MED ATLANTIC

ECOBONUS

Co-financed by the Connecting Europe Facility of the European Union

EXTERNAL COST CALCULATOR TOOL

Version 10.2 / user manual

October 2018

About Med Atlantic Ecobonus externalities calculator

- The calculator compares direct road door to door externalities with the MoS alternative considering the specific vessel technology, operating profile, port call and port access impact.
- It calculates the external cost of carbon emissions, polluting emissions (SOx, NOx and PM) as well as congestion, accidents and noise of both 'road only' and MoS alternatives
- The calculator is based on best practices and updated so that is possible a fair comparison between road and maritime transport. Two EU supported studies set the reference to monetize externalities:
  - "Handbook on estimating external cost in the transport sector" IMPACT 2008, and
  - "Update on the Handbook on External Costs of Transport", RICARDO-AEA 2014.
- The design of the calculator responds to the MAE case study (for the targeted market taken as example). Unlike the previous Marco Polo calculator, this tool estimates the socio-environmental impact of each line case by case, considering the specific technologies and operational performance of the vessels servicing the line.
- The calculator is prepared to measure the main possible actions to be taken by the shipowners to reduce external costs (technology and not technology based).
- The road behavior is calculated as an average, based on the market mix of the truck fleet operating the routes. This translates almost into EURO VI specs when considering an implementation beyond 2020.
- The tool also includes an estimation of the port access emissions by trucks as well as the vessel emissions at port. These feature of the calculator is important as ports are normally located in urban areas. Vessels that have adopted port emission reduction technologies (batteries, cold ironing, etc.) would reduce their environmental footprint and this will be calculated.
- In case of ferries or ropax vessels combining freight with passengers (private vehicles), vessel emissions must be allocated to freight and cars whereas only freight emissions will be considered for the calculation of the environmental merit (following the eligibility criteria for the MAE case study). For roro vessels, total emissions are divided by the average number of trucks carried. For ropax vessels, total vessel emissions are divided by the number of trucks equivalent (estimated as the average trucks carried plus the average passenger (cars) converted into virtual trucks or trucks equivalent using 10 pax as 1 truck. For new vehicles, also not eligible in the MAE example, a similar calculation is performed using 6 veh as 1 truck)

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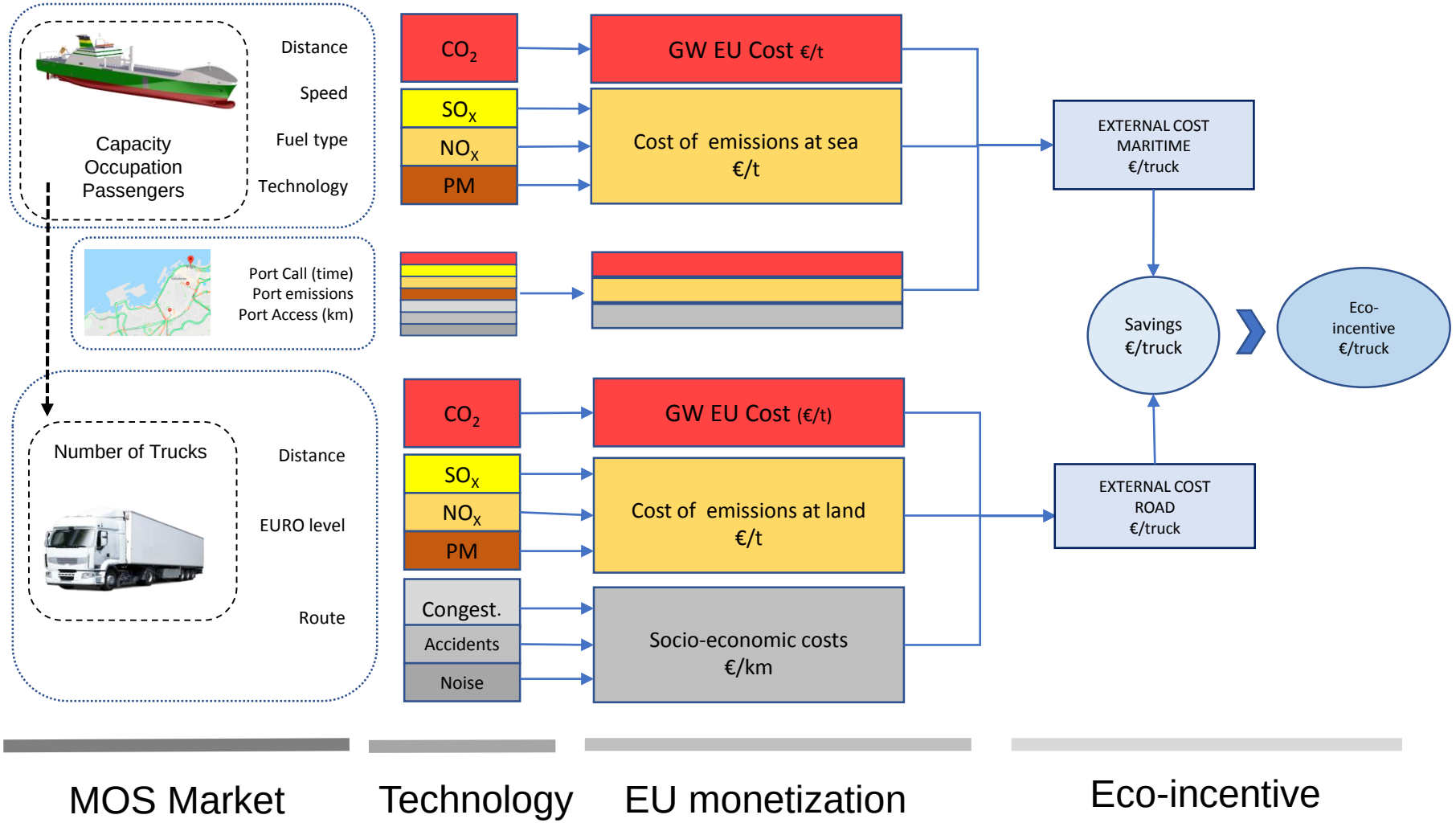
Methodological approach



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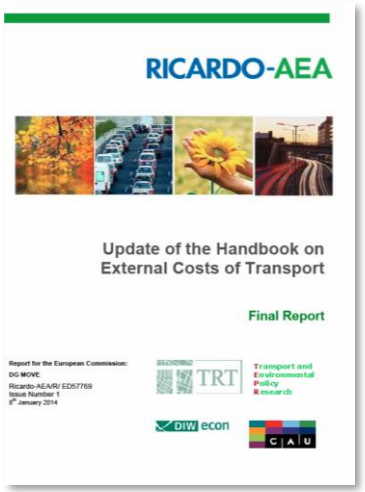
Monetization references

Two main references are used to estimate both the environmental impact and socio-economic cost of freight transport:

- **2008 Handbook on estimation of external costs in the transport sector**. Produced within the study of Internalization Measures and Policies for All external Cost of Transport (IMPACT). CE DELFT, commissioned by: European Commission (DG TREN)
- **2014 Update of the Handbook on External Costs of Transport**. Ricardo-AEA, commissioned by : European Commission (DG Mobility and Transport)

Regarding **CO_2eq** monetization, there is a high discrepancy amongst the two reports, the 2014 update report raised the cost per ton from 25€ to 90€ at 2010 values. Market value from EU Emission allowances is around 20€/t while IPCC remedial cost is above 100USD.

MAE figure is taken from the 2008 handbook, 34€ in 2016 value, which is aligned with EIB Appraisal Guidelines from 2015.



€ pollutant t	CO_2eq	SOx	NOx	PM
Road	34	11.300	11.700	29.400
Mediterranean	34	6.700	1.850	18.500
Baltic	34	5.250	4.700	13.800
Atlantic	34	2.900	2.250	5.550

€ per 1000 km	Noise	Accidents	Congestion
Road average	2,06	6,03	45,28

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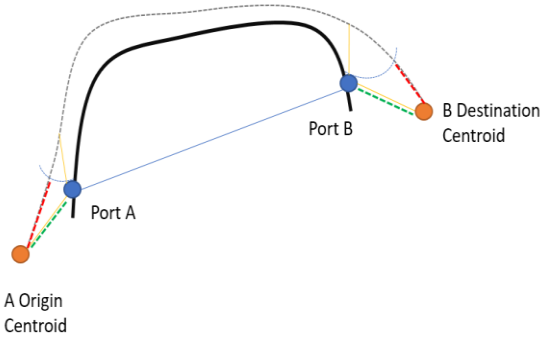
MAE Calculator designing assumptions (1 of 3)



Centroids vs port to port

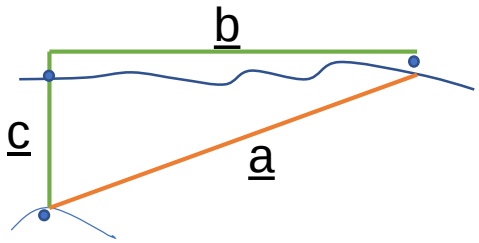
1. **Dynamic**, each voyage has its own origin/destination pair
2. **Fixed**. The shipowner, when submitting his line, declares the centroids for the calculation.
3. **Simplified**. Net road distance between the 'road-only' and the MoS alternatives is assumed to be similar to the road distances between ports of origin and destination, including port access.

Option 3 is taken

Port access

Following the previous assumption, two urban legs will be considered, one accessing origin port and one leaving destination port from/to the circumvallating highway. This assumption only applies for the calculation of the MoS emissions.

Default values set to 9 km + 9 km



Channel crossings

- Direct channel crossing brings no environmental merit for the MAE example
- Longer maritime relations will be compared with the channel crossing considered as part of the 'road only' alternative.

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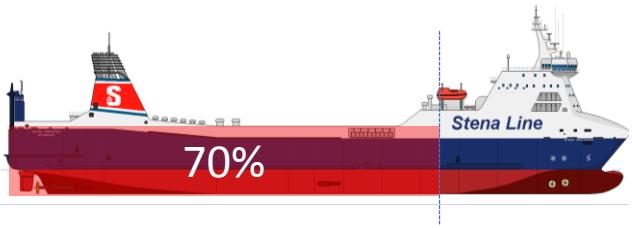
MAE Calculator designing assumptions (2 of 3)



Vessel occupation level

1. **Dynamic**, each voyage has its own occupation
2. **Declared**. The shipowner, when submitting or updating his line to the eco-incentive scheme, declares the actual occupation levels.
3. **Fixed**. Establishing a fixed (70%) occupation level for all routes and for simulation purposes.

Option 3 is taken (for simulation). Lower occupancies are considered to be not sustainable in the long term whereas higher averages would be rare.

New vehicles

Declared. The shipowner, when submitting or updating his line establishes its average deck occupancy for new vehicles.
Deck footprint: 6 vehicles = 1 truck

New vehicles takes their share of total ship emissions but this traffic is not eligible under MAE example

ROPAX Vessels

1. CEN Standard 16258
2. Simple ratio: PAX -> VEH -> TRUCKS EQUIVALENT

Option 2 is taken (simpler), calibrated with the CEN Standard

Deck footprint: 10 pax = 1 truck

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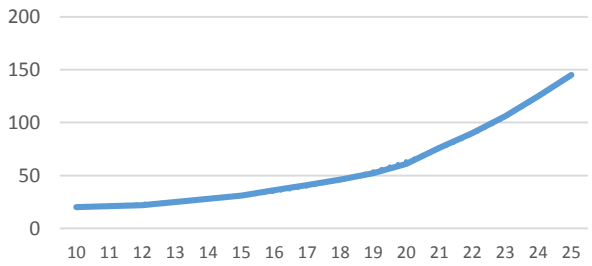
MAE Calculator designing assumptions (3 of 3)

Emission at port

Port emissions will be calculated and incurred to the total emissions of the MoS alternative. Main parameters will be call duration, the fuel consumption and the fuel type. When cold ironing is used, port emissions will not be considered.

Default call duration 6 hours. Default fuel consumption 8 t/day



Vessel fuel consumption

1. **Declared.** The shipowner, when submitting or updating his line establishes its actual fuel consumption levels.
2. **Fix curved:** Use a common emissions curve (tons per day vs speed) for all vessels.

Option 1 is taken (for simulation purposes)**.** This feature rewards the greats resource efficient vessels. Real performances would be verified through mandatory declarations such as the MRVs.

Vessel emissions

1. **Declared.** The shipowner, when submitting or updating his line establishes its actual emissions, both sailing and at port.
2. **Fix values:** Use fixed emission values

Option 1 is taken (intended for implementing actions)**.** For simulation purposes the vessel emissions will be estimated using previous assumptions (thus option 2)

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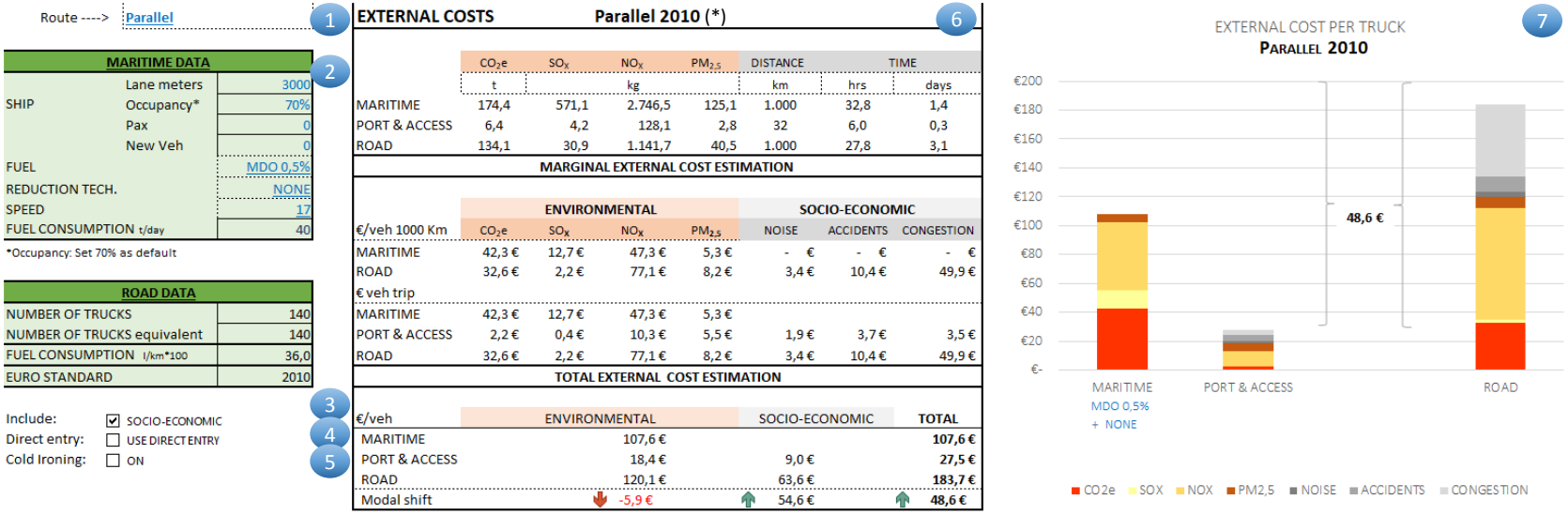
MAIN: input variables and detail results



Route ----> Parallel (1)

MARITIME DATA (2)		
SHIP	Lane meters	3000
	Occupancy*	70%
	Pax	0
	New Veh	0
FUEL		MDO 0,5%
REDUCTION TECH.		NONE
SPEED		17
FUEL CONSUMPTION t/day		40

*Occupancy: Set 70% as default

ROAD DATA	
NUMBER OF TRUCKS	140
NUMBER OF TRUCKS equivalent	140
FUEL CONSUMPTION l/km*100	36,0
EURO STANDARD	2010

Include: ☑ SOCIO-ECONOMIC (3)
Direct entry: ☐ USE DIRECT ENTRY (4)
Cold Ironing: ☐ ON (5)

EXTERNAL COSTS — **Parallel 2010 (*)** (6)

	CO_2e	SO_x	NO_x	$PM_{2,5}$	DISTANCE	TIME	
	t		kg		km	hrs	days
MARITIME	174,4	571,1	2.746,5	125,1	1.000	32,8	1,4
PORT & ACCESS	6,4	4,2	128,1	2,8	32	6,0	0,3
ROAD	134,1	30,9	1.141,7	40,5	1.000	27,8	3,1

MARGINAL EXTERNAL COST ESTIMATION

	ENVIRONMENTAL				SOCIO-ECONOMIC		
€/veh 1000 Km	CO_2e	SO_x	NO_x	$PM_{2,5}$	NOISE	ACCIDENTS	CONGESTION
MARITIME	42,3 €	12,7 €	47,3 €	5,3 €	- €	- €	- €
ROAD	32,6 €	2,2 €	77,1 €	8,2 €	3,4 €	10,4 €	49,9 €
€ veh trip							
MARITIME	42,3 €	12,7 €	47,3 €	5,3 €			
PORT & ACCESS	2,2 €	0,4 €	10,3 €	5,5 €	1,9 €	3,7 €	3,5 €
ROAD	32,6 €	2,2 €	77,1 €	8,2 €	3,4 €	10,4 €	49,9 €

TOTAL EXTERNAL COST ESTIMATION

€/veh	ENVIRONMENTAL	SOCIO-ECONOMIC	TOTAL
MARITIME	107,6 €		107,6 €
PORT & ACCESS	18,4 €	9,0 €	27,5 €
ROAD	120,1 €	63,6 €	183,7 €
Modal shift	-5,9 €	54,6 €	48,6 €

(*) Parallel. A route where road only and MoS alternative cover the same distance

1. Choose a route to be analyzed from the route box, a popup menu should appear. If your route is not shown, you can manually enter in the MOS page.
2. Choose the vessel/route details: capacity, occupancy (70% suggested), number of passengers and number of new vehicles (average figures for a sailing). Choose the fuel type, the abatement technology and the vessel speed.
3. Choose whether to include socio-economic factors (congestion, accidents and noise).
4. Choose whether actual emission data for the vessel/route are known (thus entering through the DIRECT ENTRY page) or let the calculator estimate them for you
5. Choose COLD IRONING to remove ship emission at port from the calculation.
6. Values are compared between the MoS and the 'road-only' alternative (maritime and port&access are both incurred to MoS)
7. Results

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MED ATLANTIC ECOBONUS

PORT & ACCESS

EMISSIONS AT PORT

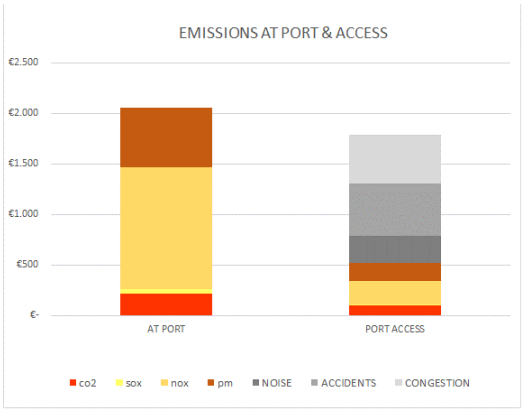
1	6	h average call	sfc	217 g/kwh
	8	t/day		0,217 kg/kWh
2	2000	kg of fuel		

	co2	sox	nox	pm		
MSD/MDO	690		13,9	0,3	g/kwh	Emission factors
MSD/MDO	3.179,72	2,10	64,06	1,38	g/kg	
LNG	2.750,00	0,02	8,40	0,02	g/kg	
	34,00	10.142,20	9.456,92	212.586,06	€/ton	Cost factors at port
Per call	6.359,45	4,20	128,11	2,76	kg	Emissions
	216,22	42,60	1.211,53	587,80	€	External cost
Total	2.058,15 €					
	14,7					

PORT ACCESS

3	18	kilometres (in & out) urban	
	0,36 kg/km	HGV URBAN	

Year	co2	sox	nox	pm		NOISE	ACCIDENTS	CONGESTION	
2010	3.185,63	0,735	27,13	0,96	g/kg				
2015	3.185,63	0,021	11,88	0,18					
2020	3.185,63	0,021	4,73	0,06					
Chosen year	3.185,63	0,735	27,128	0,962					
Emission costs	34,00	10.142,20	9.456,92	212.586,06	€/t	0,10 €	0,21 €	0,19 €	€/vkm
Access 1 veh	20,64	0,00	0,18	0,01	kg				
Per veh	0,70	0,05	1,66	1,32	€/veh	1,88	3,70	3,45	€/veh
Per call	98,26	6,76	232,74	185,48	€	263,13	517,77	483,46	€
Total	1.787,61								



	co2	sox	nox	pm	NOISE	ACCIDENTS	CONGESTION
AT PORT	216,22	42,60	1.211,53	587,80			
PORT ACC	98,26	6,76	232,74	185,48	263,13	517,77	483,46

1. Enter the average port call duration in hours
2. Enter the average fuel consumption at port in tons per day
3. Enter the sum of the port access distance from circumvallating road to the port in both origin and destination

Breakdown of values will be shown on the table and chartered on the figured.

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Using the tool

For further information about MED Atlantic Ecobonus and the External Cost Calculator tool please contact: mae.project@puertos.es

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