transportation of about 40,000 tonnes of freight per year. With the improved IWW connections to the international ports as well as to regional industry hubs, the region strengthened its economic position. As underlined at §2.2.3.2, COP transportation via IWW is very cost efficient and therefore preferred especially for long-haul moves to the main seaports in the Netherlands and Belgium. COP traffic along this critical route has been remarkably eased by the completion of this infrastructural project.

A second project that received EU funding was the construction of a new rail bridge above the Danube in Deggendorf, Bavaria. The new bridge was constructed just about 15 meters away from the old bridge built in 1887. The clearance of the old bridge was relatively low with about 4.30 metres, and therefore generating a (potential) bottleneck for the transit of large ships under the bridge. The new bridge triggered the necessity of new railway lines for a total length of about 2 km and three further railway passing (roads), although it was only located 15 metres away from the old bridge. During construction, a flooding/high water-level of the Danube and the strong winter in 2009/2010 led to minor delays. Nevertheless, the new bridge was opened in June 2010, earlier than originally planned. According to the TEN-T Execution Agency progress report, the project stayed within the budget (about EUR 35 million). While the EU project only covered the construction of the bridge, additional costs were incurred for the renewal of the railway lines. The share of EU funding amounted to about 20% of total cost, while the remaining 80% was financed through the national budget and partners’ resources. The Deutsche Bahn AG released the sum of EUR 47 million for completion of the project. This example shows that projects can finish on time and that surrounding infrastructure can be impacted by new construction. The upgrading of logistical infrastructure along the Danube, one of the main transport corridors for grains in the EU, allows to address critical bottlenecks for COP transportation.

Funded projects do not just cover actions in the construction phase but also the carrying out of studies that investigate solutions to solve bottlenecks. In some cases, early studies have been followed up by construction projects if the investigated solution seemed reasonable and created benefit. The TEN-T mid-term review of 2010 covers also study projects. Such a project is the improvement of the navigability on the Danube (2007-HU-18090). In the section of the Hungarian stretch of the Danube (between Szob and the Southern border) the fairway does not meet criteria for navigation about six months in a year. This is due to forts and bottlenecks. The study investigated whether a reduction of the constraining criteria to 20 days a year could be reached. The project included for instance: surveying the riverbed, drawing technical designs, making the necessary environmental studies and impact assessments. The study was finished by the end of 2011. The results of the study can contribute to remove bottlenecks in IWW transportation along the Danube.

Some large construction projects such as the Brenner Base tunnel cannot be completed within one funding horizon. Several smaller actions that are part of the Brenner Base tunnel project were already co-funded and completed. Completion of the entire project is expected by 2026. After completion of the 56 km tunnel, a major bottleneck in the Scandinavian-Mediterranean corridor will be removed. The construction of the tunnel will hence require nearly ten more years if accomplished within the planned time frame.

In the TEN-T EA mid-term review, 92 projects from the 2007-2013 funding horizon were investigated with the goal of assessing whether projects were running according to their original time plan, and of investigating how costs had developed. These data can also be used to anticipate whether evolution of bottlenecks can be expected within a short or long time horizon. Among the reviewed projects, 37% were expected to finish on time or earlier and 20% with a delay of under one year. 40% showed a delay of over one year at the point of the mid-term review (see Figure 3.65). Rail projects make up the largest share by mode are also the most likely to show delays of over one year. The mid-term review also showed that cross-border projects have on
average a higher end date deviation (not illustrated). According to the statistics, the delay was more likely to be longer when projects involved studies and works (Figure 3.66). Over 50% of the projects had only a slight variation (-5% to +5%) from the project budget (Figure 3.67). Railway projects are the leading mode with greater actual costs than budgeted ones (about 30%). However, it has to be considered that with only four road and eight IWW projects, these groups are most likely too small to use them as a benchmark for other projects.

*Figure 3.65 – End date deviation by mode of 2007-2013 funded projects according to mid-term review in 2010*

70 Findings from an interview with a DG MOVE officer confirmed that bottlenecks at cross-border sections are the hardest to address.
**Figure 3.66 – End date deviation by project type of 2007-2013 funded projects according to mid-term review in 2010**

Data was given in the source and does not always sum up to 100% in each project type.

Source: EC (2010)

**Figure 3.67 – Variation in budgeted costs by mode of 2007-2013 funded projects according to mid-term review 2010**

Data was given in the source and does not always sum up to 100% in each project type.

Source: EC (2010)
3.3.2.2 Evolution of bottlenecks for logistical infrastructure at national level

The elaboration and representation of time series of annual data for indicators of the overall quality of the logistical infrastructure (Logistics Performance Index), highlighting critical situations which could have negative implications for COP transportation, completes the analysis of the evolution of bottlenecks in logistical infrastructure, focusing on the national level.

Logistics Performance Index (LPI)

The evolution of infrastructural bottlenecks can be studied by analysing the evolution of the LPI. The LPI allows country comparisons on six indicators:

1. Efficiency of the clearance process (i.e. speed, simplicity and predictability of formalities) by border control agencies, including customs.
2. Quality of trade and transport related infrastructure (e.g. ports, railroads, roads, information technology).
3. Ease of arranging competitively priced shipments.
4. Competence and quality of logistics services (e.g. transport operators, customs brokers).
5. Ability to track and trace consignments.
6. Timeliness of shipments in reaching the destination within the scheduled or expected delivery time.

The LPI summarises the results of a comparative analysis of the logistics performance of all EU Member States. The results are illustrated on a scale going from the lowest score (1) to the highest score (5)\(^71\).

The overall quality of the logistical infrastructure can be assessed through the LPI. Six Member States with the 3 highest and the 3 lowest rankings per transport mode are presented in Table 3.13.

By comparing the LPI, indications on the evolution of bottlenecks on a national level can be provided.

Table 3.13 – Highest and lowest-ranked EU Member States by LPI score, by transport mode

<table>
<thead>
<tr>
<th>Road</th>
<th>Country</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road</td>
<td>NL</td>
<td>6.14</td>
<td>6.22</td>
<td>6.14</td>
</tr>
<tr>
<td></td>
<td>FR</td>
<td>6.17</td>
<td>6.08</td>
<td>6.05</td>
</tr>
<tr>
<td></td>
<td>AT</td>
<td>6.27</td>
<td>6.14</td>
<td>5.99</td>
</tr>
<tr>
<td></td>
<td>BG</td>
<td>3.14</td>
<td>3.28</td>
<td>3.37</td>
</tr>
<tr>
<td></td>
<td>LV</td>
<td>3.09</td>
<td>3.31</td>
<td>3.24</td>
</tr>
<tr>
<td></td>
<td>RO</td>
<td>2.75</td>
<td>2.75</td>
<td>2.6</td>
</tr>
<tr>
<td>IWW/Ports</td>
<td>NL</td>
<td>6.81</td>
<td>6.77</td>
<td>6.78</td>
</tr>
<tr>
<td></td>
<td>BE</td>
<td>6.37</td>
<td>6.31</td>
<td>6.30</td>
</tr>
<tr>
<td></td>
<td>FI</td>
<td>6.38</td>
<td>6.36</td>
<td>6.25</td>
</tr>
<tr>
<td></td>
<td>PL</td>
<td>3.97</td>
<td>4.02</td>
<td>4.13</td>
</tr>
<tr>
<td></td>
<td>BG</td>
<td>4.18</td>
<td>3.91</td>
<td>4.01</td>
</tr>
<tr>
<td></td>
<td>RO</td>
<td>3.39</td>
<td>3.42</td>
<td>3.36</td>
</tr>
<tr>
<td>Railroad</td>
<td>FR</td>
<td>5.89</td>
<td>5.81</td>
<td>5.84</td>
</tr>
<tr>
<td></td>
<td>FI</td>
<td>5.92</td>
<td>5.82</td>
<td>5.66</td>
</tr>
<tr>
<td></td>
<td>NL</td>
<td>5.62</td>
<td>5.69</td>
<td>5.64</td>
</tr>
<tr>
<td></td>
<td>EL</td>
<td>2.87</td>
<td>2.83</td>
<td>2.84</td>
</tr>
<tr>
<td></td>
<td>HR</td>
<td>2.86</td>
<td>2.66</td>
<td>2.73</td>
</tr>
<tr>
<td></td>
<td>RO</td>
<td>2.86</td>
<td>2.75</td>
<td>2.40</td>
</tr>
</tbody>
</table>

Source: lpi.worldbank.org

\(^71\) lpi.worldbank.org/international/
A detailed investigation on the quality of infrastructure for some Eastern EU Member States with the lowest LPIs, as well as for France, Germany and Austria (recording the highest LPIs) is performed in the following sections. Member States are listed in alphabetical order.

**Austria**

Due to the central location and the well-developed railroad and road system, Austria connects Eastern and Western Europe very efficiently. Despite the slightly negative trend of the overall quality, Austria still owns one of the world’s most competitive logistical infrastructures. Nevertheless, the significant decrease of railway quality indicates that bottlenecks are not coped with sufficiently. Figure 3.69 illustrates the quality index and EU rank of Austrian infrastructure from 2007 until 2015.
Bulgaria

Ten years ago, Bulgaria owned one of the lowest ranked infrastructure systems in Europe. Since then, improvements in each category can be noticed. While the rank increased a lot for the quality of railways, Bulgaria’s roads are still the third worst of the EU. The ports have a slightly positive trend. Despite the low rank, the improvements indicate that bottlenecks are taken care of. Figure 3.70 illustrates the quality index and EU rank of Bulgarian infrastructure from 2007 until 2015.

Source: ec.europa.eu/transport
Czech Republic

Analysing the variations of the quality of logistics score within the recent years, a slightly positive trend can be identified. Especially the railway system improved significantly over the last three years and can now be classified as above EU average. While the quality of the roads increased over the last ten years, the total rank for this category just improved by one place, indicating that the improvements are not significant enough. This notwithstanding, it can be assumed that the bottlenecks on the Czech road and railway network are taken care of. Figure 3.71 illustrates the quality index and EU rank of the Czech Republic infrastructure from 2007 until 2015.

Figure 3.70 – Quality index and EU rank of Bulgarian infrastructure from 2007 until 2015

![Quality index and EU rank of Bulgarian infrastructure from 2007 until 2015](source: ec.europa.eu/transport)

Figure 3.71 – Quality index and EU rank of Czech Republic infrastructure from 2007 until 2015

![Quality index and EU rank of Czech Republic infrastructure from 2007 until 2015](source: ec.europa.eu/transport)
France

In terms of quality of road and railway infrastructure, France can surely be considered as the clear leader in Europe with excellent performance indicators. The quality of IWW/port infrastructure shows some variations over time, but it is still comparable to other countries such as Austria and Germany. Also in the case of France, however, a slight decline in the overall logistic performance can be observed in recent years, highlighting some difficulties in coping with increased traffic volumes (see Figure 3.72).

Figure 3.72 – Quality index and EU rank of French infrastructure from 2007 until 2015

Source: ec.europa.eu/transport

Germany

Ten years ago, Germany owned one of Europe’s most outstanding logistical infrastructures, ranked at the second place in each of the analysed categories. However, a negative trend can be identified, resulting in a decrease of the scores for each category. In 2016, Germany was only ranked between the fifth and eighth place. This indicates that bottlenecks could have emerged and that the leading position of Germany in logistics could be at risk. Figure 3.73 illustrates the decreasing quality index and EU rank of German infrastructure from 2007 until 2015.
Hungary

While the quality of Hungary’s roads slightly increased, the other categories do not show any improvements. Furthermore, the increase in road quality is below the EU average, leading to the loss of three places in the ranking. Consequently, it cannot be concluded that the infrastructure improves or that existing bottlenecks are coped with in Hungary. Figure 3.74 illustrates the quality index and EU rank of Hungarian infrastructure from 2007 until 2015.
Poland

The gap between Poland’s infrastructure quality and the EU average has started to narrow during recent years due to a substantial increase in (public) investments. Especially the road network conditions benefited heavily from these investments, with a significant increase in quality. Even though this implies that bottlenecks are taken care of, Poland still offers a logistical infrastructure below the average EU level. Figure 3.75 illustrates the quality index and EU rank of Poland’s infrastructure from 2007 until 2015.

![Figure 3.75 – Quality index and EU rank of Polish infrastructure from 2007 until 2015](source: ec.europa.eu/transport)

Romania

The Romanian road infrastructure presents drawbacks in many important areas. Network coverage of the country, connections to other EU Member States and safety are poor in comparison to the EU average. However, there has been a significant improvement in both internal and external connectivity by roads, following investments in road infrastructure (see § 3.3.3.2). This is particularly true at the level of interstate roads, roads that cover adjoining countries, and corridor routes. Romania’s transport strategy aims at developing a national highway network to support continental and transcontinental transit in all directions (both North-South and East-West). However, the quality index of Romanian infrastructure still records one of the lowest rankings in the EU, as shown in Figure 3.76.
Slovakia

The road and railway quality increased significantly in Slovakia. However, in comparison to the EU average, this only results in a substantial increase in the quality of railway rank, while roads are still below the EU average. It can hence be concluded that the bottlenecks are taken care of, even though the improvements are not very significant. Figure 3.77 illustrates the quality index and EU rank of Slovakian infrastructure from 2007 until 2015.

**Figure 3.77 – Quality index and EU rank of Slovakian infrastructure from 2007 until 2015**

Source: ec.europa.eu/transport
The results of the previous LPI analysis are in line with the conclusions of the Global Competitiveness report, which has recently been published by the World Economic Forum, and confirm that a gap between Western and Eastern EU Member States still exists when it comes to transport infrastructure quality. This indicates the presence of investment and modernisation gaps.

### 3.3.3 Question 3.3: Factors influencing the evolution of bottlenecks

#### 3.3.3.1 Factors influencing the evolution of bottlenecks for storage capacity

The analysis of the factors influencing the evolution of bottlenecks was based on two main quantitative indicators:

- 2005-2015 evolution of storage needs;

A comparative analysis of these indicators allowed to identify the relative importance of these factors in determining the evolution of bottlenecks for storage capacity, in terms of improvement or deterioration of the initial situations at Member State level (storage capacity shortage or surplus). The results of this comparative analysis are illustrated at Figure 3.78 for a selection of Member States which have experienced the most significant improvements of the initial situation, in terms of further increase of existing surpluses, decrease of existing shortages or switch from shortage to surplus of storage capacity (see the reply to Question 3.2 at § 3.3.2.1).

It is worth reminding that storage capacity increased in all 28 Member States, albeit to a different extent. Storage needs increased in nearly all Member States with the exception of Romania and Cyprus, where a slight decrease was recorded.

In general, Member States which successfully reduced their shortages of storage capacity or further improved their surpluses were the ones whose increased storage needs where more than compensated by the increase of their storage capacity. In particular, Bulgaria experienced an increase in storage needs of around +50%, while it increased its storage capacity by nearly 100%; other significant examples are Poland, Spain, Hungary and Sweden.

The situation improved thanks to increases in storage capacity also in the two Member States where storage needs remained fairly stable over the 2005-2015 period, i.e. Romania (which experienced a slight contraction of storage needs) and Italy (where the increase in storage needs was marginal).

---

Figure 3.78 – Comparative analysis of the evolution of storage capacity and storage needs for selected Member States, 2005-2015

Source: Areté elaboration
3.3.3.2 Factors influencing the evolution of bottlenecks for logistical infrastructure

For a correct understanding of the reply to this question, it is important to keep in mind that transportation of COP usually takes place on infrastructure (roads, railways, inland waterways) which is also used for the transportation of other goods, and often also for passenger traffic. As a consequence, the evolution of “general” bottlenecks for freight traffic, and also for passenger traffic, can have important direct and indirect implications for the transportation of COP crops.

The key factor influencing the evolution of bottlenecks for logistical infrastructure is financial support. Financial support in the form of investments for logistical infrastructure allows overcoming infrastructural bottlenecks by providing improvement and enhancement possibilities. The evolution of investments for road, IWW and rail infrastructure of the highest and lowest-ranked Member States in terms of LPI is presented in Figures 3.79 to 3.81.

Investments in the road infrastructure have primarily been made in Romania, Croatia and Poland. On the contrary, United Kingdom, Austria and Belgium have made the smallest investments. For Romania, a decline from 2008 until 2014, followed by a slight increase, shows steady investments into Romanian road infrastructure. Croatia entered the EU in 2013, but investments into road infrastructure were - in contrast to the pre-accession period - not undertaken significantly after the accession. The second highest investments for road infrastructure were made in Poland, in order to upgrade the existing motorway network.

![Figure 3.79 – Road infrastructure investments per one thousand units of GDP in EUR (2005-2015)](image)

Source: OECD

The largest investments into the European rail infrastructure were made in Estonia, Austria and Hungary, and the smallest in Romania, Germany and Greece. Although Romania lacks adequate quality in railway infrastructure (as seen at § 3.3.2.2.2), the investments remain below the EU average. Austria struggles with capacity problems on critical cross-border tracks and connections with the former “Eastern bloc countries” - Czech Republic, Slovakia and Hungary - and therefore has seen substantial investments.
As for investments in IWWs, it is important to underline that Bulgaria and Romania entered the EU in 2007. In Bulgaria, investments for IWW infrastructure were initially substantial, followed by a rapid decline in 2008. In the past years Romania has recorded the largest investments. From the analysis of the dynamics of investments in the remaining Member States, it is rather evident that removing bottlenecks in the EU IWW infrastructure is not a high priority.

EU funding solutions described at § 3.2.4.2 play an important role in the financing of logistical infrastructure, especially for countries that can receive cohesion funding. The current funds cover the time horizon until 2020: up to present, there has been no decision on how the European investment programs will be laid out afterwards. Possible scenarios rank from extension of the existing programs to a completely new framework. The EU will have to decide in the upcoming years on its future planned investment funds.
The Horizon 2020 and CEF funding as well as the other funds are in line with the EU’s ten-year job and growth strategy (Europe 2020). Future investment programs are therefore likely to depend on the European targets after 2020. In March 2017 a White Paper on the Future of Europe was presented that addresses the faced challenges. It is based on five scenarios that describe the evolution of the EU by 2025, depending on how the future 27 countries decide to develop. This White Paper can be understood as the starting point of debates about the future of the EU.

All scenarios are based on the assumption that the 27 Member States move forward together as a Union. These are neither blueprints nor policy prescriptions; moreover, the EU27 will decide in upcoming debates on selected features of these scenarios to be addressed in the future. The scenarios - each indicated with a brief and explicit title - and their possible impacts on policies are summed up in Figure 3.82. In some scenarios, the EU budget will not change, and thus the possible future funding programs on logistical infrastructure might have a comparable design. Other scenarios, if actually materialising to some extent, might lead to different EU budget constellations, and the funding schemes are hence likely to change as well.

Since no specified investment programs for the period after 2020 currently exist, only general indications on their effects for the core transport corridors can be given. Since the core corridors, especially in their inland waterway and railway components, are important for long-haul transportation of COP crops, resolved bottlenecks along these corridors will have a positive influence on COP transportation in the EU. The TEN-T core network shall be completed until 2030 according to the TEN-T guidelines, meaning that missing links between Member States will have been completed and bottlenecks in freight transportation will have been solved. For that reason, work on infrastructural projects will last beyond the funding period ending in 2020 in order to fulfil the objectives set for 2030. This especially concerns priority projects.

In contrast to a missing EU transportation program, some EU Member States have stated at least strategic policies on logistical infrastructure for a time horizon after 2020. Although these policies are only general guidelines, their possible effects on the evolution of COP transportation or the solving of relevant bottlenecks are highlighted in the following sections.

73 Under the consideration that United Kingdom will leave the European Union.
**Figure 3.82 – White Paper: possible impact on policies of the selected scenarios**

<table>
<thead>
<tr>
<th>Scenario 1: Carrying On</th>
<th>Scenario 2: Nothing but a single market</th>
<th>Scenario 3: Those who want more do more</th>
<th>Scenario 4: Doing less more efficiently</th>
<th>Scenario 5: Doing much more together</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single market &amp; trade</td>
<td>Single market for goods and capital strengthened; standards continue to differ; no guaranteed free movements of people and services</td>
<td>Single market is strengthened and the EU27 pursues progressive trade agreements</td>
<td>Common standards set to a minimum but enforcement is strengthened in areas regulated at EU level; trade exclusively dealt with at EU level</td>
<td>Single market strengthened through harmonisation of standards and stronger enforcement; trade exclusively dealt with at EU level</td>
</tr>
<tr>
<td>Economic &amp; Monetary Union</td>
<td>Cooperation in the euro area is limited</td>
<td>As in “Carrying on” except for a group of countries who deepen cooperation in areas such as taxation and social standard</td>
<td>Several steps are taken to consolidate the euro area and ensure its stability; the EU27 does less in some parts of employment and social policy</td>
<td>Economic, financial and fiscal Union is achieved as envisioned in the report of the Five Presidents of June 2015</td>
</tr>
<tr>
<td>EU budget</td>
<td>Refocussed to finance essential functions needed for the single market</td>
<td>As in “Carrying on”; additional budgets are made available by some Member States for the areas where they decide to do more</td>
<td>Significantly redesigned to fit the new priorities agreed at the level of the EU27</td>
<td>Significantly modernised and increased, backed up by own resources; a euro area fiscal stabilisation function is operational</td>
</tr>
<tr>
<td>Capacity to deliver</td>
<td>Positive agenda for action yields concrete results; decision-making remains complex to grasp; capacity to deliver does not always match expectations</td>
<td>Decision-making may be easier to understand but capacity to act collectively is limited; issues of common concern often need to be solved bilaterally</td>
<td>As in “Carrying on”, a positive agenda for action at 27 yields results; some groups achieve more together in certain domains; decision-making becomes more complex</td>
<td>Decision-making is faster and enforcement is stronger across the board; questions of accountability arise for some who feel that the EU has taken too much power away from the Member States</td>
</tr>
</tbody>
</table>

Source: Extract from EC (2017a)
Bulgaria

The “Integrated Transport Strategy for the Period until 2030” by the Bulgarian Ministry of Transport, Information Technology and Communications represents a key strategic framework for investments in the transport system. This framework was developed in compliance with the principles of consistency, continuity and synergy with national and European strategic documents.

The mission for the transport system until 2020 consists of three parts: providing efficient, effective and sustainable transport; supporting balanced regional development; and assisting in the full integration of the country into European structures, taking into account the transit potential.

The objectives and the priorities of the integrated transport strategy for Bulgaria are presented in Figure 3.83.

*Figure 3.83 – Strategic objectives of the Bulgarian Integrated Transport Strategy for the period until 2030 and the defined priorities*


In order to promote the efficient transportation of COP, bottleneck regions within Bulgaria have to be addressed by investment projects in logistical infrastructure. Especially regions in the North-East (BG332 and BG331) could benefit from cross-border investments with Romania and from investments in the closely located port of Constanta. The Dobrich region of Bulgaria is expected to show an above national average real GDP growth in the horizon until 2050 and the road infrastructure is defined as predominantly efficient in 2015. Thanks to this growth potential, investments in the Dobrich region might offer a good cost-benefit value. Investment in railway infrastructure in the region would contribute beneficially to COP transportation.

Investment in logistical infrastructure in Bulgaria currently relies heavily on EU funding such as CEF and the Cohesion Fund. For planned projects that are listed in the strategy plan after 2020, no fixed funding scheme exists yet. Because these projects mainly focus on railway infrastructure, their completion would contribute
to an improvement of logistical infrastructure which is important for COP transportation. Possible funding solutions, if no EU funding will be available, are national budgets or - more likely - international loans.

**Czech Republic**

In the National Reform Program of the Czech Republic (2016) it is stated that for a renewal of sustainable economic growth of the Czech Republic, improved transport infrastructure and the connection of industrial centres with European routes, as well as the removal of barriers for business in regions with inadequate transport accessibility, are mandatory conditions to improve the competitiveness of the country.

As illustrated in §3.3.1.2.2.3, the region of Jihomoravsky Kraj can be identified as a critical bottleneck region for COP transportation within the Czech Republic. The territory of this region, also known as South Moravian Region, accounts for about 49% of arable land in the Czech Republic, but the region is also one of the Czech regions with the greatest economic potential and - next to Prague - of high importance for the industrial sector. According to the National Reform Program, this bottleneck region should qualify as an important target for investments in transport infrastructure, with an expected improvement in the bottlenecks which are relevant for COP transportation, once the Reform Program is set into action.

One task of the government is the amendment of existing building regulations to simplify and accelerate the administrative processes; for instance, planning and construction approval procedures will be merged into a coordinated procedure together with the environmental impact assessment.

The current national funding system for transport infrastructure in the Czech Republic does not offer stable funding amounts over the years, but shows yearly variability. Stability, including prior knowledge of funding amounts, is crucial for the preparation and implementation of logistical infrastructure projects. The general number of financial sources is diversified in the Czech Republic, but the predictability of budget is very low for adequate financial planning. Private capital or private co-funding (e.g. PPP) is currently not included in the funding of transport infrastructure. It is crucial for the stabilization of the funding system for transport infrastructure that in the long run the sector becomes less dependent on the annual approval cycle of the national budget. The infrastructure for multimodal freight transportation is owned by the private sector, which does not have enough capital to build up a network without the help of public funding.

The railway transit corridors, including railway hubs, shall be updated by 2020, while the road sections of the global TEN-T network, including the construction of missing motorway and road sections, shall be completed by 2030 for the core network, and by 2050 for the comprehensive network.

**Germany**

In Germany, the cabinet agreed on the 2030 Federal Transport Infrastructure Plan (FTIP) in December 2016. The program includes over 1 000 projects for a total investment of EUR 269.9 billion. The FTIP focuses on investment in upgrading and new construction across all modes of transport and on unblocking bottlenecks, thereby optimizing the flow of traffic throughout the network. Although generally in a good position (see § 3.3.1.2.2.5 and § 3.3.2.2.2), the German infrastructure is confronted with a decrease in the LPI and with capacity limits, that are reached due to its status of transit country. The increased need for structural maintenance, upgrading of existing infrastructure to preserve a high quality level, and the evolution of infrastructure that is efficient on a sustainable basis, are the main priorities of the plan. Maintenance of existing infrastructure has a higher priority than new construction. The target is to reach a high-capacity transport network that allows smooth mobility of passengers and efficient freight transportation with a low competition between them.
Due to the federal system in Germany seaports, inland ports and freight villages (as well as airports) are not part of the FTIP. Federal states, local authorities or private operators are responsible for their construction and maintenance. The Federal Government is, however, responsible for connecting these facilities to the federal transport infrastructure network, and provides funds for this purpose.

The 1 000 projects are grouped into priorities on the basis of technical criteria, because it is unlikely that all projects can be addressed until 2030 due to the limited financial resources. Given the prioritization method, the funds are distributed so that projects with significant impacts on large areas are selected.

With the focus on maintaining infrastructure and the removal of bottlenecks, the FTIP will contribute to a reduction in the number of bottlenecks along the main transportation corridors. Because transit traffic is primarily handled by inland waterways and railways, the impact of FTIP on COP transportation will depend on the final projects that are completed. Furthermore, German projects are not eligible for cohesion funding: as a consequence, national funding in logistical infrastructure makes up a large part of the investment volume.

Nevertheless, it is important to consider that especially the extent of capacity issues of transport infrastructure highly depends on external macroeconomic factors, such as the GDP of Germany and the other European Member States. On the one hand, further capacity issues might arise, if for instance GDP growth turns out larger than expected; on the other hand, lower GDP growth rates might have divergent effects on the transport volume of individual product groups. This might imply that COP transportation flows might only change slightly, while other product groups might show a greater decrease in transport volumes. On aggregate, capacity issues will decrease because the total transport volume that shares the infrastructure decreases.

**Slovakia**

The “Strategic Transport Development Plan of the Slovak Republic up to 2030 – Phase II” focuses on strategic objectives in terms of transportation, and on their measurement. The objectives are grouped under several categories, such as global and specific objectives. A selection of specific objectives with the focus on freight traffic is:

- Ensuring the accessibility of all Slovak regions through effective and sustainable transportation infrastructure.
- Improvement of the Slovak public ports system.
- Determining justifiability and conditions for the development, modernisation and rehabilitation of other monitored waterways.
- Ensuring preparation and conditions for systematic and conceptual transport development in Slovakia.
- Increasing rail freight transportation’s share on total traffic volumes.

With planned investments in waterways and the facilitation of rail freight transport, a positive evolution for COP transportation seems achievable in Slovakia, since the identified bottlenecks are located along railways lines and inland waterways.

The current strategic plan does not contain implementation or financial plans, but its fulfilment highly depends on the available funds. Sources are the national budget, EU funds and cooperation with the private sector. The dominant source will be EU funds, which have not yet been defined for the period after 2020. No funding plans hence exist at present, and the fulfilment of the objectives will vary depending on the available funds.
3.3.4 Question 3.4: Influence of bottlenecks on EU internal and external trade in COP crops

3.3.4.1 Influence of bottlenecks for storage capacity

In order to assess the impact of the evolution of bottlenecks for storage capacity on COP trade, the variation of shortages/surpluses of COP storage capacity at Member State level between 2005 and 2015 and the variation of total COP trade (i.e. imports plus exports) in the same period were compared. The results of this comparative analysis are reported in Table 3.14.

It has to be considered that the evolution of trade flows is the result of a wide combination of factors, such as: national and international macroeconomic trends, evolution of border protection measures, exchange rates, changes in international trade agreements, changes in microeconomic conditions (production, consumption, costs, etc.). The evolution of bottlenecks in storage capacity can also contribute to the evolution of trade, but distinguishing its influence from the influence of the above factors is extremely challenging.

Resulting from the comparative analysis described above, no direct correlation apparently exists between increased availability of storage capacity at Member State level and increases in total COP trade.

Out of the top-10 Member States with reductions of 2005 shortages / increases of 2005 surpluses, five Member States also figure among the top-10 in terms of increase in total COP trade: Bulgaria, Czech Republic, Hungary, Poland and Romania. Among these, Romania passed from a situation of storage capacity shortage in 2005 to a situation of surplus in 2015, while Poland substantially reduced (-37%) its storage capacity shortage over the same period.

The case of Spain clearly shows that improvements in the availability of storage capacity vis-à-vis needs do not automatically translate into increased COP trade. Spain passed from a negligible surplus of storage capacity in 2005 to a surplus of nearly 3 million tonnes in 2015. In spite of this positive evolution, Spain is one of the few Member States (with Greece, Cyprus and Malta) which experienced a decrease in total COP trade over the observed period.

It is worth noting that the case study on Romania highlighted the need of additional investments in storage capacity to cope with future increases in COP production in three out of four macro-regions: North-West and Centre (RO1); North and South-East (RO2); South Muntenia and Bucharest (RO3).

Assuming that recent COP production performances will be maintained also in the future, COP export performances of other Member States which are currently affected by sub-optimal availability of storage capacity might be hindered in case of insufficient investments in additional capacity - especially at farming level - in the near future.

Table 3.15 summarises the outcomes of analyses reported at § 3.1.2 (evolution of storage capacity), § 3.2.1.3 (net trade and production analysis), § 3.3.1.1 (bottlenecks for storage capacity) and § 3.3.2.1 (evolution of bottlenecks). The table highlights the relevant elements for characterising the main trends and for drawing conclusions at Member State level.

---

74 The variation in total trade was quantified through comparison of three-year averages (2004-2006 vs. 2013-2015).
75 Increased domestic COP production emerged as an important factor behind the observed increases in COP exports in the 2005-2015 period (see the reply to Question 2.1 at § 3.2.1).
76 As emerged from the assessment under Question 1.1 (§ 3.1.1) and Question 3.1 (§ 3.3.1).
Table 3.14 – Evolution of bottlenecks for storage capacity and of total COP trade, 2005-2015

<table>
<thead>
<tr>
<th>Member States</th>
<th>2005 (Shortage)/Surplus (000 tonnes)</th>
<th>2015 (Shortage)/Surplus (000 tonnes)</th>
<th>2005 - 2015 Evolution</th>
<th>Total trade average 04-06 (000 tonnes)</th>
<th>Total trade average 13-15 (000 tonnes)</th>
<th>2005 - 2015 Evolution</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>142</td>
<td>-15</td>
<td>-158</td>
<td>2 940</td>
<td>4 691</td>
<td>1 751</td>
<td>12th</td>
</tr>
<tr>
<td>Belgium</td>
<td>489</td>
<td>7</td>
<td>-482</td>
<td>14 323</td>
<td>16 056</td>
<td>1 733</td>
<td>14th</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>1 258</td>
<td>5 131</td>
<td>3 873</td>
<td>2 374</td>
<td>7 021</td>
<td>4 647</td>
<td>5th</td>
</tr>
<tr>
<td>Croatia</td>
<td>-250</td>
<td>-449</td>
<td>-199</td>
<td>560</td>
<td>1 925</td>
<td>1 365</td>
<td>26th</td>
</tr>
<tr>
<td>Cyprus</td>
<td>-128</td>
<td>135</td>
<td>264</td>
<td>657</td>
<td>594</td>
<td>-63</td>
<td>26th</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>727</td>
<td>1 119</td>
<td>392</td>
<td>2 802</td>
<td>4 696</td>
<td>1 895</td>
<td>10th</td>
</tr>
<tr>
<td>Denmark</td>
<td>-1 407</td>
<td>-2 619</td>
<td>-1 212</td>
<td>4 070</td>
<td>4 890</td>
<td>820</td>
<td>28th</td>
</tr>
<tr>
<td>Estonia</td>
<td>192</td>
<td>-319</td>
<td>-510</td>
<td>320</td>
<td>878</td>
<td>558</td>
<td>21th</td>
</tr>
<tr>
<td>Finland</td>
<td>2 119</td>
<td>2 726</td>
<td>607</td>
<td>1 047</td>
<td>1 196</td>
<td>149</td>
<td>22th</td>
</tr>
<tr>
<td>France</td>
<td>19 451</td>
<td>18 745</td>
<td>-706</td>
<td>38 430</td>
<td>44 463</td>
<td>6 033</td>
<td>3rd</td>
</tr>
<tr>
<td>Germany</td>
<td>8 169</td>
<td>-9 791</td>
<td>-1 622</td>
<td>26 719</td>
<td>38 558</td>
<td>11 839</td>
<td>2nd</td>
</tr>
<tr>
<td>Greece</td>
<td>-1 354</td>
<td>-1 398</td>
<td>-44</td>
<td>3 142</td>
<td>2 462</td>
<td>-679</td>
<td>27th</td>
</tr>
<tr>
<td>Hungary</td>
<td>1 054</td>
<td>5 817</td>
<td>4 762</td>
<td>5 456</td>
<td>8 151</td>
<td>2 695</td>
<td>7th</td>
</tr>
<tr>
<td>Ireland</td>
<td>-701</td>
<td>-652</td>
<td>49</td>
<td>1 494</td>
<td>2 068</td>
<td>574</td>
<td>20th</td>
</tr>
<tr>
<td>Italy</td>
<td>-3 459</td>
<td>-2 561</td>
<td>899</td>
<td>14 826</td>
<td>16 379</td>
<td>1 553</td>
<td>15th</td>
</tr>
<tr>
<td>Latvia</td>
<td>91</td>
<td>-1 028</td>
<td>-1 119</td>
<td>595</td>
<td>2 785</td>
<td>2 190</td>
<td>9th</td>
</tr>
<tr>
<td>Lithuania</td>
<td>1 618</td>
<td>-1 344</td>
<td>-2 962</td>
<td>1 238</td>
<td>3 851</td>
<td>2 614</td>
<td>8th</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>-151</td>
<td>-57</td>
<td>94</td>
<td>205</td>
<td>301</td>
<td>95</td>
<td>23th</td>
</tr>
<tr>
<td>Malta</td>
<td>-31</td>
<td>56</td>
<td>87</td>
<td>162</td>
<td>146</td>
<td>-16</td>
<td>25th</td>
</tr>
<tr>
<td>Netherlands</td>
<td>-780</td>
<td>-1 071</td>
<td>-291</td>
<td>26 170</td>
<td>29 741</td>
<td>3 571</td>
<td>6th</td>
</tr>
<tr>
<td>Poland</td>
<td>-10 501</td>
<td>-6 623</td>
<td>3 878</td>
<td>4 035</td>
<td>9 838</td>
<td>5 803</td>
<td>4th</td>
</tr>
<tr>
<td>Portugal</td>
<td>464</td>
<td>370</td>
<td>-94</td>
<td>5 063</td>
<td>5 129</td>
<td>67</td>
<td>24th</td>
</tr>
<tr>
<td>Romania</td>
<td>-2 836</td>
<td>5 264</td>
<td>8 099</td>
<td>2 265</td>
<td>14 808</td>
<td>12 543</td>
<td>2nd</td>
</tr>
<tr>
<td>Slovakia</td>
<td>1 814</td>
<td>1 184</td>
<td>-630</td>
<td>1 285</td>
<td>2 585</td>
<td>1 300</td>
<td>27th</td>
</tr>
<tr>
<td>Slovenia</td>
<td>80</td>
<td>61</td>
<td>-19</td>
<td>1 297</td>
<td>3 038</td>
<td>1 741</td>
<td>23th</td>
</tr>
<tr>
<td>Spain</td>
<td>12</td>
<td>2 984</td>
<td>2 973</td>
<td>20 387</td>
<td>19 465</td>
<td>-922</td>
<td>28th</td>
</tr>
<tr>
<td>Sweden</td>
<td>-1 531</td>
<td>-604</td>
<td>927</td>
<td>1 794</td>
<td>2 477</td>
<td>683</td>
<td>19th</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>-4 836</td>
<td>-10 370</td>
<td>-1 535</td>
<td>9 106</td>
<td>10 949</td>
<td>1 844</td>
<td>21th</td>
</tr>
<tr>
<td>EU 28</td>
<td>-10 624</td>
<td>4 698</td>
<td>15 321</td>
<td>192 762</td>
<td>259 142</td>
<td>66 380</td>
<td></td>
</tr>
</tbody>
</table>

Countries succeeding in overcoming 2005 shortage
Top 10 Member States in shortages reductions / surplus improvements which are also top 10 Member State in trade increase

Source: Areté elaboration
Table 3.15 – Comparative analysis of the evolution of COP production, storage capacity and net trade position (2005 vs 2015)

<table>
<thead>
<tr>
<th>Member State</th>
<th>COP Production (000 tonnes)</th>
<th>Storage capacity (000 tonnes)</th>
<th>Net trade position (000 tonnes)</th>
<th>Relevant situations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>4 803</td>
<td>5 298</td>
<td>10%</td>
<td>4 421</td>
</tr>
<tr>
<td>Belgium</td>
<td>2 860</td>
<td>3 257</td>
<td>14%</td>
<td>3 636</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>7 351</td>
<td>11 340</td>
<td>54%</td>
<td>7 291</td>
</tr>
<tr>
<td>Croatia</td>
<td>3 260</td>
<td>3 305</td>
<td>1%</td>
<td>2 277</td>
</tr>
<tr>
<td>Cyprus</td>
<td>83</td>
<td>49</td>
<td>-41%</td>
<td>95</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>8 588</td>
<td>9 616</td>
<td>12%</td>
<td>10 436</td>
</tr>
<tr>
<td>Denmark</td>
<td>9 375</td>
<td>10 325</td>
<td>10%</td>
<td>8 393</td>
</tr>
<tr>
<td>Estonia</td>
<td>730</td>
<td>1 414</td>
<td>94%</td>
<td>1 055</td>
</tr>
<tr>
<td>Finland</td>
<td>3 882</td>
<td>3 976</td>
<td>2%</td>
<td>6 540</td>
</tr>
<tr>
<td>France</td>
<td>70 498</td>
<td>76 848</td>
<td>9%</td>
<td>82 686</td>
</tr>
<tr>
<td>Germany</td>
<td>51 979</td>
<td>55 159</td>
<td>6%</td>
<td>46 521</td>
</tr>
<tr>
<td>Greece</td>
<td>4 070</td>
<td>4 127</td>
<td>1%</td>
<td>2 166</td>
</tr>
<tr>
<td>Hungary</td>
<td>17 305</td>
<td>17 018</td>
<td>-2%</td>
<td>14 714</td>
</tr>
<tr>
<td>Ireland</td>
<td>2 187</td>
<td>2 585</td>
<td>18%</td>
<td>1 993</td>
</tr>
<tr>
<td>Italy</td>
<td>20 816</td>
<td>17 759</td>
<td>-15%</td>
<td>14 650</td>
</tr>
<tr>
<td>Latvia</td>
<td>1 274</td>
<td>2 624</td>
<td>106%</td>
<td>1 569</td>
</tr>
<tr>
<td>Lithuania</td>
<td>2 656</td>
<td>5 662</td>
<td>113%</td>
<td>4 815</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>181</td>
<td>186</td>
<td>3%</td>
<td>56</td>
</tr>
<tr>
<td>Malta</td>
<td>0</td>
<td>0</td>
<td>n.m.</td>
<td>0</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1 766</td>
<td>1 775</td>
<td>0%</td>
<td>2 165</td>
</tr>
<tr>
<td>Poland</td>
<td>23 753</td>
<td>30 057</td>
<td>27%</td>
<td>15 494</td>
</tr>
<tr>
<td>Portugal</td>
<td>988</td>
<td>1 152</td>
<td>17%</td>
<td>1 755</td>
</tr>
<tr>
<td>Romania</td>
<td>21 744</td>
<td>23 777</td>
<td>9%</td>
<td>16 138</td>
</tr>
<tr>
<td>Slovakia</td>
<td>3 908</td>
<td>4 606</td>
<td>18%</td>
<td>5 698</td>
</tr>
<tr>
<td>Slovenia</td>
<td>555</td>
<td>588</td>
<td>6%</td>
<td>573</td>
</tr>
<tr>
<td>Spain</td>
<td>19 076</td>
<td>22 079</td>
<td>16%</td>
<td>22 465</td>
</tr>
<tr>
<td>Sweden</td>
<td>5 041</td>
<td>5 929</td>
<td>18%</td>
<td>4 385</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>23 099</td>
<td>25 482</td>
<td>10%</td>
<td>17 099</td>
</tr>
<tr>
<td><strong>EU 28</strong></td>
<td>311 826</td>
<td>345 993</td>
<td>11%</td>
<td>299 633</td>
</tr>
</tbody>
</table>

Source: Areté elaboration

77 Production and net trade position are quantified in terms of three-year averages (2004-2006 and 2013-2015). Negative values for the net trade position = net import; positive values for the net trade position = net export.
Based on these findings, the following considerations can be made for individual Member States.

**Belgium:** The growth in domestic COP production has not been sufficient to cover the increase in domestic consumption. This caused a substantial increase in net imports, whereas the relative increase in storage capacity has been lower than the EU average. Belgium is traditionally a net COP importer, and also serves as hub for re-exports to other Member States or third countries. Ample availability of storage capacity at logistical hubs (see § 2.1) has allowed the country to maintain this role over the observed period.

**Bulgaria:** A substantial increase in domestic COP production has been accompanied by massive investments in new storage capacity and by an increase in net exports. The substantial increase in the country's surplus of storage capacity (+308%) allows to conclude that Bulgaria is well equipped to maintain the current production and export performance also in the coming years.

**Czech Republic:** The increase in domestic COP production has been in line with the EU average, whereas the relative increase in storage capacity has been lower than the EU average. Substantial growth has been recorded in net exports. No shortage of storage capacity over the observed period has emerged for the country; this may contribute to explain the limited increase in storage capacity. Czech Republic appears to be already equipped to sustain its current production and export performance, at least in the near future.

**Estonia:** The impressive growth in domestic COP production has boosted net exports, but the process does not appear to have been sustained by adequate investments in additional storage capacity. As a result, the country moved from a situation of surplus to a situation of shortage of storage capacity over the observed period. Since Estonia has become a net COP exporter, an increasing need of storage capacity can be expected for the country in the future.

**France:** Domestic COP production grew in line with the EU average, whereas the relative increase in storage capacity has been lower than the EU average. However, thanks to ample availability of surplus storage capacity, the country's production and export performance appears to be adequately supported also for the future.

**Germany:** Domestic COP production increased below the EU average. This resulted in a substantial increase in net COP imports. Limited investments in additional storage capacity have led to a worsened capacity to needs ratio over the observed period.

**Hungary:** In spite of a rather stable domestic COP production, the country has recorded a substantial increase in net exports. The process was surely facilitated by an increase of storage capacity well above the EU average. The significant increase in the Hungarian surplus of storage capacity allows to conclude that the country is well equipped to sustain its current production and export performance also in the long term.

**Latvia:** The substantial increase in both domestic COP production and net exports was supported by investments in additional storage capacity. However, these were not enough to fully address the increased storage needs: Latvia hence moved from a surplus of storage capacity to a shortage. This raises concerns about the possibility for Latvia to implement strategic stock management and to maintain its current production and export performance in the future, in absence of investments in additional storage capacity.

**Lithuania:** More than in other Member States, the increase in domestic COP production and net exports did not evolve together with a comparable growth in storage capacity. As a consequence, the country moved from a surplus of storage capacity to a shortage. This raises concerns about the possibility for Lithuania to implement strategic stock management and to maintain its current production and export performance in the future, in absence of investments in additional storage capacity.

**Netherlands:** In the absence of significant increases in storage capacity, the increase in net COP imports resulted in an apparent deterioration of the country's capacity to needs ratio. However, the widespread use of floating barges for temporary storage should also be considered. Similarly to Belgium, the Netherlands are...
traditionally a net COP importer, and also serve as hub for re-exports to other Member States or third countries. Ample availability of storage capacity at logistical hubs (see § 2.1) has allowed the country to maintain this role over the observed period.

**Poland:** A substantial increase in domestic COP production allowed Poland to move from the status of net COP importer to the status of net COP exporter over the observed period. Substantial growth in the available storage capacity supported this trend. However, the country still has sub-optimal availability of storage capacity for a net exporting country, and might have difficulties in sustaining its current production and export performance in the absence of substantial investments in additional storage capacity.

**Romania:** Romanian net COP exports recorded a massive increase over the observed period, in spite of an increase in domestic COP production in line with the EU average. The process was also supported by a remarkable increase in the available storage capacity. The country actually succeeded in shifting from a situation of storage capacity shortage to a situation of surplus over the observed period.

**Spain:** The growth in domestic COP production allowed a reduction in net imports. The process was supported by an impressive increase in storage capacity, which was however mostly concentrated at logistical hubs and in the processing stage.

**Sweden:** The growth in domestic COP production led to an increase in net exports. Substantial investments in additional storage capacity contributed to support the process, and improved the country’s capacity to needs ratio. This result was achieved in spite of increased storage needs from the growth of exports.

**United Kingdom:** The massive growth of net imports and the simultaneous modest increase of storage capacity resulted in a worsened capacity to needs ratio over the observed period.

### 3.3.4.2 Influence of bottlenecks for logistical infrastructure

The analyses carried out to reply to Question 3.1 (see § 3.3.1) highlighted a number of bottlenecks in logistical infrastructure used for COP crop transportation that can have an influence on EU internal and external trade in COP crops. In principle, the types of bottlenecks which can have the most significant influence on COP trade are those concerning:

1. The core transportation corridors used in intra-EU COP trade and/or connecting the main seaports handling COP crops with inland production and/or consumption areas.
2. National logistical infrastructure (road, rail and IWW networks) in the Member States which are leading exporters and/or importers of COP products.

The assessment of bottlenecks in logistical infrastructure highlighted a number of critical aspects in the core corridors and in the networks of national importance. Some of these bottlenecks affects the transportation network which connects the main inland COP production and consumption areas with the main EU ports handling inbound and outbound flows of COP, namely:

1. The Black Sea ports, and especially the Port of Constanta in Romania.
2. The ARA ports (Antwerp, Rotterdam and Amsterdam).
3. The German ports of Hamburg and Bremen.
4. A number of ports in North-Western France (Rouen, La Rochelle, etc.)

These bottlenecks concern one or more transportation modes, and their seriousness varies. Also their implications in terms of influence on EU COP trade are different.

Once again, it is impossible to isolate the influence of these bottlenecks on EU COP trade performance from the influence of many other relevant factors (evolution of COP supply balance, COP prices, exchange rates, evolution of trade policies, etc.). It is also impossible to assess whether and to what extent the observed
evolution of EU internal and external trade in COP would have been different in the absence of these bottlenecks. Nevertheless, some qualitative considerations can be made, also reasoning in terms of future EU performance for COP trade.

The **Rhine-Danube corridor** has critical importance for both internal and external trade in COP of the EU. The corridor links important COP cultivation areas with regions hosting a high number of processing facilities in the Member States scattered along the corridor\(^78\), and with seaports handling substantial volumes of COP traffic (ARA ports; Port of Constanta). For this reason, the most serious bottlenecks identified on this corridor\(^79\) surely have negative implications for the competitiveness of operators which must use the corridor for their inbound or outbound shipments of COP crops. The current absence of alternatives to the use of the corridor for exporting COP crops to extra-EU markets especially affects some Eastern EU Member States which have recorded an impressive export performance over the last years, such as Hungary, Romania and Bulgaria. This situation raises concerns for the future competitiveness of these Member States as COP exporters, if the most serious bottlenecks on the corridor are not adequately addressed. It should also be noted that the case studies on Hungary and Romania highlighted a number of critical aspects concerning COP logistics which can have negative implications for the future export performance of these countries. Bottlenecks on the Rhine-Danube corridor also have implications for the future role in EU COP trade of the Dutch and Belgian seaports (Antwerp, Rotterdam and Amsterdam) served by the corridor.

On a smaller scale, also the bottlenecks identified along the **North Sea-Baltic corridor**, with special reference to rail infrastructure (capacity and interoperability issues) have implications for internal trade in COP among Lithuania, Latvia and Estonia, and between these Member States and the rest of the EU. The extent to which these bottlenecks are addressed can also have an influence in the future evolution of COP trade with Russia through the Narva transit in Estonia, even if the critical issue concerning rail traffic, i.e. the use of different gauges, is difficult to solve.

The assessment of bottlenecks in logistical infrastructure identified serious congestion issues along critical sections of corridors used for COP transportation in **Germany**. Besides bottlenecks on the Rhine-Danube corridor discussed above, which can have negative implications for COP transit traffic across Germany in the framework of intra-EU trade, rail capacity issues in the hinterland of the ports of Hamburg and Bremen can negatively affect COP exports and imports through these ports.

The assessment focusing on **France** highlighted heavy use of the rail and road network to transport COP to a number of ports in the North-Western corner of France. Even if no significant issues emerged in terms of the current performance of the concerned French logistical infrastructure, it will be important to maintain and improve such levels in case of further increase of COP traffic through these ports. It should also be noted that the rail and road network around Paris is already congested, and that there are no valid bypass routes around this critical hub for traffic flowing from Eastern France COP cultivation areas to grain ports in the North-West of France.

Bottlenecks with potential implications for COP trade were also identified in **Poland**, where rail routes in the hinterland of the port of Gdansk and other critical sections for national and international rail traffic of COP (especially with Ukraine) were found to struggle with capacity problems.

As for intra-EU trade, bottlenecks affecting the **core rail corridors connecting Italy with Central and Eastern Europe** (through Switzerland or Austria) can also have negative implications, considering the substantial traffic flows of agricultural products (including COP) between Italy and these areas. The extent to which the Austrian rail network will be able to handle increasing volumes of both transit and national traffic, together

\(^{78}\) Moving eastwards: Belgium, the Netherlands, France, Germany, Austria, Slovakia, Hungary, Croatia, Romania and Bulgaria.

\(^{79}\) Critical fairway conditions on the Danube and on the Rhine rivers; congestion issues in the rail and road network granting access to the seaports, and along critical sections of the corridor.
with the progress in the completion of important projects (Brenner and Semmering base tunnels; upgrade of Italian rail lines to Switzerland) are the major causes of concern in this respect.

3.3.4.3 Final considerations on the possible influence of bottlenecks on EU internal and external trade in COP crops

This paragraph provides a synoptic view of the possible influence of the interaction between bottlenecks in storage capacity and logistical infrastructure on EU internal and external trade in COP crops. The assessment is based on the key findings of the analyses made under Themes 1, 2 and 3. The focus of the assessment moves from the most critical situations identified at Member State level to an EU-wide perspective.

The case of France showed that the absence of bottlenecks in both storage capacity and logistical infrastructure is an important condition for a successful export performance. A surplus of storage capacity and state-of-the-art logistical infrastructure are needed to ensure strategic management of stocks and to sustain the expansion of domestic COP production and exports. Potential bottlenecks which might arise in the future from congestion on the routes towards the main North-Western seaports handling COP traffic and in the critical hub of Paris need to be monitored and addressed to avoid negative impacts on France’s future production and export performance.

The assessment identified a number of Member States which have achieved or strengthened a position of net exporters of COP over the observed period. However, some of these Member States are confronted with suboptimal availability of storage capacity compared to the current storage needs, and even more so to future storage needs, unless investments in additional capacity are made. Among these Member States, Poland, Lithuania and Latvia are also affected by rather serious logistical bottlenecks, which are only partially being addressed. Infrastructural bottlenecks identified along the North Sea-Baltic corridor (which connects these three Member States with the North-Western part of the EU on one side, and with Russia on the other side) are gradually being addressed. By contrast, critical bottlenecks in Poland’s logistical infrastructure (capacity issues and congestion in the hinterland of the port of Gdansk and in other critical sections for national and international rail traffic of COP) remain unsolved. These bottlenecks further aggravate Poland’s suboptimal availability of storage capacity for COP (in spite of important efforts to close the gap in recent years). This critical situation may prevent Poland from keeping its current COP production and export performance in the future.

A number of Eastern EU Member States - Hungary, Romania and Bulgaria in particular - have substantially increased their COP exports also thanks to substantial investments in storage capacity, which allowed them to achieve a surplus over current storage needs. COP producers in these Member States mainly use the Rhine-Danube corridor to reach destination markets for both internal and external trade. The assessment showed that this critical corridor for COP transportation is affected by a number of serious bottlenecks: suboptimal fairway conditions on the Danube and on the Rhine rivers; congestion issues in the rail and road network granting access to the main seaports handling COP; congestion issues along critical sections of the corridor. If not adequately addressed, these infrastructural bottlenecks may hinder the current COP production and export performance of these Member States, also because no alternatives to the use of this corridor are currently available.

Finally, on an EU-wide perspective, the assessment highlighted the need to address a number of critical bottlenecks which impede traffic flows in both internal and external trade in COP crops. These critical bottlenecks are mainly related to capacity issues - which result in traffic congestion - along a number of sections of key corridors and/or at critical hubs. In contrast, no significant bottlenecks were found to derive from shortage of storage capacity in the main transhipment areas and logistical hubs. There is actually ample availability of storage capacity at key transportation hubs in the Netherlands, in Belgium, and at the port of Constanta in Romania. Besides the aforementioned bottlenecks affecting the Rhine-Danube corridor, capacity...
issues in the German and Austrian transportation network are a major cause of concern, and especially affect long-distance transportation of COP by rail. Logistical infrastructure in Austria and Germany has to deal with the combined pressure of international transit traffic and domestic inter-regional traffic. This happens because substantial volumes of COP crops need to cross Germany and/or Austria to reach their final destination within the EU or in third countries. On a smaller scale, also the bottlenecks on corridors crossing the Alps through Austria or Switzerland to reach Italy have negative implications for EU internal trade in COP crops, as Italy is a major net importer of COP, and imports substantial volumes from other Member States.

3.3.5 Question 3.5: Identification of solutions to overcome existing bottlenecks

3.3.5.1 Solutions to overcome bottlenecks for storage capacity

The analyses made under Theme 1, as well as the replies to questions 3.1, 3.2 and 3.3 under Theme 3, suggest that the most straightforward solution to overcome a deficit of storage capacity in a certain area is investing in additional storage capacity, both through expansion of existing facilities and through construction of new ones. These two processes can also be combined with a rationalisation of the storage system through closure of poorly located and/or technologically obsolete and/or inadequately sized storage facilities.

The available evidence suggests that in order to effectively address bottlenecks for storage capacity, the linkages between the storage system, COP crops logistics and the related infrastructure should be carefully considered, in order to devise and implement integrated solutions addressing bottlenecks in both storage and transportation of COP crops. It actually emerged from the assessment that the appropriate location of the additional storage capacity (e.g. at key transportation hubs or export terminals) is of critical importance, together with the access to adequate logistical infrastructure.

The trend towards the implementation of JIT inventory management models by an increasing number of COP processors (see the reply to Question 1.3 at § 3.1.3) implies the need of additional storage capacity in the upstream stages of the supply chain, and especially at centralised storage facilities managed by agribusiness cooperatives. This additional capacity must be located close enough to the main COP farming areas (to avoid excess “stretching” of the catchment area), but also conveniently enough to the location of processors. In JIT supply chains, additional storage capacity in the farming stage should also be connected with logistical infrastructure allowing rather frequent forwarding of relatively smaller volumes of COP to processors through their preferred transportation mode(s).

Wherever bottlenecks for storage capacity affect export-oriented operators, these should focus their investments in additional storage capacity at locations offering access to inland waterways and railways, which offer efficient transport solutions capable of handling large volumes of products, and/or close to main inland transportation hubs in the transport corridors of interest, and/or directly at the preferred seaports for export shipping. Investments in additional storage capacity at transportation hubs, including seaports, can have direct effects on COP trade, both within the EU and with third countries.

The trend towards expansion of storage capacity at transportation hubs suggests that the “integrated approach” aimed at simultaneously addressing bottlenecks in both storage capacity and logistical infrastructure is seen as an effective solution by the concerned operators and authorities.

---

80 Results of previous research (DG AGRI, 2016; Rabobank/COPA-COGECA, 2014); results of the analyses made under Themes 1 and 2; findings from case studies; insights from interviews.

81 This trend was highlighted by the investigations made for the study (mapping of storage capacity under Theme 1; findings from case studies), by the results of previous research (Rabobank/COPA-COGECA, 2014), and by insights from interviews.
In comparison with an approach focusing on the sole “storage dimension” of bottlenecks, the “integrated approach” also presents the advantage of access to a wider range of public funding solutions, as highlighted in the replies to questions 1.4 and 2.4 (see § 3.1.4 and 3.2.4, respectively).

3.3.5.2 Solutions to overcome bottlenecks for logistical infrastructure

The overview of solutions to overcome bottlenecks in logistical infrastructure does not consider financial incentives, but provides targeted advice to address the bottlenecks which were identified in § 3.3.1.2. Insights for solutions are provided at an EU-wide level (mainly focusing on the main TEN-T corridors for COP transportation) and at a national/regional level. For a correct understanding of the proposed solutions it is essential to consider the “shared” nature of transportation infrastructure used for COP. This implies that solutions to address “general” bottlenecks in the transportation network (e.g. through capacity increases, improved interoperability, promotion of intermodal transportation, etc.) are directly or indirectly beneficial to COP transportation. This applies to both solutions to address bottlenecks which concern the core COP transportation corridors (§ 3.3.5.2.1) and solutions to address infrastructural bottlenecks at national/regional level (§ 3.3.5.2.2).

3.3.5.2.1 Proposed solutions at EU level

As illustrated in § 3.3.2.2.1, the evolution and performance of TEN-T corridors used for COP transportation are measured through key performance indicators (KPIs). These indicators focus on the physical and technical endowment which regulates the functioning of the (core) transport corridors. Besides solutions that would allow to achieve compliance with the targets for 2030, missing links and capacity issues which need to be addressed exist on all four main corridors for COP transportation.

Rhine-Danube corridor

Investments in the railway network are needed to improve railway KPIs. The KPI “permitted train length ≥ 740 m” falls short of the targets in (almost) the entire Slovakia and in Czech Republic. Longer trains allow transportation of larger volumes of COP at lower costs; this would make rail transportation more attractive for operators. Although progress is expected, the KPI “train length ≥ 740 m” is unlikely to be reached completely by 2030.

There are single track lines which currently do not show capacity problems because they are mainly used for regional transportation. Nevertheless, if freight traffic volumes increase, new bottlenecks at these single track lines are likely to occur by 2030. Some of these lines are cross-border ones (e.g. the line from Schwandorf to the German/Czech border). It is hence important to be aware of these potential bottlenecks and to investigate how, for instance, traffic changes might affect the various regions involved. Many projects that are aiming at electrification, axle load increases or permitted speed increases are still lacking reliable finalisation dates. It is hence unclear whether these bottlenecks will be solved by 2030. Some of these projects are located in Germany (e.g. electrification of the railway connection Nuremberg/Regensburg to the border with Czech Republic) and Romania.

As for IWW, several actions address critical bottlenecks, such as the Straubing-Vilshofen section that is already covered by the German national infrastructure plan. Projects to upgrade the Sava River (a tributary of the Danube) are planned, but the related funding is still unclear, and their completion by 2030 seems to be at risk. Several activities aimed at increasing fairway depth and navigation reliability address bottlenecks in the Slovakian-Hungarian border section, in the Bulgarian-Romanian border section and in other sections in Romania, but their implementation is not completed and further steps and projects are needed.
Solutions for bottlenecks or inefficiencies can also arise from a closer cooperation involving all national partners in the Danube area. In the joint “Rehabilitation and Maintenance Master Plan for the Danube and its navigable tributaries” (FAIRway), the majority of the concerned Member States committed themselves to intensify joint work to provide reliable waterway infrastructure. Thanks to the FAIRway Danube project and to the elaboration of National Action Plans, progress to resolve bottlenecks is likely to be made.

Next to the improvement of infrastructure, administrative processes and paperwork have to be harmonised, simplified and digitalized to reduce time losses and operational costs of IWW transportation that arise especially from the fact that not all Danube riparian states are EU Members (e.g. Serbia) and/or Members of the Schengen area (e.g. Romania, Bulgaria).

Investments in road infrastructure are planned and ongoing in Hungary, the Czech Republic, Slovakia and Romania: the road KPI “express road/motorway” is hence bound to increase. Germany, Austria, Hungary and the Czech Republic show capacity constraints from intensive use of key transport routes for transit traffic. National and EU-funded projects are set up to solve these bottlenecks. Another priority area focuses on improvements in the quality of non-compliant road sections in terms of capacity and safety, but also on the implementation of sufficient secure parking areas and on the interoperability of toll collection systems and real-time traffic information along the corridor.

Rhine-Alpine corridor

As a very mature corridor, the Rhine-Alpine one is affected by a limited number of unsolved bottlenecks. Most infrastructural characteristics are already compliant with the TEN-T requirements. However, ERTMS implementation remains a challenge (currently only 12% of rail lines in the corridor are equipped with ERTMS). The main bottlenecks concerning corridor-wide ERTMS rollout are located in Germany and Italy.

Next to lack of ERTMS on large rail sections of the corridor, different electrification systems potentially hinder rail interoperability. In addition, the maximum permitted train length still varies along the corridor. In Germany and Belgium, the maximum permitted train length depends on the operating hours and regional sections; 740 m trains are not allowed to operate in Italy. Such diverging situations can lead to bottlenecks or at least hinder a seamless international rail COP traffic. To harmonise maximum allowed train lengths it is necessary to have adequate side tracks for freight transportation. A study demonstrated that capacity gains of up to 15% are possible with limited financial resources.

Capacity issues are the main reason for bottlenecks along the corridor, and due to expected increases of freight traffic the corridor might face even more serious problems in the future (see Figure 3.84). Actions must hence be taken to resolve existing and potential capacity bottlenecks.

---

82 The CROCODILE project aims at exchanging real time traffic data to harmonise cross-border traffic information services along the corridor (full project members: Austria, Czech Republic, Germany, Hungary, Romania; associated members: Bulgaria and Slovakia).

83 Performed by Rail Freight Corridor Rhine-Alpine.
Most of the railway capacity issues on the Rhine-Alpine corridor affect sections located in Germany: Emmerich – Oberhausen; Köln – Mainz; Rhein/Main – Rhein/Neckar (including Frankfurt and Mannheim) and Karlsruhe – Basel. A project between Emmerich and Oberhausen is already being implemented. The current project includes the construction of a third track that will allow the separation of slower and faster trains, thus increasing capacity. A new automatic block signalling will allow an increase in train traffic density. Further projects cover a better cross-border connection between Germany and the Netherlands and the connection between Zeebrugge/Brugge/Ghent and Karlsruhe/Basel. The main bottlenecks on road infrastructure are congested sections in urban areas. Projects to solve these bottlenecks are, among others, the upgrade of the ring of Antwerp and a bypass of Genoa.

The Rhine-Alpine corridor includes a combination of IWW, railway and road transportation. Functioning multimodal terminals are hence a key component to ensure interoperability among different transport modes. A large intermodal hub is currently in operation in Duisburg: besides allowing modal changes, it also enables rail-to-rail transhipment. Intermodal terminals need to provide adequate storage capacity, but especially enough handling capacity to ensure smooth transhipment between transportation modes. Handling capacity is a problem at several intermodal terminals on the corridor (such as Duisburg, Strasbourg, Milan, and Genoa) but can be increased through new investments in the needed equipment.
Baltic-Adriatic corridor

Compared to the Rhine – Alpine corridor, the rail network on the Baltic – Adriatic corridor is not affected by serious capacity bottlenecks. Challenges on the corridor mainly arise from the poor technical standards of transportation infrastructure. If rail freight traffic increases, bottlenecks might arise in hinterland connections to the ports of Ravenna (Italy), Gdynia and Gdańsk (Poland), as well as at urban hubs such as Vienna. The road network on the corridor also faces the risk of bottlenecks from capacity issues.

Bottlenecks on the railway network mainly affect cross-border sections which require technological upgrading. Work is ongoing to achieve compliance with the TEN-T regulation standards. The implementation of a high-speed connection between Brno (Czech Republic) and Vienna is also foreseen. Operational and administrative barriers should also be addressed to harmonise standards, thus ensuring smooth rail freight traffic flows.

The road network is being improved at several cross-border sections (between Poland and Slovakia, Czech Republic and Austria, Italy and Slovenia). Several national projects are being implemented to reduce congestion in urban areas, to reduce noise emissions and to improve safety and service levels. Several multimodal terminals have been established (e.g. the one at Žilina Teplíčka), are under construction (e.g. at Wien Inzersdorf and Padova) or are being upgraded and expanded (e.g. at Bratislava and Graz Werdorf). Intermodal freight transportation should hence be strengthened.

North-Sea-Baltic corridor

Due to multiple transportation modes in the North-Sea Baltic corridor, bottlenecks can arise for a variety of reasons. There are several weak or missing cross-border links on the corridor. The most critical issue is the missing 1 435 mm standard gauge railway line through the Baltic States, linking Tallinn in Estonia to the Polish border. A dual gauge parallel 1 435/1 520 mm track should be completed from the Polish border to Kaunas in Lithuania: however, this section will have a speed limit of 80 km/h, and the 100 km/h KPI for freight traffic will hence not be met. Although the railway line is being updated for ERTMS, electrification has not been implemented. The completion of the new Rail Baltic line (see § 3.3.1.2.1) is needed to allow seamless rail freight traffic between the Baltic States and Central and Western Europe. Once completed, the Rail Baltic line should solve several interoperability issues.

There are several bottlenecks on railway lines along the corridor. In the cases of Warsaw and Poznan (Poland), bypasses can separate freight and urban passenger traffic to increase capacity. A similar bypass seems appropriate in Bremerhaven (Germany), where the current capacity limits are reached. Construction works are ongoing in Germany also on the rail line between Oldenburg and Wilhelmshaven. With the opening of the container port in Wilhelmshaven in 2012, freight traffic increased and demand for hinterland connections arose. After the completion of the rail connection to the port (2011) and after its upgrading to a 100 km/h speed limit and the construction of a second track (2014), the line is being electrified: completion of the related works is expected by 2022.

Rail interoperability on cross-border sections can be improved through the introduction of the ERTMS signalling system and of a standard maximum permitted train length, as well as through the harmonisation of operating rules. The high-speed connections between Belgium and the Netherlands and between Belgium and Germany (via Aachen), as well as the conventional line from Rotterdam to Germany, are the only cross-border sections of the corridor that operate under the ERTMS. ERTMS signalling will be installed on the conventional rail line between the Netherlands and Belgium and on the Belgian side of the conventional rail line to Germany by 2020. ERTMS should be fully implemented by 2030 in the Netherlands.
## Proposed solutions at EU level

<table>
<thead>
<tr>
<th>Corridor</th>
<th>Bottleneck</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhine-Danube</td>
<td>Missing links at cross-border rail network interconnections.</td>
<td>Enhance rail network at borders.</td>
</tr>
<tr>
<td></td>
<td>Insufficient IWW transportation capacity on the Danube and limited offer of modal alternatives for freight transport.</td>
<td>Improve navigability on the Danube.</td>
</tr>
<tr>
<td></td>
<td>High concentration of IWW transportation flows on the Western Balkans section of the Danube.</td>
<td>Increase capacity on the concerned section.</td>
</tr>
<tr>
<td>Rhine-Alpine</td>
<td>Missing links between Germany and Italy.</td>
<td>Increase capacity through upgrading of access routes via Switzerland (Karlsruhe-Basel and CH-Milano/Novara).</td>
</tr>
<tr>
<td></td>
<td>Missing interconnection between the Belgian, Dutch and German networks.</td>
<td>Address the missing link between Emmerich and Oberhausen (DE)</td>
</tr>
<tr>
<td></td>
<td>Need of better multimodal connections and handling capacity increases at ports.</td>
<td>Implementation of multimodal terminals at ports.</td>
</tr>
<tr>
<td>Baltic-Adriatic</td>
<td>Missing links in AT and at cross-border sections between PL, CZ and SK.</td>
<td>Improve cross-border connectivity and implement critical projects (especially the Semmering base tunnel).</td>
</tr>
<tr>
<td></td>
<td>Outdated multimodal cross-border connections between Vienna (AT), Bratislava (SK), Ostrava (CZ) and Katowice (PL).</td>
<td>Update multimodal cross-border connections.</td>
</tr>
<tr>
<td></td>
<td>Insufficient traffic management and multimodal connections with the ports.</td>
<td>Develop traffic management system and improve port hinterland accessibility.</td>
</tr>
<tr>
<td>North Sea-Baltic</td>
<td>Prevalence of road transportation in international freight traffic between Tallinn (EE) and Warsaw (PL)</td>
<td>Implement a multimodal transportation system in the Baltic States to enable a modal shift from road to rail.</td>
</tr>
<tr>
<td></td>
<td>Missing 1 435 mm standard gauge railway line from Tallinn (EE) to the Polish border (break-of-gauge).</td>
<td>Complete standard gauge railway tracks.</td>
</tr>
<tr>
<td></td>
<td>Maximum allowed axle load and train length differs among the concerned Member States.</td>
<td>Harmonise standards on maximum allowed axle load and train length in the EU.</td>
</tr>
<tr>
<td></td>
<td>Insufficient cross-border connectivity.</td>
<td>Improve connections from Western and Central Europe.</td>
</tr>
<tr>
<td></td>
<td>Limited implementation of the ERTMS signalling system.</td>
<td>New and upgraded infrastructure needs to be equipped with ERTMS.</td>
</tr>
<tr>
<td></td>
<td>Insufficient lock capacity and bridge height.</td>
<td>Upgrade the related infrastructure.</td>
</tr>
</tbody>
</table>

In order to address bottlenecks in European infrastructure, conditions must be provided to ensure adequate overall planning and full utilisation of funds appropriated for rail projects in the Cohesion Fund, especially in
Bulgaria, Poland, Czech Republic and Croatia. In the cases of Poland and the Baltic States, the implementation of the Rail Baltic project (which aims at connecting North-Eastern Europe with the core TEN-T network) is of critical importance to address the identified bottlenecks. Further improvement of hinterland accessibility and services at North-Western ports handling COP traffic is a priority in France. Investments aimed at the completion of TEN-T rail corridors is of paramount importance in Spain. Finally, upgrading and improved maintenance of IWWs, and particularly of sections of the Danube in Hungary, Romania and Bulgaria, may remove critical bottlenecks in the IWW network 84, with positive implications for COP transportation on the Rhine-Danube axis.

3.3.5.2.2 Proposed solutions at national level

3.3.5.2.2.1 Austria

Austria is a key transit country for international freight traffic in the EU. The Austrian transportation infrastructure already operates at capacity limits (also due to heavy inter-regional traffic) especially in the Northern part, where traffic flows on three TEN-T corridors interfere with each other. Road, rail and IWW capacity enhancements are of critical importance to ensure smooth COP traffic flows through the country.

Detailed solutions to address bottlenecks on the Danube, due to its importance for COP transportation, are outlined below.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Bottleneck</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>IWW</td>
<td>Insufficient fairway conditions in some shallow sections</td>
<td>Implementation of river engineering measures (e.g. dredging).</td>
</tr>
<tr>
<td></td>
<td>Insufficient automatic water level measurements.</td>
<td>Transfer and integration of real-time data into management systems, plus automatic validity checks with cameras.</td>
</tr>
<tr>
<td></td>
<td>Drawbacks in technical equipment of gauging stations.</td>
<td>Increase efficiency in the maintenance of the measuring network systems and installation of software for automatic checks.</td>
</tr>
<tr>
<td></td>
<td>Issues in the market of dredging services (limited domestic offer).</td>
<td>EU-wide tendering to attract additional providers of dredging services.</td>
</tr>
<tr>
<td></td>
<td>Low update rate of water depth data at critical sections.</td>
<td>Increase update rate to ensure at least monthly frequency.</td>
</tr>
</tbody>
</table>

3.3.5.2.2.2 Bulgaria

Inadequate fairway conditions on the Danube River are a critical bottleneck for COP transportation in Bulgaria. Dredging activities are required to deepen critical IWW sections, which are classified as “Heavily Modified Water Bodies” according to the Fairway Rehabilitation and Maintenance Master Plan. Regional connectivity must be improved. Intermodal terminals and ports in regions with substantial COP storage capacity must be developed, also through financial incentives.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Bottleneck</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road</td>
<td>Aging road freight vehicles.</td>
<td>Implementation of incentives to modernize road freight vehicle fleet (e.g. through scrapping bonuses).</td>
</tr>
</tbody>
</table>

3.3.5.2.2.3 Czech Republic

The most critical bottleneck is inadequate connectivity in the Jihomoravsky kraj region in the South-Eastern part of the country. The region has substantial COP storage capacity, but the most important rail connections are already heavily utilised.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Bottleneck</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road</td>
<td>Outdated vehicle fleet</td>
<td>Provide incentives to update vehicle fleet (e.g. through scrapping bonuses).</td>
</tr>
<tr>
<td>Rail</td>
<td>Shortage of wagons for COP transportation.</td>
<td>Provide incentives to rail operators for investment into additional specialised wagons for COP.</td>
</tr>
<tr>
<td></td>
<td>Low quality and capacity of rail infrastructure.</td>
<td>Promote technological upgrading and double-tracking on critical railway sections.</td>
</tr>
<tr>
<td></td>
<td>Conflicts between freight and passenger traffic on important COP transportation routes.</td>
<td>Introduce night time windows for freight traffic; increase capacity through technological upgrading and/or additional tracks.</td>
</tr>
<tr>
<td></td>
<td>Low level of interoperability.</td>
<td>Implement EU standards (e.g. ERTMS).</td>
</tr>
</tbody>
</table>

3.3.5.2.2.4 France

Thanks to logistical infrastructure well-integrated into the TEN-T network, France achieves very good levels of logistic performance. Further improvement can be sought for a number of general aspects, such as better integration between road and rail freight transportation. Potential congestion issues in the Paris area and in
the hinterland of North-Western ports handling substantial COP traffic should also be monitored and addressed.

Some of the main COP transportation routes in France are covered by the TEN-T network. Bottlenecks on such infrastructure have already been removed, or will be removed upon completion of the related projects. Some EU-funded projects support the removal of general transportation bottlenecks, and this will benefit also COP transportation.

The improvement of the IWW section between Bray and Nogent-sur Seine will have positive implications for COP transportation between cultivation areas and Paris metropolitan area. In the future, the Priority Project 30 “Inland Waterway Seine-Scheldt” might have a significant influence on the French port system and on the concerned COP traffic flows. The completion of this project will connect the French IWW network to the Belgian, Dutch, and German network, as well as to the main ports of the Northern Range (Le Havre, Rouen, Dunkerque, Zeebrugge, Ghent, Antwerp and Rotterdam). It will also allow the use of high-capacity barges for COP transportation. The completion of this project will provide a seamless IWW system for COP transportation between the Black Sea (port of Constanta), the ARA Ports and the French HAROPA Ports.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Bottleneck</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road/Rail</td>
<td>Centralized network, with many key routes converging towards Paris.</td>
<td>Creation of cross-connections and bypasses, in order to address transport capacity limitations in the Paris area, especially to avoid competition with passenger traffic.</td>
</tr>
<tr>
<td>Road</td>
<td>Lack of multilateral agreements at border crossings.</td>
<td>Alignment of multilateral agreements between neighbouring countries (e.g. on maximum weight of vehicles for cross-border traffic).</td>
</tr>
<tr>
<td>Rail</td>
<td>Insufficient level of interoperability.</td>
<td>Alignment of regulations between neighbouring countries (maximum length of trains, signalling systems, electrification systems).</td>
</tr>
<tr>
<td></td>
<td>Potential congestion issues in the hinterland of some ports handling COP.</td>
<td>Improve hinterland accessibility at ports through enhancement of the logistical infrastructure.</td>
</tr>
<tr>
<td></td>
<td>Poor maintenance conditions of some freight rail lines.</td>
<td>Provide incentives for operators to invest in freight infrastructure.</td>
</tr>
<tr>
<td></td>
<td>Lack of communication and information as well as transparency of transport flows.</td>
<td>Implementation of advanced ICT infrastructure and transport flows management systems.</td>
</tr>
</tbody>
</table>

3.3.5.2.2.5 Germany

Capacity expansion is needed on a number of critical railway sections for COP transportation which currently operate at their capacity limits. Also rail interoperability needs to be improved.

The competitive disadvantage of rail freight transportation vis-à-vis road transportation, mainly stemming from policy-related issues, also needs to be addressed. Incentives for rail freight transportation should be fostered.

The efficiency of transhipment processes from road to rail needs to be improved, and intermodal COP transportation should be promoted.
Critical fairway conditions on the Rhine and the Danube must be monitored and addressed to avoid negative implications for COP transportation.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Bottleneck</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail</td>
<td>Insufficient capacity at some critical hubs.</td>
<td>Freight trains which do not require any services at a hub might use an alternative route to skip the facility. Increase of permissible freight train length on core corridors (longer trains mean fewer trains to handle for critical hubs)</td>
</tr>
<tr>
<td></td>
<td>Outdated transhipment equipment.</td>
<td>Provision of new transhipment equipment (e.g. loading/unloading equipment). Reduce conflicts between passenger and freight traffic by promoting dedicated freight tracks.</td>
</tr>
<tr>
<td></td>
<td>Conflict with passenger traffic (especially on the Rhine-Danube corridor).</td>
<td>Construction of additional tracks (especially along the Rhine-Danube corridor). Improve infrastructure by enabling efficient processing through cycle time adjustments.</td>
</tr>
<tr>
<td></td>
<td>Long waiting times at transhipment points and terminals.</td>
<td>IT-support (e.g. terminal management software, electronic shipment notification, RFID, electronic train composition notification).</td>
</tr>
<tr>
<td></td>
<td>Insufficient transhipment capacity at hubs.</td>
<td>Provision of additional shunting locomotives.</td>
</tr>
<tr>
<td></td>
<td>Limitations to night time freight traffic.</td>
<td>Upgrading of freight equipment to reduce noise, in order to allow night time freight traffic. Align gauge, electrification and safety systems, maximum permitted train length and axle loads.</td>
</tr>
<tr>
<td></td>
<td>Issues in rail interoperability especially at cross-border sections, with negative implications for international COP traffic.</td>
<td>Implement integrated rail management systems. Elimination of technical obstacles by promoting interoperability. Elimination of administrative obstacles by adjusting customs regulations.</td>
</tr>
</tbody>
</table>

3.3.5.2.6 Hungary

The competitiveness of COP rail transportation is limited by systemic problems which affect the Hungarian railway network and by bottlenecks affecting specific sections and regions. Projects aimed at increasing capacity on the main rail lines and the planned rail bypass of Budapest can have positive implications for COP rail transportation.

A bottleneck for COP transportation was identified in the central region of Fejer (HU211), which hosts substantial COP storage capacity. The seriousness of this bottleneck is amplified by the proximity of this region to the metropolitan region of Budapest. The Hungarian railway network converges towards Budapest: this concentrates traffic flows and creates capacity shortages, which have an impact also on COP transportation. Alternative rail routes must be established to improve transport connectivity of the Fejer region.
### 3.3.5.2.2.7 Poland

A bottleneck which may play a significant role in the future of COP transportation is inadequate hinterland connectivity at the Port of Gdansk. In addition, certain rail links (including one with Ukraine) are operating at capacity limits: the construction of additional tracks is required to address these bottlenecks.

Poor road and rail track conditions, as well as road and rail construction sites, cause speed limitations, which reduce the average commercial speed substantially. Modernisation and rehabilitation projects represent a strategic goal of the Polish Ministry of Transport: however, investments are required in order to speed up the completion of these projects.

**Mode** | **Bottleneck** | **Solution**
--- | --- | ---
**Road** | Inadequate roads result in very low average speed of truck transportation. Low network capacity and road congestion. Slow and costly handling at RR terminals due to technical bottlenecks. | Modernisation of road network. Upgrade from single to double lane roads. Update terminal equipment. |
**IWW** | Lack of IWW infrastructure. Issues in access of operators to rail terminals. | Rehabilitation of rivers to allow IWW transportation. Enable public ownership of terminals. |
**Rail** | Slow commercial speed in rail freight transportation. Issues in transhipment processes at terminals. | Increase average commercial speed through improvement of rail track quality. Improve handling equipment and ITC systems. |
Limited offer and use of intermodal transportation services.

The number of intermodal hubs and logistic centres should be increased. Improve market access for international providers of intermodal transportation services.

Inadequate interoperability due to slow locomotive replacement at cross-border terminals.

Eliminate the need for cross-border tractions changes through implementation of consistent electrification systems and gauges.

Competitive disadvantage of rail transportation vs. road transportation.

Improve railway market conditions.

3.3.5.2.2.8 Romania

The most important bottlenecks concern poor fairway conditions due to low water levels on the Danube. Tactical solutions to improve COP transportation during low water periods are based on the provision of nodal alternatives (road and/or rail transportation). Road and rail infrastructure must be developed to enable a shift of COP transportation from IWWs onto road and/or rail when needed. However, this modal shift increases COP transportation costs. Strategic solutions to improve the navigability of the Danube are hence needed: these can be provided, for instance, by public support to dredging activities in the river. More detailed solutions are outlined in the table.

The region of Timis (RO424), which has substantial COP storage capacity, needs better connections to the IWW network. These can be provided through the completion of a rail link to the Danube and by locating an intermodal terminal at the inland port of Drobeta Turnu Severin.

The lack of investments in the upgrading of railway infrastructure has led to capacity restrictions on many sections. Investments in upgrading and expansion of key rail-to-road terminals and of critical rail sections are hence needed.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Bottleneck</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road</td>
<td>One lane national roads.</td>
<td>Construction of additional lanes.</td>
</tr>
<tr>
<td></td>
<td>Insufficient number of sounding vessels.</td>
<td>Support acquisition of up-to-date sounding equipment to raise the coverage of surveyed areas.</td>
</tr>
<tr>
<td></td>
<td>Insufficient number of automatic gauging stations.</td>
<td>Support acquisition of additional automatic gauging stations, especially for critical sections.</td>
</tr>
<tr>
<td></td>
<td>Lack of dredging equipment, specialized personnel and deficiency of investments in river regulation.</td>
<td>Support acquisition of dredging equipment performance to increase the efficiency of working problem areas and the possibility of intervention at any time where it is needed.</td>
</tr>
<tr>
<td>IWW</td>
<td>Lack of efficient vessels and special equipment for marking.</td>
<td>Support acquisition of vessels equipped with advanced machines to perform on-board assembly/disassembly of floating signals.</td>
</tr>
<tr>
<td></td>
<td>Unavailable forecast for water levels.</td>
<td>Support establishment of a water level forecast.</td>
</tr>
<tr>
<td></td>
<td>Information could be provided in a customer-friendly manner by using established river information portals.</td>
<td>Support customer-friendly processing and dissemination of information.</td>
</tr>
<tr>
<td></td>
<td>Insufficient number and quality of weather</td>
<td>Support improvement of meteorological information.</td>
</tr>
</tbody>
</table>
3.3.5.2.2.9 Slovakia

The most critical infrastructural bottlenecks for COP transportation derive from poor fairway conditions on the Danube river. Dredging activities are hence needed to deepen the fairway at the identified critical locations.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Bottleneck</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>IWW</td>
<td>Lack of multi-beam sounding vessels.</td>
<td>Support acquisition of up-to-date multi-beam sounding vessels, equipment and software.</td>
</tr>
<tr>
<td></td>
<td>Outdated information technology and missing database for monitoring data.</td>
<td>Installation of a fairway management system.</td>
</tr>
<tr>
<td></td>
<td>Inadequate availability of skilled staff to monitor fairway (available staff is reaching retirement).</td>
<td>Increase budget for training of personnel.</td>
</tr>
<tr>
<td></td>
<td>Inefficient information and data exchange process.</td>
<td>Definition of a common data exchange process.</td>
</tr>
<tr>
<td></td>
<td>Old dredging and marking fleet and equipment.</td>
<td>Acquisition of marking vessels and dredgers</td>
</tr>
</tbody>
</table>

3.3.6 Question 3.6: Opportunities for future investments in storage capacity and logistical infrastructure

3.3.6.1 Opportunities for future investments in storage capacity

The reply to question 3.5 suggests that the solutions for overcoming bottlenecks with high impact and strong influence on COP trade are especially focused on addressing shortages of storage capacity for COP crops at:

1. critical inland transportation hubs: IWW and rail terminals, road-to-rail transhipment points;
2. key seaports for COP export and/or import.

The reply to question 1.4 (see § 3.1.4) highlighted that public funding options available for investments in storage capacity have mostly been offered from the EAFRD via Rural Development Plans: individual farmers and agribusiness cooperatives have been the main beneficiaries. The nature and extent of investment
projects which can usually be funded through RDPs does not fit very well with the type of investments which would be needed to improve significantly the availability of adequate COP storage capacity at critical transportation hubs. This is especially the case where access to large-scale bulk transport solutions (barges, block or unit trains, oceangoing vessels) must be ensured. For this reason, the implementation of the “integrated” approach suggested at § 3.3.5.1 - through investment projects combining additional storage capacity, the related handling capability, and the adjoining logistical infrastructure - seems to offer the best opportunities for future investments in storage capacity. This was also highlighted by findings from case studies.

The “integrated approach” combines advantages in terms of access to a wider range of public funding options (see § 3.2.4) with interesting opportunities for the development of collaborative structures (such as partnerships, joint ventures etc.) among the supply chain actors: agribusiness cooperatives, independent grain traders/wholesalers, processors of COP crops and operators in the logistics sector (from third-party logistic providers to port authorities).

Other important opportunities for future investments in storage capacity, albeit with a more indirect impact on COP trade, are those offered especially to agribusiness cooperatives by the increasing trend towards the adoption of JIT inventory management models by COP processors. The switch to JIT supply chains actually requires the availability of storage capacity at intermediate, conveniently located sites between COP farming areas and areas with significant density of processing plants.

3.3.6.2 Opportunities for future investments in logistical infrastructure

Investments in logistical infrastructure have mainly focused on the expansion of the European logistical infrastructure (see § 2.2.3) to connect EU territories. The objectives are defined - among others - by the TEN-T programme and by the European transport infrastructure policy. It is evident that these policies have supported the development of the logistical infrastructure to a great extent (§ 2.2.3). Nonetheless, infrastructural investments do not necessarily support COP-related infrastructural development.

For this reason, the following opportunities for future investments in logistical infrastructure are proposed, focusing on specific areas aimed at addressing some of the critical bottlenecks for COP transportation identified under question 3.1 (see § 3.3.1.2). The proposed opportunities are classified into general and specific ones. General opportunities cover system-wide issues (e.g. interoperability), whereas specific opportunities cover problems related to well-defined geographical locations (e.g. missing links, critical bottleneck locations, etc.).

Improvement of fairway conditions

The Danube River is a critical IWW transport route in Europe for COP. The investments for improving IWW transportation on the Danube are slowly decreasing, like in the case of Romania (see § 3.3.3.2). The most critical bottlenecks on the Danube are poor fairway conditions, which do not allow continued use of this IWW in certain sections. To achieve better fairway conditions and to avoid critical situations within the COP supply chain, significant efforts have to be made. Operational budget gaps for improving fairway conditions have already been identified by the FAIRway Project. The most substantial budget gaps affect Hungary (about EUR 900 000), Romania (about EUR 400 000) and Bulgaria (about EUR 1.3 million). Considering the importance of the identified bottlenecks, EU co-financing of projects for improving fairway conditions on the Danube River seems advisable.
Improvement of interoperability of railways

Rail freight transportation constitutes an important long-haul transport solution for COP, especially for many regions that have no direct access to inland waterways. As already demonstrated at § 2.2.2, railway transport suffers from gaps in interoperability that lead to higher overall transportation costs.

To develop a European railway network without borders, a technical and legal European framework has to be established. The European Parliament and the Council created the foundation for such process by issuing several directives (e.g. 96/48/EC, 2008/57/EC; 2014/38/EU and 2016/797/EU).

The trans-European conventional rail system should include: specially upgraded high-speed lines; conventional lines intended for passenger services; conventional lines intended for mixed traffic; conventional lines intended for freight services; passenger hubs; freight hubs, including intermodal terminals; lines connecting the components (2016/797/EU Annex I). Traffic management, tracking and navigation systems are included in these infrastructural elements.

Common Technical specifications for Interoperability (TSIs) provide the technical framework within the European rail network. TSIs define the essential requirements to be met by each subsystem or part of subsystem, and are aimed at ensuring the interoperability of EU high speed and conventional rail systems. The European Agency for Railways (ERA) revises existing TSIs, develops new specifications and supports the rail sector in their application. TSIs are hence changing over time to reach a unified technical specification at the end of this process.

The concept of interoperability does not just include a border-free rail network: to operate such network, train drivers with international licences are needed (2007/59/EC and 2014/82/EU). Drivers have to communicate with the infrastructure manager on safety issues and must therefore have language skills to communicate effectively in routine, adverse and emergency situations (20014/82/EU Annex II).

According to data illustrated in Figure 3.85, the share of train drivers holding a European licence is negligible in many Member States. To achieve a higher interoperability, the number of international train drivers must increase.
Improvement in regional transport connectivity

Improvements in regional transport connectivity are aimed at resolving bottlenecks caused from traffic congestion. If regional and interregional transport corridors cross, traffic congestion might be solved by creating a (faster) bypass for interregional cargo flows. Notable examples can be found in Poland, where the EU Commission approved three “major projects” in 2016. The European Regional Development Fund (ERDF) and the Cohesion Fund (CF) approved funding for EUR 350 million to increase connectivity and to streamline nearby traffic. The projects cover the construction of bypasses to already existing express routes and the facilitation of access to the interregional links in the TEN-T road network in Poland.

Hinterland accessibility is normally related to seaports, but also inland waterways or larger railway terminals need to have good accessibility. Since COP crops are grown in agricultural areas that are mostly not located at key transportation hubs, the hinterland connectivity is of great importance for international trade. In the past, port operators focused on the development of ports, while shippers and rail operators were involved in the connectivity development of port hinterlands.

As a large share of COP transportation is handled by inland waterways and railways, bottlenecks for hinterland connectivity can be addressed through investments in the related infrastructure. A notable
example of improvement in port hinterland connectivity is offered by the upgrading of Caland Bridge at the main seaport of Rotterdam, where three core network corridors meet. The Caland Bridge is a single rail freight connection between the port and its European hinterland, a connection for road traffic, but also a critical access to the port: it is a vertical-lift bridge which allows the transit of ships headed for the port. Ships headed for the port have priority: rail and road traffic through the bridge often has to stop because the main bridge span is lifted to allow the transit of ships. With the construction of a new route (Theemsweg railway section) by 2020 this bottleneck will be resolved. The new route will not just allow a shorter travel time because trains will not have to wait at the bridge, but will also have a higher capacity.

On the longer term, and on a much wider scale, the completion of Priority Project 30 “Inland Waterway Seine-Scheldt” will have a remarkable impact on long-haul transportation of large volumes of COP crops in the EU. The completion of this project will create a seamless IWW corridor linking the Black Sea (port of Constanta), the ARA Ports (Antwerp, Rotterdam, Amsterdam) and the HAROPA-Ports (Le Havre, Rouen and Paris) through the interconnection of the French IWW network with the Belgian, Dutch and German ones.
4 CONCLUSIONS

A number of conclusions can be drawn from the analyses made under the three study themes (storage capacity; logistical infrastructure; bottlenecks) and from the results of the case studies carried out in the EU (Germany, Hungary, Romania) and in China. These conclusions are presented in the following paragraphs.

4.1 Mapping of storage capacity

The current total storage capacity for COP in the EU28 was quantified at around 359 million tonnes, up 20% from around 300 million tonnes in 2005. Over the same period, EU production of COP crops increased by 11%, from around 312 million tonnes to around 346 million tonnes85. The increase in storage capacity was therefore greater than the increase in production, as some Member States fully or partially addressed the storage capacity shortages that they faced in 2005 (see § 4.5.1). France is by far the Member State with the greatest storage capacity (around 91 million tonnes in 2015), followed by Germany (48 million tonnes) and Spain (30 million tonnes). Among the Eastern EU Member States, Poland (24 million tonnes), Romania (23 million tonnes) and Hungary (20 million tonnes) also stand out.

All 28 Member States increased their storage capacity over the observed period, albeit to a different extent. With the only exception of Spain (which recorded a 33% increase), all the major increases occurred in Eastern EU: Bulgaria more than doubled its storage capacity, Poland increased it by around 57%, Latvia by 52%. Increases above 40% were also recorded in Greece, Sweden and Romania.

The distribution of storage capacity in the different regions is not even. In France, Spain, Hungary and Romania most of the regions have substantial storage capacity. In contrast, the differences among regions are much more evident in Germany, Italy, Poland and the United Kingdom.

Facilities at individual farm level currently account for the largest share of storage capacity in the EU (143 million tonnes / 40% of EU total). Storage capacity at farming cooperatives is much more limited (38 million tonnes / 11% of EU total) and its share on total capacity greatly varies among the different Member States, also according to the specific historical background of each of them. The share of on-farm storage is substantial in Finland (78% of total capacity), Greece (70%) and the United Kingdom (62%), and important in Germany (42 %). All these Member States have a higher presence of large agricultural holdings in the COP sector. On-farm storage capacity is also important in some Eastern EU Member States, such as Poland (67% of total capacity), Bulgaria (46%) and Romania (40%). Farming cooperatives play an especially important role in COP storage in Austria (37% of total capacity), Germany (29%), Portugal (29%), Italy (27%) and Spain (25%), as well as in Lithuania (34%). Some vertically integrated agribusiness cooperatives operate mainly as processors and/or traders in a number of Member States (France in particular). The storage facilities managed by these cooperatives have therefore been counted under these categories. Vertically integrated agribusiness cooperatives manage significant storage capacity, including a number of storage facilities located at transportation hubs, such as ports.

The processing industry manages around 31.5 million tonnes of storage capacity, equal to 9% of EU total. However, it should be noted that these facilities are usually the ones with the highest annual turnover of stocks, and can hence handle substantial quantities of COP crops with a relatively limited capacity. The share of total storage capacity managed by processors is more limited in the Member States (e.g. France, Germany and the United Kingdom) where just-in-time (JIT) inventory management models have been implemented by leading processors. In contrast, it is more significant in Member States like Belgium (29% of total capacity),

Portugal (29%), the Netherlands (23%) and Italy (18%), as well as in Slovenia (42%) and Czech Republic (31%), due the relatively limited availability of storage capacity in the agricultural sector, and/or the structure and organisation of the relevant COP supply chains and procurement patterns.

The trading and wholesale sector was found to have a critical importance for COP storage (115.5 million tonnes of capacity / 32% of EU total). An important role of traders in providing COP storage capacity can be observed in Eastern EU Member States such as Bulgaria (49% of total capacity) and Romania (42%). The trading sector plays an equally important role in Western EU Member States such as France (56% of total capacity), Italy (32%), the Netherlands (32%) and Spain (24%).

Storage capacity at transportation hubs has a great strategic importance for the import and export trade of the different Member States. Although the total capacity of storage facilities at such locations might seem relatively limited (around 31 million tonnes / 9% of EU total), most of the recent investments in these facilities focused not only on the expansion of storage capacity, but also on improving handling capacity and on increasing overall efficiency to allow faster turnover of stocks. Availability of storage capacity at transportation hubs was found to be especially important in Member States heavily relying on imports to meet internal demand (such as Spain, Portugal, Italy) and/or acting as transhipment areas (this is certainly the case of the Netherlands and of Belgium). Among Eastern EU Member States, the share of total capacity located at transportation hubs is especially significant in Slovenia (52%) and Estonia (31%).

It should be noted that storage facilities operated by processors or traders, and especially storage facilities located at transportation hubs, usually provide “transit storage” before processing, domestic and export trading. This implies that their availability to handle exceptional production volumes is limited. Most of the pressure on the storage system from exceptional harvest volumes is felt during the harvest season and in the following months. In these periods, the heaviest pressure falls on storage facilities managed by individual farms and by farming cooperatives, as these are usually the first to handle the bulk of harvested production. However, since agribusiness cooperatives manage a number of large-scale storage facilities at transportation hubs in certain Member States (France in particular), their capacity can ease some of the pressure on inland storage capacity at farming level in case of exceptional harvest volumes.

4.2 Mapping of logistical infrastructure

Road, rail and inland waterways play different roles in the transportation of COP crops from EU cultivation areas to their final destinations, i.e. processing plants (flour mills, oilseed crushing plants, feed mills) or export terminals. These transport modes are often used in combination. The applied transportation solutions and the complexity of transport moves mainly depend on the specific features of the locations involved (origin and destination), on the volumes to be transported and on the characteristics of the specific COP products. The road, rail and inland waterway network used for COP crop transportation is generally also used for the transportation of other goods, and often also handles passenger traffic. This can result in competition for the use of shared infrastructure in the most congested sections. Inland waterways and railways handle almost all long-distance COP tonnage (60-70% for inland waterways, 30-40% for railways); trucks play a marginal role in long-distance transportation of COP, and are only used in the few areas where railway and/or inland waterway networks are not very well developed, or as an emergency solution. Lower cost and greater efficiency determine the prevalence of inland waterways or railways in long-distance transportation, especially when large volume shipments allow the use of block trains and/or barge convoys. However, rail transportation is affected by interoperability issues (administrative barriers, heterogeneous electrification

86 The share of total storage capacity located at transportation hubs amounts to 30% in Portugal, 23% in Spain, and 17% in Italy; it amounts to 30% in Belgium and 27% in the Netherlands.
systems and gauges, different national regulations, etc.) which do not affect inland waterways and road transportation. Greater flexibility and the density of the road network favour trucks in short-distance transportation, especially from COP cultivation areas to local users or to logistical hubs where transhipment to railcars or barges for long-distance moves takes place.

Among the 9 “TEN-T corridors” of EU importance, four core corridors for long-distance transportation of COP crops were identified: Baltic-Adriatic, North Sea-Baltic, Rhine-Alpine and Rhine-Danube. A number of key logistical hubs for COP transportation were also identified, especially along the core inland waterways. Some of the main European inland ports (Rouen, Paris, Metz and Danube ports) are key logistical hubs for COP transportation. The French port of Rouen can also handle oceangoing vessels, and is the leading EU port for cereals exports. These inland ports are connected to the key logistical hubs for sea transportation, i.e. the main Northern European seaports handling COP products (Rotterdam, Hamburg and Antwerp), the Romanian port of Constanta on the Black Sea and the French port of Marseille. Whereas COP transportation from the Upper Danube is preferably shipped towards the North Sea ports, COP transportation south of the Upper Danube is mostly shipped towards the Black Sea. Where inland waterway connections are missing, railways play an especially important role in long-distance COP transportation. This is the case for COP crop moves from Hungary to Italy, and from the Czech Republic and Poland to the North Sea ports. In addition, regions without navigable river connectivity (especially in Eastern Europe, such as in the North of Romania, or in Poland) use block trains for shipping COP crops towards Central Europe. Important international rail traffic of agricultural goods (including COP crops) was also identified between some German and Austrian regions and Northern Italy, and from Latvia and Lithuania towards Estonia. National rail traffic of COP is especially heavy in France, where it is mainly directed towards the North-Western ports handling COP crops and towards Alsace, where transhipment on IWW vessels on the Rhine takes place. Important national flows of rail traffic for COP crops were also found in Germany (mainly towards the ports of Hamburg and Bremen), in Romania (towards the port of Constanta) and in Austria, where important international transit traffic combines with heavy inter-regional traffic. The analysis of traffic flows confirmed that long-distance road transportation of COP crops should not concern substantial volumes, differently from short-distance transportation by truck. Heavy inter-regional road traffic of agricultural goods (including COP crops) was identified in Northern Italy and in North-Western France.

87 The Trans-European Transport Network (TEN-T) corridors have been defined by the European Commission mainly on the basis of overall traffic volumes. The TEN-T network comprises roads, railway lines, inland waterways, inland and maritime ports, airports and rail-to-road terminals throughout the EU. Besides the four core corridors for COP transportation identified by the study, the TEN-T network also includes the Atlantic, Mediterranean, North Sea-Mediterranean, Orient – East Mediterranean, and Scandinavian-Mediterranean corridors. Corridor development can be achieved through increased length and/or increased transportation capacity and/or technological upgrade of infrastructure. Within each corridor, the road, rail and inland waterway sections can grow in length to different extents.

88 The most important inland waterways for COP transportation are: Rhine; Moselle; North-South axis connecting the Netherlands, Belgium and northern France; Mittelland Canal connecting the Rhine-Ruhr region with Lower Saxony and Saxony-Anhalt; Danube.

89 To map the actual traffic flows of COP by road and rail, a dataset provided by the Joint Research Centre of the European Commission was used, containing data on transport flows between origin and destination regions at NUTS 2 level. As the dataset was referred to a wide and composite aggregate of products (“Products of agriculture, hunting, and forestry; fish and other fishing products”, here referred to as “agricultural goods” for sake of conciseness), this resulted in a certain degree of approximation in the analysis of COP transportation flows. Substantial volumes of a large variety of agricultural goods other than COP crops (forestry products, liquid milk, fruits and vegetables for processing and for direct consumption, sugar beets, etc.) are actually transported by truck and/or rail in both national and international traffic.
4.3 Study questions under Theme 1 – storage capacity

In the reply to question 1.1 (current need of storage capacity), the need of storage capacity at Member State level was quantified on the basis of assumptions defining different levels of surplus of available storage capacity with respect to the actual evolution of the COP supply balance over the relevant period. The detection of storage capacity shortages is hence heavily influenced by the assumptions made for the estimation of storage needs. If the estimate is based on production and export peaks recorded in the 2005-2015 period (base scenario), available storage capacity falls short of storage needs in several Member States. The most serious shortages of storage capacity in the base scenario (meaning those where total capacity falls short of both the maximum and the minimum need) affect four Member States: Germany, Lithuania, Poland and the United Kingdom. The shortages which emerged for Denmark, Estonia, Greece, Ireland, Latvia, Luxembourg and Sweden seem less critical, as the extent of the capacity gap to cover is smaller. However, the assumptions in the base scenario may lead to an overestimation of the occurrence and extent of storage capacity shortages at Member State level. A number of elements should actually be considered, namely:

i) investments in storage capacity are more likely to be determined by average production levels plus a security buffer: operators actually tend to avoid creating storage capacity which would not be utilised most of the time;

ii) no interviewed stakeholders highlighted the presence of structural shortages of storage capacity for COP in any Member State;

iii) the mapping of storage capacity did not consider temporary/emergency storage solutions like silobags, floating barges, etc., and did not consider the frequency of yearly stock turnover of storage facilities.

Two alternative scenarios were hence developed in order to make a better appraisal of potential structural shortages (rather than contingent) of storage capacity at Member State level. The first alternative scenario was based on average production and trade volumes over the 2005-2015 period. Under this scenario, available storage capacity falls below the minimum need only in the United Kingdom and Luxembourg. The second alternative scenario was derived from the base scenario by taking into account the net import/export position of each Member State. This scenario considered the different stock management models which can be applied in the two situations. Whereas the export of COP requires the availability of storage capacity in the period between harvest and actual export (whatever the length of such period), import flows usually can be managed in a more flexible way and be more tailored to the timing of consumption needs: with an accurate management of the timing of imports, a country can significantly reduce its storage needs in most years. In the second alternative scenario, available storage capacity falls below the minimum need in Latvia only. An analysis of the timing of peaks in COP exports and peaks in storage needs was also made. This allowed the detection of situations where lack of storage capacity in critical periods of the year may have put pressure on operators to “free up” storage space through increased/anticipated export sales. No issues were identified for most of the leading EU exporters of COP, with the exception of Lithuania and Poland. In the light of the above elements, and also considering the use of temporary storage solutions and the variable frequency of yearly stock turnover at storage facilities, it can be concluded that in general there is no structural shortage of COP storage capacity in the EU and that only a limited number of Member States, principally the Baltic states and Poland, may be affected. Further considerations on the strategic and operational implications of sub-optimal availability of COP storage capacity in a number of Member States, with special attention to

---

90 A minimum and a maximum storage need was estimated in each scenario. The minimum need was estimated on the basis of production only, whereas the maximum need was estimated by considering production, trade flows, beginning/ending stocks and consumption.

91 Structural shortages occur where storage capacity falls systematically short of storage needs in ordinary conditions, defined by average COP production levels. Contingent shortages occur where storage capacity falls short of storage needs in exceptional circumstances, defined by peaks in COP production.

92 The higher the frequency of stock turnover, the larger the volumes which can be handled by a storage facility over the year.
export-oriented ones, were developed under questions 3.1 (bottlenecks in storage capacity: see § 4.5.1) and 3.4 (influence of bottlenecks on EU internal and external trade in COP crops: see § 4.5.3).

As for question 1.2 (evolution of storage capacity), available storage capacity for COP has increased in all 28 Member States since 2005, although to a different degree. Increases were substantial in some Member States: this was mostly the case for Eastern EU ones, such as Bulgaria, Poland and Romania, but also for some Western EU ones, such as Spain. Storage capacity has increased by a relatively limited extent for most of the remaining Member States. The most significant investments in storage capacity, especially in terms of construction of new storage facilities, were mainly concentrated in a number of Eastern EU Member States (Czech Republic, Slovakia, Hungary, Poland, Romania and Bulgaria) which experienced an increase in COP production and/or exports over the 2005-2015 period (as highlighted in the reply to question 2.1). Investments in COP storage capacity in Western EU Member States have been more focused on the rationalisation, expansion and/or technological upgrading93 of existing storage facilities. In many cases, the most substantial investments in additional capacity were made in on-farm facilities, with some exceptions. Most of the investments in additional capacity were made at the wholesale/trade level in Hungary and France94, and at transportation hubs and the processing level in Spain.

The reply to question 1.3 (factors influencing the evolution of storage capacity) highlighted that a combination of multiple, and often interlinked factors, has influenced the evolution of COP storage capacity in the EU over the observed period. This evolution has been influenced firstly by factors related to the evolution of the COP sector and to the dynamics of the related market. The growth in COP yields and production and the increase in COP exports have resulted in an increase in storage needs. Increased volatility of COP prices has further encouraged the use of strategic stock management, which requires the availability of surplus storage capacity. Other influencing factors are related to trends in the downstream stages of the COP supply chains. The switch to just-in-time (JIT) inventory management models by an increasing number of millers, oilseed crushers and producers of compound feed has resulted in increased concentration of storage capacity in the upstream stages of the supply chain: the combined share of total capacity of individual on-farm facilities and farming cooperatives has increased from 48% to 51% between 2005 and 2015, whereas the share of processing facilities has remained stable at 9%. Also the need to ensure segregation of products with different quality features or origins has promoted investments in additional storage capacity. Policy-related factors such as the implementation of plans aimed at expanding/upgrading COP storage capacity have also had an influence. Other influencing factors are related to the functioning of the agribusiness system as a whole. This is the case of specific needs in terms of flexibility of COP storage solutions experienced by large-scale, multinational and multi-commodity agribusiness companies, and of the role played by the privatisation of the former state-owned agribusiness system in some Eastern EU Member States (Hungary, Poland and Romania). Other influencing factors are the greater availability of non-specialised, multi-purpose storage facilities at transportation hubs or, as a limiting factor, some constraints posed to the expansion of existing storage facilities.

Three profiles of prominent investors in COP storage capacity in the EU were identified in the reply to question 1.4 (investments in storage capacity). First, agribusiness cooperatives, focusing especially on technological upgrading and rationalisation of existing facilities; second, operators in the processing stage, focusing mainly on rationalisation of existing facilities in the Western EU Member States, and more on storage capacity expansion in Eastern EU Member States; and third, export-oriented traders operating at transportation hubs. Traders completed the largest individual capacity expansion projects, which concerned

93 For instance, installation of handling equipment with greater loading/unloading capacity, increase in the number and/or size of receiving bins, conversion of non-ventilated facilities into ventilated ones, etc.

94 In the case of France, investments in storage capacity by vertically integrated agribusiness cooperatives mainly operating as traders/wholesalers are included in this category.
especially storage facilities located at some ports, in both Western and Eastern EU Member States. The most common **funding solutions for investments in COP storage capacity** in the EU include internal resources and venture capital, especially used by large-scale processors and traders; public funding - mainly through EAFRD via Rural Development Programmes - has mainly been used for on-farm storage and for some investments made by agribusiness cooperatives.

### 4.4 Study questions under Theme 2 – logistical infrastructure

For the analysis of COP trade in the context of **question 2.1 (evolution of EU trade in COP crops)** a wide set of data on intra and extra-EU trade in the 2005-15 period was analysed. The average annual imports of COP in the EU in the 2005-15 period amounted to around 125 million tonnes: around 42% of imports come from extra-EU countries and 58% from intra-EU trade. The average annual exports of COP amounted to around 107 million tonnes: around 30% of exports go to third countries, and 70% are intra-EU exports. **EU COP exports grew at a higher pace than imports over the 2005-15 period**, mainly thanks to the **increasing importance of Eastern EU Member States in COP trade**. COP imports grew by 21%, mainly thanks to the increase of intra-EU volumes (+30%). The vast majority of the main importers (e.g. the Netherlands, Germany, Italy, Belgium, the United Kingdom) increased their import volumes from other Member States. The only notable exception was Spain, whose total imports decreased by around -6%. Compared to imports, export volumes showed a sharper increase over the observed period, growing by around 42 million tonnes, i.e. +50%. The largest part of the increase came from exports to third countries, which recorded a growth of around +111%. The sharpest increases were all recorded by Eastern EU Member States: Romania +750%, Poland +412%, Bulgaria +219%, Hungary +49%. Both Western and Eastern EU Member States recorded higher growth rates in extra-EU trade than in intra-EU trade. The most important suppliers of COP to the EU are Brazil, Argentina and Ukraine. Imports from South America mainly consist of soymeal and soybeans, whereas imports from North America mainly consist of soybeans and wheat (both soft and durum); maize accounts for nearly half of imports from non-EU European countries. The most important destination markets for EU COP are Northern Africa and Middle East countries, with Algeria, Saudi Arabia and Morocco as leading importers. EU COP exports to Africa mainly consist of soft wheat, while soft wheat and barley account for the majority of exports to Asia. Romania in particular increased its exports to extra-EU destinations in Northern Africa and the Middle East. The best export performances at Member State level have not always coincided with a comparable expansion of domestic COP production over the 2005-2015 period. Among the Member States which recorded the greatest increases in COP exports, Poland and France significantly increased their COP production (+16% and +13%, respectively), Germany and Romania recorded more limited increases (+6% and +5%, respectively), while Hungary experienced a slight contraction (-2%). Further considerations on the implications of the net trade position of individual Member States in terms of storage needs and of management of storage capacity were developed under questions 3.1 (bottlenecks for storage capacity: see § 4.5.1) and 3.4 (influence of bottlenecks on EU internal and external trade in COP crops: see § 4.5.3).

The reply to **question 2.2 (evolution of logistical infrastructure for COP crops)** showed that the growth in the length of the four core TEN-T corridors relevant for COP transportation over the 2005-2015 period greatly varied according to the corridor and the transport mode considered (road, rail or inland waterways). Very limited expansion concerned the Rhine-Alpine corridor, whereas more significant developments took place on the Baltic-Adriatic corridor (especially for roads), on the North Sea-Baltic corridor (especially for railways) and above all on the Rhine-Danube corridor, with significant expansion in network length for all transport modes.

---

95 Notable capacity expansion projects were completed, for instance, at the ports of Burgas (Bulgaria), Constanta (Romania), Barcellona, Cadiz, La Coruña, Malaga and Valencia (Spain).

96 The evolution of EU COP trade was analysed through a comparison of three-year averages: 2004-2006 vs. 2013-2015.
and especially for railways and inland waterways. Aside from the core corridors, significant expansion of the motorway network took place in Romania, Poland, Bulgaria and Hungary. The overall expansion of the railway and inland waterway networks in the EU was, in contrast, rather limited. Insufficient fairway depth remains an issue on a number of inland waterway sections which are of critical importance for long-haul COP transportation, especially on the Danube. Moving eastwards, locations with critical fairway conditions along the Danube are located in Germany (1 location), Austria (2 locations), Slovakia (3 locations), Hungary (5 locations), Bulgaria (3 locations) and Romania (4 locations). The reply to question 2.3 (factors influencing the evolution of logistical infrastructure) highlighted the important role of: strategical governmental actions; planning and approval procedures for infrastructural projects; “Public Private Partnerships” (PPP); user financing (mainly through toll charges); and research and technological development in the fields of construction and operation of transportation networks, mobility and intelligent transport systems, environmental and energetic aspects, and safety of operations. The reply to question 2.4 (investments in logistical infrastructure) marked the critical role of the European Union as the leading investor in logistical infrastructure, including infrastructure used for COP crops transportation. The Trans-European Transport Network Executive Agency (TEN-T EA) technically and financially manages expansion and upgrading on the TEN-T core corridors. A wide range of public funding solutions is available to finance investments in the EU logistical network. These include traditional funding schemes such as TEN/T and ERDF grants, the Cohesion Fund, European long-term investment funds (ELTIFs), and the Connecting Europe Facility (CEF), as well as innovative funding instruments such as the Structured Finance Facility (SFF), Loan Guarantee Instrument for TEN-T Network (LGTT), the EU Project Bonds and the Marguerite Fund. Also Concession Finance and Public-Private Partnerships (PPP) have played a role in the funding of infrastructural projects in the field of transportation.

4.5 Study questions under Theme 3 – bottlenecks

4.5.1 Bottlenecks for storage capacity

Bottlenecks in COP storage capacity are defined by the presence of a shortage of storage capacity with respect to storage needs. The assessment under question 3.1 was based on the average storage needs calculated for each Member State in the analyses made for answering to question 1.1. In this context, it should be underlined that these needs are more suitable for the identification of contingent shortages of storage capacity rather than of structural ones. It should also be noted that the extent of the shortages/surpluses of storage capacity in absolute terms is important to assess their strategic implications: the larger the capacity gap, the larger the investment in additional storage capacity required to address the situation. The relative measure of the extent of shortages/surpluses of storage capacity versus the average storage needs allows instead an assessment of their current operational implications. The smaller the share of average needs covered by the available storage capacity, the greater the pressure to free up storage capacity during the harvest period and in the following months, and the greater the difficulties for implementing strategic stock management.

97 The most critical fairway conditions were found in the section east of Vienna, on the Hungarian Danube, in the area around Milka/Belene/Coundur (BG) and in Cochirileni (RO).
98 The average storage need was calculated as simple average between the maximum and the minimum storage need.
99 Contingent shortages occur where storage capacity falls short of storage needs in exceptional circumstances, defined by peaks in COP production. Structural shortages occur where storage capacity falls systematically short of storage needs in ordinary conditions, defined by average COP production levels.
The Member States affected by the most critical bottlenecks in storage capacity are those combining a position of net exporters for COP crops (which would require a surplus of storage capacity to allow strategic stock management) with substantial shortages in storage capacity in both absolute and relative terms. With around 10 million tonnes of gap between capacity and storage needs, United Kingdom stood out as the Member State with the largest storage capacity shortage in absolute terms; it was followed by Germany (around 9.8 million tonnes), Poland (6.6 million) and Denmark (2.6 million). In relative terms, i.e. comparing the ratios between national storage capacity and storage needs, the most critical situation was again detected in the United Kingdom, where the current capacity only covers 65% of the average storage needs. Other significant shortages in relative terms were identified in the Netherlands (68%), Greece (69%) and Latvia (70%). In contrast, France emerged as the Member State with the largest surplus of storage capacity in both absolute value (18.7 million tonnes) and relative terms (storage capacity/storage need ratio equal to 126%). France was followed by Hungary (around 5.8 million tonnes / 141% ratio), Romania (around 5.3 million tonnes / 129% ratio) and Bulgaria (5.1 million tonnes / 158% ratio). Bulgaria – together with Malta and Cyprus – is the Member State with the highest ratio between storage capacity and storage needs. In principle, shortages in net importing countries like United Kingdom, Germany, Italy, Greece and the Netherlands appear to be less critical than shortages in net exporting countries such as Poland and Lithuania (but also Latvia and Sweden). The situation of Poland seems especially critical, as it combines a substantial gap in absolute terms with a rather low capacity/needs ratio for a net exporting country (79%). On a smaller scale, also Lithuania and Latvia combine significant gaps in absolute terms (above 1 million tonnes) with rather low capacity/needs ratios (81% and 70%, respectively). The upward trend in COP production observed in most of the Eastern EU Member States, and the consequent increase of their COP exports, might lead in the near future to the need of investments in additional storage capacity. These investments would be especially needed in the farming stage of the supply chain, as the achievement of greater efficiency in the use of available storage capacity through faster turnover of stocks is unfeasible at this stage.

Analyses under question 3.2 (evolution of bottlenecks for storage capacity) required: i) the quantification of the storage needs at the beginning and at the end of the observed period; ii) the quantification of the national shortages and surpluses of storage capacity for 2005 and 2015; iii) a comparison between the resulting values. The evolution of bottlenecks in storage capacity over the 2005-2015 period emerged as being balanced between Member States which improved their situation (13) and Member States where the situation worsened (15). The area where the most significant improvements were recorded was Eastern EU. It is worth reminding that increases in storage capacity were recorded in all 28 Member States, albeit to a different degree (see the reply to question 1.2 at § 4.3). Among the Eastern EU Member States which improved their situation, Romania switched from an initial shortage of storage capacity to a surplus of 5.3 million tonnes, and Poland managed to reduce its shortage by 3.9 million tonnes. In addition, Bulgaria and Hungary increased by 3.9 million tonnes and 4.8 million tonnes, respectively, the surpluses of storage capacity they already had. In Western EU, only Spain managed to achieve a substantial surplus of storage capacity (3 million tonnes), starting from a situation of balance between capacity and needs. Among the Member States where the situation worsened, Lithuania and Latvia moved from a surplus of storage capacity to a shortage of 1.3 million tonnes and 1 million tonnes, respectively. Six Member States experienced further aggravation of existing shortages of storage capacity, with Denmark, the United Kingdom and Germany being the most affected.

As for question 3.3 (factors influencing the evolution of bottlenecks for storage capacity), the main factors which directly influenced the evolution of bottlenecks in storage capacity are the increase of storage capacity – recorded in all the 28 Member States – and the evolution of storage needs, which grew in nearly all the Member States (with the exception of Romania and Cyprus, where storage needs decreased slightly). In general, Member States which successfully reduced their shortages of storage capacity or further improved their surpluses were the ones whose increased storage needs where more than compensated by the increase of their storage capacity. In particular, Bulgaria experienced an increase in storage needs of around +50%,
while it increased its storage capacity by nearly 100%; other significant examples are Poland, Spain, Hungary and Sweden. The situation improved thanks to increases in storage capacity also in the two Member States where storage needs remained fairly stable over the 2005-2015 period, i.e. Romania (which experienced a slight contraction of storage needs) and Italy (where the increase in storage needs was marginal).

4.5.2 Bottlenecks for logistical infrastructure

For a correct understanding of the replies to the study questions concerning bottlenecks in logistical infrastructure (presence, location and features of bottlenecks; evolution over the considered period; factors behind such evolution), it is essential to consider the “shared” nature of most transport infrastructure, i.e. the fact that transportation of COP crops takes place on the same network (roads, railways, inland waterways, and the related transportation hubs) used for transportation of other types of freight, and often also for passenger traffic. As a consequence, “general” bottlenecks along the routes which have a critical importance for COP transportation have to be regarded as relevant ones for the purposes of the assessment, as they directly or indirectly affect COP traffic flows along these routes.

The reply to question 3.1 (bottlenecks for logistical infrastructure) highlighted a number of bottlenecks in the logistical infrastructure used for COP transportation. Focusing on the core TEN-T corridors, the critical bottlenecks identified were the following:

- **Rhine-Danube corridor**: high number of critical fairway locations along the Danube (18, with 9 concentrated between Hungary and Romania); missing cross-border rail network interconnections between Germany and its neighbours, i.e. France, Austria and Czech Republic.
- **Rhine-Alpine corridor**: insufficient capacity on a number of rail sections in Germany and Italy; need of a better interconnection between the Belgian and Dutch rail networks and the German one (missing link in the Emmerich-Oberhausen section); need to upgrade access rail routes to the Swiss tunnels in Germany and Italy (Karlsruhe-Basel and Swiss border-Milano/Novara); need to upgrade inland waterways navigability in Germany and the Netherlands in terms of locks, bridge clearance and canal draught; missing motorway segment near Bad Oeynhausen (Germany).
- **Baltic-Adriatic corridor**: Semmering base tunnel and Koralm railway in Austria as main missing links along the corridor; need to upgrade multimodal cross-border connections between Poland, the Czech Republic, Austria, Slovakia and Slovenia.
- **North Sea-Baltic corridor**: break-of-gauge in the rail network between the Baltic States (1 520 mm “Russian” gauge) and Belgium, the Netherlands, Germany and Poland (1 435 mm standard gauge); non-electrified rail segments between Oldenburg and Wilhelmshaven (Germany) and between Elk (Poland) and the Lithuanian border; need to upgrade inland waterways navigability in Germany and the Netherlands in terms of locks, bridge clearance and canal draught; missing motorway segment near Bad Oeynhausen (Germany).

As for bottlenecks on a national and regional level, the assessment mainly focused on a selection of Member States hosting important COP production/consumption areas and/or critical sections of the TEN-T corridors and/or some of the main seaports for COP exports. The selection included France, Germany, Poland, Austria, Slovakia, Czech Republic, Hungary, Romania and Bulgaria. Critical bottlenecks emerged for all three transportation modes; more specifically:

- For *inland waterways*, the most serious bottlenecks were found in Romania, Bulgaria, Hungary, Austria, Slovakia. These bottlenecks are mainly related to the navigability of the Danube River.
- For *railways*, the critical bottlenecks identified in Germany, Austria and Hungary are related to congestion at key hubs, insufficient capacity on some core routes (caused - among other things - by competition with passenger traffic), and relatively low density of road-to-rail terminals. Critical bottlenecks for rail transportation identified in Bulgaria, Romania, Poland and Slovakia mainly derive
from outdated rolling stock and infrastructure (resulting in low commercial speed and poor service quality), limited development of intermodal transport solutions, and congestion in the hinterland of the ports of Constanta in Romania and of Gdansk in Poland. In a forward-looking perspective, also the heavy rail traffic towards the main seaports handling COP crops in North-Western France, as well as congestion around the critical hub of Paris, raise some concerns.

- As for road transportation, bottlenecks deriving from insufficient development of the motorway network and from poor quality/maintenance of ordinary roads were detected in Poland and Romania, whereas congestion issues were identified in some sections of core routes in Germany and the Czech Republic. Ageing of the truck fleet emerged as an issue in Romania, Bulgaria, Hungary, Czech Republic and Poland.

Some Member States (especially Austria, Germany, the Czech Republic and Hungary) were also found to face challenges deriving from the substantial volumes of transit freight traffic, originating and terminating outside their national territories. Such transit traffic flows compete with COP traffic flows originating and/or terminating in the country for the available network capacity. Finally, important COP production areas lacking adequate transportation infrastructure and direct connections with key logistical hubs were found in Bulgaria (Dobrich region) and Romania (Timis region).

The reply to question 3.2 (evolution of bottlenecks in logistical infrastructure) focused on the main transport corridors (EU level) and on national transportation networks. The analysis at EU level focused on the progress of corridor development/upgrade, measured through key performance indicators (KPI); this was supplemented by the review of selected infrastructural/research projects100 whose completion allowed to address critical bottlenecks for COP transportation. The analysis at national level focused on the evolution of a synthetic indicator, the Logistics Performance Index (LPI), for a selection of Member States: Austria, France and Germany among the highest-ranked ones; Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia among the lowest-ranked ones. Whereas improvements were observed in the LPIs of most of the lowest-ranked Member States (albeit not to such an extent to lead to remarkable changes in the ranking), the most noteworthy trend emerged from the analysis was a deterioration of the overall logistical performance in Austria (especially as far as railways are concerned) and Germany (for all transportation modes).

In the reply to question 3.3 (factors influencing the evolution of bottlenecks in logistical infrastructure), the review of national plans for the development of logistical infrastructure recently approved in Germany, Czech Republic, Bulgaria and Slovakia highlighted the role of financial support to infrastructural investments as a critical factor in the past and future evolution of bottlenecks for logistical infrastructure used for COP crops.

4.5.3 Influence of bottlenecks on EU internal and external trade in COP crops

The reply to question 3.4 investigated the possible impact of bottlenecks in storage capacity and logistical infrastructure on EU internal and external trade in COP. It has to be considered that the evolution of trade flows is the result of a wide combination of factors, such as: national and international macroeconomic trends, changes in border protection measures, exchange rates, changes in international trade agreements, changes in microeconomic conditions (production, consumption, costs, etc.). Bearing in mind these considerations, the analysis of the findings from Themes 1, 2 and 3 provided a synoptic view of the possible influence of the interaction among bottlenecks in storage capacity and logistical infrastructure on EU internal and external trade in COP crops. The focus of the assessment moved from the most critical situations identified at Member State level to an EU-wide perspective.

100 Construction of a new lock at the crossroad of Meuse and Albert Canal (Belgian/Dutch border); construction of a new rail bridge above the Danube in Deggendorf, Bavaria (Germany); completion of a study on the improvement of the navigability on the Danube river.
The case of France showed that the absence of bottlenecks in both storage capacity and logistical infrastructure is an important condition for a successful export performance. A surplus of storage capacity and state-of-the-art logistical infrastructure are needed to ensure strategic management of stocks and to sustain the expansion of domestic COP production and exports.

The assessment identified a number of Member States which have achieved or strengthened a position of net exporters of COP over the observed period. However, some of these Member States are confronted with sub-optimal availability of storage capacity compared to the current storage needs, and even more so to future storage needs, unless investments in additional capacity are made. Among these Member States, Poland, Lithuania and Latvia are also affected by rather serious logistical bottlenecks, which are only partially being addressed. In particular, a number of unsolved bottlenecks in Poland’s logistical infrastructure further aggravate the country’s suboptimal availability of storage capacity for COP (in spite of important efforts to close the gap in recent years). This critical situation may prevent Poland from keeping its current COP production and export performance in the future.

A number of Eastern EU Member States - Hungary, Romania and Bulgaria in particular - have substantially increased their COP exports also thanks to substantial investments in storage capacity, which allowed them to achieve a surplus over current storage needs. COP producers in these Member States mainly use the Rhine-Danube corridor to reach destination markets for both internal and external trade. The assessment showed that this critical corridor for COP transportation is affected by a number of serious bottlenecks which - if not adequately addressed – may hinder the current COP production and export performance of these Member States, also because no alternatives to the use of this corridor are currently available.

Finally, on an EU-wide perspective, the assessment highlighted the need to address a number of critical bottlenecks which impede traffic flows in both internal and external trade in COP crops. These critical bottlenecks are mainly related to capacity issues - which result in traffic congestion - along a number of sections of key corridors and/or at critical hubs. In contrast, no significant bottlenecks were found to derive from shortage of storage capacity in the main transhipment areas and logistical hubs. There is actually ample availability of storage capacity at key transportation hubs in the Netherlands, in Belgium, and at the port of Constanta in Romania. Besides the aforementioned bottlenecks affecting the Rhine-Danube corridor, capacity issues in the German and Austrian transportation network are a major cause of concern, and especially affect long-distance transportation of COP by rail. Logistical infrastructure in Austria and Germany has to deal with the combined pressure of international transit traffic and domestic inter-regional traffic. This happens because substantial volumes of COP crops need to cross Germany and/or Austria to reach their final destination within the EU or in third countries. On a smaller scale, also the bottlenecks on corridors crossing the Alps through Austria or Switzerland to reach Italy have negative implications for EU internal trade in COP crops, as Italy is a major net importer of COP, and imports substantial volumes from other Member States.

4.6 Case studies

4.6.1 EU case studies: Germany, Hungary, Romania

The analysis of best practices in COP storage and logistics carried out in the case study on Germany, with special attention to best practices aimed at addressing bottlenecks in storage capacity and logistical infrastructure for COP crops, confirmed that inland waterways and railways are the most efficient solutions for long-distance transportation of COP crops. Locations for new storage capacity should therefore be chosen with access to waterways or railways, and storage facilities must be equipped with high-performance handling equipment, to ensure a fast loading and unloading of different transportation means (barges, railcars, trucks)
at the same time. Storage facilities should also allow flexible use of capacity. The case study also highlighted the importance of transnational coordination and collaboration to improve long-distance transportation of COP crops, with a view to overcoming barriers to interoperability. This especially applies to rail transportation, where these barriers are more important.

The case study on Hungary started from the consideration that the country is a net exporter of COP, with annual production of around 12-17 million tonnes and annual exports – mainly consisting of wheat and maize – of about 4.5 million tonnes. When Hungary entered into the EU in 2004, its COP storage capacity amounted to around 14.7 million tonnes (2005 data), and most of its storage facilities relied on outdated technology. COP storage capacity in Hungary increased up to 20.1 million tonnes (+37%) between 2005 and 2015. Such increase is at least partially explained by the fact that in 2005 and 2006 Hungary implemented the largest intervention purchases compared to domestic production in the history of the EU, for a total volume of 8.1 million tonnes of cereals. The need to manage these huge cereal stocks promoted investments in storage facilities, also through the support of the EU SAPARD program and of the national RDP. Investments in additional storage capacity, especially at farm level, allowed the country to store all of its COP production without any sales pressure. Looking at the Hungarian internal market, a rather stable human consumption, in combination with an expected growth in feed consumption and industrial uses, may result in a reduction of around 1 million tonnes of COP volumes available for export to both EU and non-EU destinations in the near future. The geographical nature of Hungary as a land-locked country has an influence on the trade routes and on the destination markets for Hungarian exports (mainly Italy for maize exports, and mainly Germany for oilseed exports). Hungary was found to have a surplus of storage capacity; however, such capacity is not evenly distributed among the different regions, as it is mainly concentrated in the Northern and Eastern part of the country. Finally, the country’s logistical infrastructure is improving, but inefficiencies are still present: the loading/unloading capacity at rail-served facilities should be increased to 1 000 tonnes/day; bottlenecks from insufficient fairway conditions on the Danube river, affecting barge transportation of COP crops, should be addressed as well.

The case study on Romania took inspiration from the deep transformation experienced by the domestic agricultural sector in the last years. Between 2005 and 2010, a massive consolidation of farms took place in Romania, with the number of small farms (up to 10 ha) decreasing by around 800 000, and with the number of larger farms above 100 ha increasing by 3 300. A consistent trend was observed in terms of agricultural area, with around 1.4 million ha moving from smaller farms to larger farms. Together with this consolidation process, also COP yields and production constantly increased from 1990 onwards. After the country’s accession to the EU in 2007, the increasing production surplus was more and more channelled into export to other EU Member States and to third countries. Most of Romanian COP exports pass through the port of Constanta and/or through the Danube river. A significant part of the investments in storage capacity and logistical infrastructure was concentrated in these two areas, with a parallel growth in on-farm storage capacity due to the above mentioned consolidation process. Romania has currently around 23.4 million tonnes of storage capacity (a +45% increase from 2005). Around 42% of the national storage capacity is operated by traders, while another 38% is at farm level; around 6% of the storage capacity is located at ports, while the remaining share is split among the different categories of processors. In terms of geographical distribution, around 8.6 million tonnes of storage capacity (37% of total) are located in the North and South-East Region (RO 2), while 6.3 million tonnes (27% of total) are located in the South-West and West Region (RO 4). The North-West and Centre region (RO 1) is the one with the lowest storage capacity (around 2.2 million tonnes, 9% of total), while the South Muntenia and Bucharest Region (RO 3) has 6.3 million tonnes of capacity (27% of total). All the four macro-regions currently have a surplus of storage capacity with respect to their storage needs. However, an analysis on the turnover of the facilities revealed that shortage issues could emerge in the future, especially in the North-West and Centre (RO1) and North and South-east (RO2) regions. The assessment of logistical infrastructure revealed that the largest volumes of COP are moved in the regions which are most active in export trading, i.e. in North and South-East Region (RO2), as well as in the regions
with the highest number of large-scale processors, i.e. in South Muntenia and Bucharest Region (RO3). Since most COP tonnage moves by truck¹⁰¹, and since truck owners prefer to serve large local processors and large export traders, North and South-East Region (RO 2) and South Muntenia and Bucharest Region (RO 3) are those with the most important truck fleet, while North-West and Centre Region (RO 1) and South-West and West Region (RO 2) face a lack of available trucks. Finally, it should be noted that the bulk of COP exports flowing from Romanian ports have to pass the Turkish straits, which are recognized as one of the most critical chokepoints for international grain trade.

4.6.2 Case study on China

The case study on China highlighted the presence of a number of bottlenecks for EU exports of COP, meats and dairy products to that country. These bottlenecks concern both storage and logistical infrastructure.

No significant bottlenecks concerning storage were detected in the EU, whereas some bottlenecks were found in China, namely: i) shortage of cold storage capacity, and unsatisfactory technological levels in the cold storage facilities of a number of Chinese ports; ii) insufficient COP storage capacity at some Chinese ports.

More serious bottlenecks concerning logistical infrastructure were identified in the EU, in transit between the EU and China, and in China. Bottlenecks in the EU are related to operational constraints at the port of Rouen (which cannot handle fully loaded Panamax dry bulk vessels used for COP transportation), to traffic congestion issues in the hinterland of some of the main EU ports involved in containerized transportation of meat and dairy products to China, and to the sometimes complex logistics of refrigerated containers moving from inland locations in the EU to the main export ports. Serious bottlenecks in transit between the EU and China were identified: i) infrastructural and operational bottlenecks affecting the “land bridge” routes between the EU and China, which contribute to determine the overwhelming prevalence of seaborne transportation over rail transportation; ii) long duration and complexity of warehouse-to-warehouse moves requiring seaborne transportation for containerized EU meat and dairy products exported to China; iii) differences in inspection and quarantine standards for agricultural products; iv) critical bottlenecks (“chokepoints”) along maritime routes between EU and Chinese ports¹⁰². Finally, a number of serious bottlenecks were detected also in China, namely: i) limited number of large-scale specialized deep-water berths in some Chinese ports; poor technology in handling and distribution systems; limited transit storage capacity; ii) congestion issues at Chinese ports and in their hinterland, modal imbalance and poor links among the different transport modes; iii) shortage of equipment for cold chain transport, aging cold chain facilities, outdated logistics technology and equipment, and lack of funds for upgrading (all these bottlenecks affect handling and distribution of inbound EU meats and dairy products).

A number of solutions aimed at addressing the main bottlenecks for EU exports of COP, meat and dairy products to China was identified: i) promoting an upgrade of port infrastructure in China; ii) improving connections between Chinese ports and their hinterland, and promoting a more balanced modal split in freight transportation; iii) promoting an upgrade of operation and management models of Chinese ports; iv) promoting the improvement of logistical know-how in China; v) promoting new construction and upgrade of cold chain infrastructure in China, and improving operational practices and know how in the cold chain logistics sector; vi) enhancing the capacity of transport companies in China, and reducing logistic costs on EU-China land routes promoted by the “Belt and Road Initiative”; vii) reducing risks at “chokepoints” along maritime routes connecting EU ports with Chinese ports.

¹⁰¹ Especially on short-distance moves from cultivation areas to local customers or transhipment points to other transportation modes, or also on longer-distance moves if no modal alternatives are available.
¹⁰² Some of these “chokepoints” (Suez Canal, Strait of Bab-al-Mandab, Strait of Malacca) affect all EU origins, whereas other “chokepoints” (Dover Strait; Strait of Gibraltar; Turkish Straits) are relevant just for some EU origins.
The case study also mapped the main Chinese investments in logistics in the EU, and assessed their potential influence on EU exports of COP, meats and dairy products to China. The main Chinese investments in the EU are related to the setup of logistic parks in Csepel (Hungary) and Bremerhaven (Germany), the revamping of the Piraeus Port in Greece; the construction of the Serbia-Hungary Railway; the acquisition of air cargo terminals in the airports of Toulouse (France), Parchim (Germany) and Ciudad Real (Spain). In the future, all these investments should provide new transport solutions and alternative routes for exports of EU COP, meats and dairy products to China, based on a combination of seaborne and land transportation (or on airborne transportation for high-value products).

4.7 Solutions to address bottlenecks

4.7.1 Solutions to address bottlenecks for storage capacity

The analyses made under Theme 1, as well as the replies to questions 3.1, 3.2 and 3.3 under Theme 3, suggest that the most straightforward solution to overcome a deficit of storage capacity in a certain area is investing in additional storage capacity, both through expansion of existing facilities and through construction of new ones. These two processes can also be combined with a rationalisation of the storage system through closure of poorly located and/or technologically obsolete and/or inadequately sized storage facilities. However, it also emerged from the reply to question 3.5 (solutions to overcome existing bottlenecks for storage capacity) that in order to effectively address bottlenecks, the linkages between the storage system, COP crops logistics and the related infrastructure should be carefully considered, in order to devise and implement integrated solutions addressing bottlenecks in both storage and transportation of COP crops (see also § 4.7.2). It actually emerged from the assessment that the appropriate location of the additional storage capacity (e.g. at key transportation hubs or export terminals) is of critical importance, together with the access to adequate logistical infrastructure. Wherever bottlenecks for storage capacity affect export-oriented operators, these should focus their investments in additional storage capacity at locations offering access to inland waterways and railways, which offer efficient transport solutions capable of handling large volumes of products, and/or close to main inland transportation hubs in the transport corridors of interest, and/or directly at the preferred seaports for export shipping.

In the reply to question 3.6 (opportunities for future investments in storage capacity), the adoption of an “integrated approach” aimed at addressing bottlenecks in both storage capacity and logistical infrastructure was found to be highly advisable in terms of access to a wider range of public funding options than those offered by EAFRD via Rural Development Plans. This approach also presents interesting opportunities for the development of collaborative structures (such as partnerships, joint ventures, etc.) among the supply chain actors: agribusiness cooperatives, independent grain traders/wholesalers, processors of COP crops and operators in the logistics sector (from third-party logistic providers to port authorities).

4.7.2 Solutions to address bottlenecks for logistical infrastructure

The “shared” nature of the infrastructure used for the transportation of COP crops (which is used also for other freight traffic, and often also for passenger traffic), must be considered also when reasoning about solutions to address bottlenecks for logistical infrastructure and opportunities for future investments. An important implication of this feature is that solutions to address “general” bottlenecks in the transportation network (e.g. through capacity increases, improved interoperability, promotion of intermodal transportation, etc.) are directly or indirectly beneficial also to the transportation of COP crops. This applies to both
solutions to address bottlenecks which concern the core transportation corridors for COP crops and solutions to address infrastructural bottlenecks at national/regional level.

In the reply to question 3.5 (solutions to overcome existing bottlenecks for logistical infrastructure), a number of potential solutions to address the bottlenecks identified under question 3.1 was put forward. These solutions were grouped by geographical level (EU-wide solution by core TEN-T corridor concerned; national solutions) and by transport mode (road, rail, inland waterways).

Without going into national details, the key elements of the proposed solutions for the core TEN-T corridors for COP transportation are: completion of the identified missing links; capacity increases and technological upgrade at critical sections and key hubs; enhancement of intermodal transportation; harmonisation of technological standards (gauges, signalling, electrification and train control systems for railroads; locks, bridge clearance and canal draught for inland waterways).

The reply to question 3.6 (opportunities for future investments in logistical infrastructure) highlighted a number of opportunities focusing on specific areas and aimed at addressing some of the critical bottlenecks identified under question 3.1. The priority areas identified were:

1. **improvement of fairway conditions of inland waterways**, especially along the Danube river;
2. **improvement of interoperability of railways** in terms of suitable infrastructure and rolling stock and of availability of skilled personnel, in order to improve efficiency and to reduce waiting times at cross-border terminals;
3. **improvement in regional transport connectivity**, aimed at addressing traffic congestion issues on motorways and railways through capacity expansion at critical locations/sections, and through construction of bypasses to circumvent chokepoints via alternative routes.
5 BIBLIOGRAPHY

General interest
EUROSTAT (2015a), Eurostat regional yearbook, Eurostat.

Theme 1: Storage capacity

Theme 2: Logistical network
Bundesministerium für Verkehr, Bau und Stadtentwicklung; Bayerisches Staatsministerium des Innern – Oberste Baubehörde; autobahnplus A8 GmbH (2010), Bundesautobahn A 8 Augsburg – München ÖPP-Betreibermodell.
European Court of Auditors (2015), Inland Waterway Transport in Europe: No significant improvement in modal share and navigability conditions since 2001.
European Court of Auditors (2016), Rail freight transport in the EU: still not on the right track - Special Report No. 8.
European Court of Auditors (2016), Maritime transport in the EU: in troubled waters – much ineffective and unsustainable investment.
EUROSTAT (2016), Road freight transport methodology, Eurostat.
Theme 3: Bottlenecks related to storage capacity and logistical infrastructure

Bailey R. and Wellesley L. (2017), Chokepoints and Vulnerabilities in Global Food Trade, Chatham House, the Royal Institute of International Affairs


DB Mobility Logistics AG (2010), Deggendorf: Neue Bahnbrücke über die Donau in Betrieb.

European Commission, General Directorate Infrastructural Networks, Logistics and Mobility Systems (2014), Results of the RAILHUC project - Concept for effective integration of railway hubs into TEN-T, regional and local transport systems.

European Commission (2014a), North Sea – Baltic. Core Network Corridor Study.


European Commission (2014c), Rhine-Danube. Core Network Corridor Study.

European Commission (2014d), Rhine-Alpine Core Network Corridor Study.


European Investment Bank (EIB) (2015), Belgium: *Unlocking inland waterways in the heart of Europe with the EIB support (press release and presentation)*.


Ministry of Transport, Construction and Regional Development of the Slovak Republic (2016), *Strategic Transport Development Plan of the Slovak Republic up to 2030 – Phase II*.


6 ANNEXES

List of the annexes provided as separate documents:

1. Annex 1 - Case study on Germany
2. Annex 2 - Case study on Hungary
3. Annex 3 - Case study on Romania
4. Annex 4 - Case study on China
5. Annex 5 - Maps on storage capacity and logistical infrastructure
6. Annex 6 - Methodology
7. Annex 7 - Main trends in the European transport sector
8. Annex 8 - Product-specific analysis on COP trade
9. Annex 9 - List of performed interviews
10. Executive summary (in English and French)
11. Abstract (in English and French)
HOW TO OBTAIN EU PUBLICATIONS

Free publications:
- one copy:
  via EU Bookshop (http://bookshop.europa.eu);
- more than one copy or posters/maps:
  from the European Union’s representations (http://ec.europa.eu/represent_en.htm);
  from the delegations in non-EU countries (http://eeas.europa.eu/delegations/index_en.htm);
  by contacting the Europe Direct service (http://europa.eu/europedirect/index_en.htm) or calling 00 800 6 7 8 9 10 11 (freephone number from anywhere in the EU) (*).

(*) The information given is free, as are most calls (though some operators, phone boxes or hotels may charge you).

Priced publications: