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External cost calculator for Marco Polo freight transport project proposals

Call 2012 version

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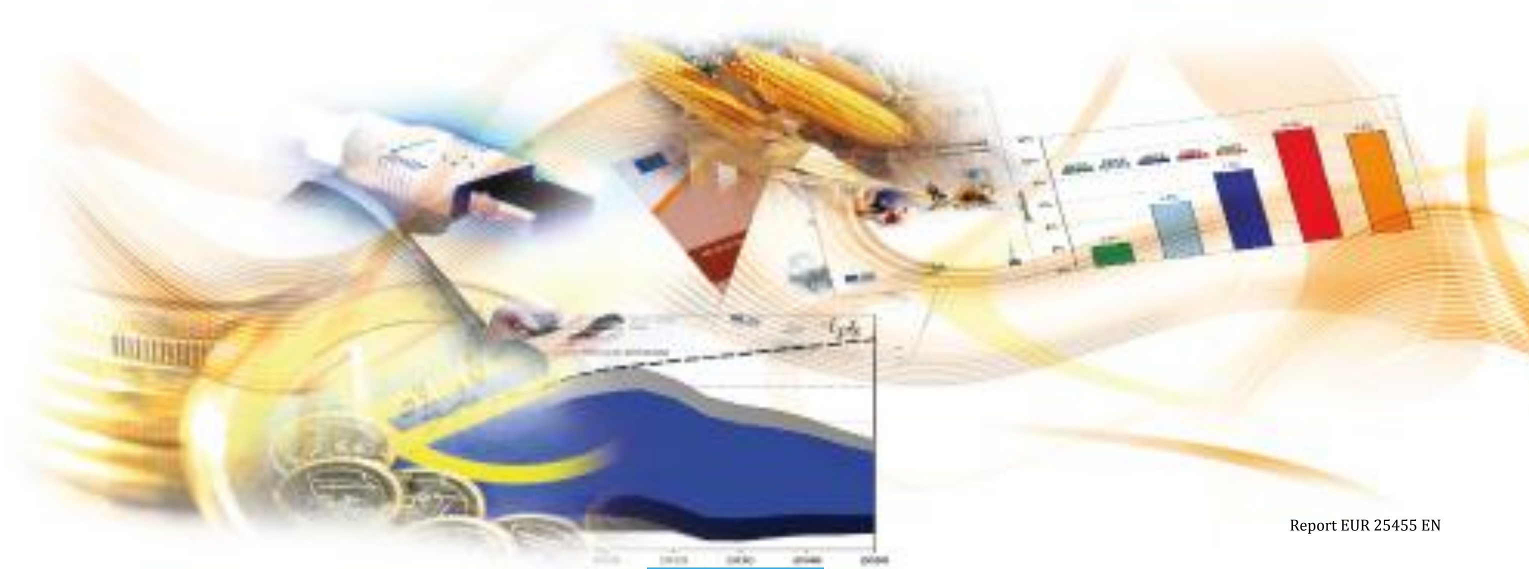

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1 Introduction

The Marco Polo programme aims to shift or avoid freight transport off the roads to other more environmentally friendly transport modes. The programme is implemented through yearly calls for proposals. The proposals received to each call are selected for financial support on the basis of their quantitative modal shift/traffic avoidance, their credibility and innovative features, and their merits in terms of environmental and social benefits. In order to calculate each proposal's merits in terms of environmental and social benefits, external cost coefficients are used for each transport (sub)mode. The specific contribution by each proposal is calculated as the difference in external costs[1] between the transport service before the project is implemented and the transport service after project implementation. Each transport (sub)mode-specific coefficient is calculated as the external costs of air pollution, noise, accidents, congestion, and climate change per tonne-kilometre transported with that specific transport (sub)mode.

The external costs coefficients used in Marco Polo programme calls before 2011 were calculated in 2004 on the basis of a number of sources, some dating back to 2000. Following a request by the European Commission's Directorate General for Energy and Transport (now Directorate General for Mobility and Transport), the Commission's Joint Research Centre, Institute for Prospective Technological Studies (JRC-IPTS) updated the external cost coefficients to be applied and developed a software application that automates the estimation of the impact on external costs for specific projects. The work was followed by an Interservice Group consisting of different Commission services[2].

The new external cost calculator, which was used for the first time for the 2011 call, covers road, rail, inland waterways and short sea shipping. External cost coefficients are provided for environmental impacts (air quality, noise, climate change) and socio-economic impacts (accidents, congestion)[3]. The methodology permits the estimation of coefficients and total external cost estimates for each of the 27 EU member states in which a certain transport mode is available as well as an aggregate value for EU27 (see JRC-IPTS 2011). For the 2012 call, additional modifications were implemented, primarily aimed at increasing the level of detail and hence accuracy of the cost coefficients for the inland waterways mode.

The work was based on a combination of data and model results that allow the estimation of transport volumes, fleet mixes, levels of utilisation and resulting externalities with up-to-date methodologies for the economic valuation of these externalities. A main priority has been the consistency and robustness of the assumptions used in order for the comparisons between different transport modes in different member states to be possible.

The remainder of the study is organized as follows. Section 2 discusses the collection and estimation of base external marginal cost values from various studies, databases and models. Section 3 discusses the additional calculations that were carried out in order to derive the marginal cost coefficients in the specific format in which they are used in the Marco Polo calculator. Section 4 presents the calculator interfaces.

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[1] External costs are the costs raised by transport activity that are not borne directly by the transport users.

[2] The Interservice Group consists of representatives from the Directorate General for Mobility and Transport (DG MOVE), the Directorate General for Environment (DG ENV), the Directorate General for Climate Change (DG CLIMA) and the Executive Agency for Competition and Innovation (EACI).

[3] The European Commission strategy for internalising external costs of transport does not foresee the inclusion of external cost charges for infrastructure use. Hence, the present analysis does not cover external costs of infrastructure use. Certain other externalities for which no reliable estimates are readily available, such as scarcity costs of rail and inland waterways and costs of energy security and dependency on fossil fuel, are not covered either.

2 Estimation of base marginal external costs

The objective of the external calculator is to allow a direct comparison of the external cost changes as a result of modal split from the proposed projects. In order to make the tools flexible and user friendly, the differentiation of external costs is done between member states, transport modes, and various transport mode-specific subcategories. As a result, it has to be assumed that the marginal change introduced by a project in terms of transport volume for a specific mode in a specific member state will follow the behaviour of the average of the fleet for that transport mode in that member state.

Each externality requires a different methodology for the estimation of both its levels and its cost. This study follows the methodology of the handbook on estimation of external costs in the transport sector (IMPACT 2008)[4] and uses the external cost estimates reported in that study as the starting point for the calculation of the cost coefficients to be used in the Marco Polo calculator (Figure 1).

The general methodology of IMPACT consists of the calculation of external costs on a per vehicle kilometre basis (e.g. CO_2 emissions per extra kilometre of a truck) and multiply this by the unit costs per externality (e.g. costs of a tonne CO2 emitted). The IMPACT approach is discussed in more detail for each externality type in the remainder of this section.

The resulting cost coefficients are then updated to 2011, aggregated at the level of detail required for Marco Polo purposes and converted into per tonne kilometre terms. The details of these and various other calculations are discussed in Section 3.

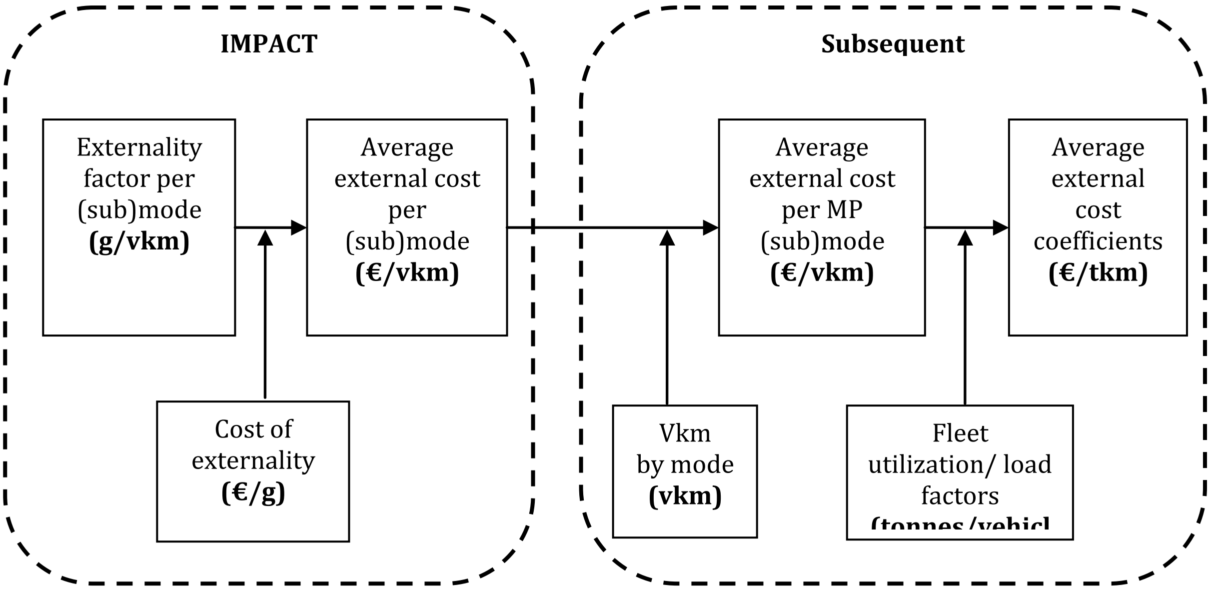

Figure 1: General overview of the methodological approach for the calculation of external cost coefficients

The aforementioned approach was followed for road, rail and inland shipping, for all externality types except congestion costs. The calculation of the congestion costs of road and rail is based on estimations of the TRANS-TOOLS transport model (TRANS-TOOLS 2008).

[4] IMPACT is a study commissioned by the European Commission to summarise the existing scientific and practitioner's knowledge, in order to provide a comprehensive overview of approaches for estimation and internalisation of external cost and to recommend a set of methods and default values for estimating external costs, referring to other projects and project studies. Annex C provides a table with qualitative information on project studies from which input values were obtained for the calculations.

The calculation of external costs of short sea shipping is based on input data from the EXTREMIS (2008) project.

2.1 Air pollution

For air pollution marginal costs are assumed to be equal to average external costs, so a top-down approach is adopted. The marginal external costs of air pollution for a specific (sub)mode are calculated as in equation (1), where *i* denotes the different types of pollutants.

$$MEC_{air} = \sum_i \text{emission per vkm of pollutant } i \cdot \text{unit cost of pollutant } i \qquad (1)$$

Road, rail and IWW

For road, rail and IWW the calculations are based on IMPACT (2008). Average emission factors per pollutant per submode[5] are derived from the TREMOVE[6] model. The valuation of $PM_{2,5}$ and PM_{10} emissions are based on results form the HEATCO (2006) study; the valuation of the emissions of other pollutants are based on results of the CAFE (2005) project.[7] Table 1 gives an overview of the level of detail at which the cost coefficients per vehicle kilometre (vkm) of air pollution are derived.

Table 1: Overview of the level of detail at which per vehicle kilometre costs of air pollution and climate change are calculated

Mode	Subcategorisation criterion:	Categories
Road	Truck size	(<7.5t; 7.5-16t; 16-32t; >32t)
	Fuel emission category	EURO-0 to EURO-5
	Network type	metropolitan; other urban; motorway; other interurban
Rail	Traction type	Diesel; electricity
	Network type	metropolitan; other urban; motorway; other interurban
IWW	Ship/cargo type	IWW ship; IWW tanker; Push barge combination
	Freight capacity	(<250t; 250-400t; 401-650t; 651-1000t; 1001-1500t; 1501-3000t; >3000t

Short sea shipping

For short sea shipping, emission estimates from the EXTREMIS database are used in combination with cost factors from HEATCO (2006) and CAFE (2005). External marginal cost data are obtained for three ship types (RoRo/RoPax; general cargo & bulk; containership).

2.2 Climate change

For climate change costs marginal costs are assumed to be equal to average external costs, so a top-down approach is adopted. Marginal external costs of climate change for a specific (sub)mode are calculated as follows:

$$MEC_{cc} = \frac{\text{emissions of } CO_2}{\text{vkm}} \cdot \text{unit cost of } CO_2 \qquad (2)$$

[5] Cost calculations are based on the cost of wheel-to-tank emissions. For electric rail, in order to render the coefficients comparable to the other (sub)modes, calculations are based on the cost of energy production (well-to-tank) minus the cost of energy production for diesel trains.

[6] TREMOVE is a transport and emissions simulation model that estimates the transport demand, modal split, vehicle fleets, emissions of air pollutants and the welfare level under different policy scenarios. For detailed information refer to TREMOVE 2006.

[7] An overview of the unit costs per tonne of pollutant is provided in IMPACT 2008, p54, Table 13.

Road, rail and IWW
For road, rail and IWW the calculations are based on the approach of IMPACT (2008). Average emission factors of CO_2 per pollutant per submode are derived from the TREMOVE model.[8] These are combined with the external costs per tonne of CO_2 for the year as recommended by IMPACT (2008) for the year 2014.[9] Table 1 gives an overview of the level of detail at which the per vehicle kilometre cost coefficients of climate change are derived.

Short sea shipping
For short sea shipping CO_2 emission factors from the EXTREMIS database are used, in combination with the external costs per tonne of CO_2 for the year as recommended by IMPACT (2008) for the year 2014. External marginal cost data are obtained for three ship types (RoRo/RoPax; general cargo & bulk; containership).[10]

2.3 *Noise*

The calculation of marginal external costs of noise for road and rail are based on IMPACT 2008 (see equation (3)).

$$MEC_{noise} = \frac{\partial dB(vkm)}{\partial vkm} \cdot \text{unit costs per person per dB} \cdot P \tag{3}$$

The first term represents the increase in decibel level following an increase in traffic by one vehicle kilometre; P is the population affected.

Road
For road a top down-approach is used based on estimated average coefficients for the EU from INFRAS/IWW (2004). Coefficients at the member states are derived based on values for external costs per person per dB(A) and population density. Costs are available for two truck sizes (<7.5t; >7.5 t).

Rail
For rail a top-down approach is used based on estimated coefficients from INFRAS/IWW (2003) and data on distribution among urban and interurban networks from INFRAS/IWW (2004). Coefficients at the member state level are derived based on differences in values for external costs per person per dB(A) and population density.

2.4 *Accidents*

The calculation of marginal costs of accidents for road and rail are based on IMPACT 2008 (see equation (4)).

$$MEC_{acc} = \frac{\partial ACC(vkm)}{\partial vkm} \cdot \text{unit costs per accident} \cdot \text{external part of costs} \tag{4}$$

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[8] See also footnote 5
[9] The Interservice Group agreed upon using the cost per tonne CO2 for the year 2014 because of the desirability for the values used to represent the damage costs when projects are likely to be implemented. The value for 2014 is calculated based on a linear interpolation of the central value for 2010 and 2020 given in Table 132 of Impact (2008) and is €31 in 2000 prices.
[10] These coefficients are used as base values to derive cost coefficients for various additional subcategories based on different fuel qualities, fuel technologies and speed categories (see Section 3 for more detail).

The first term represents the increase in accidents following an increase in traffic by one vehicle kilometre. The last term serves as a correction so as to exclude the part of the costs that is internalized through insurance schemes.

Road
For road a bottom-up approach[11] is used, based on marginal cost function and estimates from a case study on Switzerland (see UNITE, 2002b and 2002c). Results are transferred to other countries by using different input values for *inter alia* unit costs per accident, risk elasticities and insurance system. This results in marginal cost coefficients at the member state level for three different networks, i.e. (urban; motorways; other non-urban).

Rail
For rail, following INFRAS/IWW (2004), a top-down approach is used based on accident statistics from the International Union of Railways (UIC)[12]. Traffic demand data from the TREMOVE model are used. Marginal cost coefficients are calculated at the member state level for two networks (urban and non-urban).

2.5 Congestion

The approach followed uses the average costs of congestion for road and rail, calculated at country level with the TRANSTOOLS model as follows:

$$MEC_{cong} = VOT \times \frac{\sum_i L_i Q_i / V_i - L_i Q_i / V_i^*}{\sum_i L_i Q_i} \tag{5}$$

Where *VOT* is the value of time for vehicles, and *L* is the length, *Q* is the traffic flow (vehicles per hour), *V* is the actual speed and *V** is the free flow speed for each interurban road segment *i*. The right hand term calculates the loss of time per vehicle kilometre for each interurban road segments, resulting from the difference between the free flow speed and the actual speed. This is aggregated at the country level and then multiplied by the value of time in order to compute the average costs of congestion.

2.6 Overview

Table 2 shows per transport mode which externality types we estimate marginal cost coefficients for. Table 3 shows per EU27 member state which transport modes are covered in the analysis

Table 2: Externality types covered per transport mode

Externality	Road	Rail	IWW	SSS
Air pollution	x	x	x	x
Noise pollution	x	x		
Climate change	x	x	x	x
Accidents	x	x		
Congestion	x	x		

[11] A bottom-up approach uses marginal cost estimates and functions from case studies as input and employs value transfer and/or aggregation techniques to obtain representative values for typical transport clusters or national averages. A top-down approach uses data on mobility and external cost at the national data as input and estimates external unit costs for typical transport clusters or national averages.
[12] http://www.uic.org/com/article/1922?page=thickbox_enews

Table 3: Transport modes covered per EU27 member state

Country	Road	Rail	IWW	SSS
Austria	x	x	x	
Belgium	x	x	x	x
Bulgaria	x	x	x	x
Cyprus	x			x
Czech Republic	x	x	x	
Denmark	x	x		x
Estonia	x	x		x
Finland	x	x		x
France	x	x	x	x
Germany	x	x	x	x
Greece	x	x		x
Hungary	x	x	x	
Ireland	x	x		x
Italy	x	x		x
Latvia	x	x		x
Lithuania	x	x		x
Luxemburg	x	x		
Malta	x			x
Netherlands	x	x	x	x
Poland	x	x	x	x
Portugal	x	x		x
Romania	x	x	x	x
Slovenia	x	x		x
Slovakia	x	x	x	
Spain	x	x		x
Sweden	x	x		x
UK	x	x		x

3 Aggregation, conversion and additional calculations

The methodology as described in the previous section resulted in a large set of external cost coefficients on a per vehicle kilometre basis, at a detailed level of aggregation. This section discusses a number of additional calculation steps necessary to derive the cost coefficients to be used in the Marco Polo calculator. These include (i) updating the costs to the year 2011, (ii) aggregation at the desired level of detail, (iii) conversion into per tonne kilometre costs, (iv) aggregation at the EU27 level and (v) specific additional calculations for the inland waterways and short sea shipping modes.

3.1 Update of cost coefficients to 2011

The marginal cost coefficients that were derived as discussed in Section 2 were expressed in year 2000 prices. For the purpose of the Marco Polo calculator the coefficients need to be updated to year 2011 prices. The update is carried out at the member state level based on the annual average rate of change in Harmonized Indices of Consumer Prices (Eurostat). At the EU27 level the correction results in a cost increase of about thirty-five percent. In addition, we apply a correction at the member state level to account for the impact of changes in real GDP per capita (Eurostat) on the relative valuation of externalities compared to that of other goods.[13] At the EU27 level this correction results in a cost increase of about thirty-three percent.

3.2 Aggregation and conversion (road, rail and inland waterways)

In order to maximize accuracy and validity, the cost coefficients were obtained at the most detailed level possible given the data availability, i.e., at the lowest level of aggregation in terms of geography, network and mode specification The Marco Polo calculator requires marginal external cost coefficients at a specific level of detail (Table 4 provides an overview of the subcategories per transport mode used in the calculator). In order to aggregate the cost coefficients at the desired level, data on traffic demand (vehicle kilometres) is required.

Traffic data

The TREMOVE model is used to obtain for each member state data on vehicle kilometres for road, rail and inland shipping for 2010. For road, data on vehicle kilometres are obtained for four different vehicle sizes, six different fuel technologies and four different network types (in total 96 categories per country). For rail, data is available for diesel and electric trains (2 categories). For inland shipping, data is obtained for three different ship types and seven different ship sizes (21 categories).

Aggregation to relevant subcategories

The overall marginal external cost coefficients for road at the member state level are calculated as the weighted average of the cost coefficients for each of the mode's subcategories, using vehicle kilometres for each submode as weights (equation (6)).

$$MEC_i = \frac{\sum_{j \in i} MEC_{ij} VKM_{ij}}{\sum_{j \in i} VKM_{ij}} \qquad (6)$$

[13] This correction is based on the assumption that the elasticity of willingness-to-pay with respect to real GDP per capita is equal to one for all external cost categories, i.e., an increase in real GDP per capita of, say, ten percent, results in an increase in the valuation of externalities with also ten percent.

where *i* denotes the mode and *j* the mode's subcategories. In a similar fashion, marginal external cost coefficients for the two rail submodes are calculated as the weighted average of the coefficients for the lower level subcategories, using vehicle kilometres as weights. The cost coefficients for inland shipping are directly used in the calculator at the level of detail in which they were obtained.

Table 4: Overview of subcategories per transport modes used in Marco Polo calculator

Transport mode	**Categorization criterion**	**Submodes**
Road (motorways)	Network	- Motorways
Rail	Fuel technology	- Diesel - Electric
Inland waterways	Ship / cargo type	- IWW ship (with integrated engine) - IWW tanker - Push barge combination
	Freight capacity*	- <250 tonnes - 250-400 tonnes - 401-650 tonnes - 651-1000 tonnes - 1001-1500 tonnes - 1501-3000 tonnes - >3000 tonnes
	Fuel technology	- Standard low sulphur fuel oil (LSFO) - LSFO + Diesel Particulate filter (DPF) - LSFO + Selective Catalytic Reduction (SCR) - LSFO + DPF + SCR - Liquefied Natural Gas (LNG)
Short sea shipping	Ship/cargo type	- General cargo/ bulk - Containerships - RoRo/RoPax
	Speed (only for RoRo/RoPax)	- Less than 17 kn (knots) - 17 to 20 kn - 20 to 23 - more than 23 kn
	Fuel technology	- Conventional fuel (high or low sulphur) - Liquefied natural gas (LNG) - Seawater scrubbing - Freshwater scrubbing

* For certain member states (BE, DE, FR, NL) the data on emission factors per vehicle kilometre are equal among certain freight classes, effectively reducing the level of detail in terms of the number of freight classes as follows. For IWW ship and IWW tanker: 250-650t; 651-1000t; 1001-1500t; >1500. For push barge combinations: <3000t, >3000t.

Aggregation at the EU27 level

In order to aggregate the data at the EU27 level, a weighted average of the member-state specific coefficients is calculated, using the vehicle kilometres in 2010 per member states as weights (equation (7)).[14] For road, rail and IWW, data on vehicle kilometres estimated with TREMOVE are used.

[14] For EFTA-countries and Croatia, we assume that marginal cost coefficients are equal to that of the EU27 average.

$$MEC_{EU27} = \frac{\sum_{MS \in EU27} MEC_{MS} VKM_{MS}}{\sum_{MS \in EU27} VKM_{MS}} \qquad (7)$$

Conversion into per tonne kilometre costs

At the EU27 level, the marginal costs per vehicle kilometre for road, rail and IWW[15] are transformed into marginal costs per tonne kilometre, using mode-specific conversion factors, i.e. tonnes per vehicle, which are calculated as weighted averages of member-state specific conversion factors. As for certain sub-modes, the use of the same mode-level conversion factors would lead to inaccurate results, sub-mode-specific conversion factors are used. An overview of the input data on conversion factors is displayed in Table 5. All conversion factors are estimated for 2010, based on a baseline run of the TREMOVE model.

Table 5: Sub-mode-specific load factors of tonnes per vehicle

Mode	**Submode**		**Load factor**
Road	Motorways		7,7
Rail	Diesel		292
	Electric		367
Inland Waterways*	IWW ship	<250 ton	7
		250-400 ton	104
		401-650 ton	162
		651-1000 ton	226
		1001-1500 ton	297
		1501-3000 ton	488
		> 3000 ton	744
	IWW tanker	<250 ton	38
		250-400 ton	49
		401-650 ton	256
		651-1000 ton	274
		1001-1500 ton	459
		1501-3000 ton	919
		> 3000 ton	1225
	Push barge combination	<250 ton	10
		250-400 ton	35
		401-650 ton	66
		651-1000 ton	174
		1001-1500 ton	260
		1501-3000 ton	700
		> 3000 ton	1309

Source: results for 2010 from a baseline run of the TREMOVE model.

* For some subcategories of the inland waterways mode additional corrections were made to the conversion factors. These corrections are detailed in Section 3.3.

3.3 Additional calculations for inland waterways

Correction of load factors

For some member states the data on emission factors per vehicle kilometre basis are not fully differentiated for all seven freight classes (see footnote to Table 4 for details). If these partially differentiated data are combined with fully differentiated load factors in order to

[15] The cost coefficients for short sea shipping are already expressed in per tonne kilometre terms

calculate the emission factors on a per tonne kilometre basis, this would result in over- and underestimations of the cost coefficients for certain freight classes. In order to avoid such bias, load factors at the member state level are aggregated so as to match the degree of differentiation at which the emission factors are available.[16] This aggregation is carried out by calculating the weighted average of the load factors of the underlying individual freight category classes, with the weights based on the total vehicle kilometres per freight class.

Alternative fuel technologies
For IWW external cost coefficients are calculated for standard low sulphur fuel oil and four alternative fuel technologies or combinations thereof. For each of these alternative technologies we collected estimates on the reduction in CO_2 and the air pollutants PM, SO_2 and NO_X, compared to conventional fuel (see Table 6 for a list of the fuel technologies and the corresponding emission reduction factors).

Table 6: Emission reduction factors of IWW fuel technologies for various air pollutants and CO_2

Fuel technology*	NO_X	PM	SO_2	CO_2	Fuel consumption
1. Fuel oil (low sulphur)	Base option				
2. Diesel Particulate filter (DPF)	-	-68%**	-	-	+2.0%
3. Selective Catalytic Reduction (SCR)	-85%		-	-	-
4. DPF + SCR	-85%	-68%**	-	-	+2.0%
5. LNG	-75.0%	-97,0%	-	-10.0%	-

Source: NEA 2011
* all reduction factors are based on the lower end of the range given in the source.
** calculated as the unweighted average of the reduction factors for wall-flow filters (-95%) and partial flow filters (-40%).

Combined with data on the cost per unit of pollutant and the relative content of each pollutant in fuel, overall reduction factors for climate change and air pollution costs are calculated for each of the technologies.[17] Next, for each of the subcategories of IWW, fuel technology-specific cost coefficients are calculated by multiplying the cost coefficient for standard fuel with the fuel technology-specific reduction factors.

3.4 Additional calculations for short sea shipping

Marginal external cost coefficients for the three subcategories of short sea shipping based on ship/cargo type (i.e. general cargo/bulk, container and RoRo/RoPax) were directly calculated at the desired level of detail and per tonne kilometre, based on EX-TREMIS output for 2010.

Accounting for speed
Vessel speed has a considerable impact on fuel consumption, and thus on air pollution and CO_2 costs. This is particularly relevant for RoRo/RoPax ships. Hence, for RoRo/RoPax ships,

[16] This aggregation is only carried out for the member states for which the data on per vkm emission coefficients are not fully differentiated, i.e. BE, DE, FR, NL.
[17] The reduction factors for air pollution costs for DPF, SCR, DPF+SCR and LNG are 0.862, 0.353 and 0.202, 0.198 respectively. Furthermore, reduction factors for climate change costs for DPF, DPF+SCR and LNG are 1.02, 1.02 and 0.900, respectively.

cost coefficients are calculated for different speed categories (<17 knots, 17-20 kn, 20-23 kn, >23 kn).

Based on numerical information from SEAPACER[18] on ferry fuel consumption as a function of speed, cost correction factors were derived for the different speed categories. Cost coefficients for the three fastest speed categories are calculated by multiplying the cost coefficients for the base category, i.e. <17 knots with the appropriate cost correction factor. Table 7 displays the correction factors for air pollution costs and climate change costs per speed category.

Low sulphur
The sulphur content in marine fuel affects the costs of air pollution and, to a lesser degree, the costs of climate change. In order to address this we calculate separate cost coefficients for low sulphur fuel (0.1% sulphur). Based on the difference in sulphur content between low sulphur fuel and high sulphur fuel (1.5% sulphur) and the valuation of sulphur emissions, correction factors for air pollution costs and climate change costs were derived (0.642 and 0.980 respectively). The cost coefficients for low sulphur fuel were calculated by multiplying the cost coefficients for high sulphur fuel with the corresponding correction factor.

Table 7: External cost correction factors per speed category

Speed category	Air pollution	Climate change
<17 knots	1.00	1.00
17-20 kn	1.27	1.92
20-23 kn	1.92	2.88
>23 kn	3.33	3.85

Alternative fuel technologies
For SSS external cost coefficients are calculated for three alternative fuel technologies (in addition to conventional fuel), i.e., LNG, seawater scrubbing and freshwater scrubbing. For each of these technologies EMSA 2010 provides estimates on the reduction in CO_2 and air pollutants PM, SO_2 and NO_X, compared to conventional fuel. Combined with data on the cost per unit of pollutant and the relative content of each pollutant in fuel, reduction factors for climate change and air pollution costs are calculated for each of the technologies. Next, for each of the subcategories of SSS, the cost coefficients for the alternative fuel technologies are calculated by multiplying the corresponding cost coefficient for conventional fuel by the fuel technology-specific reduction factor. The reduction factors for air pollution costs for LNG, seawater scrubbing and freshwater scrubbing are 0.054, 0.580 and 0.573, respectively. Furthermore, for LNG the reduction factor for climate change costs is 0.800.

3.4 Results and interpretation

Tables 8-10 provide overviews of the estimated cost coefficients at the EU27 level for the road and rail, short sea shipping and inland waterways (sub)modes, respectively.

The external cost coefficients derived for the Marco Polo calculator are based on methodologies and/or values recommended by the Handbook on estimation of external costs in the transport sector (IMPACT 2008). The recommended values and methodologies represent the state-of-the art and best practice on external cost estimation. Even so, there is a degree of uncertainty as regards the true underlying cost of externalities. This is reflected by the fact that in many cases IMPACT 2008 reports lower and upper bounds in addition to the recommended central values. For example, the unit cost used in the calculator for a tonne of

[18] http://www8.cs.umu.se/~thomash/seapacer/seapac1.htm

CO_2 emissions is €31, calculated based on the central values given in Table 132 of IMPACT 2008. The corresponding lower estimate, calculated from the information on lower estimates in the same table would be €11 while the corresponding higher estimate would be €55. As such, the lower and upper estimates are, respectively, 65 percent lower and 77 percent higher than the central estimate. For the other externalities similar reasoning holds; for noise, the upper estimates of the unit costs are on average about twice as high as the corresponding lower estimates, while for accidents, the ranges are very large and depend very much on the country. For air pollution and congestion no information on estimate ranges is directly available.

In light of this, it is important to be aware of the fact that the cost coefficients reported and used in the Marco Polo calculator are estimates that are based on assumptions and that do not necessarily reflect the true underlying costs of the externalities.

Table 8: Marginal cost coefficients for the road and rail (sub)modes at the EU27 level (Euro per 1000 tonne kilometre).

	Road	**Rail**	
Externality	Motorways	Diesel	Electric
1. air pollution	8,58	10,25	1,00
2. climate change	3,92	1,90	1,46
3. noise	1,93	1,88	1,49
4. accidents	0,64	0,54	0,33
5. congestion	3,43	0,20	0,20
Environmental (1+2+3)	14,43	14,04	3,95
Socio-Economic (4+5)	4,07	0,74	0,53
Total	**18,50**	**14,77**	**4,48**

Table 9: Marginal cost coefficients for short sea shipping (sub)mode at the EU27 level (Euro per 1000 tonne kilometre).

		Externality	**Ship/cargo type**					
			general/ bulk	container ship	RoRo/RoPax; < 17 kn	RoRo/RoPax; 17-20 kn	RoRo/RoPax; 20-23 kn	RoRo/RoPax; > 23 kn
Fuel technology	Low sulphur fuel	1. air pollution	4,48	3,09	1,56	1,98	3,00	5,20
		2. climate change	0,21	0,40	2,94	5,65	8,47	11,29
		Total	**4,70**	**3,49**	**4,50**	**7,63**	**11,47**	**16,50**
	High sulphur fuel	1. air pollution	6,98	4,81	2,43	3,08	4,67	8,10
		2. climate change	0,22	0,41	3,00	5,76	8,64	11,53
		Total	**7,20**	**5,22**	**5,43**	**8,85**	**13,32**	**19,63**
	Freshwater scrubbing	1. air pollution	4,00	2,76	1,39	1,77	2,68	4,65
		2. climate change	0,22	0,41	3,00	5,76	8,64	11,53
		Total	**4,22**	**3,17**	**4,39**	**7,53**	**11,32**	**16,17**
	Seawater scrubbing	1. air pollution	4,05	2,79	1,41	1,79	2,71	4,70
		2. climate change	0,22	0,41	3,00	5,76	8,64	11,53
		Total	**4,27**	**3,20**	**4,41**	**7,55**	**11,35**	**16,22**
	LNG	1. air pollution	0,38	0,26	0,13	0,17	0,25	0,44
		2. climate change	0,17	0,33	2,40	4,61	6,92	9,22
		Total	**0,55**	**0,59**	**2,53**	**4,78**	**7,17**	**9,66**

Table 10: Marginal cost coefficients for the inland waterways (sub)modes at the EU27 level (Euro per 1000 tonne kilometre).

Ship/cargo type		Externality	Freight capacity (tonnes)						
			<250	250-400	401-650	651-1000	1001-1500	1501-3000	> 3000
low sulphur oil	IWW ship	1. air pollution	12,2	10,8	9,1	10,0	10,5	11,4	10,6
		2. climate change	1,7	1,5	1,3	1,4	1,5	1,5	1,3
		Total	**13,9**	**12,3**	**10,4**	**11,4**	**11,9**	**12,9**	**11,9**
	IWW tanker	1. air pollution	22,7	22,8	5,8	8,3	6,8	9,3	9,2
		2. climate change	3,1	3,2	0,8	1,1	0,9	1,2	1,2
		Total	**25,8**	**26,0**	**6,6**	**9,4**	**7,7**	**10,5**	**10,4**
	Push barge combination	1. air pollution	18,5	18,4	18,2	17,8	17,3	17,2	11,8
		2. climate change	2,6	2,6	2,5	2,4	2,6	2,4	1,6
		Total	**21,0**	**21,0**	**20,8**	**20,2**	**19,9**	**19,6**	**13,4**
Diesel Particulate Filter (DPF)	IWW ship	1. air pollution	10,5	9,3	7,8	8,6	9,0	9,8	9,1
		2. climate change	1,8	1,5	1,3	1,4	1,5	1,5	1,3
		Total	**12,3**	**10,8**	**9,2**	**10,0**	**10,5**	**11,3**	**10,4**
	IWW tanker	1. air pollution	19,5	19,7	5,0	7,1	5,9	8,0	7,9
		2. climate change	3,2	3,2	0,8	1,1	0,9	1,2	1,2
		Total	**22,7**	**22,9**	**5,8**	**8,3**	**6,8**	**9,2**	**9,2**
	Push barge combination	1. air pollution	15,9	15,9	15,7	15,3	14,9	14,8	10,1
		2. climate change	2,6	2,6	2,6	2,5	2,7	2,5	1,6
		Total	**18,5**	**18,5**	**18,3**	**17,8**	**17,5**	**17,3**	**11,8**
Selective Catalytic Reduction	IWW ship	1. air pollution	4,3	3,8	3,2	3,5	3,7	4,0	3,7
		2. climate change	1,7	1,5	1,3	1,4	1,5	1,5	1,3
		Total	**6,0**	**5,3**	**4,5**	**4,9**	**5,2**	**5,5**	**5,0**
	IWW tanker	1. air pollution	8,0	8,1	2,0	2,9	2,4	3,3	3,2
		2. climate change	3,1	3,2	0,8	1,1	0,9	1,2	1,2
		Total	**11,2**	**11,2**	**2,8**	**4,0**	**3,3**	**4,5**	**4,5**
	Push barge combination	1. air pollution	6,5	6,5	6,4	6,3	6,1	6,1	4,2
		2. climate change	2,6	2,6	2,5	2,4	2,6	2,4	1,6
		Total	**9,1**	**9,1**	**9,0**	**8,7**	**8,7**	**8,5**	**5,8**
DPF+SCR	IWW ship	1. air pollution	2,5	2,2	1,8	2,0	2,1	2,3	2,1
		2. climate change	1,8	1,5	1,3	1,4	1,5	1,5	1,3
		Total	**4,2**	**3,7**	**3,2**	**3,4**	**3,6**	**3,8**	**3,5**
	IWW tanker	1. air pollution	4,6	4,6	1,2	1,7	1,4	1,9	1,9
		2. climate change	3,2	3,2	0,8	1,1	0,9	1,2	1,2
		Total	**7,8**	**7,9**	**2,0**	**2,8**	**2,3**	**3,1**	**3,1**
	Push barge combination	1. air pollution	3,7	3,7	3,7	3,6	3,5	3,5	2,4
		2. climate change	2,6	2,6	2,6	2,5	2,7	2,5	1,6
		Total	**6,3**	**6,3**	**6,2**	**6,1**	**6,1**	**5,9**	**4,0**
LNG	IWW ship	1. air pollution	2,4	2,1	1,8	2,0	2,1	2,2	2,1
		2. climate change	1,5	1,3	1,2	1,2	1,3	1,3	1,2
		Total	**4,0**	**3,5**	**3,0**	**3,2**	**3,4**	**3,6**	**3,3**
	IWW tanker	1. air pollution	4,5	4,5	1,1	1,6	1,3	1,8	1,8
		2. climate change	2,8	2,9	0,7	1,0	0,8	1,1	1,1
		Total	**7,3**	**7,4**	**1,9**	**2,6**	**2,2**	**2,9**	**2,9**
	Push barge combination	1. air pollution	3,6	3,6	3,6	3,5	3,4	3,4	2,3
		2. climate change	2,3	2,3	2,3	2,2	2,3	2,2	1,4
		Total	**6,0**	**5,9**	**5,9**	**5,7**	**5,7**	**5,6**	**3,8**

4 Interface of external cost calculator

The Marco Polo programme makes use of two electronic Microsoft Excel-based interfaces, i.e., (i) an interface for modal shift, catalyst and motorways of the sea actions and (ii) an interface for traffic avoidance actions. Both interfaces require applicants to fill out information about proposed projects and subsequently calculate the values that are relevant for the project evaluation. The calculations are based on the external cost data at the EU27 level that were derived as described in section 2 and 3 of this methodological note. Both interfaces have been updated so as to incorporate the methodological changes with respect to the project evaluation calculations.

4.1 The interface for modal shift, catalyst and motorways of the sea actions

The interface for modal shift, catalyst and motorways of the sea actions is shown in Figure 2.

Modifications with respect to MP call 2010

The interface has a similar lay-out as the call 2010 version but add the following features.

- For rail, IWW and SSS, cost coefficients have been estimated for various sub-modes. Pull down menus are available that enable the user to select the appropriate sub-mode per transport leg.
- For one of the sub-modes of SSS (RoRo/RoPax), cost coefficients have been estimated for various speed categories. Pull down menus are available that enable the user to select the appropriate speed category per transport leg.
- For SSS, cost coefficients have been calculated for three alternative fuel technologies. In the interface pull-down menus are provided to enable the user to select the fuel technology, i.e., conventional fuel, liquefied natural gas (LNG), seawater scrubbing and freshwater scrubbing.
- For SSS, cost coefficients have been calculated for two types of fuel quality (low and high sulphur). In the interface the option is made available to select the fuel quality mix, i.e. the share of low sulphur fuel in the fuel mix. This option is only available for conventional fuel (see previous bullet point).
- Cost coefficients have been estimated at the member state level. Coefficients at the EU27 level have been calculated as a weighted average, using freight tonne-kilometres for weights.
- The option to add extra input lines (i.e. legs) to describe old and new projects is implemented.

Further modifications with respect to MP call 2011

- For IWW, cost coefficients have been calculated for five different fuel technologies. In the interface pull-down menus are provided to enable the user to select the fuel technology, i.e., standard fuel oil, Diesel Particulate filter (DPF), Selective Catalytic Reduction (SCR), DPF + SCR, liquefied natural gas (LNG).
- For IWW, cost coefficients have been calculated for seven different freight capacity classes (in tonnes), i.e., <250t; 250-400t; 401-650; 651-1000t; 1001-1500t; 1501-3000t; >3000t).

Brief instructions on testing the interface for modal shift, catalyst and motorways of the sea actions

1. In the worksheet “Original (old) service”, provide details on the original service by the following steps.

a. Indicate whether freight is measured in weight (tonnes) or volume (m^3) by using the pull-down menu in cell C4.
b. List the legs of the route in question in Column B
c. For each leg, select the (sub)mode in Columns C, D, E or H by using the appropriate pull-down menu. The pull-down menu in Column H is also used to select the speed category for RoRo/RoPax ships.
d. For IWW indicate the freight capacity and the fuel technology by using the pull-down menus in Columns F and G, respectively.
e. For SSS indicate the fuel type/technology by using the pull-down menu in Column I.
f. For SSS indicate the fuel quality (i.e. the share of low sulphur fuel in the fuel mix) in Column J. This only applies if in Column H conventional fuel is selected.
g. Select the country category with the pull down menu in Column K. Note that legs that use the same (sub)mode but go through more than one country can be combined in one leg if appropriate.
h. Indicate the distance per leg in Column L
i. Indicate the total tonnage or volume transported in Column M

2. In the worksheet "Proposed (new) service", follow the same steps with respect to the proposed new service.

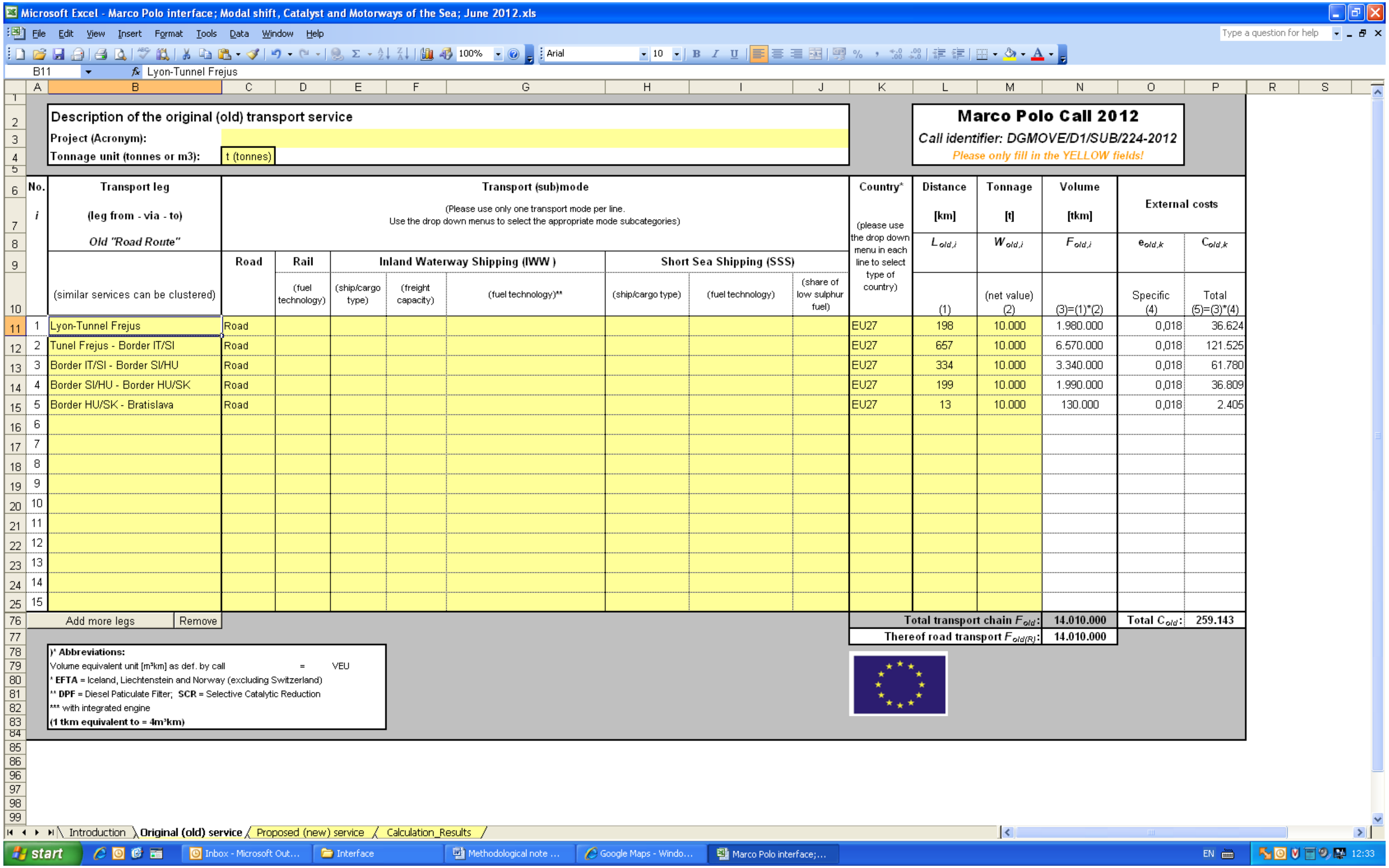
3. In the worksheet "Calculation_Results" follow the following steps.
   a. Mark the type of action in cell C11, C12 or C13, and in cell G16 or G17.
   b. Indicate the duration of the subsidy, the total eligible cost and the requested subsidy in cells C24, C26 and C52, respectively.
   c. The calculated results can now be consulted, including the shifted tonnage/volume and the environmental cost benefits.

Detailed user instructions can be found in the introduction documents to the interface provided in Annex A.

Figure 2 demonstrates the interface by means of a numerical example of a project that shifts the transport of 10.000 tonnes of freight from Lyon to Bratislava from road to rail. Figure 2a and b show the details of the original and the proposed service, respectively. Figure 2c shows the calculated results, including the shifted tonnage/volume and the external cost benefits.

4.2 The interface for traffic avoidance actions

The interface for modal shift, catalyst and motorways of the sea actions is shown in Figure 3. Figure 3a and b show the worksheets in which to indicate the original and the proposed transport service, respectively. Figure 3c shows the calculated results, including the quantity of road traffic and the external cost benefits. Compared to the call 2010 version pull-down menus have been implemented for the selection between loaded vehicles and empty runs and between country categories. Furthermore, the option to add extra input lines (i.e. legs) for old and new projects is implemented. Detailed user instructions can be found in the introduction documents to the interface provided in Annex B.


Microsoft Excel - Marco Polo interface; Modal shift, Catalyst and Motorways of the Sea; June 2012.xls

Description of the original (old) transport service

Project (Acronym):

Tonnage unit (tonnes or m3): t (tonnes)

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Please only fill in the YELLOW fields!

No. *i*	Transport leg (leg from - via - to) *Old "Road Route"* (similar services can be clustered)	Road	Rail (fuel technology)	IWW (ship/cargo type)	IWW (freight capacity)	IWW (fuel technology)**	SSS (ship/cargo type)	SSS (fuel technology)	SSS (share of low sulphur fuel)	Country* (please use the drop down menu in each line to select type of country)	Distance [km] $L_{old,i}$ (1)	Tonnage [t] $W_{old,i}$ (net value) (2)	Volume [tkm] $F_{old,i}$ (3)=(1)*(2)	External costs $e_{old,k}$ Specific (4)	External costs $C_{old,k}$ Total (5)=(3)*(4)
1	Lyon-Tunnel Frejus	Road								EU27	198	10.000	1.980.000	0,018	36.624
2	Tunel Frejus - Border IT/SI	Road								EU27	657	10.000	6.570.000	0,018	121.525
3	Border IT/SI - Border SI/HU	Road								EU27	334	10.000	3.340.000	0,018	61.780
4	Border SI/HU - Border HU/SK	Road								EU27	199	10.000	1.990.000	0,018	36.809
5	Border HU/SK - Bratislava	Road								EU27	13	10.000	130.000	0,018	2.405
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															

Transport (sub)mode: (Please use only one transport mode per line. Use the drop down menus to select the appropriate mode subcategories)

Add more legs | Remove

Total transport chain F_{old}: 14.010.000 — Total C_{old}: 259.143

Thereof road transport $F_{old(R)}$: 14.010.000

)* Abbreviations:
Volume equivalent unit [m³km] as def. by call = VEU
* EFTA = Iceland, Liechtenstein and Norway (excluding Switzerland)
** DPF = Diesel Paticulate Filter; SCR = Selective Catalytic Reduction
*** with integrated engine
(1 tkm equivalent to = 4m³km)

Introduction | Original (old) service | Proposed (new) service | Calculation_Results

Figure 2a: Interface for modal shift, catalyst and motorways of the sea actions; worksheet: 'Original (old) transport service'.

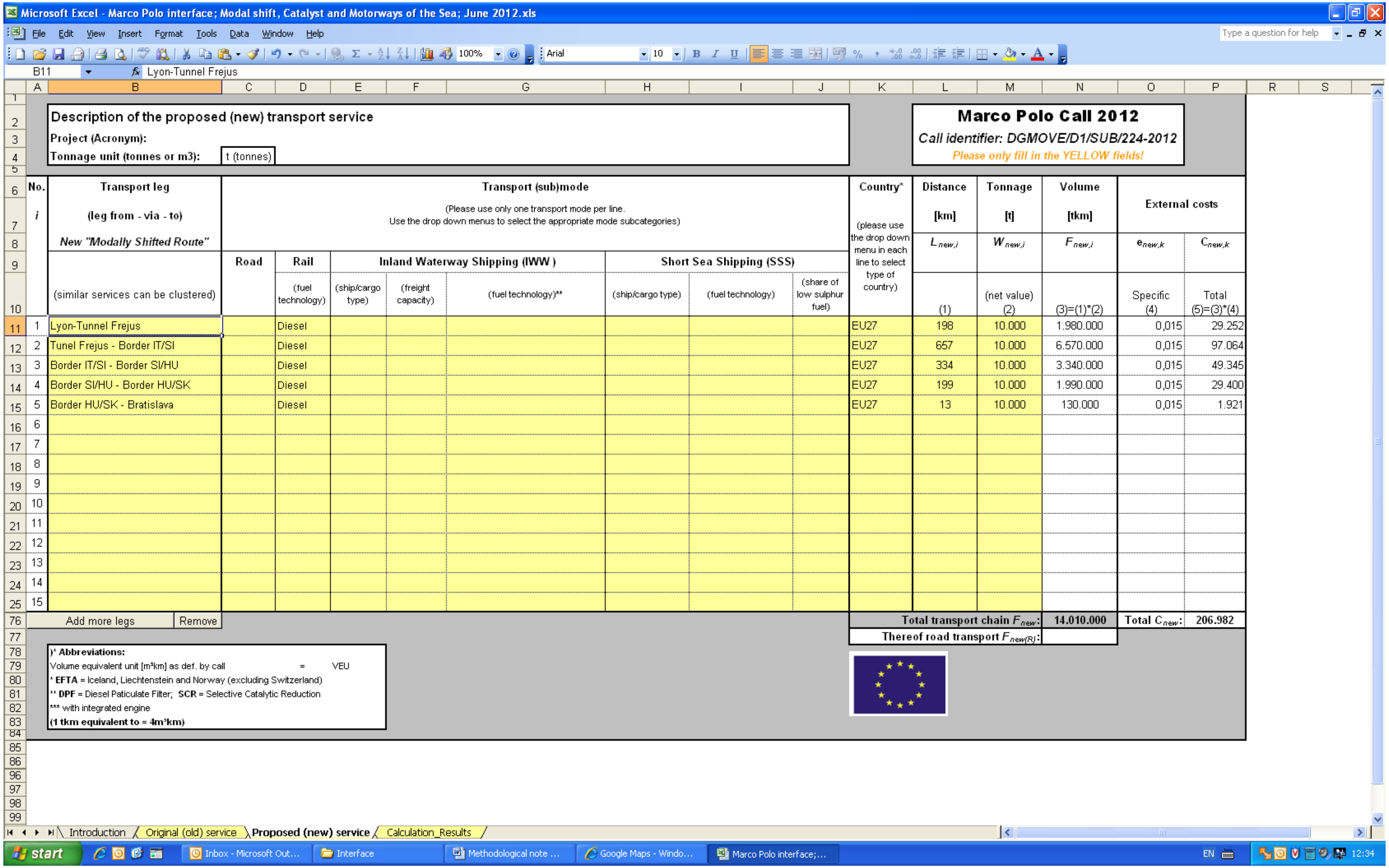

Figure 2b: Interface for modal shift, catalyst and motorways of the sea actions; worksheet: 'Proposed (new) transport service'.

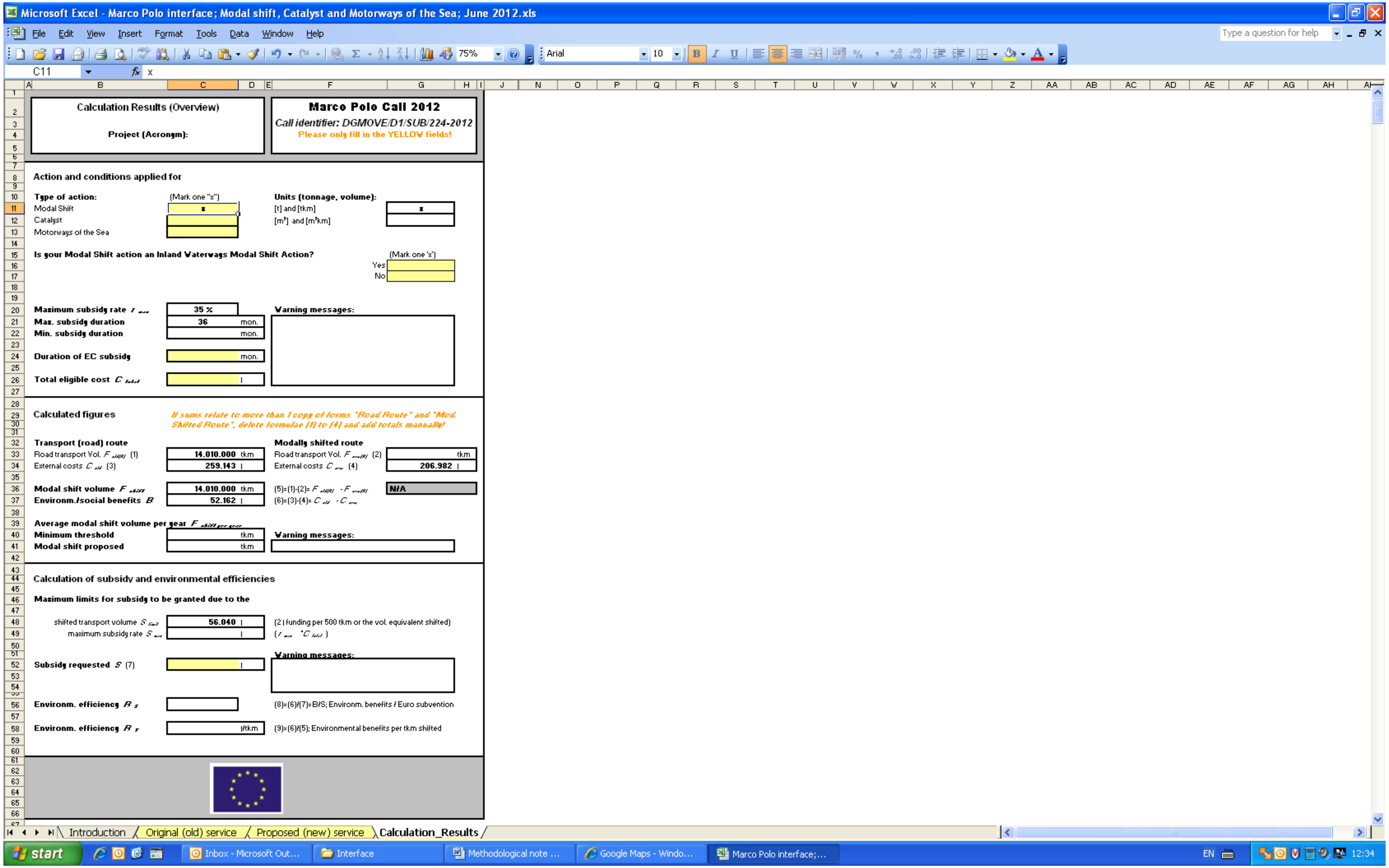

Figure 2c: Interface for modal shift, catalyst and motorways of the sea actions; worksheet: 'Calculation results'.

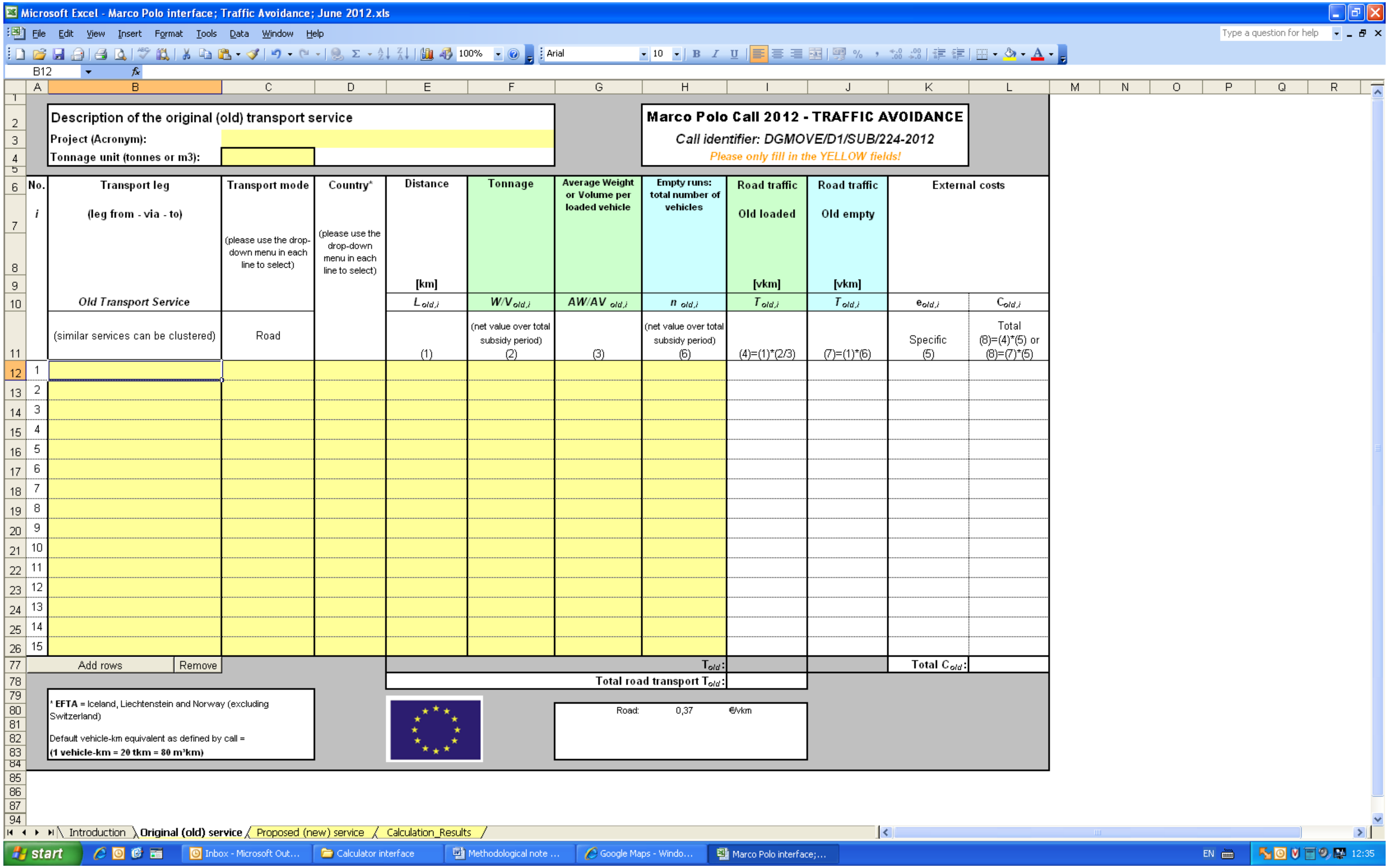

Figure 3a: Interface for traffic avoidance actions; worksheet: 'original (old) transport service'.

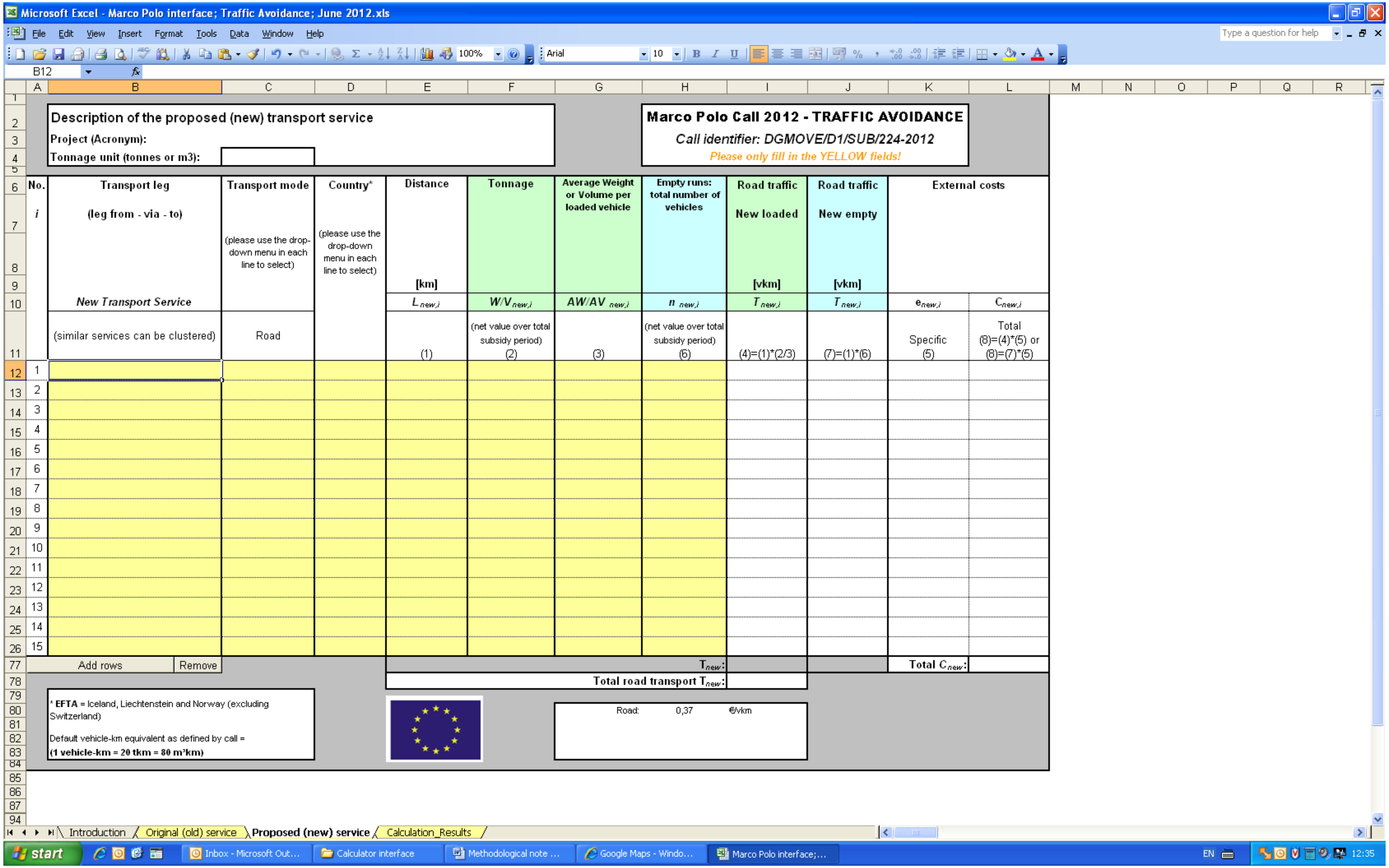

Figure 3b: Interface for traffic avoidance actions; worksheet: 'proposed (new) transport service'.

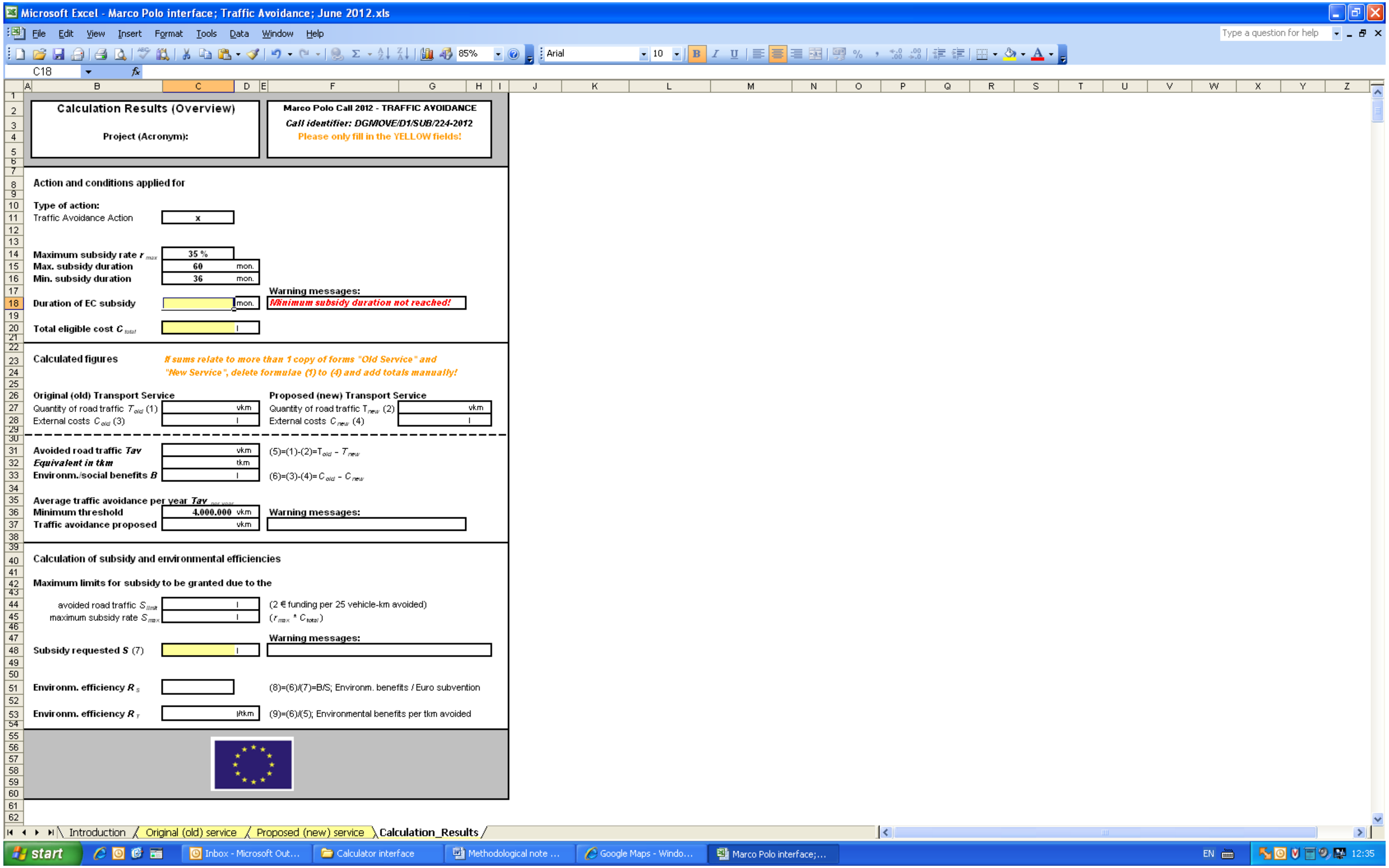

Figure 3c: Interface for traffic avoidance actions; worksheet: 'Calculation results'.

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Annex A: Introduction document to the interface for modal shift, catalyst and motorways of the sea actions

Marco Polo II Call 2012

Call identifier: DGMOVE/D1/SUB/224-2012

Introduction to the Marco Polo Calculator - Modal shift, Catalyst and Motorways of the Sea Actions

(Version MPII - 2012)

This tool allows Marco Polo applicants to easily calculate the figures requested by the application process for Modal Shift, Catalyst and Motorways of the Sea actions (cf. call text). Some integrated features might warn the user in case wrong parameters are filled in the forms or wrong assumptions are made.
This tool is requested by the call text to be included in a Marco Polo proposal. It is mandatory to make use of this tool and to include a printed version of the forms in the annexes of each proposal.

Nevertheless, additional data and calculations which are necessary to understand the proposed action but are not covered by the calculators functions, should be included in the main text of your proposal.
ALL CALCULATIONS ARE EXPLAINED IN DETAIL IN GUIDANCE NOTE ACCOMPANYING THE MARCO POLO CALCULATOR
The Marco Polo Calculator consists of four parts being represented by four "sheets" of one Excel® file (click on name flags at bottom of Excel® screen for selection):
- This "Introduction" (four pages when printed)
- Form "Original (old) service" (one page when printed)
- Form "Proposed (new) service" (one page when printed)
- Form "Calculation Results" (one page when printed)

Be aware that this tool has been tested, but **no guarantee** can be given concerning the **proper functioning of the tool**. This is also due to the fact that the tool can still be manipulated by the user.

Marco Polo helpdesk: If any questions arise or faults are detected, please contact
e-mail: eaci-marco-polo-helpdesk@ec.europa.eu, tel: +32 2 29 50924, fax: +32 2 29 79506

General instructions
Carefully read the following instructions and make yourself familiar with the forms.
Only fill in the cels marked in YELLOW, either by typing or using pull down menus. Other cells should not be accessible apart from the exemptions noted below (form "Calculation Results").

The forms ask the applicants to divide the transport routes into clearly structured legs (parts). Legs are especially defined by
- a change of route
- a change of transport (sub)mode,
- a change of type of country (participating or not participating) being crossed,
- nodes, where additional freight is loaded or freight is unloaded.
The experience from previous evaluations has shown that a clear structure is necessary but often not properly realised by the applicants. Calculations were often not understood by the reader.

When making your choice
In pulldown menus, select the appropriate parameter by clicking on it. Select the last blank entry when none of the alternatives in the pull down menu apply. This applies to the following information:

- "Tonnage unit"; "Fuel technology" (rail, IWW, SSS); "Ship/cargot type" (IWW, SSS); "freight capacity" (IWW) and "Countries", forms "Original(old)service" and "Proposed(new)service

In cells marked in YELLOW as specified below, only fill in one "x" (small letter) per parameter. Other letters or more than one specification might negatively affect the functioning of the tool. This applies to the following information:
- "Type of action" and "Tonnage unit" on form "Calculation Results"
In other cells marked in YELLOW, the requested text or numerical data can be entered directly

Specific instructions: Forms "Original (old) service" / "Proposed (new) service"

The forms each provide for 15 lines equaling to a maximum distiction of 15 specific legs of the transport services proposed (see "Transport leg"). If a further distinction is appropriate and more lines are needed, follow the next instructions. Otherwise proceed to "Form header" below.

Add additional legs: Click the button named "Add more legs" (found below the column where legs are indicated) in order to add 10 lines, up to a maximum of 65. Click the button named "Remove" to remove the last 10 rows (and clear their content).
Note: macros need to be enabled for this to function properly.

Form header: Fill in the project acronym.
Select the unit of the tonnage transported during the subvention phase. Choose between tonnes [t] or cubic metres [m^3]. The unit of the tonnage must be kept coherent throughout the description of the project. Where tonnage and transport volumes (tonnage multiplied by transport distance) are presented on the basis of the weight measure and the volumetric equivalent this must be clearly distinguished.

Transport leg: Description of the leg (part) of the transport route indicating places of "origin" and "destination" as well as a "via" if appropriate. Provide one line for each direction if a freight shift is realised in both directions and freight volumes can be specified!

Similar Transport services can be clustered to be represented in one line if appropriate, e.g. if disperse in area and time. Please ensure the following:
- Transport services make use of the same (sub)mode.
- The type of country crossed (participating or not participating) does not change.
- Transport distance and quantity (tonnage) can be represented in average figures.

The leg of the transport route can then be described as e.g. "Freight collection XY area".

Transport (sub)mode: Please indicate only one transport mode per transport leg. The appropriate (sub)modes can be selected by using the pull down menu. The available submodes per mode are given below.

- Road (no submodes)
- Rail (Diesel; Electric)
- Inland waterways:
  - Ship / Cargo type (IWW ship with integrated engine; IWW tanker; Push Barge combination)
  - Freight capacity (<250 tonne; 251-400 tonne; 401-650 tonne; 651-1000 tonne; 1001-1500 tonne; 1501-3000 tonne; >3000 tonne)
- Short sea shipping (General/Bulk; Container; RoRo / RoPax (<17 kn); RoRo / RoPax (17-20 kn); RoRo / RoPax (20-23 kn); RoRo / RoPax (>23 kn))

Fuel technology (only for IWW and SSS): Please use the drop-down menu to indicate the fuel type or technology to be used. The available technologies are given below.

- Inland waterways (Standard low sulphur fuel oil; Standard low sulphur in combination with a Diesel Particulate Filter; Standard low sulphur in combination with Selective Catalytic Reduction; Standard low sulphur in combination with both a Diesel Particulate Filter and Selective Catalytic Reduction; Liquefied Natural Gas)

- Short Sea Shipping (Conventional fuel oil; Liquefied Natural Gas; Seawater scrubbing; Freshwater scrubbing)

Share of low sulphur fuel (only for short sea shipping): Please indicate the share of low sulphur fuel in the fuel mix (only for conventional fuel). The share should be indicated as a decimal value from 0 to 1.

Countries: Please indicate only one type of country. EU-27 States are the EU Member States. "EFTA" countries include Iceland, Liechtenstein and Norway (excluding Switzerland). For any other third country (other than Croatia) concluding a special agreement with the Commission in due time, please check Marco Polo website for up-to-date information. If part of the new modally shifted route is a waterborne route between a fully participating country and a close third country, sea routes to non eligible third countries may be calculated until the foreign port. This procedure applies to all sea routes to close third countries and also for inland waterways where the river constitutes the border between a fully participating and a third country.

Distance: Length of the route leg in kilometers [km], one way!

Tonnage: The weight of the freight in tonnes [t] or net volume in cubic metres [m^3] transported in one direction (unit as in form header). The shift will include the goods transported, the intermodal transport unit plus the road vehicle, including empty intermodal transport units and empty road vehicles effectively loaded and unloaded at the beginning and the end of the multimodal journey, if these are shifted off the road too. Note: for empty loading units the option of the volumetric equivalent cannot apply.

Specific instructions: Form "Calculation Results", Part 1

Form header: Fill in the project acronym.

Action and conditions applied for

Type of action: Please indicate only one ("x"). A warning message will displayed if you indicate zero or more than one type of action.

Maximum subsidy rate: Will be automatically displayed in percent [%] when choosing the type of action.

Maximum subsidy duration: Will be automatically displayed in months [mon.] when choosing the type of action.

Minimum subsidy duration: Will be automatically displayed in months [mon.] when choosing the type of action.

Duration of EC subsity: Fill in the duration of the subsidy as requested from the European Community in months [mon.]. If the value indicated exceeds the maximum allowable duration, a warning message will be displayed.

Total eligible cost: Fill in your calculated amount in Euro [€].

Calculated figures

Road transport volumes: The road transport volumes $F_{old(R)}$=(1) and $F_{new(R)}$ =(2) in tonne-kilometres [tkm] or cubic metre-kilometres [m^3km] calculated in the forms "Original (old) service" and "Proposed (new) service" are automatically displayed in the respective cells if only one sheet is required per form.

If more than one sheet are used (copies of at least one form have been created), only the total of the original sheet will be displayed (excluding the volumes calculated on the newly created sheets), therefore you will need to delete the links in the cells and insert the correct totals manually. Alternatively you can modify the link in the formula if you're familiar with Excel®.

External costs: The external costs C_{old} =(3) and C_{new} =(4) in Euro [€] calculated in the forms "Original (old) service)" and "Proposed (new) service" are automatically displayed in the respective cells if only one sheet is required per form.

If more than one sheet is used (copies of at least one form have been created), follow the same procedure as for "Road transport volumes".

Modal shift volume: The figure is automatically displayed in tonne-kilometres [tkm]. The result in m^3km will also be displayed for information.

Environmental and social benefits: The figure is automatically displayed in Euro [€].

Specific instructions: Form "Calculation Results", Part 2

Calculation of subsidy and environmental efficiencies

Minimum modal shift threshold per year: Automatically displayed in according to the type of action chosen.

Maximum limits for subsidy: Automatically displayed in Euro [€] as far as applicable:

- Funding limited by the transport volumes shifted S_{limit} (Modal Shift and Motorways of the Sea actions only; 2 Euro per 500 tkm.
- Funding limited by the total eligible costs and the respective maximum subsidy rate S_{max}.

Subsidy requested: Indicate the total amount being requested for EC funding in Euro [€]. Only take into account eligible costs as basis for calculation. If the amount exceeds the above limits, a warning message will be displayed. Please check your figures.

Environmental efficiencies R_S and R_T: The figures are automatically displayed. They describe the efficiency of the public money being spend on the project as well as the average environmental efficiency of the modal shift envisaged.

Annex B: Introduction document to the interface for traffic avoidance actions

Marco Polo II Call 2012 - TRAFFIC AVOIDANCE

Call identifier: DGMOVE/D1/SUB/224-2012

Introduction to the Marco Polo Calculator - Traffic Avoidance Actions

(Version MPII - 2012)

This tool allows Marco Polo applicants to easily calculate the figures requested by the application process for Traffic Avoidance Actions (cf. call text). Some integrated features may warn the user in case wrong parameters are filled in the forms or wrong assumptions are made.
This tool is requested by the call text to be included in a Marco Polo proposal. It is mandatory to make use of this tool and to include a printed version of the forms in the annexes of each proposal.

Nevertheless, additional data and calculations which are necessary to understand the proposed action but are not covered by the calculators functions, should be included in the main text of your proposal.

ALL CALCULATIONS ARE EXPLAINED IN DETAIL IN GUIDANCE NOTE ACCOMPANYING THE MARCO POLO CALCULATOR
The Marco Polo Calculator consists of four parts being represented by four "sheets" of one Excel® file (click on name flags at bottom of Excel® screen for selection):
- This "Introduction" (four pages when printed)
- Form "Original (old) service" (one page when printed)
- Form "Proposed (new) service" (one page when printed)
- Form "Calculation Results" (one page when printed)

Be aware that this tool has been tested, but **no guarantee** can be given concerning the **proper functioning of the tool**. This is also due to the fact that the tool can still be manipulated by the user.

Marco Polo helpdesk: If any questions arise or faults are detected, please contact
e-mail: eaci-marco-polo-helpdesk@ec.europa.eu, tel: +32 2 29 50924, fax: +32 2 29 79506

General instructions
Carefully read the following instructions and make yourself familiar with the forms.
Only fill in the cells marked in YELLOW, either by typing or using pull down menus. Other cells should not be accessible apart from the exemptions noted below (form "Calculation Results").

The forms ask the applicants to divide the transport routes into clearly structured legs (parts). Legs are especially defined by
- a single route,
- a change of type of country (participating or not participating) being crossed,
- nodes, where additional freight is loaded or freight is unloaded.

ALL CALCULATIONS ARE EXPLAINED IN DETAIL IN APPENDIX 3 OF THE CALL TEXT.

When making your choice
In pulldown menus, select the appropriate parameter by clicking on it. Select the last blank entry when none of the alternatives in the pull down menu apply. This applies to the following information:
- "Tonnage unit", "Transport mode" and "Countries", forms "Original(old)service" and "Proposed(new)service
In cells marked in YELLOW as specified below, only fill in one "x" (small letter) per parameter. Other letters or more than one specification might negatively affect the functioning of the tool. This applies to the following information:

- "Type of action" form "Calculation Results"
In other cells marked in YELLOW, requested text or numerical data can be entered directly

Specific instructions: Forms "Original (old) service" / "Proposed (new) service"

The forms each provide for 15 lines equaling to a maximum distiction of 15 specific legs of the transport services proposed (see "Transport leg"). If a further distinction is appropriate and more lines are needed, follow the next instructions. Otherwise proceed to "Form header" below.

Add additional legs: Click the button named "Add more legs" (found below the column where legs are indicated) in order to add 10 lines, up to a maximum of 65. Click the button named "Remove" to remove the last 10 rows (and clear their content).
Note: macros need to be enabled for this to function properly

Form header: Fill in the project acronym.

Select the unit of the tonnage transported during the subvention phase. Chose between tonnes [t] or cubic metres [m³]. The unit of the tonnage must be kept coherent throughout the description of the project. Where tonnage and transport volumes (tonnage multiplied by transport distance) are presented on the basis of the weight measure and the volumetric equivalent this must be clearly distinguished.

Transport leg: Description of the leg (part) of the transport route indicating places of "origin" and "destination" as well as a "via" if appropriate. Provide one line for each direction if a freight shift is realised in both directions and freight volumes can be specified! Every empty vehicle run (see below) has to be included in a separate line!

Road: Two different inputs are possible, 'loaded vehicles' or 'empty vehicles/runs'. **'Loaded'** is every vehicle which carries freight and is not completely empty. **'Empty'** is every vehicle that carries no freight at all and is completely empty (usually at return runs).

For 'loaded vehicles', you should input distance (1), Tonnage/Volume transported - total sum over the whole duration of subsidy (2), and Average weight/volume per vehicle (3).

Average weight or volume per loaded vehicle: This means the average load in weight or volume of the truck which you use on this route. It will depend on the available loading capacity of your truck and how empty or full it is loaded.

For 'empty runs', you should input distance (1) and the total number of empty vehicles over the whole duration of subsidy (6).

Please use separate lines for 'loaded' and 'empty' and never merge both in one line!

Similar transport services can be clustered to be represented in one line if appropriate, e.g. if disperse in area and time. Please ensure the following:
- Transport services on the same route.
- The type of country crossed (participating or not participating) does not change.
- Transport distance and quantity (tonnage) can be represented in average figures.

The leg of the transport route can then be described as e.g. "Freight collection XY area".

Transport mode: Road transport exclusively. Other transport modes are not applicable in Traffic avoidance.

Countries: Please indicate only one type of country. EU-27 States are the EU Member States. "EFTA" countries include Iceland, Liechtenstein and Norway (excluding Switzerland). For any other third country (other than Croatia) concluding a special agreement with the Commission in due time, please check Marco Polo website for up-to-date information.

Distance: Length of the route leg in kilometers [km], one way!

Tonnage: Net weight of the freight in tonnes [t] or net volume in cubic metres [m³] transported in one direction (unit as in form header). Weight or volume of intermodal loading units and vehicles shall not be included. Empty loading units are not regarded as freight.

IMPORTANT: According to the Marco Polo regulation, 1 standard vehicle is equivalent to 20 tonnes which is equivalent to 80 cubic meters. The calculator therefore uses a fixed relationship Vehicle-tonnes-cubic meters. In the case that you foresee a change in the logistics chain which can't be covered by the Marco Polo calculator, please present it in an adequate form in your main document. In this case, an overview sheet (similar to the 'Calculation Results' sheet of the calculator, filled in by you) should be attached.

Specific instructions: Form "Calculation Results", Part 1

Form header: Fill in the project acronym.

Action and conditions applied for

Type of action: This MP Calculator is only for Traffic Avoidance actions, therefore this has been selected by default.

Maximum subsidy rate: Will be automatically displayed in percent [%].

Maximum subsidy duration: Will be automatically displayed in months [mon.]

Minimum subsidy duration: Will be automatically displayed in months [mon.]

Duration of EC subsity: Fill in the duration of the EC grant period in months [mon.]. If the value indicated exceeds the maximum allowable duration, a warning message will be displayed.

Total eligible cost: Fill in your calculated amount in Euro [€].

Calculated figures

Road traffic volumes: The road traffic volumes $T_{old(R)}$ =(1) and $T_{new(R)}$ =(2) in vehicle-kilometer (vkm) calculated in the forms "Original (old) service" and "Proposed (new) service" are automatically displayed in the respective cells if only one sheet is required per form.

If more than one sheet are used (copies of at least one form have been created), only the total of the original sheet will be displayed (excluding the volumes calculated on the newly created sheets), therefore you will need to delete the links in the cells and insert the correct totals manually. Alternatively you can modify the link in the formula if you're familiar with Excel®.

External costs: The external costs C_{old} =(3) and C_{new} =(4) in Euro [€] calculated in the forms "Original (old) service" and "Proposed (new) service" are automatically displayed in the respective cells if only one sheet is required per form.

The meaning of external cost is described in the call text.

If more than one sheet is used (copies of at least one form have been created), follow the same procedure as explained for "Road traffic volumes".

Avoided Traffic volume: The figure is automatically displayed in vehicle-kilometres [vkm]. The equivalent in tkm is also displayed for information.

Environmental and social benefits: The figure is automatically displayed in Euro [€].

Specific instructions: Form "Calculation Results", Part 2

Calculation of subsidy and environmental efficiencies

Minimum subsidy threshold: Automatically displayed in Euro [€]

Maximum limits for subsidy: Automatically displayed in Euro [€] as far as applicable:
- Funding limited by the transport volume avoided S_{limit} (2 Euro per 500 tkm or 25 vkm).
- Funding limited by the total eligible costs and the 35% maximum subsidy rate S_{max}.

Subsidy requested: Indicate the total amount being requested for EC funding in Euro [€]. Only take into account eligible costs as basis for calculation. If the amount falls below or exceeds the above limits, a warning message will be displayed. Please check your figures.

Environmental efficiencies R_S and R_T: The figures are automatically displayed. They describe the efficiency of the public money being spent on the project as well as the average environmental efficiency of the modal shift envisaged.

Annex C: Overview of projects/studies from which unit cost input values are taken

Project title, publication year of relevant deliverable	Base year of results	Coun-tries covered	External cost category	Costs included	Transport modes addresses	Method used	Outputs	Differentiation of results
HEATCO (2006)	2002	EU-25	Air pollution	- health costs - crop losses - material damages	road, rail, IWW	Impact Pathway Approach (IPA), ExternE approach	Unit costs of $PM_{2.5}$, PM_{10}	- urban/rural
CAFE CBA (2005)	2000/ 2010/ 2002	EU-27	Air pollution	- health costs - crop losses	road, rail, IWW	Impact Pathway Approach (IPA), ExternE approach	Unit costs of NH_3, SO_2, NO_x, and VOC's	-
INFRAS/IWW (2003)	2010	EU	Noise	-annoyance/ disutility - medical costs - fatalities	rail	Bottom-up approach	Marginal costs per decibel	- rural/suburban - day/night - thin/dense traffic
INFRAS/IWW (2004)	2000	EU-15, N, CH	Noise	-annoyance/ disutility - medical costs - fatalities	road	Top-down approach	Unit costs per decibel	- rural/suburban/ urban - day/night - thin/dense traffic
INFRAS/IWW (2004)	2000	EU-15, N, CH	Accidents	-material damages -administrative costs -medical costs -production losses/ human capital loss - risk value (pain, grief, suffering)	rail	Risk value considered as external cost	Marginal costs of accidents	-
UNITE (2002)	1998 (1996, 2005)	EU-15, H, EE, CH	Accident	-material damages -administrative costs -medical costs -production losses/ human capital loss - risk value (pain, grief, suffering)	road	- Cost to transport system treated as external costs - Risk value considered to be internalised	- Average costs of accidents - Marginal costs for specific countries (case studies)	- urban/interurban/ motorway
TREMOVE (2007)		EU-27	Air pollution	-	road, rail, IWW	-	Emissions per vkm	- fuel tech type -vehicle type -road network
EX-TREMIS (2008)		EU-27	Air pollution	-	SSS	-	Emission per tkm	- RoRo+RoPax/ container/general cargo

European Commission
EUR 25455 – Joint Research Centre – Institute for Prospective Technological Studies

Title: External cost calculator for Marco Polo freight transport project proposals. Call 2012 version.

Author(s): Martijn Brons, Panayotis

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Abstract

The Marco Polo programme of the European Commission aims to shift or avoid freight transport off the roads to other more environmentally friendly transport modes. The programme is implemented through yearly calls for proposals. The proposals received to each call are selected for financial support inter alia on the basis of their merits in terms of environmental and social benefits. The evaluation of each proposal's merits in terms of environmental and social benefits is based on the external costs for each transport mode.

On the Commission's request the Joint Research Centre, Institute for Prospective Technological Studies (JRC-IPTS) modified and updated the methodology underlying the calculation of external costs and the software application that automates the estimation of the impact on external costs for specific projects. The work was based on a combination of data and model results that allow the estimation of transport volumes, fleet mixes, levels of utilisation and resulting externalities with up-to-date methodologies for the economic valuation of these externalities.

The new external cost methodology and calculator covers road, rail, inland waterways and short sea shipping. External cost coefficients are provided for environmental impacts (air quality, noise, climate change) and socio-economic impacts (accidents, congestion). The methodology permits the estimation of external cost coefficients for specific mode subcategories based on fuel technology, cruising speed, vehicle size, and cargo type.

LF-NA-25455-EN-N

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new standards, methods and tools, and sharing and transferring its know-how to the Member States and international community.

Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security including nuclear; all supported through a cross-cutting and multi-disciplinary approach.

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