Calculation of Modal Shift, Traffic Avoidance and Environmental and other external costs effects

This appendix describes the background for the calculations which are automatically performed by the "calculator" provided in the Marco Polo website. The explanations, formulas and coefficients included in this appendix are important to understand conceptually how the calculations are done by the "calculator". However, applicants will only need to use the "calculator", which contains precise instructions for use.

For Modal shift, Catalyst and Motorways of the sea actions, a clear definition and presentation of both the old “road” route and the new “modally-shifted” route is obligatory. For Traffic avoidance actions a clear definition and presentation of both the original road transport service and the new service with avoided road traffic is obligatory.

1. CONCEPT

The overall objectives of the Marco Polo Programme are to reduce road congestion, to improve the environmental performance of the freight transport system and to enhance intermodal transport, thereby contributing to an efficient and sustainable transport system. A freight traffic shift from road to short sea shipping, rail and inland waterways or to a combination of modes of transport in which road journeys are as short as possible or traffic avoidance must be implemented.

In an action, first the entire route should be described (preferably door-to-door), i.e. including the initial freight collection and final distribution leg by truck, if any. In a second step it should be shown, which parts of the transport chain are to be shifted from road to short sea shipping, rail and inland waterways or, in the case of Traffic avoidance actions, which quantity of the road traffic is avoided and how this is achieved.

The following Section 2 describes the calculation of the modal shift which is necessary for Modal shift, Catalyst and Motorways of the sea actions. For the necessary calculations for Traffic avoidance actions please refer directly to Section 3.

All of the following required calculations can be easily made with the MARCO POLO Calculator, a pre-formatted Excel spreadsheet which is available as a support tool on the MARCO POLO website (http://ec.europa.eu/marcopolo). The proposal should include both the completed file of the MARCO POLO calculator on the CD-ROM and a printout.

---

1 Common learning actions are not required to calculate these figures. However, there are elements discussed in this chapter, such as qualitative environmental & other external costs savings, which could be also of relevance to this type of action.
2. **Modal Shift (for Modal Shift, Catalyst and Motorways of the Sea Actions)**

The effected modal shift is to be measured in tonne-kilometres \([\text{tkm}]\) (see definitions in Appendix 1). The modal shift is calculated as the **difference of the road freight transported on the old road route and the freight still remaining on the road on the new modally shifted route.**

**Alternative for light goods:** To account for the different character of the goods transported (light or heavy) applicants may choose to calculate with the weight or the volume of the freight. To allow for an easy comparison of proposals a unique conversion factor is used. Thus in legal terms a volumetric equivalent of 4 \([\text{m}^3\text{km}]\) is introduced for 1 \([\text{tkm}]\).

\[ 1 \text{ tkm} \equiv 4 \text{ m}^3\text{km} \]

In practice, when writing a proposal, the modal shift of the light freight is first estimated in \([\text{m}^3\text{km}]\) and then divided by 4 to arrive at its \([\text{tkm}]\)-equivalent, which is required for all key figures throughout the proposal (e.g. overview form). Such conversion is necessary for enabling easy comparison with projects of heavy goods.

**Important note:** Referring to section 3.2 of the main text of this call on “Specific Eligibility Criteria”, the envisaged road route from which freight is shifted by the action, i.e. the old “road” route, must be situated on the territory of at least two EU Member States or on the territory of at least one EU Member State and a close third country (see definitions in Appendix 1). However, since only costs arising on the territory of countries fully participating in the Marco Polo Programme may be subsidised by the Programme (see Section 3.1 item E.4 of the main text of this call), also only that part of the route may be used in calculating the effective modal shift in tonnes-kilometres. This is of particular importance to modal shift, Catalyst and Motorways of the sea actions when determining the upper limit of the theoretically possible Union financial assistance.

**Formulae:**

<table>
<thead>
<tr>
<th>Modal Shift Calculation in <strong>Tonnes</strong></th>
<th>Calculation in <strong>Cubic-Metres</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>[ F_{\text{old}} = \sum_{i} F_{\text{old},i} = \sum_{i} W_{\text{old},i} \times L_{\text{old},i} ]</td>
<td>[ F_{\text{old}} = \sum_{i} F_{\text{old},i} = \sum_{i} V_{\text{old},i} \times L_{\text{old},i} ]</td>
</tr>
<tr>
<td>with ( F_{\text{old(R)}} ) being a subtotal including the road sections only</td>
<td></td>
</tr>
<tr>
<td>[ F_{\text{new}} = \sum_{k} F_{\text{new},k} = \sum_{k} W_{\text{new},k} \times L_{\text{new},k} ]</td>
<td>[ F_{\text{new}} = \sum_{k} F_{\text{new},k} = \sum_{k} V_{\text{new},k} \times L_{\text{new},k} ]</td>
</tr>
<tr>
<td>with ( F_{\text{new(R)}} ) being a subtotal including the road sections only</td>
<td></td>
</tr>
<tr>
<td>[ F_{\text{shift}} = F_{\text{old(R)}} - F_{\text{new(R)}} ]</td>
<td></td>
</tr>
</tbody>
</table>

**Maximum Grant**

1. For all three actions the maximum grant is limited to 35 % of the total eligible cost.
2. As a second limit the grant cannot be more than the cumulative deficit during the duration of the action.
3. For Modal shift actions, Catalyst and Motorways of the sea actions a third limitation is that the grant is set at 2 Euro per 500 tkm. For further explanation please refer to Appendix 4).
The lowest of these three amounts will be the limit for the subsidy:

\[ S_{\text{max}} \leq \text{MIN} \{ 35 \% \times C_{\text{total}}, D_{\text{total}}, F_{\text{shift}} \times I \} \]

**Definitions:**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C_{\text{total}}) [€]</td>
<td>total eligible cost of the action</td>
</tr>
<tr>
<td>(D_{\text{total}}) [€]</td>
<td>total cumulative deficit during the duration of the action</td>
</tr>
<tr>
<td>(F_{\text{old}}) [tkm] [m³km]</td>
<td>total freight transported on the old road route</td>
</tr>
<tr>
<td>(F_{\text{new}}) [tkm] [m³km]</td>
<td>total freight transported on the new modally shifted route</td>
</tr>
<tr>
<td>(F_{\text{old},i}) [tkm] [m³km]</td>
<td>freight that would have been transported on a specific section of the old road route during the duration of the grant agreement</td>
</tr>
<tr>
<td>(F_{\text{new},k}) [tkm] [m³km]</td>
<td>freight that would have been transported on a specific section of the new modally shifted route during the duration of the grant agreement</td>
</tr>
<tr>
<td>(F_{\text{old}(R)}) [tkm] [m³km]</td>
<td>freight transported on the road sections of the old road route</td>
</tr>
<tr>
<td>(F_{\text{new}(R)}) [tkm] [m³km]</td>
<td>freight transported on the road sections of the new modally shifted route</td>
</tr>
<tr>
<td>(F_{\text{shift}}) [tkm] [m³km]</td>
<td>modal shift realised by the action during the duration of the grant agreement</td>
</tr>
<tr>
<td>(I) [2€/500 tkm] [2€/2000 m³km]</td>
<td>grant intensity (2 Euro per 500 tonne-kilometres or per 2000 cubic metre-kilometres)</td>
</tr>
<tr>
<td>(L_{\text{old},i}) [km]</td>
<td>length of a specific section of the old road route</td>
</tr>
<tr>
<td>(L_{\text{new},k}) [km]</td>
<td>length of a specific section of the new modally shifted route</td>
</tr>
<tr>
<td>(S_{\text{max}}) [€]</td>
<td>maximum grant</td>
</tr>
<tr>
<td>(V_{\text{old},i}) [m³]</td>
<td>volume of the freight that would have been transported on a specific section of the old road route during the duration of the grant agreement</td>
</tr>
<tr>
<td>(V_{\text{new},k}) [m³]</td>
<td>volume of the freight transported on a specific section of the new modally shifted route during the duration of the grant agreement</td>
</tr>
<tr>
<td>(W_{\text{old},i}) [t]</td>
<td>gross weight of the goods and all packaging (including the intermodal transport unit plus the road vehicle, even if they are empty, effectively loaded and unloaded at the beginning and the end of the multimodal journey, if these are shifted off the road too) that would have been transported on a specific section of the old road route during the duration of the grant agreement</td>
</tr>
<tr>
<td>(W_{\text{new},k}) [t]</td>
<td>gross weight of the goods and all packaging (including the intermodal transport unit plus the road vehicle, even if they are empty, effectively loaded and unloaded at the beginning and the end of the multimodal journey, if these are shifted off the road too) transported on a specific section of the new modally shifted route during the duration of the grant agreement</td>
</tr>
</tbody>
</table>

3. **Traffic Avoidance (for Traffic Avoidance Actions Only)**

The effected traffic avoidance is to be measured in vehicle-kilometres [vkm] (see definition in Appendix 1). The traffic avoidance is calculated as the *difference of the quantity of road traffic* before/without the new action and *the quantity of road traffic still remaining on the road under the new concept*. The unit “vehicle-kilometres” is more suitable to measure traffic avoidance than tonne-kilometres because it can account for the reduction of empty runs and increase of load factors. For example, if two trucks which are only filled half are replaced by one full truck driving the same distance, the tonne-kilometres have not changed but the vehicle-kilometres are decreased by 50%.

In practice, when writing a proposal, the traffic avoidance will be expressed in *vehicle-kilometres* derived by the formulas below.
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The input can be either in tonnes or in cubic metres or a combination of the two to account for the different character of the goods transported (light or heavy). To allow for an easy comparison of proposals a unique conversion factor is used. Thus in legal terms a volumetric equivalent of 4 m³km is introduced for 1 tkm.

\[
1 \text{ tkm} \triangleq 4 \text{ m}^3\text{km}
\]

As there might be cases where it is more applicable to calculate only in tonne-kilometres or its volumetric equivalent, these need to be converted to make them comparable. For this the following conversion rate will be used:

\[
1 \text{ vkm} \triangleq 20 \text{ tkm} \triangleq 80 \text{ m}^3\text{km}
\]

Important note: Referring to section 3.2 of the main text of this call “Specific Eligibility Criteria”, the envisaged road route where traffic is avoided by the action, i.e. the old road route, must be situated on the territory of at least two EU Member States or on the territory of at least one EU Member State and a close third country (see definitions in Appendix 1). However, since only costs arising on the territory of countries fully participating in the Marco Polo Programme may be financially supported by the Programme (see Section 3.1 of the main text of this call), also only that part of the route may be used in calculating the avoided road traffic in vehicle-kilometres. This is of particular importance when determining the upper limit of the theoretically possible Union financial assistance.

Formulae:

Traffic Avoidance measured in vehicle-kilometres
Calculation derived from measurement in Tonnes of freight quantity avoided:

\[
T_{\text{old}} = \sum_{i=1}^{n_i} T_{\text{old},i} = \sum_{i=1}^{n_i} \frac{n_{\text{old},i}}{L_{\text{old},i}} = \sum_{i=1}^{n_i} \left(\frac{W_{\text{old},i}}{A_w_{\text{old},i}}\right) \times L_{\text{old},i}
\]

\[
T_{\text{new}} = \sum_{k=1}^{n_k} T_{\text{new},k} = \sum_{k=1}^{n_k} \frac{n_{\text{new},k}}{L_{\text{new},k}} = \sum_{k=1}^{n_k} \left(\frac{W_{\text{new},k}}{A_w_{\text{new},k}}\right) \times L_{\text{new},k}
\]

Calculation derived from measurement in Cubic-Metres of freight quantity avoided:

\[
T_{\text{old}} = \sum_{i=1}^{n_i} T_{\text{old},i} = \sum_{i=1}^{n_i} \frac{n_{\text{old},i}}{L_{\text{old},i}} = \sum_{i=1}^{n_i} \left(\frac{V_{\text{old},i}}{A_v_{\text{old},i}}\right) \times L_{\text{old},i}
\]

\[
T_{\text{new}} = \sum_{k=1}^{n_k} T_{\text{new},k} = \sum_{k=1}^{n_k} \frac{n_{\text{new},k}}{L_{\text{new},k}} = \sum_{k=1}^{n_k} \left(\frac{V_{\text{new},k}}{A_v_{\text{new},k}}\right) \times L_{\text{new},k}
\]

\[
T_{\text{av}} = T_{\text{old}} - T_{\text{new}}
\]

Maximum Grant

1. The maximum grant is limited to 35 % of the total eligible costs.

2. As a second limit the grant cannot be more than the cumulative deficit during the duration of the action.

3. A third limitation is that the grant is set at 2 Euro per 500 tkm or 25 vkm.

>> The lowest of these three amounts will be the limit for the grant.

\[
S_{\text{max}} \leq \text{MIN} \{ 35 \% \times C_{\text{total}}, D_{\text{total}}, (T_{\text{av}} \times 1) \}
\]
### Definitions:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$A_{\text{old},i}$</td>
<td>average volume of freight that would have been transported per road vehicle on a specific section of the old routes</td>
</tr>
<tr>
<td>$A_{\text{new},k}$</td>
<td>average volume of freight transported per road vehicle on a specific section of the new routes</td>
</tr>
<tr>
<td>$A_{\text{old},i}$</td>
<td>average weight of freight that would have been transported per road vehicle on a specific section of the old routes</td>
</tr>
<tr>
<td>$A_{\text{new},k}$</td>
<td>average weight of freight transported per road vehicle on a specific section of the new routes</td>
</tr>
<tr>
<td>$C_{\text{total}}$</td>
<td>total eligible costs of the action</td>
</tr>
<tr>
<td>$D_{\text{total}}$</td>
<td>total cumulative deficit during the duration of the action</td>
</tr>
<tr>
<td>$I$</td>
<td>grant intensity (2 Euro per 25 vehicle-kilometres or per 500 tkm)</td>
</tr>
<tr>
<td>$L_{\text{old},i}$</td>
<td>length of a specific section of the old road routes</td>
</tr>
<tr>
<td>$L_{\text{new},k}$</td>
<td>length of a specific section of the new road routes</td>
</tr>
<tr>
<td>$n_{\text{old},i}$</td>
<td>number of road vehicles that would be used on a specific section of the old routes during the duration of the grant agreement</td>
</tr>
<tr>
<td>$n_{\text{new},k}$</td>
<td>number of road vehicles used on a specific section of the new routes during the duration of the grant agreement</td>
</tr>
<tr>
<td>$S_{\text{max}}$</td>
<td>maximum grant</td>
</tr>
<tr>
<td>$T_{\text{old}}$</td>
<td>total quantity of road traffic that would be on the road on the old routes</td>
</tr>
<tr>
<td>$T_{\text{new}}$</td>
<td>total quantity of road traffic on the new routes</td>
</tr>
<tr>
<td>$T_{\text{old},i}$</td>
<td>total quantity of road traffic that would be on the road on a specific section of the old routes during the duration of the grant agreement</td>
</tr>
<tr>
<td>$T_{\text{new},k}$</td>
<td>total quantity of road traffic on a specific section of the new routes</td>
</tr>
<tr>
<td>$T_{\text{av}}$</td>
<td>avoidance of road traffic realised by the action during the duration of the grant agreement</td>
</tr>
<tr>
<td>$V_{\text{old},i}$</td>
<td>volume of the freight that would have been transported by road on a specific section of the old routes during the duration of the grant agreement</td>
</tr>
<tr>
<td>$V_{\text{new},k}$</td>
<td>volume of the freight transported by road on a specific section of the new routes during the duration of the grant agreement</td>
</tr>
<tr>
<td>$W_{\text{old},i}$</td>
<td>gross weight of the goods and all packaging that would have been transported by road on a specific section of the old routes during the duration of the grant agreement</td>
</tr>
<tr>
<td>$W_{\text{new},k}$</td>
<td>gross weight of the goods and all packaging transported by road on a specific section of the new routes during the duration of the grant agreement</td>
</tr>
</tbody>
</table>

### 4. Environmental and Other External Costs Savings (for all actions)

Environmental and external costs savings may have quantitative and qualitative elements.

#### 4.1. Qualitative savings

Two kinds of qualitative environmental and other external costs savings can be envisaged:

- Those which are the consequence of the new modally shifted route avoiding environmentally sensitive areas or natural resorts or that the “new” transport service in a Traffic avoidance action leads to less road traffic in these areas. Other savings can result
from the use of clean fuels, like bio fuels, or abatement techniques on ships or any other kinds of energy efficient ways of transport. For Traffic avoidance actions the type of road vehicles used with regard to loading capacity (light goods or heavy goods vehicles), emission standards (EURO I-V), fuel type and quality, particle filters or any innovative technologies will affect the environmental benefit and should be described.

- Those which are the consequence of a decreasing traffic in heavily congested roads around metropolitan areas or in bottlenecks in several regions like the Alps, the Baltic Sea or the Pyrenees.

4.2. Quantitative savings

The environmental & other external costs savings calculation is based on a comparison and therefore calculated as the difference between the relevant environmental and other external costs for the old road route and those of the new modally shifted route or, for Traffic avoidance actions, between the relevant environmental and other external costs for the old and those of the new service. They shall be calculated by the method described below. In similarity to Modal shift, Catalyst, Motorways of the Sea and Traffic avoidance (sections 2 and 3 of this appendix), also only benefits achieved on the territory of countries fully participating in the Marco Polo Programme may be used for this calculation.

\[
\begin{align*}
C_{\text{old}} &= \sum_{\text{Section}=1}^{i} C_{\text{old},i} = \sum_{\text{Section}=1}^{i} e_{t,\text{old},i} \ast F_{\text{old},i}  \\
C_{\text{new}} &= \sum_{\text{Section}=1}^{k} C_{\text{new},k} = \sum_{\text{Section}=1}^{k} e_{t,\text{new},k} \ast F_{\text{new},k} \\
C_{\text{old}} &= \sum_{\text{Section}=1}^{i} C_{\text{old},i} = \sum_{\text{Section}=1}^{i} e_{v,\text{old},i} \ast T_{\text{old},i}  \\
C_{\text{new}} &= \sum_{\text{Section}=1}^{k} C_{\text{new},k} = \sum_{\text{Section}=1}^{k} e_{v,\text{new},k} \ast T_{\text{new},k} \\
B &= C_{\text{old}} - C_{\text{new}} \\
R_{S} &= B / S \\
R_{F} &= B / F_{\text{shift}} \\
R_{T} &= B / T_{\text{av}}
\end{align*}
\]

Definitions:

- \( B \) [\( \mathbf{\text{€}} \)] monetised environmental & other external costs savings
- \( C_{\text{old}} \) [\( \mathbf{\text{€}} \)] environmental and other external cost of the old road routes
- \( C_{\text{new}} \) [\( \mathbf{\text{€}} \)] environmental and other external cost of the new modally shifted routes or new service
- \( e_{t,\text{old},i} \) [\( \mathbf{\text{€/tkm}} \)] mode-specific environmental and other external cost coefficient applied to a specific section of the old route
- \( e_{t,\text{new},k} \) [\( \mathbf{\text{€/tkm}} \)] mode-specific environmental and other external cost coefficient applied to a specific section of the new modally shifted route
- \( e_{v,\text{old},i} \) [\( \mathbf{\text{€/vkm}} \)] road-specific environmental and other external cost coefficient applied to a specific section of the old service
### Table of Specific External Costs for the Environment and to Society:

<table>
<thead>
<tr>
<th>Mode of Transport</th>
<th>Specific External Costs ev&lt;sub&gt;old&lt;/sub&gt; and ev&lt;sub&gt;new&lt;/sub&gt; (€ per vehicle-kilometre)</th>
<th>Specific External Costs et&lt;sub&gt;old&lt;/sub&gt; and et&lt;sub&gt;new&lt;/sub&gt; (€ per tonne-kilometre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road</td>
<td>0.70</td>
<td>0.035</td>
</tr>
<tr>
<td>Short Sea Shipping⁵</td>
<td>n/a</td>
<td>0.009</td>
</tr>
<tr>
<td>Rail</td>
<td>n/a</td>
<td>0.015</td>
</tr>
<tr>
<td>Inland Waterway⁴</td>
<td>n/a</td>
<td>0.010</td>
</tr>
</tbody>
</table>

Note: Specific external cost figures are valid for the whole of Europe. The conversion factor used is 1 vehicle-kilometre equalling 20 tonne-kilometres (as introduced by Annex 1 of the MARCO POLO II regulation).

### 5. Examples

#### 5.1. Modal Shift Action

Let’s imagine a Modal shift action, where trucks would have been transporting in 3 years 300,000 tonnes of freight on a road route of 2,000 kilometres between A (being a port) and B

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⁵ These values reflect a compromise until a new large external study supported by the EC (DG Environment) will be completed. Reference is made to an internal Commission paper of 23.04.2004 on the calculation of external costs. Specific external costs taken into account are noise, pollutants and climate costs as well as accidents, infrastructure and congestion. The values given above are generated by an internal study of the EU based mainly on the external research projects UNITE and REALISE with some additional input from transport associations.

⁶ Note that this external cost figure assumes fuel of average quality and emissions from average engine performance. However, in the evaluation it will be taken as a positive element, i.e. extra points can be given in case high quality fuels with not more than 1.5% sulphur are used. In the present call usage of such environmentally friendly fuels is on a voluntary basis. It will also be taken as a positive element, if equipment to reduce NOx emissions and particulate matter is used. The same applies for any other cases as mentioned in point 4.1 of this Appendix.

⁴ see footnote number 3
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(being close to port C). From B, freight is distributed to its final destinations over an average distance of 200 kilometres.
The long-haul road transport is shifted to short sea shipping between the ports A and C. The sea route length is 2,400 kilometres. The average distance between port C and the final destinations is now 250 kilometres. The old road route would have been running entirely on EU territory. The estimate of total eligible costs is 3 million €.

a) Calculation of modal shift and environmental and other external costs savings:

Old road route:
Two successive sections:
- 1. long haul (2,000 km, road)
- 2. distribution (200 km, road)

\[ F_{\text{old,1}} = L_{\text{old,1}} \times W_{\text{old,1}} = 2,000 \text{ km} \times 300,000 \text{ t} = 600,000,000 \text{ tkm} \]
\[ F_{\text{old,2}} = L_{\text{old,2}} \times W_{\text{old,2}} = 200 \text{ km} \times 300,000 \text{ t} = 60,000,000 \text{ tkm} \]
\[ F_{\text{old}} = F_{\text{old,1}} + F_{\text{old,2}} = 660,000,000 \text{ tkm} \]
Thereof being road transport \(F_{\text{old(R)}} = 660,000,000 \text{ tkm} \).
\[ et_{\text{old,1/2}} = 0.035 \text{ €/tkm} \]
\[ C_{\text{old}} = F_{\text{old,1}} \times et_{\text{old,1}} + F_{\text{old,2}} \times et_{\text{old,2}} = 600,000,000 \text{ tkm} \times 0.035 \text{ €/tkm} + 60,000,000 \text{ tkm} \times 0.035 \text{ €/tkm} = 23,100,000 \text{ €} \]

New, modally shifted route:
Two successive sections:
- 1. long haul (2,400 km, short sea shipping)
- 2. distribution (250 km, road)

\[ F_{\text{new,1}} = L_{\text{new,1}} \times W_{\text{new,1}} = 2,400 \text{ km} \times 300,000 \text{ t} = 720,000,000 \text{ tkm} \]
\[ F_{\text{new,2}} = L_{\text{new,2}} \times W_{\text{new,2}} = 250 \text{ km} \times 300,000 \text{ t} = 75,000,000 \text{ tkm} \]
\[ F_{\text{new}} = F_{\text{new,1}} + F_{\text{new,2}} = 795,000,000 \text{ tkm} \]
Thereof being road transport \(F_{\text{new(R)}} = 75,000,000 \text{ tkm} \).
\[ et_{\text{new,1}} = 0.009 \text{ €/tkm} \]
\[ et_{\text{new,2}} = 0.035 \text{ €/tkm} \]
\[ C_{\text{new}} = F_{\text{new,1}} \times et_{\text{new,1}} + F_{\text{new,2}} \times et_{\text{new,2}} = 720,000,000 \text{ tkm} \times 0.009 \text{ €/tkm} + 75,000,000 \text{ tkm} \times 0.035 \text{ €/tkm} = 9,105,000 \text{ €} \]

Modal shift:
\[ F_{\text{shift}} = F_{\text{old(R)}} - F_{\text{new(R)}} = 660,000,000 \text{ tkm} - 75,000,000 \text{ tkm} = 585,000,000 \text{ tkm} \]

Environmental and other external costs savings:
\[ B = C_{\text{old}} - C_{\text{new}} = 23,100,000 \text{ €} - 9,105,000 \text{ €} = 13,995,000 \text{ €} \]
Hence, the environmental and other external costs savings for this example Modal shift action would be 13.995 million €.

b) Calculation of final grant request:

\[ F_{\text{shift}} = 585,000,000 \text{ tkm} \]
\[ S_{\text{max,1}} = 585,000,000 \text{ tkm} \times (2 \text{ €/ 500 tkm}) = 2,340,000 \text{ €} \]
Hence, the (theoretical) upper limit for Union financial support given by the Marco Polo Programme would be 2.34 million € for this Modal shift action.
\[ r_{\text{max}} = 35 \% \]
\[ C_{\text{total}} = 3,000,000 \text{ €} \]
\[ S_{\text{max,2}} = 0.35 \times 3,000,000 \text{ €} = 1,050,000 \text{ €} \]
Finally, the restriction through maximum grant rate and total eligible costs would allow the applicants to apply for a Marco Polo grant of up to 1.05 million € only.
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Since the grant may not exceed the deficit of the project demonstrated in the business plan \( (D_{\text{total}} = 820,000 \text{ €}) \), the applicants actually apply to the Marco Polo Programme for 0.80 million € grant only.

\[
S = 800,000 \text{ €}
\]

In the example the applicants actually request 0.80 million € only, because they otherwise would have made a profit during the duration of the EU grant\(^5\) (see section 2 of the main text of this call).

c) Environmental Efficiency:

\[
R_S = \frac{13,995,000 \text{ €}}{800,000 \text{ €}} = 17.5
\]

\[
R_F = \frac{13,995,000 \text{ €}}{585,000,000 \text{ tkm}} = 0.024 \text{ €/tkm}
\]

In this example the environmental efficiency of the grant is 17.5, meaning that for each Euro of grant spent, the benefits to society are 17.5 Euro. The environmental efficiency of the shifted traffic volume is 0.024 Euro per tonne-kilometre, meaning that society benefits with more than 2 Cents for each tonne of freight shifted away per kilometre off the old road route.

5.2 Traffic Avoidance Action

The example concerns a new production process for insulation material which reduces its volume by 40 % without reducing the quality of the product. As a result the road vehicles which transport the product to eight distribution centres in the EU can be more efficiently loaded.

The factory originally produces 1,500,000 m\(^3\) of insulation material per year export to eight EU countries. For the duration of the action of 60 months the total volume of the freight is 7,500,000 m\(^3\). With the new production method the total volume of freight is reduced to 4,500,000 m\(^3\). This production is being transported by truck to eight distribution centres which are located 600-1,500 km from the factory. An average truck load is 80 m\(^3\). All road routes are running entirely on EU territory.

The estimate of total eligible costs is 3,800,000 €.

a) Calculation of modal shift and environmental and other external costs savings:

Original transport service (with traditional production method):

Eight road routes (transport legs) in the distribution network:

\[
\begin{align*}
L_1 & = 1,000 \text{ km} & L_5 & = 1,200 \text{ km} \\
L_2 & = 1,200 \text{ km} & L_6 & = 600 \text{ km} \\
L_3 & = 800 \text{ km} & L_7 & = 1,500 \text{ km} \\
L_4 & = 800 \text{ km} & L_8 & = 1,000 \text{ km}
\end{align*}
\]

\[
\begin{align*}
T_{\text{old,1}} & = \left( \frac{V_{\text{old,1}}}{A_{\text{old,1}}} \right) \cdot L_{\text{old,1}} = (800,000 \text{ m}^3 / 80 \text{ m}^3) \cdot 1,000 \text{ km} = 10,000,000 \text{ vkm} \\
T_{\text{old,2}} & = \left( \frac{V_{\text{old,2}}}{A_{\text{old,2}}} \right) \cdot L_{\text{old,2}} = (800,000 \text{ m}^3 / 80 \text{ m}^3) \cdot 1,200 \text{ km} = 12,000,000 \text{ vkm} \\
T_{\text{old,3}} & = \left( \frac{V_{\text{old,3}}}{A_{\text{old,3}}} \right) \cdot L_{\text{old,3}} = (500,000 \text{ m}^3 / 80 \text{ m}^3) \cdot 800 \text{ km} = 5,000,000 \text{ vkm} \\
T_{\text{old,4}} & = \left( \frac{V_{\text{old,4}}}{A_{\text{old,4}}} \right) \cdot L_{\text{old,4}} = (1,200,000 \text{ m}^3 / 80 \text{ m}^3) \cdot 800 \text{ km} = 12,000,000 \text{ vkm} \\
T_{\text{old,5}} & = \left( \frac{V_{\text{old,5}}}{A_{\text{old,5}}} \right) \cdot L_{\text{old,5}} = (1,000,000 \text{ m}^3 / 80 \text{ m}^3) \cdot 1,200 \text{ km} = 15,000,000 \text{ vkm} \\
T_{\text{old,6}} & = \left( \frac{V_{\text{old,6}}}{A_{\text{old,6}}} \right) \cdot L_{\text{old,6}} = (2,000,000 \text{ m}^3 / 80 \text{ m}^3) \cdot 600 \text{ km} = 15,000,000 \text{ vkm} \\
T_{\text{old,7}} & = \left( \frac{V_{\text{old,7}}}{A_{\text{old,7}}} \right) \cdot L_{\text{old,7}} = (400,000 \text{ m}^3 / 80 \text{ m}^3) \cdot 1,500 \text{ km} = 7,500,000 \text{ vkm} \\
T_{\text{old,8}} & = \left( \frac{V_{\text{old,8}}}{A_{\text{old,8}}} \right) \cdot L_{\text{old,8}} = (800,000 \text{ m}^3 / 80 \text{ m}^3) \cdot 1,000 \text{ km} = 10,000,000 \text{ vkm} \\
T_{\text{old}} & = T_{\text{old,1}} + T_{\text{old,2}} + T_{\text{old,3}} + T_{\text{old,4}} + T_{\text{old,5}} + T_{\text{old,6}} + T_{\text{old,7}} + T_{\text{old,8}} = 86,500,000 \text{ vkm} \\
ev_{\text{old}} & = 0.70 \text{ €/vkm}
\end{align*}
\]

Other reasons for not requesting \( S_{\text{max}} \) could be availability of other public funding.
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\[ C_{\text{old}} = T_{\text{old}} \cdot e v_{\text{old}} \]
= \( 86,500,000 \text{ vkm} \cdot 0.70 \text{ €/vkm} \)
= \( 60,550,000 \text{ €} \)

New transport service (with production innovation):
Volume of the product decreased by 40 %, same road routes in the distribution network, same average volume:
\[
T_{\text{new,1}} = \left( \frac{V_{\text{new,1}}}{A v_{\text{new,1}}} \right) \cdot L_{\text{new,1}} = \left( \frac{480,000 \text{ m}^3}{80 \text{ m}^3} \right) \cdot 1,000 \text{ km} = 6,000,000,000 \text{ vkm}
\]
\[
T_{\text{new,2}} = \left( \frac{V_{\text{new,2}}}{A v_{\text{new,2}}} \right) \cdot L_{\text{new,2}} = \left( \frac{480,000 \text{ m}^3}{80 \text{ m}^3} \right) \cdot 1,200 \text{ km} = 7,200,000,000 \text{ vkm}
\]
\[
T_{\text{new,3}} = \left( \frac{V_{\text{new,3}}}{A v_{\text{new,3}}} \right) \cdot L_{\text{new,3}} = \left( \frac{300,000 \text{ m}^3}{80 \text{ m}^3} \right) \cdot 800 \text{ km} = 3,000,000,000 \text{ vkm}
\]
\[
T_{\text{new,4}} = \left( \frac{V_{\text{new,4}}}{A v_{\text{new,4}}} \right) \cdot L_{\text{new,4}} = \left( \frac{720,000 \text{ m}^3}{80 \text{ m}^3} \right) \cdot 800 \text{ km} = 7,200,000,000 \text{ vkm}
\]
\[
T_{\text{new,5}} = \left( \frac{V_{\text{new,5}}}{A v_{\text{new,5}}} \right) \cdot L_{\text{new,5}} = \left( \frac{600,000 \text{ m}^3}{80 \text{ m}^3} \right) \cdot 1,200 \text{ km} = 9,000,000,000 \text{ vkm}
\]
\[
T_{\text{new,6}} = \left( \frac{V_{\text{new,6}}}{A v_{\text{new,6}}} \right) \cdot L_{\text{new,6}} = \left( \frac{1,200,000 \text{ m}^3}{80 \text{ m}^3} \right) \cdot 600 \text{ km} = 9,000,000,000 \text{ vkm}
\]
\[
T_{\text{new,7}} = \left( \frac{V_{\text{new,7}}}{A v_{\text{new,7}}} \right) \cdot L_{\text{new,7}} = \left( \frac{240,000 \text{ m}^3}{80 \text{ m}^3} \right) \cdot 1,500 \text{ km} = 4,500,000,000 \text{ vkm}
\]
\[
T_{\text{new,8}} = \left( \frac{V_{\text{new,8}}}{A v_{\text{new,8}}} \right) \cdot L_{\text{new,8}} = \left( \frac{480,000 \text{ m}^3}{80 \text{ m}^3} \right) \cdot 1,000 \text{ km} = 6,000,000,000 \text{ vkm}
\]
\[
T_{\text{new}} = T_{\text{new,1}} + T_{\text{new,2}} + T_{\text{new,3}} + T_{\text{new,4}} + T_{\text{new,5}} + T_{\text{new,6}} + T_{\text{new,7}} + T_{\text{new,8}} = 51,900,000,000 \text{ vkm}
\]
\[ e v_{\text{new}} = 0.70 \text{ €/vkm} \]
\[ C_{\text{new}} = T_{\text{new}} \cdot e v_{\text{new}} \]
= \( 36,330,000,000 \text{ €} \)

Avoidance of road traffic:
\[ T_{a v} = T_{\text{old}} - T_{\text{new}} = 86,500,000,000 \text{ vkm} - 51,900,000,000 \text{ vkm} = 34,600,000,000 \text{ vkm} \]

Environmental and other external costs savings:
\[ B = C_{\text{old}} - C_{\text{new}} = 60,550,000,000 \text{ €} - 36,330,000,000 \text{ €} = 24,220,000,000 \text{ €} \]

Hence, the environmental and other external costs savings for this example Traffic avoidance action would be 24.22 million €.

b) Calculation of final grant request:
\[ T_{a v} = 34,600,000,000 \text{ vkm} \]
\[ S_{\text{max,1}} = 34,600,000,000 \text{ vkm} \cdot (2 \text{ €}/25 \text{ vkm}) = 2,768,000,000 \text{ €} \]

Hence, the (theoretical) upper limit for Union financial support given by the Marco Polo Programme would be 2,768 million € for this Traffic avoidance action.

\[ r_{\text{max}} = 35 \% \]
\[ C_{\text{total}} = 3,800,000,000 \text{ €} \]
\[ S_{\text{max,2}} = 0.35 \cdot 3,800,000,000 \text{ €} = 1,330,000,000 \text{ €} \]

Finally, the restriction through maximum grant rate and total eligible costs would allow the applicants to apply for a Marco Polo grant of up to 1.33 million € only.

Since the grant may not exceed the deficit of the project demonstrated in the business plan (\( D_{\text{total}} = 1,200,000,000 \text{ €} \)), the applicants actually apply to the Marco Polo Programme for 1.2 million € grant only.

\[ S = 1,200,000,000 \text{ €} \]

In the example the applicants actually request 1.2 million € only, because they otherwise would have made a profit during the duration of the EU grant\(^6\) (see section 2 of the main text of this call).

c) Environmental Efficiency:
\[ R_S = 24,220,000,000 \text{ €}/1,200,000,000 \text{ €} = 20.2 \]
\[ R_T = 24,220,000,000 \text{ €}/34,600,000,000 \text{ vkm} = 0.7 \text{ €/vkm} \]

In this example the environmental efficiency of the grant is 20.2, meaning that for each Euro of grant spent, the benefits to society are 20.2 Euro.

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\(^6\) Other reasons for not requesting \( S_{\text{max}} \) could be availability of other public funding.
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The environmental efficiency of the avoided road traffic is 0.70 Euro per vehicle-kilometre, meaning that society benefits with 70 Cents for each truck shifted away per kilometre of the old route.

These examples are also available on the Marco Polo website (http://ec.europa.eu/marcopolo). In order to facilitate the correct calculation of the required figures the Marco Polo calculator is available.