Modelling of Milestones for achieving Resource Efficiency

Turning Milestones into Quantified Objectives - further analysis on selected indicators

European Commission, DG Environment
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# Table of Contents

## DOCUMENT INFORMATION

## TABLE OF CONTENTS

### 1. INTRODUCTION

1.1 Background  
1.2 Objectives of the study

### 2. MATERIAL CONSUMPTION AND RESOURCE PRODUCTIVITY

2.1 The indicator and current EU policy  
2.2 Status of the indicator  
2.3 Current progress in the EU and Member States  
2.4 Target setting  
2.5 What are the expected risks and consequences of setting the target?

### 3. IMPROVING PRODUCTS AND CHANGING CONSUMPTION PATTERNS

3.1 The indicator and current EU policy  
3.2 Status of the indicator  
3.3 Current progress in the EU and Member States  
3.4 Target setting  
3.5 What are the potential risks and consequences of setting the target?

### 4. SUSTAINABLE PRODUCTION: BOOSTING EFFICIENT PRODUCTION

4.1 The indicator and current EU policy  
4.2 Status of the indicator  
4.3 Current progress in the EU and Member States  
4.4 Target setting  
4.5 Key actors affected

### 5. TURNING WASTE INTO A RESOURCE

5.1 The indicators and current policy  
5.2 Total waste generation per capita  
5.3 Municipal waste generation per capita  
5.4 Residual waste
6. **RESEARCH AND INNOVATION**
   6.1 The indicator and current EU policy
   6.2 Status of the indicator
   6.3 How ambitious should the target be?
   6.4 What are the expected risks and consequences of setting the target?

7. **ENVIRONMENTALLY HARMFUL SUBSIDIES**
   7.1 The indicator and current EU policy
   7.2 Status of the indicator
   7.3 Current progress in the EU and Member States
   7.4 Target setting
   7.5 What are the expected risks and consequences of setting the target?

8. **ENVIRONMENTAL TAX REFORM**
   8.1 The indicator and current EU policy
   8.2 Status of the indicator
   8.3 Current progress in the EU and Member States
   8.4 Target setting
   8.5 What are the expected risks and consequences of setting the target?

9. **WATER**
   9.1 Definitions and objectives of current EU policy
   9.2 Status of the indicators
   9.3 Current progress in the EU and Member States
   9.4 Target setting
   9.5 What are the expected risks and consequences of setting the target?

10. **LAND**
    10.1 Definitions
    10.2 The indicator and current EU policy
    10.3 Status of the indicator
    10.4 Current progress in the EU and Member States
    10.5 Target setting
    10.6 What are the expected risks and consequences of setting the target?

11. **FOOD: HEALTHY AND SUSTAINABLE DIET**
    11.1 A healthy and sustainable diet
11.2 The indicator and current EU policy 108
11.3 Status of the indicator 108
11.4 Current progress in the EU and Member States 109
11.5 Target setting 111
11.6 Key actors affected 111

12. FOOD: FOOD WASTE 112
12.1 Definitions 112
12.2 The indicator and current EU policy 113
12.3 Status of the indicator 114
12.4 Current progress in the EU and Member States 117
12.5 Target setting 118
12.6 What are the expected risks and consequences of setting the target? 121
1. Introduction

1.1 Background

Europe’s successful economic development over the past century is based on the ever-increasing use of natural resources over time. Nonetheless, if we continue with our current patterns of consumption, it would be impossible to avoid irreversible damage to the planet’s natural environment and jeopardise its very ability to provide these resources and the ecosystem services that we are so dependent upon. Resource efficiency is seen as the path where economic development and human well-being can progress with lower resource use and environmental impacts.

The Flagship Initiative for a Resource-Efficient Europe

The European Commission published in January 2011 its Flagship Initiative for a Resource Efficient Europe\(^1\) under the Europe 2020 Strategy. It establishes the importance of using all types of natural resources (and not just energy) efficiently for the European economy and environment. The Initiative is expected to boost productivity, improve competitiveness, drive down costs and secure growth and jobs for Europe. The Flagship Initiative provides a framework for policy actions for the next decade, which will guide the Commission’s efforts in many different policy areas. In particular, all the relevant policies and actions related to production and consumption should take resource efficiency issues into account.

Under the Flagship Initiative, the European Commission published a Roadmap to a Resource Efficient Europe\(^2\) in September 2011. This Roadmap provides a framework for future actions and milestones to be met by 2020. The achievement of these milestones would allow reaching the necessary structural change for a Resource Efficient Europe in 2050. These milestones include strategic goals on key aspects for Resource Efficiency such as the economy, the natural capital and ecosystem services, and specific issues in important sectors: food, mobility and buildings. Some of these milestones specified in the Roadmap are easily quantifiable targets, but others have not yet been clearly quantified. Therefore, the development of a more specific set of targets is necessary in order to progress with the Flagship Initiative’s next steps and actions. The Roadmap for a resource efficient Europe states that the setting of these specific indicators and targets should take place by 2013.

Setting targets related to resource use

Targets are specific policy objectives. They are given by a defined performance indicator that can be measured or quantified, e.g. a reduction of domestic material consumption by x % compared

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A target sets a clear orientation, it provides concrete guidance and helps prioritise actions to achieve a policy objective. If properly enforced and supported by an appropriate mix of policy measures to ensure fair global market conditions and a level playing field, it can be a powerful approach to addressing environmental issues. Long-term objectives provide actors in society, e.g. governmental organisations and companies, certainty, stability and time to achieve the target in the most efficient manner.

Scientific knowledge about environmental thresholds and carrying capacity can serve as a starting point for defining acceptable levels of risk and environmental impact on which a target could be set. For resources such as fossil fuels, land, water and fish stocks, there is some understanding of the limits to when long-term depletion and degradation occurs. For other energy and material resources, the limitation of the resource base is less clear. Instead, the knowledge of the absorption capacities of nature's ecosystems could be used for target setting. A clear example of this is the limit of a maximum 2°C rise in global mean temperature, or 350 ppm CO₂ in the atmosphere, which is used to define EU's GHG emission targets.

An important aspect when proposing targets is balancing ambition, feasibility and acceptance to determine the most appropriate level. The majority of indicators in the proposed basket of indicators have strong links to socio-economic activities and entities, e.g. material consumption and GHG emissions. Some of the indicators are however more relevant on a specific ecosystem scale rather than a national/ economy-wide level, e.g. river basins are more suitable for water indicators, human harvest or HANPP (Human Appropriation of Net Primary Production) is more relevant for agro-ecological zones. Another important consideration is how EU-wide targets could be disaggregated to Member State level or across different sectors of the economy. Some possible approaches include disaggregation according to equity of effort sharing, relative ease/difficulty to achieve the target, demographic characteristics, economic structure and features of the ecosystems including climate.

The cost-effectiveness of setting a target is an important aspect of any target-setting exercise. Although the Flagship Initiative recommends a clear vision and objectives to guide resource efficiency policy in the EU, target oriented policy may not always be the best approach. Depending on how a target and its associated indicator are defined, the mix of supporting policy instruments, and how they are implemented, target setting could lead to unintended consequences. This is of particular importance when considering how the use of resources is interlinked. For example, the targets set for biofuels in transport have demonstrated that it can have significant consequences for global land use.

Whatever the approach chosen to set targets for resource use and efficiency, it is advisable that the targets are based on relevant existing indicators, and that the knowledge of resource use and its environmental impacts is well developed.

1.2 Objectives of the study

The overall aim of this study is to analyse the suitability of establishing quantified resource efficiency targets for the milestones proposed by the European Commission under the Flagship Initiative for a Resource-Efficient Europe.
The study first performed a preliminary analysis to provide an overview of available indicators and their suitability for setting targets. The results of this first task is available online: http://ec.europa.eu/environment/envco/resource_efficiency/pdf/Task1_report.pdf

In a series of meetings in early 2013, the European Resource Efficiency Platform (EREP) Working Group II\(^3\) and the European Commission discussed the indicators and targets for the different thematic areas mentioned in the Resource Efficiency Roadmap. Based on this, a selection of indicators and thematic areas was found to have potential for the Commission to take forward.

This document summarises the additional analysis performed on selected indicators, which was used as a basis for the Working Group meetings. The indicators analysed were:

- **Materials** (material consumption and resource productivity)
- **Production** (proportion of companies with certified Environmental Management Systems)
- **Consumption** (value and number of public procurement contracts that include GPP criteria)
- **Waste** (total waste generation, municipal waste generation, residual waste)
- **Research and innovation** (public expenditure on resource efficiency)
- **Environmentally harmful subsidies** (fossil fuel subsidies)
- **Environmental tax reform** (share of environmental tax revenue)
- **Land** (land take)
- **Water** (water abstraction, Water Exploitation Index (WEI) and WEI+)
- **Food** (healthy and sustainable diet, and food waste)

Each indicator was analysed in a similar manner considering the following dimensions:

- Current EU policy
- Status of the indicator (e.g. availability, data quality, etc.)
- Current progress in the EU according to the indicator
- Proposal of targets with different levels of ambitions
- Expected risks and consequences of setting targets

Due to limited time and undefined means to fulfilling the targets, the assessments of indicators and targets are based on incomplete information and research. The results presented in this document reflect the project team’s best estimate and personal opinion at the time of the study and is not to be perceived in any way as the opinion of the European Commission.

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\(^3\) European Resource Efficiency Platform (EREP), Working Group II: Setting objectives and measuring progress.
2. Material consumption and resource productivity

The European Commission’s Roadmap to a Resource Efficient Europe⁴ provides a framework for future actions and milestones for resource efficiency to be met by 2020. Each of the milestones in the Roadmap mentions or proposes possible indicators that could be used to track progress of resource efficiency in the EU. In the Roadmap, the Commission proposed resource productivity⁵ as a provisional lead indicator as the best available proxy for resource efficiency.

After a preliminary analysis of potential indicators and respective targets for material consumption and resource productivity, the EREP Working Group II⁶ and the Commission decided to propose that the following indicators be considered for the on-going work to set objectives and measure progress of resource efficiency in Europe:

- **Resource productivity** (GDP/DMC and GDP/RMC)
- **Material consumption** (DMC and RMC)

This document briefly describes the status and suitability of these indicators to support the Commission’s future work.

### 2.1 The indicator and current EU policy

The European Union has implemented a broad range of policies to encourage the efficient use of resources in society. In 2005, the European Commission proposed a Strategy on the Sustainable Use of Natural Resources⁷ used in Europe. The objective of the strategy was to reduce the environmental impacts associated with resource use while allowing the economy to grow. The strategy introduced the concept of decoupling and called for delinking environment pressures such as resource use from economic growth.

The Action Plans on Sustainable Consumption and Production (SCP) and Sustainable Industrial Policy (SIP) were adopted in 2008 to support the economic competitiveness of the EU industry through improved energy and resource efficiency, as well as an improved capacity to develop appropriate technological solutions. This approach aimed at addressing existing production techniques, products and consumption practices and helping the EU to attain its goals related to sustainable development⁸. One of the goals of the SCP-SIP Action Plan is to improve the energy and environmental performance of products. This means setting ambitious standards throughout the internal market, ensuring that products are improved using a systematic techno-economic and environmental approach to incentives and procurement.

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⁵ GDP (= Gross Domestic Product) to represent economic development and DMC (= Domestic Material Consumption) to represent resource consumption
⁶ European Resource Efficiency Platform (EREP), Working Group II: Setting objectives and measuring progress.
⁸ As defined by the renewed EU Sustainable Development Strategy, Council of the EU 10917/06.
Concerns of the supply security of certain resources, led to the Raw Material Initiative\textsuperscript{9}. Resource efficiency was identified as key to reducing supply risk and price volatility of commodities. In relation to this the Commission identified 14 economically important raw materials (so-called critical raw materials), which are subject to a higher risk of supply interruption\textsuperscript{10}. These materials tend not to be used in large quantities, but are key to vital technologies and industries in Europe.

The Flagship Initiative for a Resource Efficient Europe\textsuperscript{11} under the Europe 2020 Strategy establishes the importance of using all types of natural resources (including energy) efficiently for the European economy and environment. The Initiative provides a framework for policy actions for the next decade, which will guide the Commission’s efforts in many different policy areas. In particular, all the relevant policies and actions related to production and consumption should take resource efficiency issues into account.

2.2 Status of the indicator

2.2.1 Material resource consumption

Material Flow Analysis (MFA) is an established framework\textsuperscript{12} for documenting and analysing an economy’s material resource use. MFA keeps track of all materials that enter and leave the economy within one year by applying the mass balance principle. MFA therefore provides a biophysical account of the level of material flow in national economies analogue to the concept of GDP in national economic accounting. These flows incorporate extracted or imported materials to be used within the national economy, and all material released to the environment as wastes, emissions or exports to other economies or added to societal stocks.

In economy-wide MFA (EW-MFA), domestic extraction of material resources, imports and exports are considered as inputs and outputs to the economy, while what happens inside the economy is usually treated as a black box. EW-MFA is compiled along a number of flow aggregates (typically biomass, fossil fuels, metal ores and non-metallic minerals) can be derived from the national economy statistics for the accounting period of one year, expressed in metric tonnes. The EW-MFA of all EU Member States can be aggregated to provide a view of material flows in the EU as a whole (intra and extra EU imports and exports are separated). EW-MFA focuses on used extraction that is all materials extracted with the intention of further using them in the economic processing and thus to derive economic value. Unused domestic extraction\textsuperscript{13} or indirect flows associated with imports and exports are not accounted for under the current framework of EW-MFA.


\textsuperscript{13} Unused domestic extraction is the part of the materials extracted that does not enter into the economy such as overburden in mining or unused by-products from harvest.
Domestic Material Consumption (DMC) is the most commonly used indicators from EW-MFA. DMC is defined as the total amount of material directly used and transformed to wastes and emissions in an economy.

\[
DMC = \text{Domestic Extraction Used} + \text{Imports} - \text{Exports}
\]

DMC can be used as an indicator for resource consumption in an economy, as it is tracked by Eurostat. However, the term “consumption” is misleading because DMC refers to “apparent consumption”, not total consumption associated to final demand. Part of the resource use and environmental pressures is occurring in other parts of the world and thus not accounted for in DMC, shifting the consequences of domestic consumption to other regions. In order to account for these “indirect” flows that include all global used extractions and consumptions associated to domestic final demand (i.e. taking a life cycle approach), methods to account for Raw Material Equivalents (RME) were developed. RME comprise all raw materials extracted and use to produce the imports and exports. The Raw Material Equivalents are used to calculate the indicators Raw Material Inputs (RMI) and Raw Material Consumption (RMC). These indicators include the used raw material extraction associated to imports and exports, but exclude unused extraction.

\[
RMI = \text{Domestic Extraction Used} + \text{Used RME of imports}
\]

\[
RMC = RMI - \text{Used RME of Exports}
\]

Eurostat has carried out some work to estimate RMC for the EU-27 for the period between 2000 and 2009. As can be seen in Figure 1, the RMC estimates for biomass, non-metallic minerals and fossil energy sources are very similar to the DMC data (maximum deviation of 4%). On the other hand, RMC estimates for metal ores are 2.5 to 3 times higher than DMC data.

Finally, a third indicator set exists that takes into account all materials used and unused (e.g. overburden in mining or by-products from harvest) in the economy: Total Material Requirements (TMR) and Total Material Consumption (TMC).

DMC is a widely accepted indicator, but has drawbacks in representing material consumption as presented above. RMC statistics have not been systematically developed\(^1\), but it has the potential to be a relevant and robust indicator of resource consumption. It is accepted, credible, and easy to understand, because its calculation is similar to that of DMC. Several Member States (Germany\(^17\), Austria\(^18\), the Czech Republic\(^19\), Netherlands\(^20\) and the UK\(^21\)) have tried calculating their RMC. The calculation method for RMC is more complicated than for DMC as it involves using average raw material coefficients for imports and exports. There are various methods to

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\(^{16}\) Eurostat has provided estimates for raw material coefficients that could be used for calculating RMC. IFEU (2012) Conversion of European product flows into raw material equivalents. Project commissioned by DG Eurostat.


\(^{19}\) Kovanda, J. (2013) Material Consumption in the Czech Republic: Focus on Foreign Trade and Raw Material Equivalents of Imports and Exports. STATISTIKA 2013, 93 (1).


calculating the raw material coefficients. Eurostat has provided a first estimate of raw material coefficients for the EU based on an expanded hybrid Input-Output model. There are however some issues related to the RMC calculation that needs to be investigated or resolved. For example, the material consumption to produce electricity that is imported or exported depends very much on the energy mix of individual countries – an EU average would not be accurate enough. Likewise, the raw material equivalents need to take into consideration that some countries import significant amounts of goods only to re-export them again.

The factors used at present for unused extraction in TMC are lacking detail and disaggregation as well as time series information and therefore make the indicator less credible.

As conclusion, the RACER analysis of the existing material consumption indicators is presented below:

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Relevant</th>
<th>Accepted</th>
<th>Credible</th>
<th>Easy</th>
<th>Robust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Material Consumption (DMC)</td>
<td>Medium</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Raw Material Consumption (RMC)</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Medium (Medium to high when RMC data is available)</td>
<td>Medium</td>
</tr>
<tr>
<td>Total Material Consumption (TMC)</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
</tbody>
</table>

2.2.2 Resource productivity

Measuring resource productivity is a good proxy to track the decoupling of economic growth from resource consumption. Resource productivity is a metric for measuring the level of efficiency associated with resource consumption (measured in DMC or RMC) relative to the economic output (measured in GDP) derived. It is typically expressed in €/kg.

**Resource productivity = GDP / DMC**

**Resource productivity = GDP / RMC**

Resource productivity is the leading indicator chosen to represent and measure the effectiveness of policy initiative set out in the Roadmap to a Resource Efficient Europe.

As explained in the previous section, resource productivity is tracked by official Eurostat statistics\(^\text{22}\). At present GDP/DMC, but the limitation of this indicator is that DMC only accounts for the materials consumed within the EU. If RMC would be fully developed and available at EU and MS level, resource productivity could be monitored as the ratio between GDP and RMC.

As conclusion, the RACER analysis of the existing resource productivity indicators is presented below:

### Table 2: RACER framework

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Relevant</th>
<th>Accepted</th>
<th>Credible</th>
<th>Easy</th>
<th>Robust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource productivity expressed as: GDP / DMC</td>
<td>Medium</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Resource productivity expressed as: GDP / RMC</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Medium (Medium to High when RMC data is available)</td>
<td>High</td>
</tr>
</tbody>
</table>

#### 2.3 Current progress in the EU and Member States

##### 2.3.1 Material resource consumption

The average material resource consumption per person in the EU is about 16 tonnes. This consists of 5.1 tonnes of sand and gravel (32%); 3.8 tonnes of fossil fuel (24%); 3.5 tonnes of biomass (21%); 2.9 tonnes of other non-metallic minerals (18%); and, 0.6 tonnes of metal ores (4%). There are large differences in quantities and composition of domestic material consumption between Member States representing different consumption rates, living standards and economic structures.

![Figure 3: Average DMC per capita for each Member State calculated as the average of the years 2000 – 2009 (Source: Eurostat)](image-url)
When comparing DMC with RMC (which does account for the upstream material flows), it can be seen that total RMC is about 6% greater that total DMC (see Figure 4). The main difference is due to the materials used for mining and refining metal ores. Although overall there does not seem to be a big difference between total amounts of DMC and RMC, the imports and exports tell a different story. Calculations in RMC give a better insight into the distribution of material consumption and ultimately the associated environmental pressures between countries and their trading partners.

![Figure 4: Average DMC per capita compared to average RMC calculated as the average of the years 2000 – 2009 (Source: Eurostat)](image)

### 2.3.2 Resource productivity

As explained above, only a first estimate of the indicator GDP/RMC is available, but in the meantime GDP/DMC can serve as indicator for decoupling economic growth and resources inputs, and is available from Eurostat, calculated as million € per thousand tonnes of materials.

The graph below shows resource productivity in the EU-27 Member States in 2000, 2005 and 2009, measured in GDP/DMC. The average resource productivity in the EU-27 in that period is around 1.5 €/kg, with the highest resource productivity presented in Malta, Luxembourg, Netherlands and UK. (As Malta and Luxembourg are such small countries, they tend to be outliers in the MFA statistics). As a general trend, it can be noted that the overall resource productivity has increased slightly in the last decade (increase of 18% in that period in the EU27). Ireland’s resource productivity increased 83% and Romania's decreased 40%.
The big differences between resource productivity in MS might be due to the relative volume of imports and exports to the domestic economy. Resource productivity based on DMC is lower in countries with higher shares of primary sector in the domestic economy (i.e. high extraction, high export rate of raw materials and low added value), whereas countries with the highest share of secondary and tertiary sectors (i.e. low raw materials extraction, high material imports and high added value) present higher resource efficiency. In this sense, the indicator of resource productivity based on RMC would be more accurate than the current GDP/DMC. Furthermore, the level of GDP has a major effect on the development of resource productivity.

Regarding resource productivity based on RMC, the estimates proposed by Eurostat can be used to give an idea of the ratio between GDP and resource consumption at EU level. RMC is not yet available at Member States level, but only at EU level. As shown in Figure 6, from 2000 to 2007 GDP grew more than the use of resources, and both indicators decreased in 2008 and 2009 (DMC and RMC decreased faster than GDP), resulting in a general constant trend of increasing resource productivity, measured either by GDP/DMC or GDP/RMC.
an indicator for decoupling. The graph below shows the evolution of resource productivity in the EU-27.

![Average annual growth of resource productivity in Member States in the EU](image)

**Figure 7: Average annual growth of resource productivity in Member States in the EU (Source: Eurostat)**

### 2.4 Target setting

Targets could be set on resource consumption indicators (representing absolute material use) or on resource productivity indicators (representing material use in relation to the economy). The milestone proposes the objective of decoupling economic growth (and wellbeing\(^{23}\)) from resource inputs. This means that economic growth has to grow faster than the use of resources. Absolute decoupling would mean that the resources consumed will decrease while the economy will grow. A relative decoupling implies that the economic growth is higher than the increase on the use of resources, but resource use could still grow. One way to ensure absolute decoupling would be to set targets on reducing resource consumption while maintaining economic growth or to set a target where resource productivity is requested to increase faster than economic growth. In order to reach relative decoupling, the target can be set on the ratio between economic growth and use of resources increases.

#### 2.4.1 Resource consumption

On resource consumption, a target could be set based on the RMC estimates presented above. Figure 5 shows the evolution of RMC in the EU-27 from 2000 to 2009. RMC is estimated to have increased (8%) from 2000 to 2007, and decreased (12%) from 2007 to 2009. The overall evolution from 2000 to 2009 was a decrease of 5%.

However, absolute reduction of material resource consumption in a growing economy would represent the most ambitious target. Material consumption is driven by the trends in each of the sectors and markets as well as public policy, e.g. renewable energy and waste policy. The most coherent way of setting targets is to perform a sectoral analysis of the resource use of each of the sectors.

\(^{23}\) Since there is no accepted indicator for wellbeing, economic development measured by GDP is used.
The consumption of biomass is driven by food production and the demand for bioenergy and biomaterials. Biomass consumption will be most likely affected by an increase of bioenergy (due to the Climate and Energy 20-20-20 targets) and increased global demand of food due to growing world populations and the share of animal biomass therein.

Metal ores and non-metallic minerals are required mostly for construction, housing and transport sectors. An increase of recycling and waste prevention practices in these sectors and materials would decrease the total resource consumption. Other targets such as land use and planning and the increase uptake of renewable energy technologies and new infrastructure could also increase demand of metals and minerals.

Recently, targets for reindustrialisation (increasing the economic activity in industry in the EU) have been proposed. The contribution of GDP from industries in the EU has fallen from around 22% in 2000 to 18% in 2010. This is thought to be due to offshoring of manufacturing to countries outside of the EU and the increase of the service sector. If the EU were to succeed in reindustrialisation (currently a target of 20% industrial contribution to GDP by 2020 is being discussed), this would probably also result in an increase of material consumption. The magnitude of the impact of this on DMC or RMC would depend on which types of material resources and sector activities would increase. If reindustrialisation resulted in an increase in material extraction in the EU (e.g. mining and quarrying), but most of the materials were exported, this would result in a slight increase in DMC and actually a decrease in RMC. If reindustrialisation required more imports, but most of the materials were exported again, this would result in a slight increase in both DMC and RMC. If reindustrialisation also entailed an increase in EU consumption, then both DMC and RMC would increase.

Based on this, no specific targets on absolute resource consumption are proposed. Instead, only targets on decoupling economic growth from resource use are set.

### 2.4.2 Resource productivity

The estimates of RMC presented by the Eurostat can be used as reference for setting a target on resource productivity, measured as GDP/RMC. As decoupling means that GDP increases at a faster rate than material consumption, the target proposed is based on the difference between the annual growth of GDP compared to RMC. Formulating the target in this manner, allows the EU to constantly improve its resource efficiency regardless of how fast the economy is growing. Different ambition levels of targets are proposed, varying the level of decoupling based on the trends observed in the previous section. On average annual GDP growth was 1.9% higher than RMC growth between 2000 and 2009 (1.6% when measured in DMC).

As there is not a big difference in total DMC compared to RMC, GDP/DMC can be used for the target until RMC datasets for Member States become available. The potential targets proposed above could be considered to be applied directly to each Member State. A further analysis is however required to investigate whether this would be achievable in countries with economies that depend highly on external trade.
Table 3: Potential targets for resource productivity

<table>
<thead>
<tr>
<th>Level of ambition</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>By 2020, the annual GDP growth should always be 1.5% higher than material consumption (measured in RMC)</td>
</tr>
<tr>
<td>Medium</td>
<td>By 2020, the annual GDP growth should always be 2% higher than material consumption (measured in RMC)</td>
</tr>
<tr>
<td>High</td>
<td>By 2020, the annual GDP growth should always be 2.5% higher than material consumption (measured in RMC)</td>
</tr>
</tbody>
</table>

In relation to reindustrialisation in the EU, it is expected that reindustrialisation would boost the EU economy and thereby GDP. The impact on resource productivity would depend on which sectors are industrialised. Extraction industries (e.g. mining and quarrying) and basic industries (e.g. refineries, iron and steel) have relatively high material and resource intensity compared to other industries. A more in-depth analysis is required, but in general reindustrialisation of EU industries is not thought to be detrimental to any resource productivity target.

2.5 What are the expected risks and consequences of setting the target?

2.5.1 Key actors affected

The EU industry is responsible for reducing the amount of materials used and increase the economic productivity obtained from them. Public authorities can promote these practices by including resource efficiency criteria in their procurement processes or funding R&D on resource efficient technologies and by setting incentives for making industry more efficient. Consumers can also influence the industry by making the choice of purchasing or contracting resource efficient products and services, or substituting material products by services.

2.5.2 Contribution to reduced resource use or environmental impacts

The increase of resource productivity does not necessarily decrease resource use in the EU. Relative decoupling would not necessarily drive a reduction of the environmental impacts caused by the use of resources. The reduction of resource use and environmental impacts will thus have to addressed by other means. The best approach would be by setting specific targets for specific resources and environmental impacts on an industry or sectoral level more directly addressing specific production processes and technologies.

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2.5.3 Contribution to economic growth or well-being

The other aspect of increasing resource productivity is the raise of the economic benefits obtained by the use of resources. Decoupling would boost productivity, increasing the GDP, which would be beneficial for the entire economy. This would have positive impacts such as creation of jobs and increase of wellbeing.

2.5.4 Links with other milestones

This milestone on boosting efficient production is closely related to the milestone on “Improving products and changing consumption patterns”. Indeed, this couple of milestones are complementary and together act on both the offer and demand side of the market.

The milestones on taxation and improving R&D are also related to this milestone, since the public funding of R&D is crucial to the uptake of resource efficient technologies. Also, the milestone on “using waste as a resource” is closely linked to boosting efficient production, because the optimisation of resources and the reuse of waste within the industry is one of the main strategies for improving resource efficiency.

As explained above, the milestones on food production, energy, land use and transport are also closely linked to the total consumption of resources. The targets set for these specific resources and sectors will drive the total consumption of resources and therefore affect the resource productivity.

2.5.5 Risk of objective to be counter-productive

One approach to increasing resource productivity (as has been the case for several Member States) is to offshore extraction and manufacturing industries and base the economy on more services. If this were to happen, this could increase the dependency on imported material resources. The consumption of material resources would not decrease, and neither the environmental impacts associated to them.
3. Improving products and changing consumption patterns

This milestone covers several issues with the three key issues being:

- **the supply or availability** of resource efficient products (and services) on the market
- **the uptake or demand** of resource efficient products (and services) by citizens and public authorities
- **the improvement of environmental performance** of products and services on the market

In all cases, environmental information is a prerequisite. After a preliminary analysis of suitable indicators for setting resource efficiency targets related to consumption patterns, the EREP Working Group II and the Commission requested further analysis to be performed on the "**share (and number) of public procurement contracts that include Green Public Procurement (GPP) criteria**". This indicator informs on the uptake or demand of resource efficient products and services by public authorities.

3.1 The indicator and current EU policy

Based on the Integrated Product Policy (IPP) approach, the European Commission’s 2008 Action Plan on Sustainable Consumption and Production and Sustainable Industrial Policy\(^\text{25}\) (SCP/SIP) seeks to reduce the environmental impact of products throughout their life cycle by taking action where it is most effective. The SCP/SIP Action Plan includes a broad range of policy instruments that address products from both the supply (production) and the demand (consumption) side. One of the key tools to create or enlarge markets for resource efficient products and services with improved environmental performance is the EU Guidelines on Green Public Procurement (GPP). The EU-27 had a collective annual public purchasing budget of more than €2.4 trillion in 2010, which accounts for approximately 20% of the EU’s GDP.\(^\text{26}\)

GPP is defined in the European Commission’s Communication “Public Procurement for a Better Environment” as “**a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured**”. Through the use of GPP criteria, public authorities can stimulate the market for efficient products and services by

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\(^{25}\) [http://ec.europa.eu/environment/eussd/escp_en.htm](http://ec.europa.eu/environment/eussd/escp_en.htm)

\(^{26}\) European Commission - Public Procurement Indicators 2010. The indicator of public procurement provides a very broad estimate of the total expenditure of the government, public sector and utility service providers on public works, goods and services.
rewarding suppliers who can demonstrate the improved environmental performance of their offerings.

GPP guidelines support authorities in defining and setting green procurement criteria in their procurement procedures\(^\text{27}\). Other EU instruments such as the EU Ecolabel, Energy Label and Energy Star instruments support the GPP Guidelines by providing criteria for specific products and services. The current GPP policies in the EU are all voluntary. The SCP Action Plan planned to introduce mandatory GPP requirements in the implementing measures of the Energy Label Directive. However, the Council rejected this proposal as it was found that further research was necessary in order to increase political support.\(^\text{28}\)

In 2008, the European Commission set an indicative target that, by 2010, 50% of all public tendering procedures should be green in the EU, where “green” means compliant with endorsed common core EU GPP criteria for ten priority product/service groups such as construction, transport, cleaning products and services.

The EU GPP guidelines currently cover transport, office IT equipment, mobile phones, thermal insulation, windows, glazed doors & skylights, hard floor coverings, wall panels, construction, garden products & services, catering & food, textiles, cleaning products & services, furniture, and copying & graphic paper. It also includes the following product areas: electricity (supply of), combine Heat and Power (CHP), road construction & traffic signs, and street lighting and traffic signs. The significant budget of public purchasing and the wide range of product and service groups with different technical, economic, market and environmental characteristics could be seen as a good proxy for the entire market for resource efficient products and services.

Eighteen Member States have adopted dedicated National GPP Action Plans (NAP) and have put measures into place to enhance the uptake of GPP\(^\text{29}\). These Action Plans are not usually legally binding, but some might include mandatory rules. Five Member States are in the process of adopting or developing their NAP, with different levels of progress (Estonia, Hungary, Ireland, Latvia and Romania). Two Member States do not properly have NAPs, but have equivalent policy instruments at the national level (Germany, Czech Republic) and two Member States have yet to develop NAPs (Greece, Luxembourg). The degree of ambition of the various NAPs is very different across Member States. Fourteen countries have set targets for the percentage of public procurement that will comply with national GPP criteria:

- Belgium, Cyprus, Denmark, Ireland, Malta, Portugal, Slovakia and Slovenia have set a target of 50% of public procurement, corresponding to the indicative target set at the EU level.
- Finland and the Netherlands have set more ambitious targets than 50%.
- Italy, Lithuania, Poland and Romania have targets that are less ambitious than 50%.


Finland, the Netherlands and Denmark have also set targets at the regional and local level.

Some countries have set GPP compliance targets for specific product groups, including Bulgaria, France, Germany, Hungary and Spain. In terms of product groups, specific targets are particularly frequent for green vehicles (applied by Germany, the Czech Republic, Hungary, Latvia, Spain, Bulgaria and France) and recycled paper (applied by Germany, Hungary, Spain, Bulgaria and France).

Cyprus requires the adoption of only a set of core GPP criteria for each product group.

Almost a third of the countries apply legally reinforcing approaches that make some GPP considerations compulsory:

- The use of GPP is made mandatory at the federal level by Austria, Bulgaria, Denmark, Finland, Hungary, Lithuania, the Netherlands, Poland and Portugal to achieve the targets set for all product groups covered by their scheme.
- The use of GPP is made mandatory for some specific product groups and/or specific criteria in Cyprus, Belgium, France, Germany, Italy, Latvia, Spain and Sweden.

The Netherlands had set voluntary ‘Sustainable Public Procurement’ targets for 2010 of 100% uptake by central government, 50% by provinces, 75% by municipalities. All these have been achieved and even surpassed.

3.2 Status of the indicator

The indicators of performance related to public procurement that are currently tracked systematically are:

- **Total expenditure on works, goods and services**

  This indicator provides a very broad estimate of the total expenditure of the government, public sector and utility service providers on public works, goods and services. The figures include expenditure on items, which are clearly exempt under the public procurement, such as fuel for energy generation and warlike materials, as well as other excluded items such as the purchase of land or existing buildings and contracts below the thresholds of the legislation. They also include, for example, the costs of health care and medical products reimbursed through statutory health insurance funds or by government.

  The figures for the government sector are derived from ESA 95 data for National Accounts. Data for the energy, water, coal, oil and gas utility sectors are

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extrapolated from the latest available intermediate consumption data reported in ESA 95 compliant input-output tables and from some other sources such as company accounts for sectors such as rail, urban transport, ports and airports, which are not separately detailed in those tables. The utility sectors make up more than one quarter of the total estimate.

The data for this indicator is available for at least the past five years.

- **Value and number of calls for tender published in the Official Journal**

This indicator is derived from information published in the Official Journal of the European Union through the Tenders Electronic Daily database (TED). It estimates the value of procurement for which calls for competition have been published in TED. The number of calls for competition published is multiplied by an average based, in general, on all the prices provided in the contract award notices published during the relevant year. Contracts above €100 million have been taken at their own value and not included in the calculation of the averages. An estimate is necessary because the value of the contracts awarded is not always provided in the published contract award notices. It should also be noted that the indicator measures what is competitively advertised, rather than contracts actually awarded: a small proportion of all procedures advertised are either abandoned or for various reasons do not lead to a contract award.

The data for this indicator is available from Eurostat for all EU Member States since 2005:

- [tec00128] - Public procurement - Value of public procurement, which is openly advertised
- [gov_oth_procur] - Public procurement advertised in the Official Journal

The above indicators do not include the share of public procurement contracts that include environmental criteria (EU GPP core criteria or other criteria). At present, the share of public procurement that include GPP criteria is not systematically gathered. Several studies have estimated both the share of ‘green’ contracts of total procurement value and the number of ‘green’ contracts of the total number of contracts awarded. The latest study was performed by the Centre of European Policy Studies and the College of Europe (covering procurement in the period 2009/2010). The study was based on an online survey of public contracting authorities. It used statistical methods to estimate the value and number of green contracts in a country based on a representative sample of all contracting authorities. The study estimated that for a 90%
Turning Milestones into Quantified Objectives

confident level, the precision of the results were less than 3% at EU level. Precision at individual Member States varied significantly – up to 40%. It would be possible to gather more robust data if there was a harmonisation and standardisation of data collection.

The following table summarises the indicator based on the RACER framework.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Relevant</th>
<th>Accepted</th>
<th>Credible</th>
<th>Easy</th>
<th>Robust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of the value of public procurement contracts that include GPP criteria</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Percentage of the number of public procurement contracts that include GPP criteria</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
</tbody>
</table>

As both indicators are already part of EU and Member State policies they are very relevant and accepted by most. The lack of harmonised definitions and systematic data collection methods result in issues related to the availability, credibility and robustness of the indicators. These could however be improved.

3.3 Current progress in the EU and Member States

The latest study monitoring the uptake of GPP estimated that 38% of the total value of the contracts included green criteria. See Figure 12 for the uptake in individual Member States.

In terms of number of contracts, 26% of the last contracts signed in the 2009-2010 period by public authorities in the EU included all surveyed EU core GPP criteria (Figure 9 shows the uptake by Member State). However, 55% of these contracts included at least one EU core GPP criterion, showing that some form of green procurement is being done at a large scale.

The uptake of EU GPP criteria varies significantly across Europe. Looking at the last contract signed by public authorities, there are four top performing countries (Belgium, Denmark, Netherlands and Sweden), in which all EU core GPP criteria were applied in 40%-60% of the cases. On the other hand, there are as many as twelve countries where this occurred in less than 20% of the last contracts.

The use of GPP criteria also varies according to product groups. Out of a total of 24 EU core GPP criteria, only three were used by more than 50% of the respondents in the last contracts they signed.

In general, there seems to be an overall positive trend for increasing use of GPP criteria: a greater share of the last contracts signed included at least one core GPP criterion compared to the share of all contracts in the whole period 2009-2010.
3.4 Target setting

Even though there are no official statistics on the share of green public spending in the EU, the European Commission had already set an indicative target in 2008: 50% of all public spending should be green by 2010. This target has only been achieved in some Member States, not at an EU level. Given the current progress in individual Member States, it would seem possible that 75% or even 100% of public procurement contracts could include EU core criteria by 2020, if
prioritised politically. The ambition level would depend on how many priority categories of goods, services and works have GPP core criteria that must be applied. Assuming that the proposed target for GPP only included EU core criteria that currently exist, three different target levels could be proposed (see Table 3). It is expected that more EU core criteria will be developed over the next few years. If future EU core criteria are to be taken into account, then 75% might represent a moderate or ambitious level.

The target would be for total EU public purchasing budget with all Member States encouraged to make an effort to increase their share of GPP. This means that all Member States would have to set green procurement targets to be met by 2020 and negotiate how to disaggregate the target between them. Member States could decide on their own how the target would be distributed nationally. For example, 75% at central level and 50% at local government; or by setting different targets for certain priority categories of goods, services and works.

Table 5: Proposed targets

<table>
<thead>
<tr>
<th>Level of ambition</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>By 2020, 75% of the value of public procurement contracts include Green Public Procurement (GPP) EU core criteria</td>
</tr>
<tr>
<td>Medium</td>
<td>By 2020, 85% of the value of public procurement contracts include Green Public Procurement (GPP) EU core criteria</td>
</tr>
<tr>
<td>High</td>
<td>By 2020, 100% of the value of public procurement contracts include Green Public Procurement (GPP) EU core criteria</td>
</tr>
</tbody>
</table>

The responsibility for meeting this target would be exclusively on the public authorities and their contracting functions at EU, national central level and local authority level. The appropriate level of exigency on the green criteria for public procurement should be analysed, and furthermore, the green criteria should be balanced among the rest of the award criteria. Including green criteria in public procurement may not be enough if they do not have similar importance as the rest of the criteria.

To achieve the target the EU and Member States would have to increase awareness of GPP criteria among public purchasers; ensure clear guidelines and training; develop tools to support GPP (e.g. indicators and a benchmarking system); establish common monitoring procedure; and possibly even introduce some minimum environmental performance criteria mandatory for some products and services.
3.5 What are the potential risks and consequences of setting the target?

An established EU target on GPP would drive the demand for green products\textsuperscript{36}. Public expenditure on products and services with EU core criteria represents a significant value, which would provide substantial incentives to the market to adhere to environmental criteria set under GPP and offer more resource efficient products and services.

3.5.1 Key actors affected

Public authorities are responsible for including green criteria in public contracts. For producers and suppliers, the existence of green criteria within the public procurement requisites means the possibility of recognising better design of their products, services and processes, which could potentially create a more level playing field for competition. Tenderers’ efforts in innovation and design of resource efficient products would be rewarded, although the lack of homogeneity in the criteria requested by different public authorities may be a barrier for the development and uptake of green tenders. This barrier would be especially important in the case of SMEs.

3.5.2 Contribution to reduced resource use or environmental impacts

The increase of resource efficient products and services is very much aligned with the Flagship objectives of reducing resource use and environmental impacts and contributing to economic growth and well-being. A key element of shifting to a Resource Efficient Europe is to ensure sustainable consumption and production.

GPP can help to green the market of certain products and services for which traditionally green products are not available on the market (e.g. clothing). This effect on the market can also influence private demand\textsuperscript{37}.

An increased uptake of green products will lead to reduced resource use and environmental impacts, if consumption patterns do not change. When this happens there is a risk for rebound effects. This is, however, unlikely to happen as any savings in public budgets would not lead to increased consumption.

3.5.1 Contribution to economic growth or well-being

By including green criteria in their contracting processes, public administrations encourage companies and retailers to offer green products. With time this will lead to an increased offer of green products in the market (second-order effect), which again will allow consumers to make better purchasing and consumption choices. This is also a way to further innovate and develop the market for green products and ultimately strengthening and maintaining EU’s global leading position in the area.

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\textsuperscript{37} Öko-Institut e.V. (2007) Costs and benefits of Green Public Procurement in Europe. Commissioned by EC DG ENV.
An increase of the market for resource-efficient products and services is supposed to reduce costs of production or operation to the businesses providing these products. This cost reduction will therefore indirectly increase the competency of the companies.

GPP is not always more expensive than conventional procurement. A 2009 study, which investigated public procurement in seven selected Member States showed that GPP can lead to decreases in costs for the purchasing organisation. From a life cycle costing perspective the average cost reduction was 1% with GPP. In the 2011 survey, 38% of the survey respondents reported cost increases, whereas 33% reported costs remaining constant. Some respondents indicated that costs may decrease, but these were a minority. Interviews with procurement officers indicated that the purchase price is expected to be higher in the short term when GPP requirements are included. The explanations given of constant costs reflect a long-term perspective.

The price is related to other aspects such as brand, aesthetics, quality, or price reductions. For energy-using products, higher purchase prices are usually compensated by lower operating costs. The purchase of resource-efficient products (especially energy-efficient products) is expected to cut the life cycle cost of the product, mostly due to a reduction of operating expenses.

GPP could also promote new resource saving business models such as product-service systems, particularly if contracts were outcome- or performance-based.

Some Member States have included aspects other than environmental criteria within their GPP policies, such as social responsibility and innovation, mostly requiring the inclusion labour rights of people with disabilities, or criteria related to job quality, such as reduced noise levels. If these social criteria are generalised in the EU GPP criteria, the impacts of GPP would go beyond environmental and economic impacts, and would also have a positive influence on health and wellbeing of workers. The environmental benefits would also affect health and safety conditions, since these impacts are closely linked (e.g. restrictions on hazardous substances, particulate emissions that affect health, etc).

If similar GPP requirements are set in different Member States, some of the barriers for the sale of green products could be overcome, since businesses would be able to fulfil the GPP requisites of different national or regional administrations without much burden. This would increase competition and innovation within EU businesses. The impacts will vary between MS, according to the existing national legislation already in place.

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40 Adelphi (2011) Strategic Use of Public Procurement in Europe. Study commissioned by the European Commission.
3.5.2 Links with other milestones

Targets for increasing the share of GPP in the total public spending are linked to other milestones such as ‘Boosting efficient production’ and ‘Turning waste into a resource’. Providing green products is also linked to ‘Marine resources’ (sustainable yields of fish) and ‘Food’ (healthier and more sustainable food production and consumption). Similarly, products for buildings and transport should also adhere to any targets related to GPP, as these sectors usually account for a big share of public spending.

The existence of public procurement that rewards greener products is linked to research and development policies. R&D efforts of companies are rewarded by these contracts, and therefore promoted. International agreements such as the adoption of the Energy Star programme in GPP criteria is linked to the milestone on supporting resource efficiency internationally. The international recognition of such certification schemes is a key issue in a global market of products and services.

3.5.1 Risk of objective to be counter-productive

A target for GPP must not lead to inefficient policies where green products and services are subsidised unfairly, or money is spent to artificially promote a market. Any target for market uptake must not lead to rebound effects where cost savings that are made from improving the efficiency of a product can actually induce people to consume more.
The milestone covers four key concepts for increasing efficient production:

- **Market and policy incentives** that reward business investments in efficiency: this includes options that would put in place incentives that stimulate a large majority of companies to measure, benchmark and improve their resource efficiency systematically and continuously.

- **Innovations in resource efficient production methods**: this refers to innovative solutions, technologies, processes and strategies that can facilitate novel products and processes with higher resource efficiency. This is also referred to as eco-innovation.

- Measure and benchmark **company resource efficiency performance**: this refers to existing methodologies to assess, display and benchmark the environmental performance of products, services and companies based on a comprehensive assessment of environmental impacts over the life-cycle. Current work by the EC aims to establish a common methodological approach to enable this (Organisational Environmental Footprint).

- **Economic growth and wellbeing is decoupled from resource inputs**: this refers to the principle of reducing the amount of resources used or reduced environmental impact, while increasing economic output/growth. The milestone puts the emphasis on increases in the value of products and associated services than absolute reduction of resource inputs.

After the a preliminary analysis of potential indicators and respective targets for this milestone, the EREP Working Group II and the Commission requested further analysis to be performed on the following indicator: ‘proportion of companies with certified Environmental Management Systems such as ISO 14001 and EMAS’. This indicator informs on the number of companies that measure and benchmark their resource efficiency performance.

Environmental Management Systems (EMS) are management tools that help businesses track their environmental (including resource use) performance, which allows them to continuously improve their resource efficiency. A typical EMS follows a Plan-Do-Check-Act process cycle and when implemented in an organisation becomes part of its business processes and strategic management. The international standard for EMS is ISO 14001. The EU encourages EMS through its Eco-Management and Audit Scheme (EMAS). Businesses certified under EMAS must have third party verification and make publicly available the environmental impact and performance of their organisation.

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4.1 The indicator and current EU policy

The European Union has implemented a broad range of policies to encourage the efficient use of resources in society. The 2008 Action Plan on Sustainable Consumption and Production (SCP) and Sustainable Industrial Policy (SIP) was adopted to support the economic competitiveness of the EU industry through improved energy and resource efficiency, as well as an improved capacity to develop appropriate technological solutions. This approach aimed at addressing existing production techniques, products and consumption practices and helping the EU to attain its goals related to sustainable development. One of the goals of the SCP-SIP Action Plan is to improve environmental performance and resource efficiency of production.

Company resource efficiency performance can be tracked through certified Environmental Management Systems such as ISO 14001 and EMAS. The Commission is currently developing a common methodological approach to assess, display and benchmark the environmental performance of companies (Organisational Environmental Footprint), which is based on a comprehensive assessment of environmental impacts over the life-cycle.

4.2 Status of the indicator

The EMAS register contains the data of all the companies certified in the EU, thus it would be possible to track the number of companies registered, as well as country, sector, etc. However, this is not the case for ISO 14001 certifications, but the EEA reports the amount of companies with ISO 14001 certification in the EU. The proportion of companies with certified EMS could be calculated related to the total number of companies in the EU or alternatively to the number of inhabitants. At the time of writing the number of companies registered in the EU is provided by Eurostat for the years 2008 and 2009.

Both certifying schemes are widely recognised and accepted by the public and businesses. This said, these schemes do not provide information on the environmental performance of the companies that hold the certification, but only on their mechanisms to measure, evaluate and reduce the main environmental aspects of their activities. This is, the EMS certifications are indicators of actions towards improving the environmental performance of companies, and not indicators of good environmental performance itself.

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\(^{43}\) As defined by the renewed EU Sustainable Development Strategy, Council of the EU 10917/06.

As a summary, the RACER analysis of this indicator is presented below:

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Relevant</th>
<th>Accepted</th>
<th>Credible</th>
<th>Easy</th>
<th>Robust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of companies with certified Environmental Management System</td>
<td>Medium</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

4.3 Current progress in the EU and Member States

Proportion of companies with certified Environmental Management Systems such as ISO 14001 and EMAS: The EMAS register allows tracking the number of companies registered. According to Figure 10, around 8,000 organisations and sites in the EU are registered in EMAS in 2012, which means an average of 5.5 registers per million inhabitants. Organisations in Europe registered under ISO 14001 in 2009: 89,237.45

Figure 10: Organisations and sites registered in EMAS (Source: EC DG ENV46)

Figure 11 shows the current share of organisations with some form of EMS certification. As can be seen, very few companies are EMS certified. The number of companies using some form of EMS could be much higher.

46 http://ec.europa.eu/environment/emas/index_en.htm
Analysis of indicators and targets

Figure 11: Organisations with EMS certification (Source: based on Eurostat, EEA)

4.4 Target setting

The ambition level for the target will depend on which policies are put in place to motivate companies to register under EMAS. At present EMAS is a voluntary scheme. Besides being a structured and systematic manner of tracking a company’s environmental and resource efficiency performance, and allowing companies to market themselves as environmentally responsible, the benefits of EMAS and ISO 14001 are limited. If EMAS or ISO 14001 certification were linked to mandatory requirements and/or market-based instruments such as resource or environmental performance based taxes, then a much larger uptake could be achieved.

Table 7: Potential targets

<table>
<thead>
<tr>
<th>Level of ambition</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>By 2020, the share (% of total) of private organisations registered under EMAS increase by at least 50% compared to 2010.</td>
</tr>
<tr>
<td>Medium</td>
<td>By 2020, the share (% of total) of private organisations registered under EMAS should be doubled compared to 2010.</td>
</tr>
<tr>
<td>High</td>
<td>By 2020, the share of private organisations registered under EMAS should be at least 10% of the total</td>
</tr>
</tbody>
</table>

4.5 Key actors affected

- The certification of companies (EMAS or ISO certifications) implies investment costs for manufacturers.
- Purchasers and consumers would be able to make better choices based on the environmental performance of companies.
- Third party auditors certify companies’ EMS.
- Public authorities manage EMAS.
5. Turning waste into a resource

Waste management has been a significant feature of European environmental policy for several decades\(^47\). Indeed, proper waste management is key to achieving a closed-loop economy and ultimately to decoupling material consumption from environmental degradation. EU legislation has recently begun to recognize the potential of waste management in promoting resource efficiency, and has begun to orient waste policy towards conversion of waste into a resource.

Waste is already widely used as a resource in certain sectors, particularly for easily recyclable metals\(^48\). However, barriers remain, including underdeveloped collection, sorting and recycling systems and facilities in certain Member States (MS); weak markets for certain secondary raw materials; issues with implementation of waste legislation; lack of life-cycle approach to product design and use; and lack of cooperation between actors along the value chain.

With European consumption growing alongside GDP, it will be crucial to improve systems aimed at decoupling resource use from growth, including managing waste as a resource.

After a preliminary analysis of suitable indicators for setting resource efficiency targets related to waste, the EREP Working Group II and the Commission found the following three indicators as most relevant to pursue in the context of the Roadmap to a Resource Efficient Europe:

- **Total waste generated per capita**
- **Municipal Solid Waste (MSW) generated per capita**
- **Residual waste** (landfill + incineration)

According to European waste policy, prevention is the most preferable approach to waste management; however, no single indicator currently exists to measure prevention. Total waste generated per capita and municipal solid waste generated per capita are often used as proxies for prevention. These indicators are amongst the most commonly used waste prevention indicators\(^49\).

5.1 The indicators and current policy

High waste generation is an indicator of inefficient processes. Waste is defined in the Waste Framework Directive (2008/98/EC) as "any substance or object which the holder discards or intends or is required to discard".

The Waste Framework Directive, set to be revised in 2014, forms the backbone of EU waste management legislation, with treatment-specific or stream-specific supplementary legislation providing further guidelines. The Waste Framework Directive provides basic definitions of key

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\(^{48}\) European Commission (2011) Roadmap to a Resource Efficient Europe, Analysis Part II.

waste management terms and lays out basic waste management principles. Notably, it sets out a waste management hierarchy to help steer policy towards more favourable waste management principles such as prevention or re-use, and to leave disposal as a last resort. The waste management hierarchy therefore directly contributes to decoupling material consumption from waste generation and increasing material efficiency. Where waste prevention is not possible, converting generated waste into a resource via recycling and re-use helps decrease the consumption of primary raw materials and increase the productivity obtained from them, thus contributing to a more material-efficient economy.

![Waste management hierarchy](image)

**Figure 12: Waste management hierarchy – Source: European Commission**


In keeping with the Waste Framework Directive requirements, all EU MS have national and/or regional waste plans covering their entire territories. Several of these plans – as well as additional stream-specific or treatment-specific legislation – have set national targets for indicators such as waste prevention or recycling. The Landfill Directive further includes an obligation for MS to set up a national strategy for reducing biodegradable waste going into landfills. Most MS have therefore set bans or restrictions for disposal of municipal waste into landfills, though ten MS have no such restrictions, partially due to lack of alternative systems and infrastructure.

The Waste Framework Directive also notably introduced the concept of extended producer responsibility (EPR), further promoting a life-cycle approach to waste management, with producers responsible for taking into account the full life cycle of their products in the course of their design. It also includes the polluter-pays principles, placing the costs of waste management on the waste producers or waste holders.


EU recycling targets are set in the Waste Framework Directive (2006/12/EC).

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Table 8 presents an overview of the waste and recycling legislation that make use of recycling targets, the collection targets, reuse/recycling/recovery-targets and deadlines. The following key definitions are included in the Waste Framework Directive:

- **Preparing for reuse**: checking, cleaning or repairing recovery operations, by which waste products or components of products are prepared for reuse without any other pre-processing.

- **Recovery**: any operation the principal result of which is waste serving a useful purpose by replacing other materials in order to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy.

- **Recycling**: any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.

A List of Wastes was established by the EC Decision 2000/532/EC, and provided a thorough classification system for wastes, with 20 main waste categories and a number of sub-categories. It also provided a system for distinguishing between hazardous and non-hazardous waste.

Importantly for the milestone on turning waste into a resource, the EU **Thematic Strategy on the prevention and recycling of waste** recognized the link between waste and resource, setting out an approach that introduced life-cycle thinking into waste management and promoted recognition of waste as a resource to be reintegrated into production.

To help track progress of policy implementation and determine priorities for new legislation, Regulation (EC) 2150/2002 created a framework for harmonized EU statistics on waste. The Regulation requires the EU Member States to provide data on the generation, recovery and disposal of waste every two years, starting with 2004. Data on waste generation and treatment in the EU are therefore available from the Eurostat Data Centre on Waste for four reference years, namely, 2004, 2006, 2008 and 2010.

There are, however, differences in data coverage across countries, as well as methodological changes in individual countries, that may still have a significant impact on the comparability of waste statistics and on the waste statistics time series, particularly at a national level.
### Table 8: Overview of rates related to reuse, recycling or material recovery

<table>
<thead>
<tr>
<th>Material/waste</th>
<th>collection target</th>
<th>deadline</th>
<th>reuse</th>
<th>recycling</th>
<th>material recovery</th>
<th>energy recovery</th>
<th>recovery target**</th>
<th>deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Framework Directive</td>
<td>separate collection</td>
<td>2015</td>
<td>x</td>
<td>x</td>
<td>≥ 50 w%</td>
<td>2020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>paper Municipal Solid Waste (MSW)</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td>≥ 50 w%</td>
<td>2020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>metal MSW</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td>≥ 50 w%</td>
<td>2020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>plastic MSW</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td>≥ 50 w%</td>
<td>2020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>glass MSW</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td>≥ 50 w%</td>
<td>2020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction and Demolition (C&amp;D) waste</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td>≥ 70 w%</td>
<td>2020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End-of-life vehicles (ELV) Directive</td>
<td>100 w%</td>
<td></td>
<td>x</td>
<td>x</td>
<td>≥ 85 w%</td>
<td>2006</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td>≥ 95 w%</td>
<td>2015</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td>≥ 85 w%</td>
<td>2015</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65 w% of EEE put on market in two preceding years has to be separately collected and fully sent to treatment</td>
<td>2016***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>large domestic appliances and automatic dispensers</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td>≥ 80 w%</td>
<td>2006</td>
<td></td>
<td></td>
</tr>
<tr>
<td>small domestic appliances, lighting equipment, electrical and electronic tools, toys, leisure and sports equipment and monitoring and control instruments + medical devices</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td>≥ 75 w%</td>
<td>2011***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IT and telecommunications equipment and consumer equipment</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td>≥ 75 w%</td>
<td>2011***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>discharge lamps</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td>≥ 80 w%</td>
<td>2011***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>large domestic appliances and automatic dispensers</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td>≥ 80 w%</td>
<td>2011***</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Turning Milestones into Quantified Objectives

### Modelling of Milestones for achieving Resource Efficiency

<table>
<thead>
<tr>
<th>Material/waste</th>
<th>collection target</th>
<th>deadline</th>
<th>reuse</th>
<th>recycling</th>
<th>material recovery</th>
<th>energy recovery</th>
<th>recovery target</th>
<th>deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>small domestic appliances, lighting equipment, electrical and electronic tools, toys, leisure and sports equipment and monitoring and control instruments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ <strong>medical devices</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IT and telecommunications equipment and consumer equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Batteries Directive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portable batteries and accumulators</td>
<td>25 w%</td>
<td>2012</td>
<td>x</td>
<td>x</td>
<td>250 w%</td>
<td></td>
<td>2006</td>
<td></td>
</tr>
<tr>
<td>Industrial and automotive batteries and accumulators</td>
<td>45 w%</td>
<td>2016</td>
<td>x</td>
<td>x</td>
<td>255 w%</td>
<td></td>
<td>2011</td>
<td></td>
</tr>
<tr>
<td>lead acid</td>
<td>100 w%</td>
<td>2009</td>
<td>x</td>
<td>x</td>
<td>265 w%</td>
<td></td>
<td>2006</td>
<td></td>
</tr>
<tr>
<td>Ni-Cd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>other (button cells excluded)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packaging and Packaging Waste Directive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>packaging waste</td>
<td>25 w%</td>
<td></td>
<td>x</td>
<td>x</td>
<td>&gt; 65 w%</td>
<td></td>
<td>2010</td>
<td></td>
</tr>
<tr>
<td>packaging materials</td>
<td>45 w%</td>
<td></td>
<td>x</td>
<td>x</td>
<td>&gt; 75 w%</td>
<td></td>
<td>2010</td>
<td></td>
</tr>
<tr>
<td>packaging waste</td>
<td>100 w%</td>
<td></td>
<td>x</td>
<td>x</td>
<td>&gt; 50 w%</td>
<td></td>
<td>2010</td>
<td></td>
</tr>
<tr>
<td>glass</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>paper &amp; cardboard</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>metals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>plastics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>wood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>As defined in Directive 75/442/EEC</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>**** Recovery/recycling targets for WEEE and waste batteries are expressed as a percentage of the total weight of WEEE/batteries that has to be separately collected and fully sent for treatment and recycling.</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
| *** As proposed in COM(2008)810 final

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5.2 Total waste generation per capita

Waste generation is the most basic waste-related measure, providing a direct indication of the level of post-consumption disposal of materials. Total waste generation reflects all waste generated by the entire economy, and includes both hazardous and non-hazardous waste. Total waste can be further subdivided into mineral and non mineral waste, with non mineral waste allowing for better comparability between MS.


5.2.1 Status of the indicator and data availability

Eurostat tracks total waste generation, divided by various economic activities contributing to total generation. Total waste generation can also be divided into mineral and non mineral waste, as well as hazardous and non hazardous waste. Eurostat provides data per Member State and EU totals available in two-year increments for the period 2004-2010.

Eurostat’s Sustainable Development Strategy indicator set\textsuperscript{52} uses non-mineral waste generation to represent total waste generation in the EU. The European Environmental Agency’s Sustainable Consumption and Production indicator set\textsuperscript{53} uses waste generation other than mining and agricultural waste and residual waste from waste treatment.

The following table summarises the indicator based on the RACER framework.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Relevant</th>
<th>Accepted</th>
<th>Credible</th>
<th>Easy</th>
<th>Robust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total waste generation per capita</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
</tbody>
</table>

The indicator is directly relevant to conversion of waste into a resource, and is generally accepted by stakeholders. A system is already in place for collecting this data across MS, though disparities remain in the ways MS collect waste data for different economic sectors, which may have an impact on comparability of statistics between MS and across several years.


5.2.2 Current performance and trends in the EU and Member States

According to Eurostat data, total 2010 waste generation in the EU-27 was at about 2.503 million tonnes, or 4.987 kg/capita. Total EU waste generation has been lower in 2008 and 2010 than in 2004 and 2006, at least in part due to the economic downturn of recent years. Eurostat data shows that the largest contributors to total waste generation in the EU-27 are construction (33% of total waste in 2010) and mining and quarrying (28%). Total waste generation per capita varies by MS, with the highest rates observed in Bulgaria (21.874 kg/capita) and the lowest in Latvia (359 kg/capita).

The non-mineral waste component of total waste is considered to better reflect the general trend in waste generation, and to allow for greater comparability between MS, as it limits the effects of a high discrepancy in per-country economic activities and structure (for example, the relative significance of the construction or mining sectors).54

According to Eurostat, total 2010 non-mineral waste generation in the EU-27 was at 912 million tonnes, or about 1817 kg per capita. Non-mineral waste generation per capita decreased by an annual average rate of 1.9% between 2004 and 2008, with 2010 rates similar to those of 2008. Non-mineral waste generation differs significantly across MS, with particularly high levels in Estonia, due largely to enrichment and incineration of oil shale.55 Overall, downward trends in non-mineral waste generation have been observed in almost two-thirds of MS since 2004, suggesting that targeting underperformers and spreading best practices could help further decrease EU-27 generation levels.

According to Eurostat data, three key sectors contribute most significantly, and about equally, to non-mineral waste generation: household, waste and water management and manufacturing. Manufacturing has seen a steady decline in non mineral waste generation in the period since 2004, (~20.5% from 2004 to 2010), while waste and water management has seen a significant

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increase in the same period (+59.4%). Household generation levels have remained roughly stagnant.

Figure 14: Non-mineral waste generation in the EU (kg per capita), 2004 and 2010 – Source: Eurostat

5.2.3 How ambitious should the target be?

Despite relative stagnation between 2008 and 2010, non-mineral total waste generation decreased at an average annual rate of about 1.9% from 2004 to 2008. If this rate of decrease were to resume, non-mineral total waste generation per capita in 2020 could potentially be reduced by over 17% as compared to 2010 levels.

As a different approach, the notion that all production and end-of-life waste can be prevented is taken as an ambitious assumption. A previous study used this assumption to calculate the waste prevention potential for most significant materials, which totalled approximately 425 million tonnes for non-mineral waste. If waste reduction of approximately this amount were to be achieved by 2050, this would amount to about 15% reduction in total non-mineral waste by 2020 compared to 2010. Based on these two approaches, an ambitious target of 15% reduction in total non-mineral waste per capita is proposed by 2020.

However, lower targets are also suggested, bearing in mind the discrepancies between MS performance, the contribution of the economic downturn to recent decreases in waste generation and the inconsistent trends amongst the three key contributing sectors to non-mineral waste.

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If Member States succeed in re-industrializing (i.e. increasing the contribution of industrial activities to GDP and thereby also the amount of material resources used in manufacturing in the EU) this would increase the total amount of waste generated in the EU. The extent of re-industrialization and which sectors in particular would increase their production (and waste generation) would have to be taken into consideration when determining the level of ambition for the target.

5.2.4 What are the expected risks and consequences of setting the target?

**Contribution to reduced resource use or environmental impacts**

Waste prevention will help drive the EU towards greater material efficiency and smarter use of resources, contributing to decoupling of economic growth from waste generation. Further, reduction of waste generation and disposal will help reduce the negative environmental and health impacts of landfill and other waste disposal and treatment methods (water pollution, emissions of toxic materials, etc).

**Contribution to economic growth or well-being**

Greater waste prevention can help create value by reducing material demand and extending the lifetimes of products and resources. Incentivizing producers to take the end-of-life phase into account could help lead to product and packaging redesign which may in some cases lead to reduced costs (for example via minimal packaging). Lower waste generation could also create savings in waste collection, treatment and disposal expenses.

**Key actors affected**

- **Public authorities (national and local):** Public authorities are responsible for complying with and implementing EU waste legislation and targets, notably by establishing national and local policy in line with EU policy. Public authorities can set national targets for waste generation, and can implement national frameworks within which local policy and initiatives can function effectively. They can also help set up collection systems and other related waste services.

- **Waste generators (households, businesses, industry, etc):** Waste generators have some of the most direct impact on total waste levels. Their choices throughout the product lifetime impact their contribution to total waste. Lifestyle choices of households, as well as business models and processes of businesses and industry, help determine their material demand and waste generation levels.

- **Producers/manufacturers/retailers:** Producers, manufacturers and retailers can impact waste generation via the choices they make about product and packaging composition, durability and design. Producers can provide consumers (including
households, businesses and industry) with relevant information to help minimize waste of their products, and may participate in waste generation reduction via take-back schemes and other arrangements.

Risk of objective to be counter-productive

Overly stringent waste reduction targets could lead to illegal shipment of waste abroad.

Eurostat currently has only limited data on export of waste, particularly outside of the EU. Because the Waste Shipment Regulation requires that all hazardous waste movement (and select non-hazardous streams) be notified to authorities, Eurostat waste shipment data focuses primarily on hazardous waste. Due notably to the ban on hazardous waste shipment to non-OECD countries contained in the Basel Convention, most documented hazardous waste shipments tracked by Eurostat occur within the EU. However, illegal exports of both hazardous and non-hazardous waste are not captured in the data, and the figures provided by Eurostat are likely to underrepresent waste exports outside of the EU.

The impact of re-industrialization

Looking forward, the recent financial crisis may lead to a movement towards re-industrialization of European MS. This would likely increase generation of industrial waste, which is a major waste stream. A rebound in industrial activity could therefore contribute tangibly towards total waste generation. If effective recycling and other recovery systems are set up in parallel, the growth in industrial waste may help drive the waste treatment market, as well as the secondary raw materials (SRMs) market, considering the potential for uptake of SRMs by industrial actors. However, if treatment systems are unable to keep up with growth in industrial waste, there is a risk of increased industrial waste dumping in developing or Eastern European countries. The possibility of re-industrialization should be kept in mind when setting total waste targets.

5.3 Municipal waste generation per capita

Municipal solid waste is solid waste collected by a municipality, and typically consists primarily of household waste, with additional input from small businesses, public institutions and other local sources of waste generation. Municipal waste is an important waste stream, and accounts for about 10% of total waste produced in the EU57.


5.3.1 Status of the indicator and data availability

Eurostat tracks municipal waste generation, with data per Member State and EU totals available for the period 1995-2010.

The following table summarises the indicator based on the RACER framework.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Relevant</th>
<th>Accepted</th>
<th>Credible</th>
<th>Easy</th>
<th>Robust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipal waste generation per capita</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
</tbody>
</table>

The indicator is directly relevant to conversion of waste into a resource, and is generally accepted by stakeholders. A system is already in place for collecting this data across MS, though disparities remain in the ways MS account for municipal solid waste data, which makes a universal definition of municipal waste difficult and may have an impact on comparability of statistics between MS and across several years.

5.3.2 Current performance and trends in the EU and Member States

According to data recently made available by Eurostat, 2011 municipal waste generation in the EU-27 was at about 253 million tonnes, or 503 kg/capita. Total EU municipal waste generation had increased by 11% between 1995 and 2010\(^8\), due largely to growth in number of households and growth in consumption, but a consistently downward trend in municipal waste generation per capita can be observed from 2007 (522 kg/capita) to 2011. This steady decrease in recent years indicates potential for a reduction target by 2020.

The EEA European Environment – State and Outlook 2010 found that growth of municipal waste generation between 1995 and 2010 was slower than that of GDP, indicating relative decoupling.

Municipal waste generation per capita varies widely across EU Member States. Denmark has the highest waste generation levels, with 718 kg/capita generated in 2011, while Estonia only generated 298 kg/capita in the same year.

In 2010, the European Commission launched a study to investigate the wide discrepancies in municipal waste treatment across Member States. A screening of waste policies and performance across Member States was conducted in 2012, and provides an overview and scoreboard of Members’ municipal waste management policies and performance, while identifying the ten Member States with the largest implementation gaps. Policy recommendations and roadmaps are to be issued for these Member States in order to boost their waste management performance in coming years.

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\(^8\) Idem.
5.3.3 How ambitious should the target be?

With a compound annual growth rate of about -1% since 2007, MSW generation per capita shows potential for further reduction by 2020. Continuing at the same rate of decrease, MSW generation per capita in 2020 could potentially be reduced by about 10% as compared to 2010 levels. However, given the upward trend in MSW generation until 2007, and taking into account the disparity in MS performance, lower targets are also suggested.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipal solid waste generation per capita</td>
<td>By 2020, municipal waste per capita is reduced by at least 2% compared with 2010</td>
<td>By 2020, municipal waste per capita is reduced by at least 5% compared with 2010</td>
<td>By 2020, municipal waste per capita is reduced by at least 10% compared with 2010</td>
</tr>
</tbody>
</table>
Efforts to reduce municipal waste generation can include informational approaches, development of efficient collection and sorting systems, involvement of producers, and economic instruments such as pay-as-you-throw systems (PAYT).

5.3.4 **What are the expected risks and consequences of setting the target?**

**Contribution to reduced resource use or environmental impacts**

As for total waste, a reduction in MSW generation will help drive material efficiency and better use of resources, thus contributing to decoupling of economic growth from waste generation. A reduction in MSW generation will also help reduce the negative environmental and health impacts associated with waste disposal and treatment (pollution, emissions, etc).

**Contribution to economic growth or well-being**

Initiatives towards waste prevention can help generate savings by extending product lifetimes and reducing the demand for replacements. Incentivizing producers to take the end-of-life phase into account when creating their products could help generate more appropriate pricing and thus distribute costs of waste treatment more fairly across the various actors involved (producers and consumers / waste generators), rather than placing the entire financial burden on municipalities, while creating economic incentives for waste prevention amongst all key actors. Further, redesigning products and packaging with waste prevention in mind could actually help reduce costs (for example via minimal packaging). Lower MSW generation could also reduce the costs of local waste collection and related services.

**Key actors affected**

- **National authorities**: National authorities are responsible on a high level for complying with and implementing EU waste legislation and targets, notably by establishing national policy in line with EU policy. Public authorities can set national targets for MSW generation, and can implement national frameworks within which local policy and initiatives can function effectively.

- **Local authorities / municipalities**: Local authorities are responsible for municipal waste management, and have the ultimate responsibility for implementation of municipal waste generation targets. They are responsible for developing effective local waste management systems that ensure both efficient collection and proper treatment and disposal. Local authorities also have the capacity to promote waste reduction in their areas by informing the public, providing user-friendly waste-sorting disposal systems, or involving producers or other stakeholders.

- **Waste generators (households, small businesses, institutions, etc)**: Various municipal waste generators play a key role in municipal waste generation. Their choices at the time of purchase (e.g. quantity of packaging, durable or disposable goods, etc.), throughout the life span of the goods (e.g. maintenance and repair decisions) and at the end-of-life (e.g. way of disposal) all have a significant impact on rates of waste generation.

- **Producers/manufacturers/retailers**: Producers, manufacturers and retailers can have a strong impact on waste generation. They can help determine the need for
disposal by making choices about product composition and durability, as well as packaging quantity and design. Producers can also provide consumers and other agents throughout the life cycle of the product with information on materials and recommended disposal or treatment options. Further, producers involved in extended producer responsibility systems may help reduce waste generation by directly treating products via take-back and other arrangements.

**Links with other milestones**

The milestones on food and food waste are also closely related to the targets on waste prevention. Food waste is a priority sector within household waste, and the targets proposed for waste prevention for both milestones will be coherent.

**Choice of municipal waste vs. total waste as an indicator**

Total waste generation per capita and municipal waste generation may both be considered as appropriate waste indicators. Municipal waste is sometimes seen as particularly useful for meaningful comparison between Member States, as it excludes specific categories of waste (for example, construction and demolition waste) which can vary significantly between MS\(^\text{59}\). (For total waste, focusing on the non mineral component can also help reduce discrepancies). Perhaps more importantly, municipal solid waste data is generally more robust and reliable than total waste, as it is the only waste-related indicator for which a long time series exists for the EU. Data reliability aside, however, the two indicators give conceptually differing insights. As MSW reflects waste generated by households, it is a strong indicator of consumption patterns by end users, while total waste gives a better indication of the total resource efficiency of the economy. Ultimately, the choice of indicator could be made with respect to both data availability and the insight of interest.

5.4 Residual waste

Residual waste is not specifically defined in the Waste Framework Directive, but can be defined as the fraction of waste, which is not recycled, reused or recovered. In practice, this most often refers to waste, which is disposed of, notably via landfill, or incinerated without energy recovery\(^\text{60}\).

Residual waste is a good indicator for the effectiveness of sustainable consumption, waste prevention and waste recycling measures, and can help provide a meaningful comparison between MS with high consumption levels and high recycling rates, and those with lower consumption levels but lower recycling rates\(^\text{61}\).

\(^{59}\) Idem.


Achieving sustainable material efficiency will require the phasing out of residual waste, by using materials from which further use can be recovered and by improving recycling and reuse systems and processes.

The phasing out of residual waste is closely conceptually related to the introduction of life cycle thinking into waste policy. Taking a life cycle approach can help address underlying causes of residual waste and can help develop products that maximize use of recyclable materials by impacting the entirety of a product’s supply chain.

5.4.1 Status of the indicator and data availability

While residual waste is not classified as such in the Eurostat database, it can be calculated by using available data on landfill and incineration.

The following table summarises the indicator based on the RACER framework.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Relevant</th>
<th>Accepted</th>
<th>Credible</th>
<th>Easy</th>
<th>Robust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residual waste</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Reduction of residual waste is directly relevant to greater material efficiency, and the concept of residual waste, while not defined explicitly in waste legislation, is generally accepted amongst stakeholders. While residual waste is not currently measured as its own indicator by MS, it can be extrapolated from available waste data on landfill and incineration. Thus, the same limitations to availability, comparability and consistency of data apply to residual waste as to other waste treatment indicators.

5.4.2 Current performance and trends in the EU and Member States

According to 2010 Eurostat data, residual waste (calculated here as waste treated either by incineration without energy recovery or disposal) accounted for about 47% of EU-27 total waste treated. Performance per MS varied widely, as for other waste statistics. For example, Belgium and Denmark were both below 20%, while Bulgaria and Romania were above 90%.

5.4.3 How ambitious should the target be?

The Roadmap to a Resource Efficient Europe envisions driving residual waste close to zero by 2020. Given current performance levels, this target is seen as ambitious.

The compound annual growth rate of total residual waste generation from 2006 to 2010 was about -2%. Continuing this decrease, total residual waste generation could be reduced by about 15% as a low-level target. However, with policy recently becoming more focused on zero-waste ambitions and residual waste prevention being driven by better recycling practices, general waste prevention and life-cycle approach by producers, an intermediary target of a 50% reduction is proposed.
### Analysis of indicators and targets

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residual waste</td>
<td>By 2020, total residual waste generation is reduced by at least 15% compared to 2010</td>
<td>By 2020, total residual waste generation is reduced by at least 50% compared to 2010</td>
<td>By 2020, total residual waste will be close to zero (from Roadmap)</td>
</tr>
</tbody>
</table>

#### 5.4.4 What are the expected risks and consequences of setting the target?

**Contribution to reduced resource use or environmental impacts**

Phasing out residual waste will ensure that the economy primarily uses materials which can be recycled or reused, thus contributing to material and resource efficiency. Further, reducing residual waste will curb the negative environmental and health impacts associated with incineration and landfill disposal. These include soil and water pollutions, toxins and gas emissions from landfills, as well as CO2 emissions and air pollutants from incineration.

**Contribution to economic growth or well-being**

Phasing out residual waste will help eliminate the significant costs of incineration and landfilling, with the possibility of diverting associated budgets towards waste management systems more in line with the waste hierarchy. Placing greater emphasis on creating effective collection and sorting systems to divert recyclables from residual waste will also help drive the waste collection, sorting and recycling sectors, creating economic opportunities and jobs in these sectors.

**Key actors affected**

- **Public authorities (national and local):** Public authorities would be responsible for setting and meeting targets to help gradually phase out residual waste. They can use policy approaches to encourage waste prevention, while setting up effective separate collection systems which facilitate waste sorting and ensure that recyclable waste does not end up in the residual waste stream.

- **Waste generators (households, businesses, etc):** Waste generators can play a role in reducing residual waste generation, both by choosing to purchase recyclable products and by making sure to properly sort their waste and prevent recyclable materials from being disposed of with residual waste.

- **Producers/manufacturers/retailers:** Producers, manufacturers and retailers can help eliminate residual waste by taking a life cycle approach to their entire value chain and designing and manufacturing recyclable or reusable products.
6. Research and innovation

The milestone on research and innovation involves three main aspects to consider. Firstly, it implies investment in research and innovation related to resource efficiency, the impacts of the results of the scientific and innovation efforts related to resource efficiency, and the implementation of research and innovation policy (coherence, specialisation and cooperation) related to resource efficiency, climate change and resilience. Research and innovation in resource efficiency is key towards fulfilling the EU’s goals for resource efficiency. Research and innovation make it possible to gain knowledge and develop technologies, products and services that contribute towards resource efficiency. One of the targets proposed in the Europe 2020 Strategy was that 3% of the EU’s GDP should be invested in R&D by 2020. This analysis considers whether a target should be set for the share of public R&D expenditure that should be related to resource efficiency.

After a preliminary analysis of suitable indicators for setting resource efficiency targets related to consumption patterns, the EREP Working Group II and the Commission requested further analysis to be performed on the "share of public R&D expenditure (of total R&D spending) that is related to resource efficiency". This indicator informs on investments in resource efficiency related research and innovation by the public sector.

Research and development expenditure in the EU is tracked well; however existing databases do not provide data on the share of expenditure dedicated to resource efficiency. Traditionally, the statistics report on R&D expenditure related to socio-economic objectives such as energy and the environment however does not capture all the activities linked to resource efficiency such as eco-innovation and sustainable development.

6.1 The indicator and current EU policy

This milestone includes essential objectives towards achieving two Flagships of the Europe 2020 Strategy: the Resource Efficient Europe Flagship Initiative and the Innovation Union Flagship Initiative. The Innovation Union Flagship Initiative aims to strengthen the knowledge base and reduce fragmentation of national and regional research and innovation; getting good ideas to the market; maximising social and territorial cohesion, and making it easier to cooperate with the European research area.

Several financial instruments exist at EU and MS level to fund research and innovation in resource efficiency. At present, the largest such programme in the EU is the Seventh Framework Programme for Research (FP7). Since the early 1980s, the Framework Programmes have steadily increased in size and scope and spending under FP7 (2007-2013) is now in the order of €6 billion

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63 FP1 1984-1988 had a budget of €3.75 billion; FP5 1998-2002 €14.96 billion; FP6 2002-2006 €17.88 billion and FP7 2007-2013 a budget of €50.5 billion
per year, and is rising steadily towards an indicated €10+ billion by 2013. FP7 currently funds around 5% of public investment in the EU-27 in research and innovation (the rest coming from national governments and the private and charitable sectors). Horizon 2020 will replace FP7 and will run from 2014 to 2020 with a total budget of €80 billion. Under Horizon 2020, at least 60% of the total Horizon 2020 budget will be related to sustainable development, including funding for climate action and resource efficiency. It is expected that around 35% of the Horizon 2020 budget will be climate related expenditure.

The EU’s Environmental Technologies Action Plan (ETAP) was Europe’s first major drive to boost eco-innovation. The Action Plan was adopted in 2004 in response to rising demand for environmentally friendly techniques, products and services in both industrialised and developing countries. ETAP has been replaced with the Eco-innovation Action Plan (EcoAP), which aims at building on the valuable experience gained to date. The EcoAP goes beyond development and promotion of green technologies by also fostering a comprehensive range of eco-innovative processes, products and services.

The European Strategic Energy Technology Plan (SET Plan) establishes an energy technology policy for Europe. It is a strategic plan to accelerate the development and deployment of cost-effective low carbon technologies. The SET Plan aims to help achieve the following European objectives:

- In the short term by increasing research to reduce costs and improve performance of existing technologies, and by encouraging the commercial implementation of these technologies;
- In the longer term by supporting development of a new generation of low carbon technologies.

The Eco-innovation initiative was designed under the auspices of the Competitiveness and Innovation Framework Programme (CIP). The initiative is designed to help the EU meet its environmental objectives and boost economic growth, and is managed by the EACI. It also contributes to implementation of the Eco-innovation Action Plan. Approximately, €200 million are available for Eco-innovation projects from 2008-13.

Between 2007-2013, EU Cohesion Policy instruments will provide approximately €86.4 billion (almost 25% of the total budget) for R&D and innovation, including the mainstreaming of innovative actions and experimentation. Out of this total, Commission data suggests that €50.5 billion will go to R&D and innovation in the narrow sense including research facilities,
R&D-intensive SMEs and technology transfer. However, it is not clear how much of this allocated budget will go towards eco-innovation or resource efficiency related research and innovation projects in particular.

A recent report published by the EEA (European Environment Agency) provides an overview of resource efficiency policies and instruments in 31 member and cooperating countries of the European Environment Agency network. The report indicates that a few countries have set up 'specialised agencies' or research consortia to support policy development in resource efficiency. Finland and Germany in particular have specific objectives related to research and innovation in resource efficiency. Both Member States engage with networks of experts at the interface of research, policymaking and practical implementation, to build up a national knowledge base for resource efficiency, stimulate knowledge transfer and enable better implementation of resource efficiency measures within business sectors and individual companies.

6.2 Status of the indicator

There are good indicators for research and innovation, which measure the support (expenditure) from businesses, governments, universities and the private non-profit sector. The collection of data for public R&D funding follows the guidelines laid out in the OECD Frascati Manual. The data can be disaggregated in many ways such as by source of funds, by type of economic activity (NACE), by type of R&D, by fields of science (e.g. physical/chemical/biological/engineering/etc. sciences) and by socio-economic objectives. The socio-economic objectives list several research areas potentially related to resource efficiency, but 'energy' and 'environment' are the two areas most directly related. Eurostat gathers two types of public R&D spending data:

- Gross domestic expenditure on R&D (GERD), which is composed of: Business enterprise expenditure on R&D (BERD), Higher Education expenditure on R&D (HERD), Government expenditure on R&D (GOVERD) and Private Non-profit expenditure on R&D (PNPRD). GERD is based on reports by R&D performers and covers only R&D performed on national territory.

- Government Budget Appropriations or Outlays on R&D (GBAORD), which are budgets provisions, and not actual expenditure. GBAORD is based on reports by R&D funders and includes payments to foreign R&D performers.

GBAORD generally corresponds to HERD and GOVERD. As GBAORD is based on budgets, the data is available sooner than the actual R&D expenditure. The data availability of GBAORD by socio-economic objective (e.g. energy, environment, etc.) is also better than GERD. GERD has

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70 BIS (2011) Funding for EU Research and Innovation from 214: A UK Perspective
72 The 1992 Nomenclature for the Analysis and Comparison of Scientific Programmes and Budgets (NABS) had a more detailed breakdown, e.g. rational utilisation of energy, renewable energy sources, etc.
data gaps in Member States and EU-27 when it comes to socio-economic objectives. Efforts are being made to improve the reporting of energy related R&D.

An alternative to the existing Eurostat indicators, which only provide data based on 'energy' and 'environment', could be to track the funding allocated to resource efficiency topics in EU and Member State funding programmes. This was, for example, done for sustainable development related research on the website FP7-4-SD (www.fp7-4-sd.eu). However without a clear definition of research and innovation related to resource efficiency, this approach would be subject to interpretation and would not be so robust.

The indicators that are most related to public R&D expenditure related to resource efficiency are:

- Public R&D expenditure on renewable energy
- Public R&D expenditure on energy
- Public R&D expenditure on environment

6.2.1 Public expenditure on renewable energy

A study was carried out in 2004 to gain a clearer picture of the public and private research spending in the field of renewable and to evaluate each Member State’s share of the research spending in the last decade. The most important results from this study are that:

- More than half of the renewable energy research is done by the public sector;
- One quarter of the public spending comes directly from the EU budget;

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75 Eurostat – [gba_nabsfin07] Government budget appropriations or outlays on R&D
One third of the EU-15 Government research spending and half of the personnel working on research for renewables are from Germany.

Denmark and The Netherlands have the highest ratio of research spending on renewables in comparison to their GDP.\(^76\)

At the Member State level, large differences are seen among MS in terms of setting priorities for R&D investment in renewable energies. Some Member States invest in R&D on a wide range of energy technologies, whereas others tend to specialise. For example, Austria and the Netherlands spend about 60% of their R&D energy budgets on energy efficiency and renewables compared to an EU average of 30%. Denmark and Spain spend 16% and 15% of their respective budgets on wind energy; research on solar heating accounts for 52% of the Portuguese budget; and 75% of the Hungarian budget goes to research in bioenergy.\(^77\) Danish spending on research in hydrogen and fuel cells is the second highest in the EU after Germany. At EU level, most of the R&D funding for energy goes to nuclear research, followed by renewable energies, fossil fuels and energy efficiency.\(^79\) Figure 18 shows the relationship between RTD&D budget for RES and RTD&D budget for the overall energy sector for certain MS. With the exception of France, Ireland and Italy, the expenses for RES increase proportional to the countries' budgets for energy research. In Denmark and the Netherlands, the expenses of RTD&D for RES have the largest share of all EU countries with about 0.7% of the total expenses for RTD&D.

EU and Member State support remains crucial for R&D in renewable energy technologies. The main tools for supporting R&D at the EU level are the multi-annual "Framework Programmes for R&D", managed by the European Commission. The total budget allocated to FP7 (period 2007 – 2013) is €50.5 billion (current prices), with €2.35 billion is dedicated to non-nuclear energy (€335 million per year), out of which at least 50% will be dedicated to renewable energy and energy efficiency in the period 2007-2013 (€167 million per year). Nuclear fusion and fission energy will receive €550 million per year in research funding under the FP7 Euratom Research Framework in 2007-2011. Hence, renewable energy and energy efficiency will receive only about 30% of the sum available for nuclear energy research.\(^80\),\(^81\)

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\(^{79}\) EC (2008) Additional quantitative and semi-quantitative information to the report "A more research-intensive and integrated European Research Area Science, Technology and Competitiveness"

\(^{80}\) EC (2008) Additional quantitative and semi-quantitative information to the report "A more research-intensive and integrated European Research Area Science, Technology and Competitiveness"

The IEA database provides reliable and more up to date information on energy technology R&D budgets for various energy sources, including renewable energy. In 2011, the IEA published their Guide to Reporting Energy RD&D Budget/Expenditure Statistics, which distinguishes between seven groups of energy-related RD&D topics:

- Energy efficiency
- Fossil fuels: oil, gas and coal
- Renewable energy sources
- Nuclear fission and fusion
- Hydrogen and fuels cells
- Other power and storage technologies
- Other cross-cutting technologies or research

The figure below provides government R&D budgets for renewable energy technology from 2009-2011 for the MS where data was available.

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83 Data used to come up with the figures came from the IEA database as well as through questionnaires sent to relevant Member State authorities
Turning Milestones into Quantified Objectives

Modelling of Milestones for achieving Resource Efficiency

The following table summarises the indicator based on the RACER framework.

Table 9: RACER framework

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Relevant</th>
<th>Accepted</th>
<th>Credible</th>
<th>Easy</th>
<th>Robust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public R&amp;D expenditure related to renewable energy</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
</tr>
</tbody>
</table>

6.2.2 Public R&D expenditure related to energy and environment

For this indicator, at EU level, some data is available on the amount of funding allocated specifically for R&D in resource efficiency under the FP6 and FP7 programmes, as well as the Eco-Innovation initiative.

According to a recent report published by the EC on FP6 and FP7 projects related to resource efficiency, approximately 30 projects in resource efficiency were provided with a total funding of approximately € 2.5 billion. Resource efficiency projects under FP7 were granted €118 130 570 (or 0.7% of FP7 total budget of € 17.88 billion) and projects under FP6 were granted €133 848 979 (or 0.3% of FP6 total budget of € 50.5 billion).\(^8\) It should be noted however that this is only a selection of projects covering resource efficiency, therefore does not represent the actual percentage of all resource efficiency related projects under FP6 and FP7. However, the selection does represent the largest, most significant completed or on-going research projects related to resource efficiency funded by FP6 and FP7.

\(^8\) EC (2011) *Innovation for Resource Efficiency: A selection of FP6 and FP7 projects*  
ec.europa.eu/research/environment/pdf/innovation_for_resource_efficiency.pdf
The budget breakdown of FP7 (2007-2013) and Euratom\(^\text{86}\) (2007-2011) in EUR million provide some further indications on the amount that is allocated towards resource efficiency research projects (see Table 10). In total, approximately, 8.4 % (or €4240 million) is allocated to projects related to Energy and Environment (including Climate Change). A further breakdown of the amount allocated towards resource efficiency projects in particular within these themes was not possible to identify.

### Table 10: Budget breakdown for Energy and Environment Themes of FP7 (2007-2013) and Euratom (2007-2011) (in EUR million)\(^\text{87}\)

<table>
<thead>
<tr>
<th>Theme</th>
<th>Amount</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>2,350</td>
<td>4.7%</td>
</tr>
<tr>
<td>Environment (including Climate Change)</td>
<td>1,890</td>
<td>3.7%</td>
</tr>
</tbody>
</table>

At MS level, a database does not specifically exist for public expenditure on resource efficiency. However, the OECD provides yearly data on Member Countries government budget and appropriations and outlays for R&D (GBAORD) according to energy or environmental objectives. The Eurostat database also provides similar data. Finally, IEA database provides data on Member country budgets on R&D in energy. These data sources can provide some indication of the funding that is being allocated towards resource-efficiency related projects and research. Figure 19 shows the share of budgeted public R&D expenditure in the areas of energy and environment in the EU compared to total public R&D expenditure. The average share between 2007 and 2011 is about 6.5% of total public expenditure is related to energy or environment.

\[\text{Figure 19: Public R&D expenditure (budgeted) on energy and environment related areas as share of total public R&D expenditure [Eurostat, GBAORD]}\]

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\(\text{86} \) Euratom energy research activities are carried out under the treaty with the same name, which in 1957 established the European Atomic Energy Community (Euratom). Euratom is legally separated from the European Community (EC) and has its own Framework Research Programme, however managed by the common Community institutions.

\(\text{87} \) FP7 website: \text{http://cordis.europa.eu/fp7/budget_en.html}\
The figures below illustrate MS funding for energy and environment in 2011 based on Eurostat data. Latvia, Romania and Finland are the only Member States where over 10% of (budgeted) public R&D spending is related to either energy or environment. It should be however noted that the total size of public R&D expenditure varies across Member States, e.g. Latvia and Romania spend much less on R&D compared to their GDP than Finland. Six Member States spend more than 8% of (budgeted) public R&D on areas related to either energy or environment.

![Figure 20: Government budget appropriations or outlays allocated to R&D (GBAORD) in energy and environment (% of total public R&D spending and % of GDP), 2011, Source: Eurostat](http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=gba_nabsfin07&lang=en)

The following table summarises the indicator based on the RACER framework.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Relevant</th>
<th>Accepted</th>
<th>Credible</th>
<th>Easy</th>
<th>Robust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public R&amp;D expenditure related to energy and environment (by Government Budget Appropriations or Outlays on R&amp;D)</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Public R&amp;D expenditure related to energy and environment (by actual expenditure)</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
</tr>
</tbody>
</table>

The data availability and robustness for R&D expenditure on energy and environment is better for the indicator based on budget appropriations and outlays than on actual expenditure.

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6.3 How ambitious should the target be?

Research shows that public R&D expenditure related to resource efficiency is in place in all EU MS, however at varying degrees and in different areas.

The targets that are defined below in Table 11 for the selected indicators are based on the current progress of EU performance. The indicator to best represent public R&D expenditure related to resource efficiency is public R&D expenditure related to energy and environment based on Eurostat data on GBAORD. At present the data availability for actual public spending on energy and environment has data gaps. This is not thought to be an issue as actual R&D expenditure corresponds well to the budgeted R&D expenditure.

More specific data on resource efficiency is not available at the moment, but could be developed if energy and environment is thought to be too restrictive a proxy compared to resource efficiency in general. Member States could be asked to complement their R&D statistics with information according to research themes more related to resource efficiency, e.g. renewable energy, material efficiency, water minimisation, etc.

Table 11: Proposed targets for public R&D expenditure

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public R&amp;D expenditure related to energy and environment</td>
<td>By 2020, at least 8% of public R&amp;D expenditure in Member States (of total public R&amp;D spending) should be related to resource efficiency</td>
<td>By 2020, at least 10% of public R&amp;D expenditure in Member States (of total public R&amp;D spending) should be related to resource efficiency</td>
<td>By 2020, at least 12% of public R&amp;D expenditure in Member States (of total public R&amp;D spending) should be related to resource efficiency</td>
</tr>
</tbody>
</table>

Several aspects should be considered in order to reach the different target levels specified in Table 11. The responsibility of meeting the targets in Table 11 would lie principally with MS governments. A large R&D effort is seen throughout Europe and several financial instruments exist at the EU and MS level that fund research and innovation related to resource efficiency. Strengthening the coherence between these instruments would facilitate the identification of areas where resource efficiency funding is being allocated to and which areas may need additional funding (e.g. investments related to environmental technologies, organisational innovation for the environment, product and service innovation offering environmental benefits, and green system innovations). In addition to greater coherence, it is also important to agree upon a set definition of resource efficiency and the research activities that would fall under this category. As has already been mentioned, resource efficiency covers many areas; therefore greater harmonization of the concepts of resource efficiency would facilitate the data gathering process.

To achieve the various target levels the EU and Member States would need to prioritise resource efficiency within their R&D budgets. Further, for R&D budgets in the energy sector, renewable energies would also need to increase in importance. In order to do this, it is important to promote and raise awareness on the strong link between resource efficiency and economic growth at all levels of society – from governments, business, academia and civil society. Another
important aspect to consider is the labour force needed to match levels of funding. The funding for R&D in resource efficiency would be useless if the necessary labour force (i.e. research institutions, researchers, etc.) were not available. In this respect, involving universities, setting up appropriate educational programmes and networks would be essential. The links between research and industries is also especially important. Such collaborations merge the discovery-driven culture of the research organisation with the innovation-driven environment of the company. These sort of strategic partnerships ensure funding to bolster academic strength and produce researchers who understand the realities of markets.

Finally, the results or outputs of investments in R&D in resource efficient are also important to highlight. Currently, there are few indicators to measures the results of research or its application in businesses and society. An example of an existing indicator which could potential be used includes for example the number of patents or exports of products from eco-industries, which are provided by Eurostat. The development of such indicators could be used to promote the value and importance of resource efficient to relevant stakeholders.

The measurement of research and innovation investment can be carried out by comparing the funding allocated to resource efficiency topics in EU and MS funding programmes and through existing databases (OECD, Eurostat and IEA databases). However, currently, a harmonized database or similar tool recording specific and disaggregated information on the public R&D expenditure related to resource efficiency, renewable energy and eco-innovation does not exist. Therefore, it would be important to improve data collection from MS as well as international organisations. This could include for example developing specific codes for financed research projects (at EU as well as national level), which could enhance the knowledge about the financed activities. Further, the structure of financing and the flow of funds from sources to the research performers is not always clear because in many countries the channels of financing are quite diverse and dispersed.

6.4 What are the expected risks and consequences of setting the target?

Research and innovation in resource efficiency will drive Europe towards the smarter use of scarce resources and also presents an economic opportunity by improving productivity, reducing production costs and boosting competitiveness.

6.4.1 Key actors affected

Member States would be the main actor responsible in terms of allocating their public R&D expenditure towards resource efficiency. The EU also has a role to play by being able to set resource efficiency research as a priority in EU wide funding programmes and providing guidance on what targets would be most appropriate and in what areas of resource efficiency. Priorities

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are bound to differ among MS based on aspects such as regional specificities, the status of environmental technologies, etc.

For the research sector, achieving this milestone would mean the possibility of developing innovative systems, processes and technologies that could transform the EU into a resource-efficient economy. Currently there is a lack of qualified and skilled workers (engineers, academics, etc.). Therefore, increased research funding in resource efficiency would attract researchers from across the world and encourage education and research institutions to develop relevant programmes to attract the knowledge capacity needed.

Industries and SME’s would benefit from the processes and products innovations developed by researchers. Finally, there is also a strong potential for job growth in the sector.

6.4.2 Contribution to reduced resource use or environmental impacts

By substantially increasing the investment, coherence, and cooperation related to resource efficiency, the objectives of the milestone would be attained. Improved knowledge on new materials, new production technologies as well as new innovative processes will lead to increased resource efficiency.

Research in resource efficiency includes cleaner technologies, technologies and systems for environmental protection and the understanding and assessment of eco-innovation. Different technologies have been developed in order to produce electricity from renewable sources (wind, biomass, hydro, solar photovoltaic, geothermal, concentrating solar power, marine energy). However, these technologies are at a different stage of development, and all require some R&D to reach its full potential in order to reduce their costs, facilitate their integration into the grid and increase their consumption. Renewable energy in particular has the potential to provide sustainable electricity and other energy sources, however could present problems with regard to cost in the short term. There are many factors which influence the viability of renewable electricity generation across Europe and beyond and consideration of regional issues is important.

6.4.3 Contribution to economic growth or well-being

Research in eco-innovation can help to provide solutions for novel and competitively priced goods, processes, systems and services. Enhancing resource efficiency therefore requires eco-innovative solutions for which investments and funding is needed. Research is key to understanding, initiating, adapting and accompanying the transition to a green economy. The role of research for achieving a resource-efficient Europe is the development and co-creation of knowledge. Research can work together with business to develop technological knowledge to drive product and process eco-innovation in industry. Further, by strengthening the relationship between research, policy makers, citizens, business, and other scientific fields, knowledge would be created about the interactions between humans and natural systems, as

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well as how change can happen to create more resilient systems – and thus promote increasing well-being.

6.4.4 Links with other milestones

This milestone will have transversal effects and is therefore linked with many other milestones, and in particular with:

- Sustainable production because research and innovation in resource efficiency seeks solutions to render production processes more efficient and less costly;
- Sustainable consumption because research and innovation in resource efficiency and sustainable consumption seeks solutions for novel and competitively priced goods, thereby providing incentives to consumers when purchasing products with a likely impact on the environment;
- Turning waste into a resource because research and innovation in resource efficiency seeks solutions for more resource efficient and less environmentally harmful waste treatment options.

6.4.5 Risk of objective to be counter-productive

A target for R&D in resource efficiency must not lead to inefficient policies where funds are used unfairly or inefficiently. Therefore, it is not only important to be able to identify and prioritise the areas of research and innovation in resource efficiency, but also capable of monitoring the results of research. In order to get an idea of the productivity of research and development activities one should consider the outcomes, outputs and impacts. This is often difficult to do as the relationship between investment and outcome is not straightforward, and there is often long lag times between R&D efforts and useful results. Patents and publications are used as proxies for the immediate outputs of R&D activities, but these do not necessarily indicate the (economic and societal) value of research. The amount or rate of new resource efficient products, processes and solutions (including their turnover) could be used to inform on the performance of R&D efforts, but as mentioned under the milestone for resource efficient products, it is difficult to identify these types of products. Finally, one could also track the overall consumption or efficiency of resources (and environmental impacts) in an economy to inform of R&D performance, but this is influenced by many other factors, e.g. prices, consumption patterns, etc.

One of the principal challenges of this milestone is to ensure that the results (or outputs) of research and innovation in resource efficiency is integrated into policies and translated into concrete actions. However, the relationship between investment and outcome is not straightforward, and there is often long lag times between R&D efforts and useful results. Therefore, it would be important that efforts are made to strengthen the link between the science-policy interfaces.
7. Environmentally Harmful Subsidies

At present, there is no commonly adopted definition for a subsidy, and there is no established rule for setting which subsidy should be considered as environmentally harmful. The completion of this milestone therefore requires that clear definitions are adopted at least at the EU level.

After a preliminary analysis of suitable indicators for setting resource efficiency targets related to consumption patterns, the EREP Working Group II and the Commission requested further analysis to be performed on “fossil fuel subsidies”.

7.1 The indicator and current EU policy

The narrowest definition of a subsidy only considers direct transfers of funds. However, this definition is too narrow because a government can resort to many tools to provide public support to a target group. For example, governments can freely provide goods or services to private agents, which is quite equivalent to a direct money transfer in terms of consequences. Furthermore and conversely to money transfers and the provision of goods and services, government can also provide “off-budget” public support. For example, revenues that are not collected, due to tax credits, can also be considered as a type of subsidies.

The OECD 2011 inventory\(^2\) distinguishes between:

1. Direct transfer of funds
2. Transfer of risk to government
3. Induced transfers
4. Tax revenue foregone
5. Other government revenue foregone

Note that direct transfers, risk transfers and induced transfers usually constitute government expenditures whereas tax revenues and other revenues foregone are always off budget.

The OECD developed a checklist to remove subsidies that are harmful to the environment based on targeting resource use\(^3\). In fact, the basic line of reasoning of this checklist is that removing subsidies has the largest environmental impact if they directly affect the production and use of natural resources or emissions. According to the OECD, subsidy removal is likely to have a larger environmental impact if:

- The subsidies have been implemented for a long time;
- They have been targeted at environmentally relevant variable costs;

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They have had (upstream) effects on industries that are relatively polluting or resource intensive by themselves; and

They have been applied to existing production capacity, not just new additions.

Ineffective or harmful environmental subsidies were already identified as an area in need of reform in the EU Sustainable Development Strategy. Over the years, the OECD has conducted several reviews of harmful policies and proposed potential policy reforms. In September 2009, the G20 Leaders committed to “rationalize and phase out over the medium term inefficient fossil fuel subsidies that encourage wasteful consumption”, while recognising “the importance of providing those in need with essential energy services, including through the use of targeted cash transfers and other appropriate mechanisms”. They called on all countries to “adopt policies that will phase out such subsidies worldwide”.

Several EU Member States are already in the process of reforming their fossil fuel subsidies.

### 7.2 Status of the indicator

Recently, the OECD and the IEA carried out inventories of subsidies leading to an increased use of fossil fuels. The methodologies developed separately by the OECD and the IEA are presented below.

#### 7.2.1 Fossil fuel consumer subsidies (price gap method) – IEA

Each year the IEA undertakes a global survey to identify economies that artificially lower end-use prices for fossil fuels to below the full cost of supply. The estimates cover subsidies to fossil fuels consumed by end users and subsidies to fossil fuel inputs to electric power generation. The IEA’s analysis of energy subsidies compares the end-use prices paid by consumers with reference prices (i.e. prices that would prevail in a competitive market). The difference between the consumer price and the reference price is the price gap, and subsidy removal amounts to its elimination.

#### 7.2.2 Fossil fuel subsidies (PSE-CSE framework) – OECD

Official institutions in 24 countries reported over 250 measures that support fossil fuel production or use to the OECD. The OECD inventory identified government actions that effectively...
support fossil-fuel use or production by using the PSE-CSE framework. “The PSE-CSE framework distinguishes among those measures that benefit producers (PSE: Producer Support Estimate), consumers (CSE: Consumer Support Estimate), and those that benefit producers collectively, or that do not support current production, such as industry-specific R&D (GSSE: General Services Support Estimate)”. For more information, see the OECD’s PSE Manual, available online at: www.oecd.org/agriculture/PSE” (OECD, 2011). Data for the non-OECD countries in the EU has been calculated by the European Commission.

7.2.3 Differences between excises on unleaded petrol and diesel

Based on an OECD methodology to identify environmentally harmful subsidies, a simple indication for environmentally harmful subsidies is given by the difference between excises on diesel and unleaded petrol. Used in the iGreenGrowth indicator set.

7.2.4 Differences between standard and households’ energy consumption VAT rates (in %)

This indicator attempts to take account of the size of environmentally harmful subsidies in the economy. This indicator considers VAT rates for solid fuels, fuel oil, natural gas and electricity consumption. Reduced VAT rates for energy consumption distort incentives. Removing these reduced tax rates would free-up budgetary resources that could be used, in turn, to more directly target the social objectives that might have been supported via the subsidies. Used in the iGreenGrowth indicator set.

The estimates from the IEA and OECD provide different, but complementary, information due to the calculation methods. Both the IEA and OECD calculation methods are however closer to determining the total amount of fossil fuel subsidies compared to the other two indicators as these only cover a single type of fossil fuel subsidy. On the other hand, the latter two indicators are easier to track and gather information. The following table summarises the indicators based on the RACER framework.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Relevant</th>
<th>Accepted</th>
<th>Credible</th>
<th>Easy</th>
<th>Robust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil fuel consumer subsidies (price gap method) - IEA</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Fossil fuel subsidies (PSE-CSE framework) – OECD</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Difference between excises on unleaded petrol and diesel (€/1000 l)</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Difference between standard and households’ energy consumption VAT rates (in %)</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>


http://www.oecd.org/site/tadffss/methodology.htm
7.3 Current progress in the EU and Member States

In the recent years, many countries have realised or are about to realise reforms to eliminate EHS associated with fossil fuels, because of commitments were made and also because of high international energy prices make subsidies a growing liability for public expenditure. For 2010, the OECD estimates that support to fossil fuels could have amounted to 60 billion US dollars (equivalent to 45 billion Euros in 2010, see Figure 21).

![Figure 21: Support to fossil fuels in OECD countries](image)

According to EEA estimates with a different methodology for 37 economies, fossil fuel subsidies could have amounted to 400 billion dollars (equivalent to 300 billion euros) for this same year.

![Figure 22: Government support and subsidies to the production and consumption of fossil fuels in 2010](image)

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103 Source: OECD (2011) Inventory of Estimated Budgetary Support and Tax Expenditures for Fossil Fuels, OECD Publishing. [http://dx.doi.org/10.1787/9789264128736-en](http://dx.doi.org/10.1787/9789264128736-en). “This graph is based on an arithmetic sum of the individual support measures identified for a sample of 21 OECD countries, i.e. the 24 OECD countries included in the inventory net of those countries for which estimates have not been collected yet (Chile, Iceland and Luxembourg). It includes the value of tax relief measured under each jurisdiction’s benchmark tax treatment. The estimates do not take into account interactions that may occur if multiple measures were to be removed at the same time”.

Analysis of indicators and targets

Figure 23: Economic value of fossil fuel consumption subsidies by fuel\(^{105}\)

Figure 24 shows the difference between standard and households’ energy consumption VAT rates (in %) in the OECD countries.

Figure 24: Taxes on petrol (P) and diesel (D) in OECD countries (excluding VAT)\(^{106}\)

7.4 Target setting

The milestone proposes that EHS in general are phased out by 2020. In relation to EHS related to the production and consumption of fossil fuels, the 2020 target could be all fossil fuel subsidies in the EU should be phased out.

\(^{105}\) IEA (2011) *World Energy Outlook*. “Electricity subsidies include only those resulting from under-pricing of fossil fuels consumed in power generation”. Estimates are based on an aggregate of 37 economies.

### Table 13: Potential targets for fossil fuel subsidies

<table>
<thead>
<tr>
<th>Level of ambition</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>By 2020, 75% of fossil fuel subsidies (measured in economic value compared to 2010) in the EU should be phased out</td>
</tr>
</tbody>
</table>
| Medium            | By 2020, all fossil fuel subsidies in the EU should be phased out [proposed in the Roadmap]  
A progressive decrease with respect to 2010, based on OECD’s inventory, could be possible:  
- 30% by 2015;  
- 60% by 2017;  
- 90% by 2019; and  
- 100% by 2020. |
| High              | By 2018, all environmentally harmful subsidies in the EU should be phased out (not just fossil fuel subsidies) |

The feasibility of removing environmentally harmful subsidies will clearly depend on the concerned sector and on the design of the subsidies. For the OECD\textsuperscript{107}, the removal of EHS can find three types of barriers:

- **Political barriers**: the EHS removal could be regarded as unacceptable for example for equity reasons.
- **Institutional barriers**: when the actors of government most concerned with the problems created by the subsidy have no power to remove the subsidy; and
- **Technological barriers**: for example, fully integrating environmental externalities may require very expensive control and monitoring capacities.

Actions to be undertaken to achieve these targets include:

- Choice of a definition for subsidies and inventory of EHS relating to the use of fossil fuel for all MSs (eventually OECD inventory as a starting point);
- International cooperation for the removal of these EHS out of the EU;
- Phasing-out of these EHS;
- Development of compensatory measures for target groups to support welfare and economic growth; and
- Monitoring that no more new EHS relating to the use of fossil fuels are adopted.

In particular, governments must pay attention to the impacts of removing subsidies on certain social groups. Often subsidies are in place for groups that are in some way viewed as disadvantaged. The removal of subsidies can cause politically undesirable distributional effects. There are however ways of compensating for these through policy reforms\textsuperscript{108}.

\textsuperscript{107} OECD (2005), Environmentally Harmful Subsidies: Challenges for Reform, OECD, Paris.  
7.5 What are the expected risks and consequences of setting the target?

An established EU target on GPP would drive the demand for green products\(^{109}\). Public expenditure on products and services with EU core criteria represents a significant value, which would provide substantial incentives to the market to adhere to environmental criteria set under GPP and offer more resource efficient products and services.

7.5.1 Key actors affected

*The former recipients* from any EHS (consumers or companies) will be affected by its removal. However, the intensity of the negative impact of the removal of the subsidy for the recipient will depend on whether the recipient was benefiting or not from a windfall effect. As a matter of fact, some of the recipients of a subsidy are eligible to it even though their behaviour would not change if they did not receive the subsidy. These are ‘windfall beneficiaries’ for which the subsidy constitute a money transfer, but has no impact on their activities as such. On the other hand, there are recipients that depend on a subsidy to engage in a particular practice. The removal of the subsidy will affect the behaviour of these recipients, for example because an activity is no longer profitable without the subsidy or because it becomes too expensive for a consumer to purchase a particular good (e.g. gasoline) without a subsidy.

*The actors of the value chain of a sector* that are upstream or downstream with respect to the former recipients of a subsidy being removed will also be affected whenever the actions undertaken by the former recipients are modified due to the removal of the subsidy. For example, the provider of some equipment entering into a manufacturing process could lose clients who engaged in a specific activity if this latter is no longer profitable due to the removal of the subsidy.

In the particular case of subsidies for the use and consumption of fossil fuels, the removal of these EHS will have macroeconomic effects as energy price will rise and modify the behaviour of all energy users (businesses and households). Energy intensive sectors will be the most affected by the removal of the subsidies. On the other hand, the removal of these EHS could have an impact on energy poverty for the most vulnerable households\(^{110}\). Compensatory measures (e.g. by subsidising energy efficiency improvements) will therefore have to be put into place to avoid jeopardising economic growth and the welfare of vulnerable groups of households.

7.5.2 Contribution to reduced resource use or environmental impacts

The removal of EHS will clearly contribute to reducing resource use and environmental impacts provided that EHS have been properly identified and that no new kind of environmentally

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\(^{110}\) Studies on fuel poverty:
- [http://fuelpoverty.eu/](http://fuelpoverty.eu/)
harmful government support replaces it. According to IEA simulations\textsuperscript{111}, if fossil fuel consumption subsidies in the 37 economies captured by the IEA survey were completely phased-out by 2020, CO\textsubscript{2} emissions in these economies would drop by 4.7% for this same year.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure25.png}
\caption{Impact of fossil-fuel consumption subsidy phase-out on global energy demand and CO\textsubscript{2} emissions\textsuperscript{112} (2012-2035)}
\end{figure}

According to preliminary macro-economic modelling\textsuperscript{113} of subsidies in the EU, there is a clear environmental benefit from phasing out fossil fuel subsidies. In almost all cases final energy consumption falls, by as much as 2% of the national total. The potential reduction in energy-related CO\textsubscript{2} emissions is of a similar magnitude.

\textbf{7.5.3 Contribution to economic growth or well-being}

The removal of some EHS could have negative impacts on economic growth and the well-being of some specific groups of citizens if no compensatory measures are implemented. Resource-intensive sectors and vulnerable households could be particularly affected by the removal of EHS, but solutions may exist to mitigate such negative impacts, considering that the removal of the EHS will provide extra funds for government to take compensatory actions. In particular, these compensatory actions could take the form of subsidised improvements in resource efficiency that will reduce the actors’ dependency on resource use and therefore their need for environmentally harmful subsidies.

According to the preliminary modelling\textsuperscript{114} of phasing out subsidies related to energy consumption and CO\textsubscript{2} emissions (including reduced VAT rates) would have a positive but small effect on GDP (less than 0.1% of GDP) in nearly all cases. This is primarily due to reductions in fossil fuel imports to Europe and the beneficial effects of revenue recycling (assuming that the reduction of government expenses to subsidies lead to reduced income tax).

\textsuperscript{111} This is mentioned in IEA, OPEC, OECD and World Bank (2011) Joint report by IEA, OPEC, OECD and World Bank on fossil-fuel and other energy subsidies: An update of the G20 Pittsburgh and Toronto Commitments.

\textsuperscript{112} IEA (2011) World Energy Outlook. “Savings from the progressive phase-out of all subsidies by 2020 compared with a baseline in which subsidy rates remain unchanged“.


7.5.4 *Links with other milestones*

This milestone will have transversal effects and is therefore linked with many other milestones, and in particular with:

- Sustainable production because EHS encourage inefficient use of resources in production processes;
- Sustainable consumption because EHS give wrong incentives to consumers when purchasing products with a likely impact on the environment;
- The shift from labour taxation to environmental taxation, because the removal of EHS will lead to government cut-offs with similar impacts than an increase in the tax rate associated with environmental taxation.
- The need for full pricing of ecosystem services, because underpricing of ecosystem services constitutes an EHS as long as implicit income transfers resulting from a lack of full cost pricing enter into the definition of subsidies.

At the sectoral level, EHS could have impacts on food, buildings and transport. The removal of EHS could have positive impacts on other milestones relating to biodiversity, water, air, land and soil, marine resources, etc.

7.5.5 *Risk of objective to be counter-productive*

The removal of EHS could negatively affect economic growth and the well-being of vulnerable households if no compensatory measures are implemented. It could also affect EU competitiveness, if other regions of the world keep subsidising resource-intensive activities through EHS.

Care must be made to ensure that only environmentally harmful subsidies are phased-out. The environmental impacts of a subsidies can be difficult to assess, like in the case of public transportation. Subsidies can have both positive and negative environmental impacts (e.g. positive impacts on climate change but negative impacts on land use, or vice-versa). In this context, Valsecchi *et al.* (2009) assess various tools developed by OECD to identify EHS. Monitoring of subsidies is necessary to ensure that the phased-out EHS are not replaced with other forms of government support that are as environmentally harmful or even more environmentally harmful than the withdrawn EHS.

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8. Environmental Tax Reform

This milestone covers several issues with the two key issues being:

- Increasing the volume and effectiveness of environmental taxes; and
- Engaging in labour tax reforms to reduce the high tax rates on labour in the EU.

Labour taxation partly explains the high cost of EU labour, which has a direct effect on employment and on EU competitiveness. On the other hand, there are many market failures that lead to environmental damages. To correct these market failures, economic instruments, such as environmental taxes, are usually recommended by economists but not always fully implemented today. Therefore, replacing some of the tax burden on labour by environmental taxes could have a positive impact on social welfare, by reducing pollution, and by increasing the employment rate.

After a preliminary analysis of suitable indicators for setting resource efficiency targets related to consumption patterns, the EREP Working Group II and the Commission requested further analysis to be performed on "environmental taxes as share of total taxes and social contributions".

8.1 The indicator and current EU policy

Tax policy in the European Union (EU) consists of two components: direct taxation, which remains the sole responsibility of Member States, and indirect taxation, which affects free movement of goods and the freedom to provide services.

Labour taxes

Implicit labour tax rates in the EU range from 21.7% in Malta to 42.6% in Italy. Labour taxes consist of personal income taxes and social security contributions. Except in Denmark, Ireland and the United Kingdom where the income tax corresponds to a relatively large part of labour taxes, social security contributions are a much larger share of labour taxes than personal income taxes in the EU.

Despite measures taken by EU countries to reduce the tax burden on labour during the last years, the EU as a whole is still characterised by high labour taxation. A study by Bocconi University noted that Southern European countries increased labour taxation whereas North and Eastern

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European countries reduced it. Finally, continental European countries did not substantially modify their tax burden on labour.

In a context of economic crisis and high public debt levels, reducing labour-related tax rates will be difficult unless tax reductions are compensated fully with environmental taxes or other kinds of taxes, such as VAT.

Environmental taxes

Environmental taxes are indirect taxes, in general consumption taxes, but they sometimes include taxes on capital stocks. Environmental taxes are currently mainly levied on transport fuels, not principally for environmental reasons, but above all for revenue raising purposes. According to the European Commission\(^{117}\), various measures could be implemented at the Member State level to improve the environmental effectiveness of energy-related taxes, including:

- Adjusting tax rates on fossil fuels according to their carbon and energy content;
- Indexing excise duty levels to inflation, in order to ensure constant real revenues and also to maintain the real impact of the taxes on relative prices, and therefore their impact on consumer behaviour;
- Reconsidering reduced VAT rates on energy;
- Reducing tax subsidies for company cars; and
- Introducing CO\(_2\)-related vehicle taxation.

8.2 Status of the indicator

The relevant indicators of performance related to environmental taxation that are currently tracked systematically are\(^{119}\): total environmental tax revenues as a share of GDP and total environmental tax revenues as a share of total taxes and social contributions.

8.2.1 Total environmental tax revenues as a share of GDP

Eurostat defines total environmental tax revenues as the revenues that are derived from taxes “whose tax base is a physical unit of something that has a proven, negative impact on the environment”. In practice, it includes taxes on transport, energy, pollution and resources. Such information can be expressed as a share of total taxes and social contribution to analyse the contribution of environmental taxation to the tax system. A shift from labour taxation to environmental taxation should therefore lead to an increase of this indicator. Data is available from Eurostat for all Member States since 1995 [ten00065].


8.2.2 **Total environmental tax revenues as a share of total taxes and social contributions**

Total environmental tax revenues can be also expressed as a share of GDP. Such an indicator then provides an overview of the importance of environmental taxes on national economies. Data is available from Eurostat for all Member States since 1995 [ten00064].

The following table summarises the assessment of the two indicators based on the RACER framework.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Relevant</th>
<th>Accepted</th>
<th>Credible</th>
<th>Easy</th>
<th>Robust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total environmental tax revenues as a share of total taxes and social contributions</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Total environmental tax revenues as a share of GDP</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
</tr>
</tbody>
</table>

These indicators are constructed based on a precise definition from Eurostat. They have been used in official publications from European institutions to analyse tax systems and tax reform: they are both accepted and credible. On the other hand, they are very relevant to the matter of environmental reform:

- Environmental tax revenues expressed as a share of total taxes and social contributions allows assessing the weight given to environmental taxation with respect to other forms of taxation, including labour taxation.
- Environmental tax revenues expressed as a share of GDP is a measure of the stringency of environmental taxes in an economy.

Yearly trends are easy to interpret, considering that an increase in both indicators means that the importance of environmental taxation for the tax system or for the economy is increasing. However, even if such an interpretation is usually correct for time-series analysis, it can be misleading in a few cases, and the indicators are not well suited for cross-country analysis. This is because tax revenues do not depend only on the tax rate, but also on the tax base. Therefore, high revenues from environmental taxation, in particular energy-related taxes, can be an indicator of an inefficient use of resources and energy in an economy, leading to high levels of resource consumption in a context of eventually low tax rates.

This element is important and careful attention to the specific conditions of energy and resource use in each Member State should be taken into account before setting policy targets with these indicators.

Another potential bias in cross-country, or even time-series analysis, is that no account is made of environmentally friendly/harmful subsidies in the calculation of environmental tax revenues. Therefore, total revenues raised from environmental taxes do not provide a comprehensive overview on how economic instruments contribute to enhance the environmental status of Member States.
8.3 Current progress in the EU and Member States

In 2010, the total revenue from environmental taxes in the EU-27 was about €292 billion, corresponding to 2.4% of EU GDP and 6.2% of the total revenues derived from all taxes and social contributions.

![Figure 26: EU average shares of environmental and labour taxes in total tax revenues from taxes and social contributions (Source: Eurostat [tsdgo410])](image)

![Figure 27: Shares of environmental and labour taxes in total tax revenues from taxes and social contributions in EU Member States (Source: Eurostat [tsdgo410])](image)
Energy taxes represented 74.9% and transport taxes about 21.2% of total revenues levied. On the other hand, pollution and resource taxes only represented 3.9% of total environmental revenues in the EU-27 in 2010\textsuperscript{120}.

\textsuperscript{120}Eurostat – Statistics explained:  
According to OECD\textsuperscript{121}, except for taxes on motor vehicles and motor vehicle fuels, the rates of environmentally related taxes in OECD countries are in most cases below the value of the associated environmental damages (Figure 30).

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure30}
\caption{Revenues from environmentally related taxes in per cent of GDP, by tax-base, 2000 and 2009 (Source: OECD\textsuperscript{121}).}
\end{figure}

In this context, raising environmental taxes has not the same meaning for energy and transport as for pollution and resource use:

- For energy and transport, high tax rates benefit from inelastic demand, which makes them good items for raising revenue.
- For pollution and resource use, current tax levels are usually below the value of the associated environmental damages, which make them meaningful from the economic perspective of increasing social welfare through environmental taxation.

### 8.4 Target setting

With low ambitions, improvements in the environmental effectiveness of energy and transport taxes, and the increase in the tax rates of pollution and resource taxes are attainable:

- **Improving the structure of energy and transport taxes.** Because energy related taxes have long been implemented with the purpose of raising revenues, their effect on the environment has not been at the core of their design. Consequently,

it is possible to improve their effectiveness with parametric adjustments (principally on the applied tax rates according to the energy source).

- **Increasing the tax rate of pollution and resource taxes.** For pollution and resource taxes, the currently applied tax rates are well below the environmental damage. Therefore, increasing the low tax rates of these taxes seems feasible and perfectly in accordance with economic principles.

With moderate ambitions, increases in environmental taxation (in energy, transport, pollution and resource use) could be higher because the negative effects from increasing environmental taxation could be counterbalanced by reductions in labour taxation. However, when increasing the tax rate of environmental taxes, their distributional effect (likely to be negative) and their potential effect of EU competitiveness will have to be taken into account.

With high ambitions, the increase in the tax rates of environmental taxes could be quite sharp for price-elastic goods (in the field of pollution and resource taxes) because the increases in tax rate will lower demand. The regressive impact of environmental taxes could be counterbalanced if the increases in tax rates take place in a context of green growth, as encouraged by the Roadmap to a Resource Efficient Europe\(^{122}\). Furthermore, the potential negative effects on EU competitiveness of increasing environmental taxation could be lower if other regions in the world were also adopt stringent environmental policies.

Table 15: Potential targets for an Environmental Tax Reform

<table>
<thead>
<tr>
<th>Level of ambition</th>
<th>Target</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td><em>By 2020, the share of environmental taxation in public revenues in the EU on average should be at least 8%, with specific targets set at the MS level to account for specificities at national level.</em></td>
<td>As a minimum, Member States should maintain their current level of revenues raised from environmental taxes, expressed as a share of GDP.</td>
</tr>
<tr>
<td>Medium</td>
<td><em>By 2020, the share of environmental taxation in public revenues in the EU on average should be at least 10%, with specific targets set at the MS level to account for specificities at national level.</em> [proposed in the Roadmap Annex 6]</td>
<td>At least half of the increases in public revenues from environmental taxation should be used to reduce labour taxes.</td>
</tr>
<tr>
<td>High</td>
<td><em>By 2020, the share of environmental taxation in public revenues in the EU on average should be at least 12%, with specific targets set at the MS level to account for specificities at national level.</em></td>
<td>Except for the EU countries with a very high level of public debt (over 100% of GDP, for example), all the extra revenues from higher environmental taxation will be used to reduce labour taxes.</td>
</tr>
</tbody>
</table>

Measures to reach this goal will include increases in the tax rate and environmental effectiveness of energy-related taxes, and new taxes and tax increases for pollution and resource taxes.

8.5 What are the expected risks and consequences of setting the target?

### 8.5.1 Positive consequences of environmental tax reform

The use of environmental taxation to achieve environmental goals could result in many circumstances more efficient command-and-control instruments than those currently employed. This is because the pollution abatement costs associated with economic instruments are usually lower than the abatement costs entailed by command-and-control instruments. When economic instruments are used, each polluter has the incentives to abate pollutions in the least-expensive ways, whereas command-and-control instruments impose specific means to do so, which may be expensive for some of the compelled firms. Therefore, implementing environmental taxes could provide both environmental and economic benefits:

- It could lower the abatement costs of private companies to reduce pollution; and
- Abatement thresholds could be more stringent, considering first that average abatement costs have been reduced.

Furthermore, command-and-control instruments usually provide no incentive for companies to go beyond the defined minimum standards. On the other hand, economic instruments such as taxes provide incentives for companies to develop new technologies and go beyond minimum standards.

Finally, environmental taxes generate revenues. In the context of this milestone, these revenues would be spent to cut-off the taxes levied on labour. By doing so, some of the disadvantages usually associated with EU high labour tax rates could be mitigated.

With respect to the distortions caused by labour taxation, Bocconi University\textsuperscript{118} found that tax policy might play only a minor role in increasing participation to the labour market as a whole. However, the decision to participate in the labour market is sensitive to tax incentives for specific target groups. Therefore, the shift from labour taxation to environmental taxation could be the occasion for reducing the tax burden on these target groups, in order to encourage their participation to the labour market. In this direction, OECD\textsuperscript{123} recommends that labour taxes are alleviated for:

- **Low-income workers**, in particular because the motivation to seek work is often accompanied by social benefit withdrawals. Solutions to increase low-income workers labour market participation include reducing personal income tax and social security contribution burdens on low-income workers or introducing in-work tax credits.
- **Older workers**, for which taxes and pension systems often combine to create incentives to retire. According to the OECD\textsuperscript{123}, possible options to improve work incentives include providing age-based rather than pension-specific tax

\textsuperscript{118} Bocconi University

concessions; reducing social security contribution burdens on older workers to match those due on pension income; and providing in-work tax credits targeted at older workers.

- **Mobile high-skilled workers**, because migration decisions are sensitive to the tax burden, and international mobility may be a concern for governments as high-skilled workers can add significant value to an economy. In certain cases, introducing tax concessions targeted at mobile high-skilled workers could have positive macroeconomic impacts.

- **Second earners** (e.g. spouses), because the tax systems usually offer disincentives for second earners to participate in the labour market.

Furthermore, the tax system has an impact on the unemployment rate of low-skilled workers. For OECD\textsuperscript{123}, high employer social security contributions, generous minimum wage laws, or a combination of both can price low-skilled workers out of employment. Possible options to improve labour demand for low-skilled workers include reducing employer social security contributions and providing employer tax credits targeted at low-skilled workers.

Finally, competitiveness gains could be obtained for private companies if part of the revenues from increasing environmental tax rates were employed to reduce the cost of labour for EU firms, for example, through reductions in employers’ social security contributions.

### 8.5.2 Risk of objective to be counter-productive

- **Need of ensuring constant revenues**

This milestone will be reached only if the revenues from environmental taxation compensate the decrease in labour taxation. This will require a very good understanding of the revenues likely to be raised with environmental taxes and their evolution in the long-run.

In particular, the stability and predictability of environmental tax revenues will depend on the erosion resulting from short-run and long-run behavioural responses of polluters to the implementation of new environmental taxes. According to Fullerton, Leicester and Smith\textsuperscript{124}, the problem of the stability of environmental revenues might have been overstated by many economists, because energy-related taxes are based on inelastically-demanded commodities. Furthermore, a broad tax base that does not limit environmental taxation to fossil energy could help reduce the volatility of environmental tax revenues. However, the still uncertain evolution of the energy mix of EU countries, in a context of climate change and increasingly stringent environmental policies, could have an impact on environmental tax revenues in the long-run.

- **Risk of affecting EU competitiveness**

Taxes on industrial inputs (e.g. raw materials) will increase production costs. If environmental taxes only apply to EU firms competing on a global market, increasing environmental taxes may negatively affect the position of EU firms with respect to their competitors outside the EU. However, such a negative impact of increasing environmental taxation could be compensated by

a reduction of the cost of labour for private companies, for example through reductions in employers’ social security contributions.

Political and social acceptability of the reforms

Any tax reform will be dependent on the political and social acceptability of the reforms. Unfortunately, the change from labour to environmental taxation is likely to have negative distributional effects. Fullerton et al.\textsuperscript{124} note that many environmental taxes geared to households are regressive: for example, a significant share of low-income budgets is spent on electricity, heating fuel and transportation.

8.5.3 Links with other milestones

This milestone is closely linked with:

- The removal of Environmentally Harmful Subsidies, considering that the phasing-out of such subsidies could have a similar effect on the EU economy and government revenues as an increase in environmental taxes; and

- The proper pricing of environmental externalities (e.g. valuation of ecosystem services), which could be fostered in the framework of this milestone through an increase in specific environmental taxes.

- Encouraging research and innovation in environmental technologies, considering that a rise in environmental taxes will provide additional incentives for companies to develop non-polluting technologies.
9. Water

The European Commission’s Roadmap to a Resource Efficient Europe\textsuperscript{125} provides a framework for future actions and milestones for resource efficiency to be met by 2020. Each of the milestones in the Roadmap mention or propose possible indicators that could be used to track progress of resource efficiency in the EU.

After a preliminary analysis of suitable indicators for setting resource efficiency targets related to water, the EREP Working Group II and the Commission requested further analysis to be performed on the \textit{“Water Exploitation Index (WEI) and WEI+”} and \textit{“total annual water abstraction”}. WEI and WEI+ inform on the availability of water in relation to water use (i.e. water scarcity). Water abstraction is a measure for the amount of water removed from a source.

9.1 Definitions and objectives of current EU policy

The Water Framework Directive (WFD)\textsuperscript{126} provides the regulatory framework, the governance (River Basin Authorities and Common Implementation Strategy) and tools (e.g. River Basin Management Plans) to implement the EU policy related to freshwater. The River Basin District (RBD) is the main unit for management of river basins\textsuperscript{127}. In most cases, the RBDs have been established respecting the hydrological boundaries of the river basins, thereby keeping the catchment intact, beyond national borders. However, in some Member States the administrative boundaries, rather than the hydrological boundaries of the catchment, have dictated the designation of the RBD\textsuperscript{128}. The WFD requires that each Member State produces a plan for each of the RBD within its territory. River Basin Management Plans (RBMPs) are comprehensive documents that cover many aspects of water management and aim to help achieve protection of water bodies and sustainable use of water across Europe. They include objectives for each water body, reasons for not achieving objectives where relevant, and the actions required to meet the objectives set.

Good status of all waters, i.e. surface and groundwater, is the overarching objective of the WFD and is defined in its Annexes. It corresponds to ecological and chemical requirements (e.g. quality of the structure and functioning of aquatic ecosystems associated with surface waters, compliance of groundwater with chemical quality standards) to be achieved in all EU river basins. These may be complemented by other requirements for particular water uses, such as water for drinking purposes. On the other hand, derogations from the requirement to achieve good status

\textsuperscript{127} Defined as: “areas of land from which all surface run-off flows through a sequence of streams, rivers and, possibly, lakes into the sea at a single river mouth, estuary or delta”, in the WFD.
can be decided for activities considered essential, such as water abstraction for human drinking purposes or flood protection, as long as all appropriate mitigation measures are taken. Derogations for some activities are also provided for cases where alternatives are technically impossible, are prohibitively expensive, or produce a worse overall environmental result\textsuperscript{129}.

Water abstraction is the process of withdrawing water from natural hydrologic sources. Water use refers to water actually used by end users (e.g. households, services, agriculture, industry) within a territory for a specific purpose such as domestic use, irrigation or industrial processing\textsuperscript{130}. It does not necessarily correspond to the volumes abstracted since losses can occur before use, e.g. leakages during distribution or evaporation. In addition, a certain amount of the water abstracted can be returned to the aquatic environment, e.g. through the discharge of treated wastewater from households in surface water bodies, the discharge of most of the water used for cooling in energy production, or groundwater recharge by water percolation). Various uses can be more or less consumptive. For example, water used for irrigation will have a very low return rate, whereas water used for cooling will be mostly returned to the water body. The levels of abstraction and return influence the status of water bodies by affecting the environmental flows and therefore the quality and quantity of water at the source and downstream\textsuperscript{131}. A lower amount of water in rivers or aquifers implies higher concentrations of pollutants, with potential negative environmental and socio-economic impacts.

\begin{align*}
\text{Water used} &= \text{Water abstracted} – \text{Water losses} \\
\text{Water consumed} &= \text{Water used} – \text{water returned to the water body} \\
\text{Environmental flows} &= \text{Total water in the water body} – \text{Water abstracted} + \text{Water returned to the water body}
\end{align*}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{water_flowchart.png}
\caption{Differences between water abstracted, water used and water returned}
\end{figure}

\textsuperscript{129} http://ec.europa.eu/environment/water/water-framework/info/intro_en.htm
\textsuperscript{130} http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Glossary:Water_use
\textsuperscript{131} EEA (2012) Building the Future we want. EEA Signals 2012.
Ensuring sustainable supplies of freshwater requires a good understanding of how much water is available in a region, where it is coming from, who uses it, when (summer, winter, peak consumption) and how. The quantification of how much water is available in the water body in total, minus the water needed by ecosystems (ecological flows) allows to calculate how much water is available as a maximum for human use. The importance of managing water availability and supply in the long-run has been recently reinforced in the Blueprint to Safeguard Europe’s Water Resources\textsuperscript{132} and work is being done with the technical support of EEA on water accounts\textsuperscript{133}, to enable water managers to have a more realistic picture of water availability at river basin or sub catchment level.

9.2 Status of the indicators

Annual data on freshwater resources, water abstraction and use are collected biennially by means of the OECD/Eurostat Joint Questionnaire - Inland Waters.\textsuperscript{134} At present the statistical unit is the country, but in the future it will also be River Basin Districts (RBD) and River Basin District subunits. There is data available for freshwater resources from 1970 to 2009 (as well as a long-term annual average) and for water abstraction from 1970 to 2007. There are however considerable data gaps (e.g. there is no year for which all Member States reported data, making an estimation of total water use or abstraction in the EU complex). Data and other information on water is accessible via WISE, the water information system for Europe.\textsuperscript{135}

The Water Exploitation Index (WEI), developed by the EEA, is currently used to track water scarcity. WEI, or withdrawal ratio in a country (or a river basin when available), is defined as the mean annual total abstraction of fresh water divided by the long-term average freshwater resources. It describes how the total water abstraction puts pressure on water resources. Thus it identifies those countries or river basins which have high abstraction in relation to their resources and therefore are prone to experience water stress on an annual basis.

Data per hydrological unit (river basin district) and on a monthly basis would be the most appropriate scale to reflect the hydrological realities and seasonality effects\textsuperscript{136}. However, while monthly calculation is technically possible, it requires detailed information and simulation of seasonal water storages, which is a considerable effort in data acquisition\textsuperscript{137}. Hydrological data for a specific area and long time series are not always easily available, partly because of the great number of organisations involved in water resources management.

Within the 2010-2012 Common Implementation Strategy (CIS) period, an updated mandate on water scarcity and droughts was approved, requesting to deliver a set of common indicators for

\textsuperscript{133} http://ec.europa.eu/environment/water/blueprint/balances.htm
\textsuperscript{134} http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/EN/env_wat_esms.htm
\textsuperscript{135} http://water.europa.eu/
\textsuperscript{137} JRC (2012) A multi-criteria optimisation of scenarios for the protection of water resources in Europe. Available at: eur25552en_jrc_blueprint_optimisation_study.pdf
both water scarcity (influenced by human activity) and drought (natural), including the Water Exploitation Index Plus as an upgraded version of WEI. This indicator represents the ratio of annual freshwater abstraction to long-term water availability taking into account return water and ecological requirements. The advantages and shortcomings of both these indicators are discussed below.

9.2.1 Water Exploitation Index (WEI)

WEI provides an overview of the scale and location of water availability issues. It indicates the level of pressure that human activity exerts on the natural water resources of a particular territory and helps identify those prone to suffer problems of water stress over time.

\[
\text{WEI} = \frac{\text{Mean annual total abstraction of fresh water}}{\text{long-term annual average freshwater resources}}
\]

This indicator identifies whether the rates of abstraction are sustainable, and help analyse how changes in human consumption affect the freshwater resources either by adding pressure to them or by making their use more sustainable. WEI is relatively easy to monitor and can be presented in the form of maps and graphs, providing information both on the spatial distribution of the level of pressure that human activity exerts on the natural water resources and the temporal evolution over long time periods. This allows for the qualitative and quantitative comparison of the intensity and duration of human pressure on water resources with recorded impacts such as yield reductions, low flows, or lowering of groundwater levels, for example.

Thresholds of water stress for WEI have been defined. A water body is considered to be under stress when WEI exceeds 20% (the abstraction of water represents more than 20% of the long-term average freshwater resources). Severe water stress is considered to occur where this percentage exceeds 40%. Although these thresholds are debated among the experts, they represent reference values in the EU that can be easily interpreted.

WEI was however criticised because it does not consider that the water abstracted can be returned to the environment. For instance, water abstraction for energy cooling purposes is

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138 Following a testing exercise conducted by several Pilot River Basins, two other indicators were selected: Standardized Precipitation Index (SPI): to detect and quantify meteorological drought situations by comparing the current situation to historical records; and the fraction of Absorbed Photosynthetically Active Solar Radiation (fAPAR): it represents the fraction of the solar energy which is absorbed by the vegetation canopy and is a biophysical variable directly correlated with the primary productivity of the vegetation. Its anomalies (the deviation from the long-term mean for a certain period of time) are considered a good indicator to detect and assess drought impacts on vegetation canopies.

139 EEA. Indicator Fact Sheet (WQ01c) Water Exploitation Index. Authors: Conchita Marcuello and Concha Lallana, CEDEX EEA project manager: Niels Thyssen; version 01.10.03


taken into account in the WEI, although it is largely returned to the environment. This may overestimate abstraction and related water stress, and eventually penalise certain sectors such as hydropower, in case targets are set.

The WEI has however increasingly been used in EU policy. Groundwater abstraction and surface water abstraction as a share of available resources are used in the iGG\(^\text{142}\), in the EU Sustainable Development Strategy (SDS)\(^\text{143}\), and in the EEA Set of Indicators on Sustainable Consumption and Production (SCP)\(^\text{144}\). It has also been used as a key indicator in the EU ClimWatAdapt project to model water vulnerability of EU water resources in 2050 following SCENES scenarios. The WEI is also used for communication, for example it is represented for illustrative purposes in the Blueprint leaflet. This use is in line with a working document from the Expert Group on Water Scarcity and Droughts of the CIS, where it is classified as a public awareness indicator\(^\text{145}\). However, WEI is not unanimously accepted amongst stakeholders, and in particular in Member States where there is a high share of activities returning high amounts of water (e.g. cooling water). The development of the WEI+ is expected to address the WEI’s shortcomings for an increased acceptability by all stakeholders.

9.2.2 WEI+

WEI has been revised to be upgraded into WEI+ by a Technical Working Group (TWG) within the Expert Group on water scarcity and drought in the frame of the CIS. WEI+ aims to capture the balance between natural renewable water resources and abstraction by incorporating Returned Water\(^\text{146}\) and Water Requirement\(^\text{147}\) (i.e. Environmental Flows) parameters. It therefore better depicts conditions to be achieved in line with WFD objectives than the WEI, should water be returned to the natural environment at the same state (e.g. quality, temperature) and location without disturbing ecological flows. It is formulated in the following terms\(^\text{148}\):

\[
\text{WEI+} = \frac{\text{Abstractions} - \text{Returns}}{\text{Renewable Water Resources}}
\]

Renewable Water Resources can be defined following two options:

**Option 1.** \(RWR = \text{ExIn} + P - \text{Eta} - \Delta \text{Snat}\)

**Option 2.** \(RWR = \text{Outflow} + (\text{Abstraction} - \text{Return}) - \Delta \text{Sart}\)


\(^{143}\) http://epp.eurostat.ec.europa.eu/portal/page/portal/sdi/indicators/theme8

\(^{144}\) http://scp.eionet.europa.eu/publications/SCP_Indicator_frame/wp/WP2010_1b


\(^{146}\) Returned Water refers to the volume of water that is returned and available for re-use in the catchments, which in the case of e.g. cooling water may be a significant volume (Source: EEA) Artificial groundwater recharge is also considered as returned water for the current purposes of calculation of WEI+. Discharges to the sea are excluded.

\(^{147}\) Water Requirements: The level of stress or relevant water scarcity in a catchment changes if we subtract an amount of water that is not actually available for abstraction since it needs to be left in the catchment to maintain its ecological status (in line with WFD) or other legal requirements (e.g. treaties in transboundary rivers) (Source: EEA)

\(^{148}\) Note: the water resources provided by artificial reservoirs are included in the denominator
WEI+ carries the potential to improve the analysis of structural and episodic categories of water stress\(^{149}\). WEI+ is currently being tested in pilot river basins. Defining thresholds for WEI+ is challenging\(^{150}\). Unlike WEI there are no specific guidelines to determine when a river basin is water stressed. Some Members of the TWG are working on the definition of thresholds for WEI+. Because of the lack of a harmonized and comparable method of calculation, environmental flows are not included in the WEI+ formula yet. They could be considered in the definition of thresholds.

Difficulties identified during the testing stage of WEI+ mostly relate to the estimation of the changes in storage\(^{151}\) (\(\Delta S_{\text{nat}}\)). As suggested by some TWG members\(^{152}\), a complementary sub-indicator could be developed, reflecting the water scarcity in relation to the overall available water resources, including all storage, natural and artificial. This sub-indicator could illustrate the water availability to solve e.g. emergency situations. A way of representing this indicator might be the evolution of stored water resources over time, and comparing data with previous years or reference periods.

So far, the TWG recommends “using the best option based on available information and certainty”. To limit efforts in data acquisition, the TWG also recommends a two-step approach. In a first step the WEI or WEI+ at annual scale would be applied. Where appropriate and if data are available, WEI or WEI+ at monthly scale should be calculated either for every month or in the worst month where water scarcity situations could be expected.

### 9.2.3 Comparison of WEI and WEI+

Testing on pilot river basins shows that WEI+ is more robust than WEI. It strengthens or inverts the conditions of water stress in certain countries compared to WEI calculations. E.g. WEI overestimates water stress compared to WEI+ in NL, ES, EE, BE and underestimates water stress in AT, UK and IT\(^{153}\).
Numerous interpretations of WEI and WEI+ are however possible because of the variety of definitions and procedures to estimate water use (e.g. some include cooling water while others do not) and freshwater resources in Member States. Remaining ambiguities between boundaries may also be the source of discrepancies when comparing data of water balances in neighbouring countries, particularly for those along the Rhine, Danube and Oder rivers, where the allocation of the flow along borders is decisive in the water balance\textsuperscript{55}. Moreover, the EEA specifies that “the scope for inferring concrete policies or actions from these types of indicators are limited unless they are complemented with more concrete sub-assessments that explain more about the reasons for e.g. high or low productivity, the economic activities driving water abstraction, and how these activities relate to the regional economy”\textsuperscript{55}.

There is currently insufficient data to produce the WEI and/or WEI+ at the required spatial and temporal scales across Europe and inform management decisions at the regional (sub-national) level. More refined data are being developed together with Member States. WEI+, which relies on water consumption and includes the issues of storage, is more difficult to monitor than WEI.

The following table summarises the indicators based on the RACER framework.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Relevant</th>
<th>Accepted</th>
<th>Credible</th>
<th>Easy</th>
<th>Robust</th>
</tr>
</thead>
<tbody>
<tr>
<td>WEI</td>
<td>Medium</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>WEI+</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
<td>High to Medium</td>
</tr>
</tbody>
</table>

9.3 Current progress in the EU and Member States

Although water is generally abundant in Europe, demand for water may still exceed water availability and increasing water stress has been observed in recent years (Figure 32). Over-abstraction is currently considered the second most common pressure on ecological status of water bodies in the EU\textsuperscript{56}. There are considerable differences in the per inhabitant amounts of freshwater abstracted within each of the EU Member States (Figure 32), in part reflecting the resources available, but also abstraction practices depending on climate as well as on the industrial and agricultural structure of the country.

Overall water demand in most of Europe is expected to be stable or to decrease (due to increased efficiency), although many river basins will continue to face high water stress due to high demand for water compared with availability (Figure 33). In Europe, abstractions from the cooling, agriculture, public water supply and industry respectively account for approximately 37%, 33%, 20% and 10% of the WEI. In 2010, MS with WEI>40% include Cyprus, and 40%>WEI>...
20% include Belgium, Spain, Italy and Malta\textsuperscript{557}. However, the WEI decreased in 24 countries over the last 10-17 years, representing a decrease of about 12% in total water abstraction.

![Water exploitation index (WEI %) and total annual water abstraction per capita (m$^3$) for different river basin districts of six Member States, 2007\textsuperscript{558}](image)

**Figure 32:** Water exploitation and total annual water abstraction per capita in river basin districts of six Member States, 2007\textsuperscript{558}

Most of the decrease occurred in the Eastern countries, because of the decline in abstraction in most economic sectors as a result of institutional and economic changes. This trend is expected to continue with greater water efficiency in the major water using sectors. It can be assumed that the Member States with high abstraction for irrigation (i.e. Cyprus, Spain, Italy and Malta) will continue to experience severe water stress in the future without strengthening of current policy\textsuperscript{559}. MS that do not have to face water scarcity issues have a more pronounced interest for water quality over water quantity (EEA survey 2011)\textsuperscript{560}, although reducing their water use could contribute to reducing their water-related energy use (e.g. for pumping and heating water).

Today in the EU, it is estimated that at least 100 million inhabitants and 17% of EU territory have been affected by water scarcity (Figure 33). Water availability is expected to decrease in most


\textsuperscript{558} EEA (2012) Towards efficient use of water resources in Europe. EEA Report No 1/2012.

\textsuperscript{559} BIO (2012) Assessment of resource efficiency indicators and targets. On behalf of the European Commission.

Turning Milestones into Quantified Objectives

Modelling of Milestones for achieving Resource Efficiency

parts of Europe in the context of changing climate. Water scarcity and drought is expected to affect half of EU river basins\textsuperscript{161}. Under a “business-as-usual” development, water withdrawals could increase by more than 40%, to cope with increased needs for irrigation, cooling, etc. Figure 33 shows WEI at the lowest level of disaggregation available in each MS, based on a specific data collection exercise by EEA. Data may however not be systematically available annually at such a disaggregation level.

![Figure 33: Water Exploitation Index at the river basin level and projection in 2050, and comparison with urban population number\textsuperscript{162}](image)

Better knowledge of water vulnerability in terms of availability has been acquired, in particular in the context of changing climate, through modelling (e.g. ClimWatAdapt project\textsuperscript{163}, EU Project on the impacts of climate change on drinking water\textsuperscript{164}). However, water objectives could still be more integrated into EU sectoral policies, such as the Common Agricultural Policy that supported irrigated crops and investments related to irrigation technologies.

### 9.4 Target setting

**Following the recommendations from the Blueprint\textsuperscript{165}, water targets** should be developed by the river basin authorities for the river basins which are — or are projected to be — water stressed, on the basis of water stress indicators such as WEI and WEI+ developed in the CIS process and applied at river basin level.

\textsuperscript{161} Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the regions. A Blueprint to Safeguard Europe’s Water Resources. COM(2012)673 final
\textsuperscript{162} EEA website. May 2012 \textsuperscript{163} http://www.eea.europa.eu/data-and-maps/figures/precipitation-deficit-in-summer-jja-1
\textsuperscript{163} http://climwatadapt.eu/
\textsuperscript{164} \textsuperscript{164} http://adwice.biois.com/
9.4.1 **WEI or WEI+**

Several options of targets for WEI and WEI+ indicators can be considered, alone or in combination, depending on whether the focus is on the:

- scope of water stress: this can be expressed relatively to administrative scales (e.g. MS or RBD), to the size of the territories experiencing water stress and/or to socio-economic indicators (e.g. percentage of inhabitants);
- intensity of water stress (e.g. relatively to the thresholds set);
- duration of water stress.

A priori and for indicative purposes, Table 17 highlights these three options for EU targets, with their respective levels of ambition, based on past and current trends. Their respective strengths and weaknesses are compared in Table 18. Today, based on a rough extrapolation from available data at river basin and national levels, approximately half of river basins might experience water stress, and 15 to 30% may experience severe water stress. To our knowledge, there is no precise and readily available information on the annual proportion of population or EU/MS territory experiencing water stress.
Modelling of Milestones for achieving Resource Efficiency

Table 17: Three options for target settings and respective levels of ambition

<table>
<thead>
<tr>
<th>Level of ambition</th>
<th>Option A: reducing the scope of water stress</th>
<th>Option B: reducing the intensity of water stress</th>
<th>Option C: reducing the duration of water stress</th>
</tr>
</thead>
</table>
| Low               | 1. By 2020, 60% of river basins in the EU do not experience water stress at any time.  
2. By 2020, 85% of EU territory does not experience water stress at any time.  
3. By 2020, 85% of EU population do not experience water stress at any time.  
Water stress measured with WEI+, but until the indicator and data is available with WEI. | Decrease the WEI for all countries with WEI > water stress threshold by 2020, at the national level, and maintain levels below this threshold for the other Member States.  
Water stress measured with WEI+, but until the indicator and data is available with WEI. | By 2020, maintain or reduce the number of consecutive months where water stress is occurring.  
Water stress measured with WEI+, but until the indicator and data is available with WEI. |
| Medium            | 1. By 2020, 80% of river basins in the EU do not experience water stress at any time.  
2. By 2020, 90% of MS territories do not experience water stress at any time.  
3. By 2020, 90% of MS population do not experience water stress at any time.  
Water stress measured with WEI+, but until the indicator and data is available with WEI. | By 2020, no river basin districts experiences severe water stress at any time.  
By 2020, all river basin districts experiencing water stress decreased the intensity of water stress (measured by WEI+ but WEI in the mean time) by at least 30% (measured annually, and then per month)  
The water stress threshold for WEI could be set at 20% and severe water stress at 40% | By 2020, reduce the number of consecutive months where water stress is occurring.  
Water stress measured with WEI+, but until the indicator and data is available with WEI. |
| High              | 1. By 2020, no river basin in the EU should experience water stress at any time.  
2. By 2020, EU does not experience water stress at any time.  
3. By 2020, no EU population should experience water stress at any time.  
Water stress measured with WEI+, but until the indicator and data is available with WEI. | By 2020, no river basin in the EU present WEI>20% at any time.  
(The water stress threshold for WEI could be set at 20% and severe water stress at 40%) | EU and all its Member States do not experience water stress at any time.  
Water stress measured with WEI+, but until the indicator and data is available with WEI. |

The proposed targets are only preliminary. Deeper analysis of the feasibility of the targets should be performed. The proposals reflect the project team’s best estimate and personal opinion at this stage of the study and is not to be perceived in any way as the opinion of the European Commission.
Table 18: Strengths and weaknesses of each option

<table>
<thead>
<tr>
<th>Options</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option A: Reducing the scope of water stress</td>
<td>% of RBD Practicality of setting targets related to administrative boundaries and easy to identify responsibilities in terms of monitoring and coordinator of actions</td>
<td>No indication of the magnitude of water stress. The size and population of RBDs can vary broadly, as well as intensity of water stress.</td>
</tr>
<tr>
<td></td>
<td>% of territory Indication of the size of the area experiencing water stress, which can be a proxy for impacts on ecosystems and allows calibrating efforts in terms of prevention and/or mitigation</td>
<td>Does not correspond to administrative boundaries, which may limit the targets' practicality and enforcement</td>
</tr>
<tr>
<td></td>
<td>% of population Indication of the share of population experiencing water stress, which can be a proxy for potential impacts on economic activities and allows calibrating efforts in terms of prevention and/or mitigation</td>
<td>Focus on economic activities. No consideration of the extent of ecosystems experiencing water stress. Variations of the size of the population may limit data collection and the targets’ practicality and enforcement, in particular in touristic areas where large population fluctuations may occur in specific seasons.</td>
</tr>
<tr>
<td>Option B: Reducing the intensity of water stress</td>
<td>Ensure overall improvements in terms of sustainable use of water in the EU.</td>
<td>Does not necessarily reflect impacts of less severe but long term water stress.</td>
</tr>
<tr>
<td>Option C: Reducing the duration of water stress</td>
<td>Indication of the possible impacts on ecosystems and economic activities Possible indication of responsiveness of governance in case of water stress and success of preventive actions</td>
<td>Dependence upon variations in climatic trends Monthly-basis data requirements</td>
</tr>
</tbody>
</table>

9.4.2 Water abstraction

Efficient water use is closely linked to efficient use of other resources\(^\text{167}\). For example, energy is required to supply water; water is often heated before it is used in homes; and, the wastewater treatment can be energy intensive. Reducing water abstraction would thus also reduce energy consumption. Water treatment also involves the use of chemicals, for example chlorine or ozone (disinfectants), aluminium and iron salts (coagulants). Similarly, water distribution involves the use of metals, such as iron, lead, copper and sometimes zinc\(^\text{168}\).

\(^{168}\) www.who.int/water_sanitation_health/dwg/cmp130704chap8.pdf
On the basis of reducing the risk of water scarcity, an EU target on water abstraction could also be considered for river basin districts, in particular in those prone to water stress. Although it may not be justified at the EU level to reduce water abstraction in areas where water is abundant, setting water abstraction targets for the whole EU would still make sense considering an energy consumption perspective.

Table 19: Proposed targets for water abstraction

<table>
<thead>
<tr>
<th>Level of ambition</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>By 2020, total annual abstraction in river basins that risk water scarcity (assessed by WEI+ but WEI in the mean time) should be reduced by 10% compared to 2010.</td>
</tr>
<tr>
<td>Medium</td>
<td>By 2020, total annual abstraction in river basins that risk water scarcity (assessed by WEI+ but WEI in the mean time) should be reduced by 20% compared to 2010.</td>
</tr>
<tr>
<td>High</td>
<td>By 2020, total annual abstraction in river basins that risk water scarcity (assessed by WEI+ but WEI in the mean time) should be reduced by 30% compared to 2010.</td>
</tr>
</tbody>
</table>

The targets set could be achieved through a combination of various instruments. First, **WEI (or WEI+) targets could be integrated into regular river basin management plans** under the WFD. However, managing water sustainably also requires ambitious and **integrated policies** in particular in the sectors of agriculture, building and energy. It would also require **monitoring efforts**, in order to improve data collection for the WEI and better reflect seasonal (monthly data) and geographical (river basin level) variability as well as various status of water bodies (groundwater vs. surface water). Such data will help to take concrete mitigation steps where the area is under stress. The collection of datasets by 2017 at river basin level should allow switching swiftly from WEI calculations to WEI+. Multi-purpose water retention measures (e.g. green infrastructures), which contribute to water availability e.g. through better infiltration, are still under-developed. So far, water availability has been mostly ensured through supply-side measures\(^{169}\). Demand management requires efforts from a greater number of actors along with **strong coordination**\(^{170}\). Regulating water demand through better water pricing is not necessarily the best option given the low elasticity of the water demand\(^{171}\) and the difficulty of developing a fair pricing (e.g. water tariffs), although the cost-recovery principle included in the WFD and highlighted in the Water Scarcity and Droughts Strategy should be better implemented. Demand management would require tackling the issue of **illegal abstractions**, which are by nature not considered in the accounting, with better detection with GMES and penalisation\(^{172}\). Overall, new challenges for water management, both from a supply and demand perspective, will arise in the context of a changing climate.

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170 Commission staff working paper. Analysis associated with the Roadmap to a Resource efficient Europe. Part II. Accompanying the document “Roadmap to a Resource efficient Europe” (COM(2011)571 final).
171 Commission staff working paper. Analysis associated with the Roadmap to a Resource efficient Europe. Part II. Accompanying the document “Roadmap to a Resource efficient Europe” (COM(2011)571 final).
172 In line with the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the regions. A Blueprint to Safeguard Europe’s Water Resources. COM(2012)673 final
Depending on the level of ambition, water scarcity target should be disaggregated by river basin districts, as well as per water bodies (surface or groundwater). Water consumption (abstraction minus returns) reductions could also be set per sector for river basins prone to water stress, with more ambitious targets set for sectors, which return low volumes of the abstracted water to the environment.

9.5 What are the expected risks and consequences of setting the target?

An established EU target on water scarcity/stress would support resource efficiency actions and help secure a sustainable supply of water for all economic sectors without jeopardising the well-functioning of ecosystem services. Setting a target on overall water abstraction would have different impacts on water availability and economic activities, depending on the weight of economic sectors and the European region. For example, setting an abstraction target in countries with activities returning a high amount of water to the environment will not have the same impact on the resource as countries where the use is largely consumptive. Hence, an overall target on water abstraction would have to be broken down to the sectoral level, in order to ensure that sectors contribute to the overall goal according to their share in overall water abstraction and the saving potentials within the sector.

9.5.1 Key stakeholders involved in reaching the targets

These targets would have implications for a range of stakeholders:

- River basin authorities: assessment of water availability, possible risks of scarcity and drought; where relevant, definition of targets per sector and category of water bodies; assessment of the effectiveness of policy measures.
- Water utility companies: supply of clean water in sufficient quantity and at a reasonable cost; maintenance of networks and increase in water efficiency; adaptation to climate change.
- Public society, including users: water savings and reduction in demand
- Sectors: e.g. industries, agriculture, transport, buildings. Water savings and water efficiency, innovation and competitiveness, mitigation of environmental impacts, adaptation to climate change.
9.5.2 Contribution to reduced resource use or environmental impacts

The targets contribute both to reduced resource use and reduced environmental impacts. Avoiding water stress and preserving environmental flows contributes to good ecological status, which allow preserving ecosystems and the multiple services they provide. Furthermore, regulating water abstraction/consumption, e.g. through increases in water efficiency, also allows reducing the water-related use of other resources, such as energy.

9.5.3 Contribution to reduced resource use or environmental impacts

Ensuring sufficient water supply/water levels also contributes to the wealth, in the long run, of various economic sectors, including agriculture, industry, energy production (e.g. water needed in power stations for cooling as well as hydropower), transport, tourism, and recreational services like fishing. In this context, increasing water efficiency has the potential to boost the competitiveness and growth of the European water sector, which includes 9000 active SMEs and provides 600 000 direct jobs in water utilities alone. It also offers potential for green growth in other water-related sectors (e.g. water-using industries, water technology development), where innovation can increase operational efficiency. Maintaining adequate levels of water also contributes to safeguarding water quality, which has considerable impacts on human health and which allows reducing treatment costs. Lastly, flood management allows avoiding substantial material damages and large economic losses, as well as death and displacement of people.

9.5.4 Links with other milestones

The milestone on water is intricately linked with a number of other milestones:

- Food (e.g. "a 20% reduction in the food chain's resource inputs.")
- Boosting efficient production (e.g. "Economic growth and wellbeing is decoupled from resource inputs and come primarily from increases in the value of products and associated services.")
- Ecosystem services
- Biodiversity
- Land and soils (particularly, soil erosion)

9.5.5 Risk of objective to be counter-productive

Setting WEI or WEI+ targets or water abstraction targets may be counter-productive with a number of other socio-economic objectives, depending on progress in water productivity (e.g. yields in irrigated agriculture). This may raise sectoral competition for the access to water as well as increase illegal abstraction. Possible changes in water pricing associated with new challenges of sufficient supply of water of good quality may further impact socio-economic activities.

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The European Commission’s Roadmap to a Resource Efficient Europe\textsuperscript{174} provides a framework for future actions and milestones for resource efficiency to be met by 2020. Each of the milestones in the roadmap mention or propose possible indicators that could be used to track progress of resource efficiency in the EU.

After a preliminary analysis of potential indicators and respective targets for land use and soils, the EREP Working Group II\textsuperscript{175} and the Commission decided to propose that annual \textit{land take} (conversion of agricultural, forest and other semi-natural land being taken for urban and other artificial land development) as the most suited indicator. Soil erosion, organic matter and contamination were also considered but indicators for these issues were not seen as sufficiently developed.

10.1 Definitions

10.1.1 Land use

Land use corresponds to the socio-economic description (functional dimension) of areas: areas used for residential, industrial or commercial purposes, for farming or forestry, for recreational or conservation purposes, etc\textsuperscript{176}. ‘Land use’ must be distinguished from ‘land cover’, which corresponds to a (bio)physical description of the earth’s surface (including areas of vegetation (trees, bushes, fields, lawns), bare soil, hard surfaces (rocks, buildings) and wet areas and bodies of water (watercourses, wetlands)\textsuperscript{177}. For example, grasslands (land cover) can be used or not for agricultural purposes (land use). Unlike land cover, land use is difficult to observe directly. This explains why land cover is often used as a proxy for land use. Yet, the distinction between these two concepts is important since it impacts on the development of classification systems, data collection and information systems in general.

10.1.2 Land take

Land take is defined by the EEA as “\textit{the amount of agriculture, forest and semi-natural land taken by urban and other artificial land development}”\textsuperscript{178}, i.e. the area of land that is ‘taken’ by the different economic categories: housing, services and recreation, commercial and industrial sites, transport and infrastructure, mines, quarries and dumpsites, as well as construction\textsuperscript{179}. It

\textsuperscript{175} European Resource Efficiency Platform (EREP), Working Group II: Setting objectives and measuring progress.
\textsuperscript{176} EEA: \texttt{http://glossary.eea.europa.eu}
\textsuperscript{177} EEA: \texttt{http://glossary.eea.europa.eu}
\textsuperscript{178} www.eea.europa.eu/data-and-maps/indicators/land-take-2/b
\textsuperscript{179} Construction sites represent transitional areas that will turn into other newly urbanised classes in future. Thus large coverage of construction sites indicates a potential of further artificial development.
therefore includes areas sealed by construction and urban infrastructure as well as urban green areas and sport and leisure facilities. Land take is associated to the development of scattered settlements in rural areas, urban sprawl and conversion of land within urban area (densification), and is directly related to potential conflicts within land demands and uses. It is always associated to increase in soil sealing areas, soil sealing being the most intense form of land take, which consists in the destruction or covering of soils by buildings, constructions and layers of completely or partly impermeable material (asphalt, concrete, etc.). It is also associated to loss of biodiversity and habitat fragmentation.

10.2 The indicator and current EU policy

EU policies, e.g. in the field of agriculture, energy, transport, biodiversity, may influence (directly or indirectly) the way land is used, both within the EU and abroad. The demand for natural resource, commodities production, development of infrastructures, etc., can trigger modifications of usage (e.g. agricultural vs. urban area; land abandonment) or modifications of practices (e.g. intensification), implying possible conflicts between competing needs and significant effects on ecosystems and habitats (e.g. fragmentation). The distinction between direct and indirect impacts is emerging and increasingly present in the literature. Progress towards the consideration of land take issues into EU policies is however likely to be impeded by necessary trade-offs between social, economic, geopolitical and environmental parameters, in the context of growing population, rising consumption of meat and dairy products in the emerging economies, and increased use of biomass for energy and other industrial purposes.

Examples of land-use related policies, include the Environmental Impact Assessment (EIA) Directive and the Thematic Strategy for Soil Protection. The Environmental Impact Assessment (EIA) Directive ensures that environmental implications of individual large scale projects such as the construction of highways and airports are taken into account before decisions are made. The Strategic Environmental Assessment (SEA) Directive is similar to EIA except that it relates to public plans and programmes. Both Directives thereby directly considers the environmental impacts of land use in the EU. Following a review a new EIA Directive was proposed in 2012. This will provide an opportunity for better integrating soil concerns at an early stage of project planning. The Thematic Strategy for Soil Protection, which was adopted in 2006, aims to protect soil while using it sustainably, through the prevention of further degradation, the preservation of soil function and the restoration of degraded soils. The Soil Thematic Strategy consisted of a proposal for a Soil Framework Directive, but this was blocked by some Member States on the grounds of subsidiarity, excessive cost and administrative burden.

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181 Directive 85/337/EEC.
182 Directive 2001/42/EC
183 Directive 2011/92/EU
In order to measure the environmental impact of the actions to be taken in the EU according to the Roadmap, the JRC has been working on land-use scenarios and models integrating EU policies likely to impact land use (e.g. land use changes due to the increase of crops for fuel), based on the Land-Use Modelling Platform (LUMP) (Lavalle et al., 2011).

Even before the Roadmap for Resource efficiency, some Member States had formulated their own targets related to land take:

- In Denmark the area for nature should increase by at least 100 000 hectares by 2020.
- In France at least 2\% of the national landmass should be placed under robust protection within 10 years, in particular by creating three new national parks. In addition, 20 000 hectares of wetlands should be acquired and preserved and by 2020–2030 one third of riverbanks should be preserved.
- In Germany growth in land use for housing, transport and related soil sealing should be reduced to 30 ha per day by 2020.

### 10.3 Status of the indicator

There are two main land accounting systems in the EU – both are managed by the EEA:

- The CORINE (Coordination of information on the environment) Land Cover database is based on satellite imagery and exists for the years 1990, 2000 and 2006.
- The LUCAS (Land use/cover area frame statistical survey) database is based on actual land surveys and exists for the years 2001/02, 2006, 2009 and 2012.

<table>
<thead>
<tr>
<th>Method</th>
<th>CORINE (CLC)</th>
<th>LUCAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum mapping unit</td>
<td>25 ha</td>
<td>3x3 m</td>
</tr>
<tr>
<td>Geometric accuracy</td>
<td>&lt;100 m</td>
<td></td>
</tr>
<tr>
<td>Geographical coverage</td>
<td>32-38 countries</td>
<td>23 (27) countries</td>
</tr>
</tbody>
</table>

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A land take indicator is relevant since the environmental impacts of urbanisation depend on the areas of land taken. Land take is generally irreversible and mostly results in soil sealing, and therefore in the loss of soil resources, due to the covering of land for housing, roads or other construction work. Land take is one of the 37 indicators included into the EEA Core Set of Indicators. It is well accepted in the EU. In itself the land take indicator does not account for soil sealing nor fragmentation, which may have substantial ecological impacts and may limit its relevance from a biodiversity and ecosystem services perspective.

The indicator is easy to understand and expressed in a straight-forward unit (ha or km²). Some uncertainties may sometimes be raised regarding the actual scope of this indicator, which may neglect some infrastructures. Land take for transport infrastructures is underestimated in surveys that are based on remote sensing such as Corine Land Cover. Land take by linear features with a width below 100 m (majority of roads and railways) is not included in the statistics, which focus mostly on infrastructures such as airports, harbours, etc. Soil sealing and fragmentation by linear infrastructures need to be observed by other means.

The indicator is usually monitored from Corine Land Cover (CLC) mapped from Landsat satellite images. The use of the CLC database provides a comparability of results between countries and allows computing the same indicator for smaller units such as regions or river basins. Results can be aggregated at the MS or regional levels or be disaggregated at the 100m grid-level (using the refined version CLC from 2006 (Batista e Silva, et al. 2011)). Results are available on the EEA indicators database: [www.eea.europa.eu/data-and-maps/figures/land-take-by-artificial-development-eea-core-indicators-csi014-1](http://www.eea.europa.eu/data-and-maps/figures/land-take-by-artificial-development-eea-core-indicators-csi014-1)

The following table summarises the indicators based on the RACER framework.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Relevant</th>
<th>Accepted</th>
<th>Credible</th>
<th>Easy</th>
<th>Robust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average annual land take</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

### 10.4 Current progress in the EU and Member States

The issue of land take is still often ignored because of its gradual consequences, which is not necessarily observed by key actors in the short-term. The 2010 Status of the Environment Report of the European Environment Agency demonstrates that land take is increasing.

Built-up and other man-made areas account for around 4% of the total area in EEA countries (data exclude Greece, Switzerland and the UK), of which about 50% are actually sealed. In the EU, more than 900 km² are subject to land take every year for housing, industry, roads or recreational purposes. In EU-27 territory about 92,016 ha were annually subject to land take for new artificial surfaces in the period 2000 – 2006 (Prokop, et al., 2011). In the EU, natural areas like forests benefit from high levels of protection and built-up areas have therefore been mainly

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enlarged at the expense of agricultural land. About half of the surface taken is sealed. Between 2000 and 2006, productive soils continued to be lost to urban sprawl and transport infrastructures. Conversions for residential purposes decreased, at the benefit of economic sites and infrastructures.

Annual land take indicators show Europe as one of the most intensively used areas in the world. It is difficult to halt land take in the EU without negative effects on the economy or society, in particular in the context of growing population.

The changes in the industry in Western Europe in last decades have switched from an industrial economy to a services economy, and land uses have changed consequently. This can be seen as an opportunity to achieve a net reduction in land take by 2020.

JRC (2013) estimated future trends following baseline and linear scenarios. According to the baseline scenario, artificial land take is driven by demographic and economic trends. According to the Linear Growth Scenario, past trends in land take (based on CLC land use change between 2000 and 2006) are linearly extrapolated to 2020. Artificial land take is therefore independent from demographic and economic trends.

Figure 34: Average annual land take, under the Baseline scenario between 2006 and 2020, at NUTS2 level

Under the Baseline scenario, the annual land take could increase by 38% in the EU (92,016 ha/y to 126,695 ha/y) (Figure 34). Under the Linear Growth Scenario, the highest average land take/y occurs in Spain (22,885 ha), France (13,714 ha) and Italy (8,049 ha) (Figure 35). The lowest

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191 http://www.eea.europa.eu/soer/europe/land-use
average land take occurs in Malta (1 ha), Luxemburg (164 ha) and Latvia (813 ha). Except in Spain and Portugal where a decrease in land take would be observed and in Denmark, Cyprus and Austria where land take could remain stable, an increase of annual land take could occur in all EU-27 territory.

![Figure 35: Average annual land take under the Linear Growth scenario between 2006 and 2020, at NUTS2 level](image)

A number of concrete actions have been taken at the EU level that are likely to foster progress in the field. These especially include:

- Awareness raising initiatives;
- Supporting research projects, including the expansion of the activities of the European Soil Data Centre which hosts soil data and information at European level;
- Consolidating harmonised land and soil monitoring;
- Further integration of land protection in different policies.

### 10.5 Target setting

The analysis published along with the Roadmap suggests specific targets for the land take indicator. The Roadmap set a “no net land take by 2050 in the EU” target. Based on JRC modelling, if we follow a linear path of growth of new artificial surfaces, the average annual land take in the period 2006-2020 in EU-27 would be 92,016 ha. Based on JRC calculations for

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this linear path, in order to achieve the “no net land take by 2050” target proposed in the Roadmap, this average annual land take must be decreased to 76,331 ha by 2020, which is even more ambitious than the 800 km\(^2\) by 2020 set as an intermediary target in the Roadmap. This corresponds to a need to reduce by 17% the average yearly land take in EU in the period 2006-2020.

Figure 36: Average annual land take in hectares from 2006 to 2020, under the Baseline (blue), Linear Growth (red) and Target Zero (green) scenarios at Member State.

In any scenario (Linear Growth or Baseline), the target set in the Roadmap is ambitious. Figure 36 below represents the distance to target under both scenarios. Despite increasing opportunities for dematerialisation and denser cities, the increasing trends modelled in land take and the important trade-offs with economic activities of setting land use constraints may require considerable effort to achieve such a target. Moreover, such a European target must then be disaggregated at the MS level.

<table>
<thead>
<tr>
<th>Level of ambition</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>By 2020, net annual land take (of artificial land) does not exceed 1000 km(^2) per year at the EU level.</td>
</tr>
<tr>
<td>Medium</td>
<td>By 2020, net annual land take (of artificial land) does not exceed 900 km(^2) per year at the EU level.</td>
</tr>
<tr>
<td>High</td>
<td>By 2020, net annual land take (of artificial land) does not exceed 800 km(^2) per year at the EU level.</td>
</tr>
<tr>
<td></td>
<td>By 2050, there is no net land take (of artificial land) in the EU [proposed in the Roadmap]</td>
</tr>
</tbody>
</table>

Further modelling exercise would allow allocating efforts in each MS to be able to reach these EU targets.

Here, it is interesting to come back to the example of Germany, which set a target of land take of max. 30 ha/day by 2020. Over a year, this corresponds to an overall land take of about 110 km\(^2/yr\), i.e. about 11% of the current EU land take (1000 km\(^2\)) (whereas Germany represents 8%
of the EU territory). An extrapolation at the EU level of such a national target would mean that about 1365 km$^2$ would be taken each year in the EU. Such a target is not very ambitious at the EU level but may still represent significant efforts for Germany, which currently consumes about 80 ha/day (292 km$^2$/yr)$^{195}$.

10.6 What are the expected risks and consequences of setting the target?

10.6.1 Key stakeholders involved in reaching the targets

- Land owners (subject to additional constraints and/or incentives)
- Land planners (arbitrage between land demands, regulation of land use changes e.g. control of cropland conversions to artificial land)
- Public authorities/Environmental agencies (monitoring, risk assessment, mitigation and remediation actions)
- Producers (e.g. farmers: impact on agricultural practices; industrials: additional environmental constraints and associated costs – polluter pays principle)
- Public society (benefits from better water quality, landscape values, etc.)

10.6.2 Contribution to reduced resource use or environmental impacts

Land uses significantly impact socio-economic activities (for example by arbitrating between, conflicting uses) and the provision of regulating, supporting and provisioning ecosystem services (e.g. water quality). Assessing the (direct or indirect) impacts of EU policies on land use before ratifying these decisions with long-term implications is in line with principles of sustainability and resource efficiency. Taking into account indirect impacts on land use also allows considering the worldwide environmental impacts of EU policies, e.g. through the land use embedded in traded commodities.

Reducing land uptake contributes both to reduced resource use and reduced environmental impacts. It allows reducing resource use through the construction materials saved by limiting artificial areas. Furthermore, it reduces environmental impact through reduced soil sealing, with has severe detrimental impacts on:

- water regulation (reduced infiltration increasing run-offs; increased occurrence of floods),
- productive land (e.g. between 1990 and 2006, 19 Member States lost a potential production capability equivalent to a total of 1.6 million tonnes of wheat)$^{196}$,
- carbon storage,

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195 www.destatis.de/EN/PressServices/Press/pr/2013/01/PE13_023_331.html
biodiversity,
- temperature regulation.

10.6.3 Contribution to economic growth or well-being

Altogether, the objectives of the milestones contribute to avoid substantial socio-economic costs related to soil degradation and risks of geopolitical imbalances due to increased land competition. In particular, the safeguarding of the productive capacity of soils, through the reduction of land take, has positive impacts on farmers' incomes and more largely on food security. Finally, beyond environmental impacts, assessing the impact of EU policies on land uses beforehand allows e.g. limiting land abandonment, handling tourism, etc.

10.6.4 Links with other milestones

- Water: link with quality (e.g. environmental load of contaminants, erosion and sedimentation) and quantity (abstraction)
- Marine resources: link with quality (e.g. issue of sedimentation and subsequent algae bloom)
- Food: link with productivity and sustainability
- Biodiversity: link with loss of biodiversity and degradation of ecosystems
- Environmentally Harmful Subsidies: link with activities and subsequent land uses promoted
- Ensuring efficient mobility

10.6.5 Risk of objective to be counter-productive

Setting land take targets may be counter-productive with a number of other socio-economic objectives related to the use of land, depending on progress in land multi-functionality. This may raise sectoral competition for the access to land as well as increase the intensity of land take, through increased soil sealing.
11. Food: Healthy and Sustainable Diet

The four key issues covered by the milestone on food are:

- the supply or availability of healthy, sustainable and affordable food;
- the uptake or demand of healthy and sustainable food and drink products by citizens and public authorities;
- sustainable production methods in the food chain; and
- the reduction of waste along the food chain with final consumers

In all cases, a shift in the way we produce and consume food is required.

After a preliminary analysis of suitable indicators for setting resource efficiency targets related to consumption patterns, the EREP Working Group II and the Commission requested further analysis to be performed on the indicators related to:

- Development in consumption of different meat and dairy products (bovine, pork, poultry, butter, cheese, milk) per capita per year
- Intake of animal protein per capita per year

This indicator informs on a healthy and sustainable diet.

11.1 A Healthy and Sustainable Diet

There is provision of adequate quantities of food across the EU, even in Member States with lower levels of per capita income. There is an excess on calorific intake in the EU-27 (at around 36% since the early 1990s\textsuperscript{197}) and this excess may have negative health and environmental consequences. FAOSTAT shows that the food system supplies\textsuperscript{198} an EU mean of 3466 kcal/day\textsuperscript{199}.

In addition, protein consumption is universally higher than requirements and the proportion of protein supplied from animal sources is high. The consumption of protein in excess of needs and especially the reliance on animal sources is a consumption-based structural weakness in the food cycle from a resource efficiency viewpoint, as production of animal products is relatively resource-intensive. Consumption change (including waste reduction) is central to measures to reduce resource use and environmental impacts.\textsuperscript{200} For example, changing the human diet

\textsuperscript{198} The analysis uses the phrase ‘supply’ as it is used by the FAO: Supply for domestic utilization = Production + imports - exports + changes in stocks (decrease or increase). See Appendix A, Box 1, for further explanation.
\textsuperscript{199} FAOSTAT presents the supply of food commodities in terms of weight, dietary energy, protein and oils/fat for each country. This data set, which extends back to 1961, therefore allows examination of national supply in terms of quantity and dietary quality on a per capita basis.
\textsuperscript{200} BIO Intelligence Service (2012) Assessment of resource efficiency in the food cycle
Analysis of indicators and targets

towards a lower share of animal-based food could have several effects on both environmental and social impacts, and resources:

- positive effects on human health (less obesity, less cardiovascular diseases, lower risk of livestock-related epidemics);
- decreasing livestock and thus lowering pressure on land because less land area is needed for agricultural production (i.e. market fodder for livestock);
- lowering pressures on groundwater (nitrification);
- savings of energy (cooling, transportation);
- decreasing GHG emissions from ruminants; and
- savings on water use.

Availability and affordability of food should reflect the needs of a nutritionally balanced diet, within the context of sustainable and resource efficient production.

In addition, there is the question of whether global environmental pressures and resource use associated with European consumption of food and drink is decreasing.

11.2 The indicator and current EU policy

In the EU, there is an absence of definitions and clear rules of what is considered as a ‘sustainable’ or ‘healthy’ diet. Most Member States do have guidelines for healthy diets based on the distribution and amounts of nutritional energy requirements.

11.3 Status of the indicator

The EEA’s Sustainable Consumption and Production indicator set provides two indicators that could be used for this aspect of the milestone:

- Development in total calorie intake per capita compared to daily requirements.
- Development in consumption of different meat and dairy products (bovine, pork, poultry, butter, cheese, milk) per capita per year.

Another possible indicator for measuring the progress for this milestone includes proportion of animal products in nutritional energy supply. Data on food supply is available at FAOSTAT Food Supply module ‘Livestock Primary Equivalent’, but this relates to the amount of food made available for consumption, not what is actually consumed. Some countries regularly conduct food consumption and nutritional surveys.

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201 BIO Intelligence Service (2012) Assessment of resource efficiency targets and indicators
203 BIO Intelligence Service (2012) Assessment of resource efficiency targets and indicators
11.4 Current progress in the EU and Member States

Figure 37 shows that per capita calorie intake has grown in the EU-27 over the period from 1990 to 2004, significantly above calorie requirement. FAOSTAT\(^{205}\) shows that the food system supplies from 2766 kcal/day/capita in Bulgaria to 3819 kcal/day in Austria, with an EU mean of 3466 kcal/day, exceeding WHO requirements.

![Graph showing calorie intake per capita](image)

**Figure 37**: Development in average calorie intake per capita compared to average daily requirements in EU27, 1992-2006 (Source: EEA\(^{205}\))

11.4.1 Consumption of different meat and dairy products per capita per year

Figure 38 shows that average per capita meat and dairy consumption has been relatively stable in the EU-15 over the period 1992-2009, although consumption of milk has decreased. However, given that high levels of meat and dairy consumption can be associated with detriments to health and the environment, and that levels of consumption per capita remain high, there is no sign of a shift towards healthier diets with lower environmental impacts in the EU-15.

\(^{205}\) FAO statistics relevant to commodity consumption are based on the total quantity of commodity supplied to the food system. This is not just food eaten, it includes food wasted in the post-farm food system, and inedible components. The analysis uses the phrase ‘supply’ as it is used by the FAO: Supply for domestic utilization = Production + imports - exports + changes in stocks (decrease or increase).

Figure 38: Consumption of meat (poultry, cattle, pork) and dairy products (cheese, milk and butter) in EU 15, 1992-2009 (Source: EEA 207)

Figure 39 shows that beef consumption in EU-12 is less than half that of the average for EU-15 in 2003 and also fell during the period to 2009. Pork and poultry consumption in the EU-12, however, is stable and at similar levels to EU-15, while cheese consumption has doubled.

Figure 39: Consumption of meat (poultry, cattle, pork) and dairy products (cheese, milk and butter) per capita per year in EU 12, 2003-2009 (Source: EEA 208)

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11.4.2 Proportion of animal products in nutritional energy supply

Mean per capita supply exceeds WHO requirements in all countries for protein, taking into consideration losses (i.e. inedible proportion of food, for example animal bones) and waste between commodity supply and food eaten\textsuperscript{209}. Protein supply in commodities ranges from 76 g/day in Bulgaria to 115 g/day in Portugal (protein supply data for Luxembourg and Malta are higher). In general, the new Member States tend to have lower levels of total commodity and livestock supply in dietary energy terms. Dietary energy supply from livestock commodities ranges from 22\% for Bulgaria to 39\% for Denmark, with a mean of 30\%; animal product energy supply ranges from 600 kcal/day in Bulgaria to 1301 kcal/day in Denmark, with a mean of 1024 kcal/day for the EU\textsuperscript{210}.\textsuperscript{211}

11.5 Target setting

Although it is possible to reduce meat and dairy consumption without compromising nutritional protein requirements, reducing meat and dairy consumption in the EU is a politically sensitive subject. Any quantitative targets must be set in a way that it does not limit individuals, where a certain high protein diet is justified, e.g. active athletes. Due to this and the current lack of robust data on diets, no target for intake of animal protein or meat and dairy is proposed. Instead a general objective to reduce animal protein consumption is recommended. To achieve this, concerted action would be needed. Awareness-raising, voluntary agreements, economic instruments and innovation can all play a role in reaching these objectives.

11.6 Key actors affected

- Public authorities provide guidelines related to the diets, e.g. legal nutritional requirements for school canteens. Healthier diets can lead to lower health care costs.
- Retailers and catering firms should also seek to incorporate GGP criteria and provide sustainable, healthy and affordable options.
- Healthier diets can improve well-being of consumers.

\textsuperscript{209} Westhoek, H., et al. (2011) The Protein Puzzle. Netherland Environmental Assessment Agency

\textsuperscript{210} Data indicate that lower intakes of animal products are compensated by high intakes of starch-rich foods such as bread and potatoes. These energy supply patterns are reflected in protein supplies.

\textsuperscript{211} BIO Intelligence Service (2012) Assessment of resource efficiency in the food cycle
12. Food: Food waste

While the milestone is set on disposal of edible food waste in the EU, the food chain is global and changes in the diet and thus demands of consumers in Europe will impact production and thus resource inputs worldwide. After a preliminary analysis of suitable indicators for setting resource efficiency targets related to consumption patterns, the EREP Working Group II and the Commission requested further analysis to be performed on an indicator related to "edible food waste".

In the analysis (Annex 6) document accompanying the Roadmap to a Resource Efficient Europe, a more specific version of the milestone was proposed:

*Decrease of edible food waste in households, retailers, and catering by 50% in the EU.*

This clarifies that any quantified indicator used to track progress of this milestone should focus on:

- edible material only;
- on waste in a narrow sense i.e. focusing on final stages of food chain starting from retailing; and excluding losses occurring at early stages;
- (implicitly) on edible material intended for humans.

Food waste is an integral part of the overall milestone on food, offering significant low hanging fruit in allowing Europe to reduce food chain resource inputs by 20%.

12.1 Definitions

A significant amount of food suitable for human consumption is unnecessarily discarded (179 kg per capita in the EU27, with evidence showing that over 60% of it may be avoidable). Reducing food waste is a key lever for improving resource efficiency in the food system.

The definition of food waste is a topic under significant discussion this year. The Preparatory Study, Parfitt *et al.* (2010) and the FAO point to differing definitions currently in use, and the resulting difficulty comparing data across the EU.

Bio-waste is defined in the Directive 2008/98/EC as biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises, and comparable

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213 Annex VI section 4.3.1.2. of Commission staff working paper. Analysis associated with the Roadmap to a Resource efficient Europe. Part II. Accompanying the document “Roadmap to a Resource efficient Europe” (COM(2011)571 final).

214 WRAP (2009) Household food and drink waste in the UK


216 FAO(2012) Food Wastage Footprint: An environmental accounting of food loss and waste - Concept Note
waste from food processing plants. Food waste forms a fraction thereof. The food loss/waste distinction and edibility are key aspects to consider.

**Food losses and waste**

Food loss, according to the final draft of the FAO definitions currently in circulation (March 2013), refers to food that during its movement along the food supply chain gets spilled, spoilt or otherwise lost or incurs reduction of quality before it reaches its final product or retail stage. Food loss is the unintended result of the process or the institutional/ legal framework. Food waste, according to a working definition (March 2013) to be finalised by the FUSIONS project\(^{217}\), refers to food intended for human consumption that is discarded, whether through negligence, choice or economic necessity. Food waste can occur at all stages of the food supply chain from farm to fork, whereas losses are limited to the pre-sale phases. Given the focus of the milestone on food waste in households, retail and catering towards the consumption end of the supply chain, we will be focusing on food waste in this report.

**Edible and non-edible food waste**

Food waste (in a broad sense) can be both edible and inedible. Edible food waste refers to food that is normally eaten and can be digested by humans. Inedible food waste refers to fractions of discarded food that are not normally eaten or digested, such as bones, pineapple and banana skins, egg shells, etc. From a quantification perspective, it is very burdensome to separate the edible and inedible fractions of food waste because these occur naturally together, both in food preparation and in leftovers. Cultural and regional preferences regarding food exist and change over time, for example the consumption of offal, bread crusts and potato skins. These are nevertheless edible, and the introduction of categories such as “possibly avoidable” may be confusing to consumers and provide justification for unnecessary food waste.

### 12.2 The indicator and current EU policy

Besides the Resource Efficiency Roadmap, there is no specific EU policy addressing food waste. There are however general EU waste policies in place such as the Waste Framework Directive (2008/98/EC) and the Landfill Directive (1999/31/EC). The Waste Framework Directive forms the backbone of EU waste management legislation. It provides basic definitions of key waste management terms and lays out basic waste management principles. In particular, it sets out a waste management hierarchy to help steer policy towards more favourable waste management principles such as prevention or re-use, and to leave disposal as a last resort. In relation to the waste management hierarchy, reducing food waste is considered a waste prevention action.

The Landfill Directive sets as a policy target the staggered reduction of biodegradable municipal waste (BMW) going to landfill. The Landfill Directive places an absolute target on the tonnage of BMW that can be land filled by 2006, 2009 and 2016 by linking the quantity permitted to the quantity produced in 1995. Thus the Directive obliges MS to reduce the amount of biodegradable waste in landfills by 65% by 2016 compared to 1995 levels. However, the Landfill Directive does

\[^{217}\text{Working documents not yet publicly available www.eu-fusions.org}\]
not submit countries to binding specifications on methods for disposal of BMW not sent to landfills, a situation which has led most MS to opt for incineration rather than waste prevention, composting or anaerobic digestion.

The European Parliament passed a resolution in January 2012 calling upon the European Commission and Member States to take “radical measures” to reduce waste from farm to fork by 50% by 2025.

The 2008 Waste Framework Directive requires Member States to establish National Waste Prevention Programmes and objectives by December 2013. The European Commission should by the end of 2014 also set waste prevention and decoupling objectives for 2020 based on best practices. Member States have been encouraged to include food waste prevention policies and targets in their National Waste Prevention Programmes. A handful of Member States have already set targets, but some of these are not yet official. Actions so far are summarised below.

France has already announced its 50% reduction goal of the volume of food waste by 2025, and furthermore proposes a national pact against food waste, signed by a wide range of leading stakeholders to signal their shared commitment.

In the case of the Netherlands an intermediate target of 20% has been set for 2015.

In the UK, the Courtauld Commitment develops voluntary, quantified targets over short time spans, working with industry and wider stakeholder partners. The current relevant target is a 4% reduction in household food and drink waste between January 2010 and December 2012, against a 2009 baseline, and a follow-up target will be announced shortly.

In Sweden a 20% food waste reduction target for 2020 was suggested, but this was not passed by the government. This will be proposed again as part of their National Waste Prevention Programme to be delivered later this year.

In a recent press release, the Austrian Environment Ministry has proposed a 20% food waste reduction target for 2016, but no baseline year has yet been stated.²¹⁸

12.3 Status of the indicator

Possible indicators for the reduction of edible food waste along the food chain:

- Amount of food waste, based on existing Eurostat waste statistics
- Amount of food waste, using Eurostat plug-in food waste statistics (currently voluntary)
- Amount of food waste and overconsumption (difference between food supply and nutritional requirement)

²¹⁸ http://www.lebensministerium.at/lebensmittel/kostbare_lebensmittel/lebensmittelkostbar.html
12.3.1 Indicator based on existing Eurostat waste statistics

The main resource for waste statistics at European Level is Eurostat most notably through its "Data Centre on Waste". However, there is not as yet a specific food waste data category, the closest being "animal and vegetal waste", which may include by-products or tobacco in some instances, as Member States have some freedom in interpreting the scope of this category. There is a further issue that specifically edible food waste is very difficult to quantify, requiring a burdensome level of waste separation. Eurostat data is presented in tonnes of waste or kg per capita. Data can be broken down per category of waste and per sector where the wastes were generated.

Waste categories in Eurostat\(^\text{219}\) are based on the European Waste Classification for Statistics\(^\text{220}\) (EWC-Stat). The Preparatory Study on Food Waste calculated the category (EWC_09_NOT_093): Animal and vegetal waste excluding slurry and manure as the most pertinent proxy for food waste.

Note that methodologies of data collection and calculation differ between MS. Eurostat states that "Member States are free to decide on the data collection methods. The general options are: surveys, administrative sources, statistical estimations or some combination of methods." Data is available for all MS in this stream, though given different MS interpretations of the data categories, green waste, tobacco and by-products may be included in this data in some instances, presenting an important limitation in robustness.

The EWC_09_NOT_093 data are available for all MS by NACE-branch\(^\text{221}\). A relevant NACE branch for tracking progress of the milestone is “EP_HH – Households”. However, there is no specific data for retail and catering. These two sectors are included in the broad branch “Services” covering NACE sections G to U (except G46.77).

Eurostat data includes both edible and non-edible food waste. Gustavsson et al. (2011), having used FAO statistics separated by food category, indicate a conversion factor they used to determine the part of the agricultural product that is edible. Some examples are 80% for fruits and 50% for fish and seafood. Using such factors however implies the ability to breakdown the food waste stream by commodity group (cereals, starchy roots, oil crops & pulses, etc.), which is not the case with Eurostat data.

The EWC_09_NOT_093 category in households could be used as proxy for this milestone. Major limitations are it takes into account both edible and non-edible material and, it does not breakdown food waste generated the catering and retail sectors. Data is available for years 2004, 2006, 2008 and 2010.


\(^{221}\) The NACE (Nomenclature des Activités Economiques des Communautés Européennes) designates the type of activity selected. Relevant NACE branches for this preparatory calculation are DA (Manufacture of food products, beverages and tobacco), HH (Households), A (Agriculture, Hunting and forestry). The “Other category” NACE branch has also been used.
12.3.2 Indicator based on Eurostat plug-in food waste statistics

Eurostat is presently conducting a voluntary data collection on 2012 food waste generation, in which 17 Member States are participating. This collection will be based on the NACE system, introducing a data plug-in with more detailed indicators within the existing framework. Results will be available in 2014. This new collection will fill the food service and retail data gaps, and will be able to suggest where edible and inedible food waste are most likely to occur.

Through this trial data collection process, a robust data collection process may emerge that would enable more clearly defined and comparable data to be submitted by Member States. The evident limitation of this indicator is that it is still in a trial stage, and that it may be some time before a mandatory requirement for Member States to submit this data is accepted.

12.3.3 Indicator based on food supply (FAOstat)

FAO data is available on food supply in terms of calories, while the daily food requirement per person is known based on WHO recommendations. From this basis, it is possible to estimate calories "lost", either to overconsumption or to waste. The average food supply per person in the EU is just over 3400 kcal/capita/day. The EEA calculated average EU-27 dietary energy requirement for 2006-2008 to be 2537 kcal/capita/day. Thus is can be suggested that there is overconsumption and waste of around 860 calories daily.

A potential difficulty of this indicator is edibility: it is unclear that the FAO conversion factors that derive calories from the total weight of the food supply remove inedible fractions (such as banana skins and meat bones). If the second indicator on waste comes into force, as more accurate data collection on food waste expands, this food supply indicator may then enable us to estimate the scale of overconsumption, through subtraction. This could be useful in developing indicators on a healthy diet.

12.3.4 Assessment of the three indicators according to RACER criteria

In sum, all indicators suffer from difficulty measuring edibility, as removing the inedible fraction from food waste quantities is burdensome and impractical. Eurostat suggests that it knows under which NACE codes inedible food waste is likely to occur, but has no plans to separate this data (possibly given risks to accuracy and limited usefulness).

Progress on this milestone can be evaluated using existing waste statistics, and could be done so more effectively using the second indicator if the Eurostat data plug-in on food waste becomes mandatory. The use of waste data statistics is the main way in which food waste has been quantified until now, so benefits from general acceptance among stakeholders. This is a credible approach, particularly if definitions and measurement techniques are harmonised through the work of the FUSIONS project and the Eurostat data plug-in experimentation. It is anticipated that this will be easy to monitor, as Eurostat waste data is already collected, and the additional data request builds on existing NACE codes. Further feedback on the difficulty of data collection will be available in April 2013 as Member States collecting voluntary data report back to Eurostat.

Comparable with any Eurostat data collection, this is auto-declarative, and so not completely without risk of manipulation.

As regards the indicator using food supply data, it suffers from the difficulty in separating food waste from overconsumption. Thus slightly less pertinent and has been less commonly used. However, food supply statistics are already collected and widely available, and relatively robust.

It is thus suggested on balance that waste statistics offer the more suitable indicator for this milestone, with the significant provisos that the waste data plug-in be generalised, and that the condition on the edibility of food waste be either removed from the milestone or integrated into the Eurostat plug-in data collection. It is our view that data on edibility is excessively burdensome to collect and not essential to the measurement of food waste reduction progress.

### Figure 40: Comparison of three indicators using RACER

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Relevant</th>
<th>Accepted</th>
<th>Credible</th>
<th>Easy</th>
<th>Robust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of food waste, based on existing Eurostat waste statistics</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Amount of food waste, using Eurostat plug-in food waste statistics (voluntary)</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Amount of food waste and overconsumption (difference between food supply and nutritional requirement)</td>
<td>Medium</td>
<td>Medium</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

#### 12.4 Current progress in the EU and Member States

The first quantification of food waste in the EU-27 was conducted by BIO in 2010. A global estimate of food losses and waste was conducted by the Swedish Institute for Food and Biotechnology (SIK) for the FAO in 2011. The EU food waste research project FUSIONS is conducting a more detailed estimation of food waste arisings at European level, to be published before the end of the project in 2016. A number of Member States have already conducted national level studies on their food waste generation, some are conducting such research at the moment, and a further 17 Member States are participating in the voluntary Eurostat food waste data collection.

The EU generates an estimated 89 million tonnes of food waste annually, or 179 kg per capita, based on food waste generated across the supply chain (see Figure 41). Total and per capita food waste arisings by Member State are presented below, using the current best available data source, the EC Preparatory Study. The publication of this data in 2011 stimulated some Member States to begin investigating ways to further reduce food waste.
States to undertake a more detailed national data collection; the Netherlands notably have a reduced estimate based on new research.

From the 2006 data estimate of 89 million tonnes in the EU, the Preparatory Study forecasts a roughly 40% rise in food waste generation based on anticipated EU population growth and increasing affluence only, to about 126 Mt in 2020. An assumption made here is that, with an increase in disposable income, there is an associated increase in food waste generation.

It was not possible to take into account the impact of prevention activities, given that at the time of writing, there were no national policies or target on food waste prevention, and very few even local level initiatives had quantified their results.

![Figure 41: Quantification of food waste in the EU27 by Member State and by sector, 2006 baseline, (kg per capita per year), from the BIO 2010 Preparatory Study on Food Waste](image)

### 12.5 Target setting

It is difficult to set targets given the current lack of robust food waste data in most Member States, as progress towards targets should be measurable. Nevertheless, some Member State targets as well as the EU milestone have been set regardless, demonstrating strong political will to move forward on this issue. Only France has thus far mirrored the EU’s ambition with its 50% target, with the small number of other MS setting targets in the 20-25% range, to 2015 or 2020, and even then, many of these have not been able to pass national legislatures.

It would be helpful to consider the minimum quantity of food waste achievable, but as the 2011 Umweltbundesamt-BIO study Evolution of Bio-Waste Generation/Prevention and Indicators study points out, it has not been possible to identify this minimum, because the estimated
quantities currently generated vary so widely by MS and by sector. The following targets are thus proposed based on current Member State ambition.

Table 23: Proposed targets for food waste

<table>
<thead>
<tr>
<th>Level of ambition</th>
<th>Target</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>By 2020, edible food waste in households, retailers, and catering is reduced by 10% (compared with 2010) in the EU</td>
<td>This target is likely to be achievable across the EU, even in new MS where food waste generation is generally lower. It addresses households, for which a wide range of prevention strategies are available and where edible food waste is likely to be concentrated.</td>
</tr>
<tr>
<td>Medium</td>
<td>By 2020, edible food waste in households, retailers, and catering is reduced by 20% (compared with 2010) in the EU</td>
<td>The Netherlands have set a 20% target for 2015, so this target is not inconceivable. Fair period in which to implement prevention policies, though possibly more challenging in new MS where food waste levels are already lower.</td>
</tr>
<tr>
<td>High</td>
<td>By 2020, edible food waste in households, retailers, and catering is reduced by 50% (compared with 2010) in the EU</td>
<td>This target would require systemic change across the supply chain in all MS over a relatively short period, and there is no precedent of 50% reductions being achieved.</td>
</tr>
</tbody>
</table>

To achieve these prevention targets, concerted action would be needed. Awareness-raising, voluntary agreements, economic instruments, reduction of barriers such as aesthetic standards and health-based restrictions on redistribution, and innovation can all play a role in reaching these objectives.

Research to understand national food consumption and wastage behaviours and a nationwide campaign adapted to this context would be suitable in addressing consumers in the household, retail and food service settings. The UK campaign Love Food Hate Waste is a good example here. NGOs can also support these activities. Voluntary agreements engaging and supporting industry actors in reaching prevention targets can also be helpful (cf the UK Courtauld Commitment).

Economic instruments to catalyse change would be most effective: separate collection of food waste and pay as you throw schemes for households, bans or significant taxes on the landfilling of food waste for business (as in the Republic of Ireland). Further options aimed at the catering and retail sectors include incentives for redistribution (e.g. tax credits for food donations) and reducing barriers to redistribution (e.g. protecting food donors and foodbanks from civil and criminal liability for food donated in good faith).

Policymakers can also provide guidance or regulation on contractual clauses that impact food waste in the supply chain, principally quality standards and contractual issues. Quality standards on size, shape, colour etc. imposed by retailers on suppliers can lead to important tonnages of edible produce being discarded. Awareness raising towards consumers on this issue and the

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UBA, BIO (2011) Evolution of (Bio-)Waste Generation/Prevention and Indicators
provision of evidence that consumers are willing to purchase imperfect products can support this.

As regards supply contracts, retailers have large freedoms in refusing stock due to changes in their supply needs, due to quality standards, and in imposing penalties on suppliers for failure to deliver agreed quantities of fresh fruit and vegetables, resulting in a strong impetus for an overproduction buffer\footnote{IME (2013) \textit{Global food: Waste not, want not.}}, a food waste driver that would benefit from additional government oversight and regulation. Policymakers can also facilitate the transfer of otherwise wasted food to livestock feed, reducing legal barriers or providing incentives depending on the national context.

Innovation in finding commercial uses for foodstuffs that would otherwise become waste is an important lever for retailers (bruised apples for apple juice for example). Retailers can also stimulate packaging innovation by demanding resealable packaging, packs that easy to empty completely, a variety of portion sizes, smart packaging such as ethylene absorbers. Retailers can also contribute by removing “sell-by” dates from products, replacing these with codes that are unidentifiable to consumers. The avoidance of “buy one get one free” schemes, that can encourage customers to buy more than they need, is also helpful. Alternatives include for example Tesco’s “Buy One Get One Free LATER” initiative.

Retailers also have an important potential role in customer education and awareness raising. Such actions may focus on storage guidance, how to use leftovers from given products or ingredients, or how produce, like people, are not identical and thus encouraging the acceptance of natural variation.

In the food service sector, the provision of flexible portion sizes is a major driver for waste prevention, be it by offering two serving sizes as does TGI Friday’s or by providing self-service or family-style serving options where customers can adjust their portion to their appetite.

In order to meet the ambitious milestone target, regulatory action along with strong use of economic instruments would likely be needed, in order to effect such a significant reduction in a short time. Bans on the landfilling and incineration without energy recovery of food waste might begin to make food waste prevention a more economically viable option. A legal requirement for companies to publicly disclose food waste data would also provide an incentive for businesses to compete and to communicate on their performance to customers. These regulatory approaches should be accompanied by the range of softer instruments outlined above.

Targets should be applied to Member States within which there should be flexibility to assess where food waste can be reduced most effectively given national circumstances and wastage patterns.
12.6 What are the expected risks and consequences of setting the target?

This milestone and its high level of ambition sends a strong message to Member States and the food supply chain that food waste is a critical issue for resource efficiency in Europe.

12.6.1 Key actors affected

Food waste is generated across the entire supply chain. The annex of the Roadmap nevertheless specifies that the 50% target on edible food waste is applicable only to households, retailers and catering, thus limiting the actors impacted. Retailers and the food service sector have numerous options to reduce food waste, and if the milestone target became mandatory, they may be affected by regulatory measures, such as landfill bans and waste data disclosure requirements. Retailers also impact food waste at farm level, via stringent quality standards or lack of certainty in supplier contracts, leading farmers to overproduce food to ensure they can always fulfil a last minute order. Thus if it is not possible to include all actors in the supply chain in the milestone, the impacts of those covered by it on other actors should also be taken into account, otherwise the milestone would create a precarious incentive for retailers to shift their waste to other actors.

12.6.2 Contribution to reduced resource use or environmental impacts

Grown but uneaten food has significant environmental and economic costs. The foodstuffs we consume have embedded environmental impacts because of the energy, natural resources used and associated emissions generated throughout their life cycle (European Commission 2006; UNEP 2010).

When food is discarded, all of the embodied energy and resources, as well as related environmental impacts such as GHG emissions, are effectively wasted. Where food wastage occurs at a given phase of the food supply chain, three types of impacts must be considered:

- Impacts associated with the end-of-life of the waste;
- Impacts of the given phase;
- Impacts of the previous phases so far, if any.

Indeed, each phase of the life cycle adds its own environmental impacts, therefore the impact of food wastage accumulates along the food chain. In other words, the later a product is lost along the chain, the higher is the “environmental cost”: food processed, transported, and cooked that is then wasted at home has a higher impact per kg than low processed food products lost at farm.

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12.6.3 Contribution to economic growth or well-being

Waste reductions in retail and catering sectors could generate cost savings for these actors of the chain (although measures for food waste limitation may also have a cost), leading potentially to increased profitability for retailers/caterers or lower prices for consumers. A low food price relative to disposable income is however one of the drivers of the rise of food waste at consumption level in the past decades Parfitt et al. (2010). As regards waste at consumer level, a WRAP study has shown that cutting all avoidable food waste from households could save £480 per household per year. Consumer savings through reduced food wastage may trigger consumers to purchase higher quality (higher priced) food products.

12.6.4 Links with other milestones

- Sustainable production because environmental impacts of food waste could be limited if consumer have access to more sustainable food products;
- Turning waste into a resource because environmental impacts of food waste could be limited if food waste streams are dealt with more sustainable practices. This milestone calls for absolute reductions in waste generation per capita, in which food waste reduction can play a role. The separate collection of food waste furthermore enables composting and anaerobic digestion, among options for valorisation that are environmentally preferable to landfilling.

12.6.5 Risk of objective to be counter-productive

A major risk of this milestone, regardless of the level of ambition set, is its focus on only the downstream phase of the food supply chain. Waste (not loss) is generated at every phase from farm to fork, not only at the point of consumption. It is estimated that in the UK for example, 30% of vegetable crops are never harvested, because it is not sufficiently profitable to do so or because they do not meet buyer-imposed aesthetic standards. Comparatively little is known about food waste at the agricultural phase of the food supply chain and its exclusion from the milestone misses an opportunity to support greater understanding and reduction of food waste overall.

Furthermore, the food supply chain functions as an interactive ecosystem. Food waste is already shifted significantly between sectors, in the distribution chain through refusals to accept stock too close to its use by date and by encouraging consumers to buy more than they need through two for one offers. The focus of the milestone on retail, catering and households presents a significant risk that food waste generated in these sectors will be shifted upstream, to distributors, processors, manufacturers and to farmers, threatening its overall objective of halving the disposal of edible food waste in the EU.

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