MED ATLANTIC ECOBONUS PROJECT

---

preliminary report for consensus

2	Final	ES	23/10/2018	TC committee	
1	First draft	ES	14/10/2018		
VER.	DESCRIPTION	PREPARED BY		CHECKED BY	
MED ATLANTIC ECOBONUS		 Co-financed by the Connecting Europe Facility of the European Union The sole responsibility of this publication lies with the author. The European Union is not responsible for any use that may be made of the information contained therein.			

TABLE OF CONTENTS

A. SCOPE 3
B. BACKGROUND 3
C. MAE STUDY 6
D. COMMON EU APPROACH 7
E. THE CASE FOR MAE STUDY 8
F. THE EX-ANTE ANALYSIS 10
Eligibility criteria 11
External cost calculator 15
Transport modelling tool 18
Shipowners' perspective tool 26
Simulation scenarios 30
Simulation and results 31
West Mediterranean 36
Atlantic 41
Aggregate results 46
G. SCHEME'S POSSIBLE IMPLEMENTATION APPROACH 47
H. CONCLUSIONS AND NEXT STEPS 52

A. SCOPE

The present document describes a possible common approach to the use of eco-incentives measures for the further development of sustainable freight mobility in the territory of the European Union (EU) taking the case of motorways of the sea in the West-Mediterranean and Atlantic regions as example. This proposal is a partial result of the Med Atlantic Ecobonus Action, an institutional and feasibility study led by Spain, France, Portugal and Italy, with the financial support of the European Commission (EC) in the context of the Trans-European Transport Network.

If accepted, the proposed approach to eco-incentives aims at being a type of actions eligible to the EU funding priorities on the development of the sustainable freight transport services component of the TEN-t, opened to all modes of transport and EU regions.

However, moving to real implementing actions based on this approach requires broad consensus at all levels. In this regard, the present document is aimed to the debate with the transport industry and the relevant institutions regarding the principles and assumptions taken for the common approach and for the case study used as example.

B. BACKGROUND

Regulation (EU) 1315/2013 of the European Parliament and of the Council of 11 December 2013 on Union guidelines for the development of the trans-European transport network introduced a new approach which seeks to ensure better modal integration of the common transport system, departing from a list of isolated projects to a true network approach (comprehensive and core networks).

Furthermore, the objectives of sustainability and greening technologies in the transport sector are firmly addressed in the Regulation as a means of reducing the negative impacts of transport activity on the environment.

In this context, the 2013 TEN-t guidelines included the need for sustainable freight transport services as part of the network contributing to more efficient and greener transport. By doing so, the Guidelines not only take future infrastructure needs into account -as in the past- but also the mobility needs to reduce polluting and carbon emissions.

This approach to freight transport services as set in the current TEN-t framework is fed partly from the experienced achieved in previous funding programs at EU level -namely the Marco Polo programs-. Furthermore, it takes into account the transport market evolution over the last decade -already delivering multimodal solutions for freight on a market basis-, strengthening the goals of decarbonization, lower emissions and improved efficiency of freight mobility

On the other hand, improving multimodal transport has been in the scope of the EU transport policy for many years. In this regard, shifting the balance between modes of transport while reducing road congestion has been a major policy objective towards sustainability in the different transport White Papers issued by the EC since 1992, even with specific targets -e.g. 30% of road freight over 300 km should shift to other modes such as rail or waterborne transport by 2030, as set in the 2011 White Paper (COM(2011) 144 final)-.

The rationale of the Marco Polo programs supporting modal shift actions came from this context and assumed market failings that discouraged transport operators from setting up alternatives to road transport. The main justification for the Program was then to compensate transport operators for the initial losses on new or upgraded transport services that shifted traffic from the road.

Even the concept of 'start up' support was endorsed by the Commission's interpretation to the compatibility rules of the Union on state aids -articles 106-109 and 93-96 of the Treaty of the Functioning of the European Union (TFEU)-, although with differences between inland and maritime transport.

In this regard, several Member States followed a similar approach supporting with national budgets the development of multimodal logistics chains by incentivizing a greater use of rail or waterborne transport.

After all, the policy goals for a Union's more sustainable, competitive and multimodal -balanced- transport system remain valid since the 1992 transport White Paper (COM(92) 494 final of 2 December 1992). Although, the transport market behavior is evolved, and new challenges are in the transport agenda that worth new approaches to the means of achieving and supporting the policy goals.

Transport operators are today more integrated and self-convinced on the advantages of transport integration and collaboration between the different modes of transport, partially thanks to the given support. Now, the ever-increasing pressure on costs, flexibility and reliability of transport to secure competitiveness is pushing the transport market itself towards integration, with no need for compensating losses. A good example is in the truck flows between Spain and Italy, 40% of which is currently using regular maritime services to complete the door-to-door transport.

On the other hand, road transport has dramatically reduced the level of emissions during the same period.

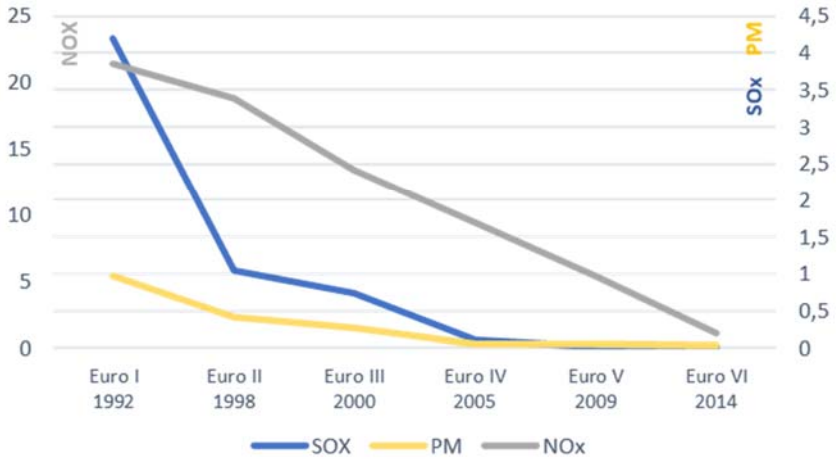

Figure 1.- Heavy goods vehicles (HGV) emissions (g/kg). Evolution (1992-2014)

And although the rail and the waterborne transport still outperform the road with regards to other socio-environmental factors (i.e. congestion, noise and accidents), the gap in the overall externalities account between the road and these other modes of transport has been narrowed. Therefore, reducing 'road only' operations might not be in all cases the most efficient way to improve sustainability, as it certainly was in the past. This new context brings also the need to update and improve the tools measuring external costs in the different modes of transport.

The Commission already took this approach in his Communication on the results of the Marco Polo program (COM (2013) 278 final) recommending that the EU support to the further development of sustainable freight transport services should "depart from the pure start up aid for modal shift". Shortly after, in his reply to the European Court of Auditors Special Report Nº3/2013 'Have the Marco Polo programs been effective in shifting traffic off the road' (COM (2013) 321 final), the Commission insisted that further support to sustainable freight transport services would "not necessarily remain on modal shift and its targets will not necessarily be set in respect to the volumes shifted off the road".

By the end of 2013, the European Parliament and the Council adopted the Regulation (EU) 1315/2013 on the TEN-t guidelines and the Regulation (EU) 1316/2013 on the Connecting Europe Facility, including the sustainable freight transport services as part of the network and of the funding priorities with the new approach to efficient and greener transport.

C. MAE STUDY

Having regard to this background, Spain, Italy, Portugal and France launched the Med Atlantic Ecobonus study within the CEF program to undertake a comprehensive analysis on the potential use of eco-incentives measures as part of the EU support to stimulate sustainable freight transport services at EU level.

As a result, the MAE Action has formulated a possible approach, proposing common principles for the EU support to eco-incentives schemes at EU level (including all modes and EU regions) and developing, as example, a complete ex-ante analysis on the particular case of the Motorways of the Sea market servicing alternative routes for the road transport in the Atlantic and West Mediterranean regions.

The study takes over the reflections and recommendations of the Commission and the European Court of Auditors produced by 2013 on the occasion of the ending of the Marco Polo programs, as a main reference, as well as the experienced achieved in certain national programs such the Italian Ecobonus, implemented during the 2007-2010 period and recognized by both the Commission and the Court as a best-practice.

The case for the ex-ante analysis focuses in a particular segment of the Motorways of the Sea market favorable to modal integration and targets one major environmental challenge in the short term for the maritime transport as it is the low sulphur limits for the marine fuels that will apply by 2020. In this regard, MAE Action follows the recitals 30 to 32 of the Directive (EU) 2016/802 of the European Parliament and the Council relating to a reduction in the sulphur content of certain fuels, where the Commission and the Member States are recommended to provide targeted assistance, including operators, so as to minimize the risk of modal (back) shift from sea to land-based transport as a direct consequence of the increase in the maritime costs to complying with the lower sulphur limits for marine fuels by 2020, which could run counter to the Union's climate change objectives and increase road congestion.

MAE study is not an implementing Action. As previously mentioned, moving to implementing actions requires consensus. In this regard, MAE Action ends at proposing the principles for the common UE approach to eco-incentive measures and at performing a complete ex-ante analysis, following the recommendations of the European institutions. If broad consensus is achieved, then the aim would be taking this approach to eco-incentives measures as part of the EU funding priorities for the supporting of sustainable freight transport services in the next Multiannual Financial Framework 2021-2027 (i.e. CEF2).

D. COMMON EU APPROACH

As mentioned, the 2013 TEN-t Regulation together with the Commission's communications and the ECA's special report issued on the occasion of the finalization of the Marco Polo programs, bring the basis of EU approach on the Union's support to freight transport services. These references have been deeply analyzed within the MAE study. Based on this analysis, **the following list is proposed as a summary of the main common principles -applicable to any mode of transport and EU region- that should be part of any eco-incentive scheme to freight transport services seeking EU support**:

- No market distortion
- Targeting mature markets (i.e. not targeted to start-up services)
- No longer pure modal shift goals, as in the Marco Polo programs (road is no longer EURO III). However, the eco-incentive shall facilitate multimodal transport.
- Incentive calculation shall be based exclusively on demonstrated socio-environmental merits reducing negative externalities in transport (i.e. measuring external costs savings is needed)
- Technologically agnostic on how the socio-environmental merit is achieved
- Making funding conditional upon results
- Member States co-responsibility in the co-financing and implementation of the eco-incentive scheme (the intensities and duration of the eco-incentive might therefore need compatibility assessment with state aid rules)
- Minimizing deadweight
- Minimizing the risk of fraud
- Minimizing the need for additional bureaucracy
- Demonstrating performance achieved (i.e. monitoring)

In addition to these common principles, granting financial support to an eco-incentive scheme shall be conditional to an **ex-ante analysis** showing whether and to what extent there is an EU added value.

Last but not least, the eco-incentive scheme shall adequately address the consistency with the operational structures of the CEF or any other financing program to which the scheme is submitted.

The Member States' co-responsibility principle in the common approach means that Member States are the ones to take the initiative and to mobilize the budget needs on the basis that the EU could co-finance the eco-incentive scheme.

Depending on the formula used by Member States to mobilize the budget, state aid rules might apply as a requirement in the new approach. In this regard, the MAE study has delivered a thorough legal analysis on the subject, with a particular focus on the maritime transport, leading to some practical conclusions:

- State aid to freight transport services must be justified on grounds of socio-environmental impacts, implemented in a non-discriminatory way and budgeted accordingly to the socio-environmental merit. Therefore, measuring externalities and having a pre-established environmental impact is a requirement for state aid support.
- State aid compatibility is typically limited to new or upgraded services.
- Both 2004 and 2008 maritime guidelines should be updated as the former is still approaching start up aids to pure modal shift goals whereas the latest keeps reference to obsolete EU funding programs (Marco Polo and former TEN-t).
- However, it is unlikely that 2004 Maritime Guidelines are amended to consider the new approach to greener shipping due to the variety of legal issues covered by this Guidelines.
- On the other hand, 2008 Motorways of the Sea Guidelines were conceived with the only purpose of adapting the intensities and duration of the state aid to maritime services to the EU funding programs in force at that time. Therefore, the scope is much narrow, and it would be easier (as well as necessary) to propose its revision adapting the Commission's interpretation to the new limits as of the CEF Regulation.
- Regarding the state aid rules to the inland transport, and the further interpretation of the Commission, particularly for the rail, there is no additional comments as long as the flexibility is higher for inland modes than for the maritime.

E. THE CASE FOR MAE STUDY

The vision of the proposed common EU approach to eco-incentives schemes is aimed at enabling Member States to target a transport market of their interest and to decide on the goals they want to address with the eco-incentive measure. Both the targeted market and the goals shall be compliant with the backing principles of the common approach, as described, and with the rules of the EU funding program to which the scheme is submitted.

Moreover, since the eco-incentive scheme must be justified on grounds of a socio-environmental merit (i.e. reduction in external costs), the goal should target a greener transport.

Therefore, the Member States should decide in first place the targeted transport market and the goal for their eco-incentive scheme proposal.

In this regard, the Member States involved in the MAE study (Portugal, Spain, France and Italy) agreed to address, as example, the motorways of the sea ferry and ro-ro market servicing alternative routes to the road transport in the West Med and Atlantic regions. This particular market is considered strategic to the four national administrations. Moreover, the motorways of the sea complementing the road transport in the door to door logistics chain is consistent with the aiming of the sustainable freight transport services component of the 2013 TEN-t guidelines, as described in article 32 of the Regulation (EU) 1315/2013.

As for the goals, the eco-incentive scheme is intended to trigger a greener performance of the maritime leg while securing modal balance -thus contributing to an improved efficiency of the transport system and to an overall external cost savings-. By doing so, the scheme would also follow the recommendations of the European Parliament and the Council to the Member States in the Directive (EU) 2016/802 regarding the sulphur content of certain fuels, where the need to provide targeted assistance to the operators is considered so as to minimize the risk of modal (back) shift from sea to road transport.

This targeted market is currently running around 200.000 units (heavy good vehicles -HGV-) per year in average that are very sensitive to the maritime price as long as they have, by definition, an alternative route in the 'road only' transport. On the other hand, these maritime services typically sail at higher speeds to secure frequencies that are attractive to the road haulers. Moreover, this market has been using smaller vessels to secure viable utilization rates. Last but not least, the shipowners' fleet designs have been considering classic marine fuels for the vessels to minimize costs so as to offer competitive prices to the road haulers (a scenario changing by 2020). As a result, the external costs per transported unit in this market are not optimized and the net savings referred to the 'road only' alternative has been reduced with time as a direct consequence of the transition in HGV from EURO III to EURO VI standard.

The case for the eco-incentive scheme in the targeted market is therefore **stimulating green actions in the maritime leg by incentivizing the users of the maritime services with the external costs savings they would produce when using the maritime option instead of the 'road-only' alternative, as a direct result of the green action**. To be proportionate to the intended objective the eco-incentives given shall never be higher than the induced external cost savings.

In other words, the eco-incentive would only apply if maritime operators make their own motorways of the sea greener. Moreover, it is demonstrated through the ex-ante analysis that going for a strict compliance of the environmental regulation by 2020 will not be a merit deserving a relevant incentive. Therefore,

the eco-incentive scheme that is proposed would be effective to greener solutions going beyond the regulation (referring in particular to the Sulphur Directive).

F. THE EX-ANTE ANALYSIS

As part of the proposed approach to eco-incentives measures any future action seeking the EU support shall be based on a dedicated ex-ante assessment. This is a clear requirement included in the Commission's replies to the Special Report of the European Court of Auditors on the occasion of the finalization of the Marco Polo programs (COM (2013) 321 final).

MAE study has taken over this requirement and has developed, as example, a complete ex-ante analysis for the proposed eco-incentive scheme in the selected case of the motorways of the sea in the West Mediterranean and Atlantic regions.

The methodological approach (figure 2), the simulation tools developed *ad hoc* to the MAE case study and the main results of the analysis showing the impacts of the scheme are summarized in this document, highlighting the main assumptions behind to facilitate the consensus process.

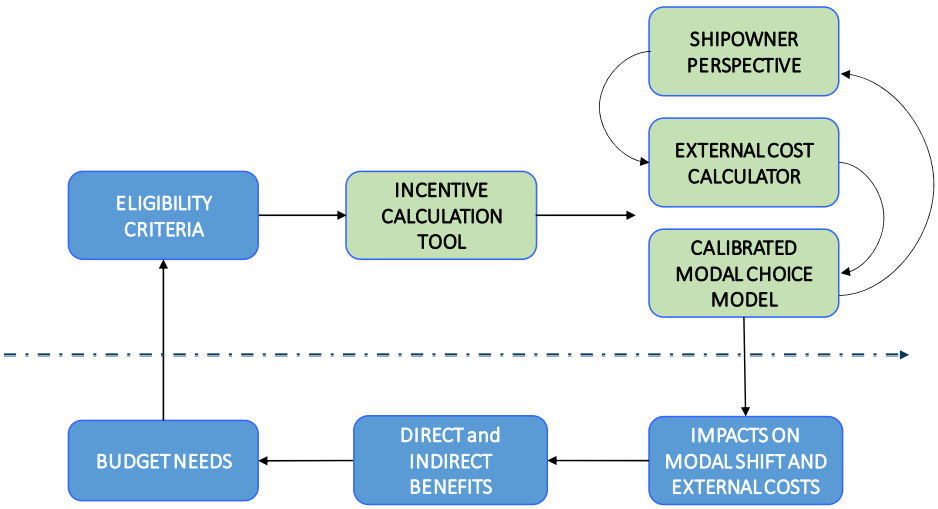

Figure 2.- Methodological approach to the ex-ante analysis (MAE study)

In a nutshell, the ex-ante analysis is conceived as a (i) simulation exercise performed for the targeted market -limited through the eligibility criteria-, (ii) using consistent tools based on the market performance and prepared for sensitivity analysis -i.e. simulation-, where (iii) the main outcomes are the impacts of the eco-incentive scheme in the targeted market and the budget needs -that shall be positive and proportionate to the intended objective in order to be acceptable-.

Moreover (iv) the compliance with the backing principles of the common EU approach, as previously described, is observed as a general rule.

All in all, this short definition could be valid to any ex-ante analysis for an eco-incentive scheme under the common EU approach.

As for the MAE case study, the sequence starts by setting the eligibility criteria.

Then, an eco-incentive per unit is calculated per each line as a direct result of the reduction on external costs produced by this unit using a greener maritime service compared to the 'road only' alternative. This external cost saving represents the 'environmental merit' that is measured through an external cost calculator tool developed *ad hoc* for the MAE case study. Therefore, the external cost savings will always be higher than the value of the eco-incentive, by definition.

Next, a transport modelling tool which has been calibrated *ad hoc* for the targeted market returns the relative effects on modal balance and the total external costs savings by giving the eco-incentive directly to the road operator. Moreover, it estimates by aggregation the total budget needs for the eco-incentive scheme.

A third tool -so called the shipowners' perspective tool- assesses to what extent the indirect benefit to the shipowner by means of the eco-incentive given to the users is contributing to trigger the investment decisions needed for the green action to be taken.

As a result, the ex-ante analysis provides all the relevant information needed to assess the impacts of the eco-incentive scheme.

Eligibility criteria

The eligibility criteria delimitate the targeted market and have a great influence in the budget needs of the eco-incentive scheme. Therefore, they are an essential feature of the ex-ante analysis. On the other hand, since they set what is eligible for funding they shall be compliant with the backing principles of the common EU approach.

On the other hand, it is emphasized that the eligibility criteria that are proposed for the MAE case study are just at proposal level and do not relate to any implementing action already committed by the promoters of the study. Therefore, these eligibility criteria might be adapted in the future and should be considered just as example at this stage.

As mentioned, the MAE case study is targeting the MoS ferry and ro-ro market servicing alternative routes to the road transport in the West Mediterranean and Atlantic regions.

In this context, the following eligibility criteria are proposed (all criteria shall be considered together):

- Only maritime services consisting in international lines with no more than 2 stops or one enroute call.
- Direct beneficiaries shall be the users of the maritime services upon proof of boarding and proof of purchase (i.e. provided by the transport operator and the shipowner). By users it is meant the purchasers of the maritime ticket. Users will be also responsible for the proof of the boarding event.
- Lines shall go from / to a port of the implementing Member States to / from another EU port or between ports of the implementing Member States.
- Domestic services are not eligible in the example.
- Only maritime services having a door-to-door road alternative in operation are eligible (i.e. no pure channel crossing lines)
- Only ro-ro, ro-pax or con-ro vessels are eligible (for ro-pax and con-ro, only freight on ro-ro units is eligible)
- Regular services with a minimum frequency of 1 departure per week by a dedicated vessel (i.e. no seasonal services).
- Services consisting in new or upgraded lines demonstrating a reduction in external costs per transported unit compared to the door-to-door road alternative. Such environmental merit shall be demonstrated and quantified - using the scheme's external cost calculator tool- and incur direct costs to the shipowner by means of a green action improving the environmental performance of the maritime service.
- Only accompanied or non-accompanied trips of rolling cargo, intended as freight that can be loaded and unloaded autonomously on the vessel (i.e. no cranes used), can be considered eligible. New cars would be considered eligible as long as they are loaded on trucks.
- Direct beneficiaries shall commit to a minimum number of trips (100 trips a year).
- Maritime services shall be open to all users under the same conditions and in a non-discriminatory way.
- Only services using vessels complying with 2020 thresholds as set in the Sulphur Directive (or its equivalent with abatement technologies) are considered eligible

As previously mentioned, these eligibility criteria have also to be compliant with the backing principles of the common EU approach at EU level. In this regard **the following considerations summarize this compatibility check for the MAE case study**.

In first place, the eco-incentive scheme is aimed at stimulating the adoption of greener solutions in maritime services as a main goal. Moreover, since the eco-incentive is proportional to the environmental merit -described as the external costs savings of the maritime based transport compared to the 'road only' alternative-, the scheme will push for greener solutions going beyond the strict compliance with the environmental regulation.

On the other hand, by directing the incentive through the users of the maritime service, the modal back shift effect -that might run counter to the UE climate changes and could increase congestion- is limited. Directing the eco-incentive through demand should also have an induced modal shift effect as a consequence -not as a goal-, improving the utilization rates of the vessels and contributing to an improved efficiency of the multimodal transport.

Therefore, both the goal and the effects of the eco-incentive scheme meet the priorities of the TEN-t with regards to sustainable freight transport services. Moreover, limiting to international routes contributes to the EU added value of the MAE case study.

Regarding market distortion, directing the eco-incentive through demand also secures that the scheme is implemented in a non-discriminatory way (same rules apply to all lines and users). Moreover, lines shall keep proving the commercial competitiveness -i.e. quality, prices, etc.- of their services in market conditions as a basis to keep the market share.

This approach takes also over the recommendations of the European Court of Auditors' Special Report 3/2013 for taking in consideration best practices at national level. In this regard, directing incentives through demand was the approach of the Italian Ecobonus -implemented in the period 2007-2010- which already met the compatibility rules for state aids in the maritime transport.

Although with different shares in the West Mediterranean and the Atlantic regions, the targeted market is considered a mature market, with maritime services currently operating in both seas. Therefore, the incentive is not intended as start-up aid to developing the market but for the transition to a greener shipping within the existing market.

As mentioned before, the eco-incentive is calculated per road unit and per line as a direct proportion of the external cost savings achieved by each unit when using the maritime services compared to the 'road only' alternative. Therefore, the eco-incentive is calculated exclusively on grounds of a socio-environmental merit. In order to measure the merit, an external cost calculator has been developed *ad hoc* for the MAE case study. Moreover, when assessing the current performance of this market with the external cost calculator, it is demonstrated that the maritime services shall implement greener actions to attain a merit deserving good eco-incentives -since road transport is not anymore EURO III, as in the past-

. Therefore, the socio-environmental merit, as defined, would bring by itself the push for the green action.

However, to minimize the deadweight effect as well as to secure the compliance with state aid rules -limited to new or upgraded services- an additional requirement is included for all lines, which shall demonstrate a green action incurring direct costs to the shipowner to be considered as eligible.

Also, is worth noting that the green action is not necessarily based on greening technologies and not necessarily favoring a particular technology. In fact, the external cost calculator measures other means to achieve the merit such as increasing capacity or reducing speed of the vessels, that are currently considered amongst the maritime operators' strategies.

On the other hand, making funding conditional upon results is addressed through the eligibility criteria by paying the incentive upon proof of boarding.

Regarding Member States co-responsibility in the co-financing and implementation of the scheme, this is something which does not really depend on the eligibility criteria. However, it is an essential feature for the common EU approach. As mentioned before, the rationale behind the proposed approach to eco-incentives measures is that Member States are the promoters of such schemes whereas the EU funding contributes to the scheme's budget accordingly to the applicable co-financing rates. The approach is therefore conceived as a blend effort of the Member States and the Commission.

In this regard, state aid rules should apply. Nevertheless, Ecobonus actions have proved to be compatible with state aid rules in the past -i.e. Italian ecobonus-. Moreover, MAE case study facilitates this compliance through different means, some already mentioned before. By directing the eco-incentives through demand, the approach is preventing the measure from market distortion. In addition, the state aid is exclusively given on grounds of a socio-environmental merit and is proportionate to the merit, by definition. Moreover, being considered as eligible to the EU funding would probably facilitate the compliance with state aid rules. Finally, the ex-ante analysis as a requirement of the common EU approach would also contribute to the further compatibility assessment.

The intensities of the state aid as a result of the eco-incentive scheme are assessed through the shipowners' perspective tool, showing in all cases results below 30% over the operational costs of the maritime services. Regrading duration, the MAE case study is considering a 5 years period in the ex-ante analysis, which could be the case if the 2008 Motorway of the Sea Guidelines are updated to the CEF standards. As mentioned before, the case for other eco-incentive schemes in the field of inland transport would have more flexible rules as regard states aids -e.g. on rail transport-.

Other baking principles such as minimizing the risk of fraud, minimizing the need for additional bureaucracy and monitoring the scheme performance cannot be

validated through the ex-ante analysis exercise. However, the MAE study has delivered specific tasks summarizing a possible approach to the administrative process and technological background in the event of an implementing action where this backing principles are addressed.

Ultimately, as mentioned before, these eligibility criteria are proposed as example for the ex-ante analysis. They are not intended for a real implementing action at this stage. In that event, they could be broadened or restricted as long as they keep compliance with the common EU approach and they are consistent with the targeted market and goals. However, the budget needs would also change as a result.

With the proposed eligibility criteria, maritime operators shall keep ensuring competitive, frequent and reliable services with the best environmental behavior to attract demand on a level playing field.

External cost calculator

The external cost calculator is an essential feature not only for the MAE case study but for the common EU approach.

This new approach to the EU funding on freight transport services, as proposed by the MAE study, differs significantly from the Marco Polo approach. However, as recognized by the Commission, the external cost calculator used by the MP programs to evaluate projects was considered at that time an exceptional instrument.

Moreover, there is virtually no other means of incentivizing an environmental merit if it is not measuring and monetizing the merit itself. In this regard the external cost calculator is not an option to the use of eco-incentives.

On the other hand, the quality of the calculator depends on the quality of the data used and, even more important, on the existing consensus around these data. This is particularly relevant for the monetizing of the different external cost factors, both environmental (such as air pollution and climate change) and socioeconomic (typically congestion, accidents and noise).

By quality of data it is meant as much representative and consistent with the real performance of each mode and with the existing references regarding the monetization, at any given time. This is with now doubt a major challenge, due to the constant evolution in transport technologies and the lack of harmonized references on monetization of emissions and socioeconomic factors. In this regard, the Marco Polo calculator represented a unique exercise towards a harmonized approach on external costs calculation at EU level that should be recognized beyond discrepancies.

Anyhow, with the finalization of the Marco Polo program, the calculator was also discontinued. Later on, this exercise on the external cost calculator has not been retaken as a means of evaluating projects in the current TEN-t framework.

Nevertheless, the need to measure and monetize external costs in transport at EU level cannot be ignored when coming to eco-incentives measures as a potential way forward to the EU funding on sustainable freight transport services.

This pose a major challenge, as in the past, due to the required consensus. However, it also meets the right time, with the environment firmly addressed in the political agenda at international level.

In this context, the proposed approach to eco-incentives measures bring the Commission an excellent opportunity to build the required consensus on an EU calculator by having the Member States involved through the developing of external costs calculations as part of the ex-ante analysis required for a particular mode of transport and a particular EU region.

As example, the MAE case study has developed an external cost calculator addressing the particular needs for the targeted market, as part of the ex-ante analysis. To doing so, a thorough analysis has been taken over many references from the academia to emission markets values, including technical and statistical reports from the consultancy sector and from the institutions, outcomes from other projects, etc. Also, the basic references behind the Marco Polo calculator, including the data base of the calculator, have been considered. As a result, the MAE study has put together a significant library of the cumulated knowledge on external costs calculations up to date. All these references have been deeply analyzed and confronted as part of the work. Following the common EU approach this calculator -which is building consensus for the targeted market amongst the Member States involved- would be a main contribution to a possible EU calculator.

Nevertheless, there is still a lack of information and harmonized references. In this regard, the calculator takes some assumptions that will have to be validated through consensus (e.g. regarding the monetization of SOx and CO_2 emissions and congestion). The main references used as a basis to monetization are the “Handbook on estimating external cost in the transport sector” (IMPACT 2008), and the “Update on the Handbook on External Costs of Transport” (RICARDO-AEA 2014), both supported by the Commission. The values have been updated to 2016 by using consumer price indexes (CPI).

The tool is set up in excel format for easy use and understanding, including all the supporting tables. The excel file is included as part of this document, together with a short user’s manual. Some of the main features are described below.

The calculator is design *ad hoc* to assess the socio-environmental merit as proposed for the MAE case study. Therefore, it compares the external costs per unit using the maritime service with the ‘road only’ alternative. On the maritime

service, it considers the specific vessel technology, operating profile, port call and port access impact. As environmental costs, it calculates the CO_2 emissions and the main pollutants -e.g. SOx, NOx and PM- for both the 'road-only' and the maritime alternative. In addition, congestion, accidents and noise are also considered -assuming that the maritime service does not produce impacts on these factors-.

Unlike the Marco Polo calculator, in this case the external cost calculator measures the socio-environmental impact per unit in each line, case by case, considering the specific technologies and operational behavior of the vessels servicing the line. Therefore, 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-. On the other hand, 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 estimates port access externalities by boarding trucks and vessels' emissions at port, as an average. These externalities run counter the environmental merit of the maritime service and are significant 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 ro-pax vessels where freight capacity is combined with private vehicles, vessel's emissions shall be allocated to freight and passengers. However, to measure the environmental merit, the calculator will only account for freight. Therefore, total vessel emissions are divided in this case by the number of trucks equivalent. This figure represents the average trucks carried plus the average passengers' vehicles converted into virtual trucks or trucks equivalent, based on their utilization of the vessel capacity. For new vehicles, not eligible in the MAE case study, a similar calculation is performed.

The calculator is intended for simulation. Therefore, some parameters are set for a 'generic' vessel. At implementation, the calculator would consider the specific engine specifications and operational profile of the vessel so as to reflect the specific navigation and port emissions performance. On the contrary, road emissions will be calculated for the 'average' truck fleet operating in the market and this will be the basis of the incentive calculation.

As example, the following figure shows the result for a generic line call "Parallel" in 2020. This line runs parallel to the road -no geographical advantage compared to the road- with a 3.000 lane meter roro vessel at 70% occupancy, resulting in 140 trucks per trip. The vessel sails at 19 knots using MGO with a 0,5% sulfur content in the left case and LNG in the right -i.e the greener action-. 62% of the truck fleet is EURO VI -the estimated share for 2020-. The results show no environmental merit when using MGO -i.e. the external cost generated per unit is

44,7€ higher in the maritime service compared to the 'road only' alternative-. When using LNG the situation is reversed and yields a positive 51,9€ external costs saving. All CO_2, SOx, NOx and PM are reduced when using LNG. Also, the external costs are reduced at port when auxiliary engines run on LNG.

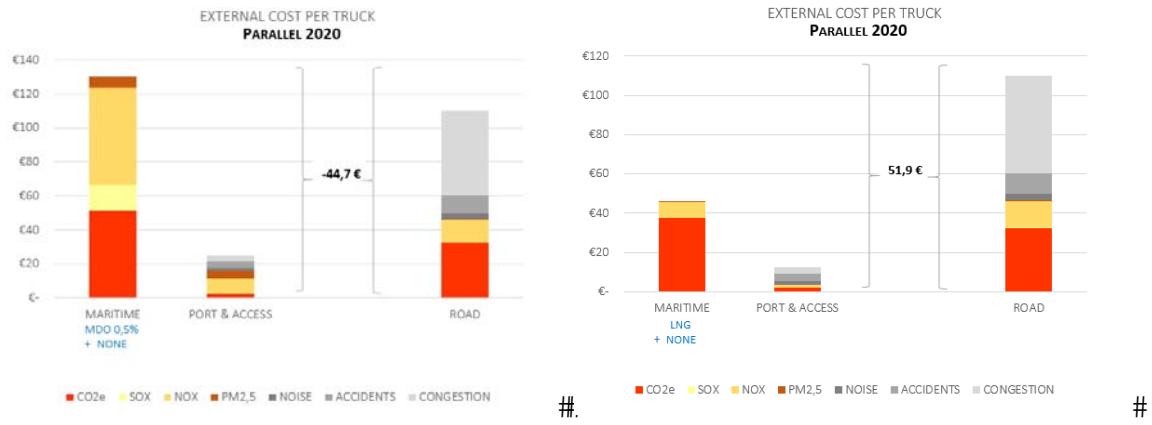

Figure 3.- Example of the MAE external cost calculator (MGO vs LNG)

The complete report explaining with more detail the calculator's designing exercise and the references and assumptions used will be made available as part of the final report of the MAE study.

Transport modelling tool

Following the recommendations of the Commission and the European Court of Auditors on the occasion of the finalization of the Marco Polo programs, EU support to freight transport services, such us the proposed approach to eco-incentives measures, shall require a detailed market analysis as part of the ex-ante analysis, enabling the simulation of the effects of the measure.

In this regard, a complete transport modelling tool has been calibrated for the targeted market as a main contribution from the MAE case study. This tool, together with the external cost calculator and the shipowners' perspective tools brings the possibility for a complete market analysis and impact assessment exercise on the effects of the eco-incentive scheme, as proposed.

Therefore, the modelling tool is intended to replicate the actual performance of the targeted market by using advanced modelling methods in a way that makes possible a sensitivity analysis of the relevant variables affecting the behavior of the transport demand.

The goodness of the calibration is considered as good despite the lack of data availability, which is the main limitation for this kind of modelling tools. Therefore, the calibrated tool allows the market analysis and the simulation exercise for the eco-incentive scheme.

In this regard it worth saying that the MAE Action, as initially proposed to the CEF call, included a specific task to update the Pyrenees and the Alps transport observatories, supported by the French, Italian and Spanish administrations, to securing the statistical data needed for the calibration exercise of the modelling tool. On the award of the Action, the financing was cut due to oversubscription and this budget line decayed. However, the calibration has been completed, as mentioned, and could be easily improved in the future when new statistical data are available.

On the other hand, the performance of the motorways of the sea roro and ferry markets is quite different in the West Mediterranean region compared to the Atlantic region, with different market shares and different maritime network densities.

Therefore, two models have been calibrated, one for each market, following the same methodological approach.

A thorough report has been elaborated explaining in detail the designing and calibration process for both models, including the market analysis for the West Mediterranean and the Atlantic regions as a result. This report will be included as part of the final documentation of the MAE Action, as a main contribution of the study.

Nevertheless, the main features are summarized below.

The methodology for the design and calibration of the models in each region uses the classic four-step transport modelling approach. In a typical ‘micro’ approach, it implies the calibration of four stepped models, with the following scopes: (i) Global mobility model, (ii) Spatial distribution model, (iii) Modal choice model and (iv) Route assignment model (including the share between shipping lines).

However, due to the lack of data and the fact the data available came from different sources -leading to not harmonized information-, an aggregated -macro- approach is taken where each available data is assumed to be representative of a group of individual travels. The statistical errors as a result of this assumption are not very high. Moreover, in the aggregated approach the spatial distribution model is integrated in the global mobility model.

The influential area and the geographical zoning for the spatial distribution considered in the mobility model is shown in the next Figure:

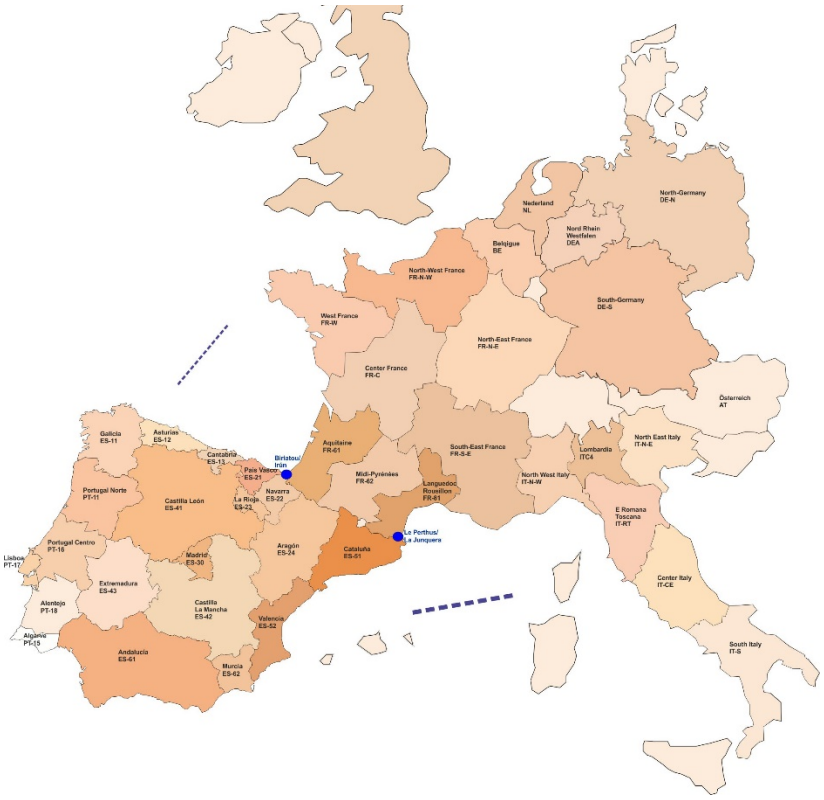

Figure 4.- Mobility model. Influential area and zoning

It comprises 20 zones in the south of the Pyrenees (15 in Spain and 5 in Portugal) and 21 zones in the north (8 in France, 6 in Italy, 3 in Germany, plus Belgium, the Netherlands, Austria and UK as a whole). Therefore, 420 origin-destiny pairs are considered initially. However, 26 of them have no actual traffic in the sample and have been discarded to avoid statistical issues.

On the other hand, only general cargo has been considered. Typically, bulks have different transport patterns and are not in the scope of the targeted market for the MAE case study.

The explanatory variable used in the mobility model is the GDP of each zone. It is commonly accepted and confirmed by statistical data that freight mobility -general cargo in particular- between two different zones increases or decreases accordingly to the evolution of the GDPs of both zones.

As example, the figure below shows the evolution of the growth rates for the total GDP and for the total freight mobility in the area of analysis. The result is well known: freight mobility grows in the same direction as the GDP but with a higher rate. This pattern is what the mobility model replicates per each O-D pair.

Figure 5.- Total freight mobility (in blue) and GDP (in red) growth rates evolution in the influential area

The next step in the modelling exercise, as described, is the modal choice model. This model is aimed at explaining the modal balance per each O-D pair between the two alternatives under consideration in the MAE case study -i.e. trucks using the maritime services, which includes road sections also, and trucks using the 'road only' alternative-.

The model that has been calibrated uses two basic explanatory variables to replicate the demand's behavior when deciding between the two options. On the one hand, the average price for the door to door transport in each alternative, including the maritime price when using the maritime option. On the other hand, the frequency of the maritime services, affecting exclusively to the maritime option.

The formulation used for the designing of the model -in both the West Med and the Atlantic region- is a binary logit, which is a commonly accepted approach for modal choice modelling.

For the calibration of the model, the following sources of statistical data have been used. For the road, the very extensive 'Transyt' survey campaigns carried out in 2004 and 2010 by the Spanish and French Governments as part of the statistical observatory of the Pyrenees. For the motorways of the sea, the sources are more limited. In the West Mediterranean, the only available sources including quantitative data are the European Projects West-MoS and West-Med corridors -with data from 2008-. In addition, some data have been used from the study on the Italian ecobonus carried out within the MAE study. Finally, direct information from transport operators, ports, etc. has been considered. As for the Atlantic, the only available data for the maritime came from a survey campaign undertaken during 2010 and 2011 and directed to the users of the Gijon-Nantes Motorway of the Sea.

Beyond these limitations, the goodness of the calibration is acceptable -statistically speaking- in both the Atlantic and the West Mediterranean markets. The binary logit models give therefore the possibility to replicate the actual shares as well as to simulate new shares by altering the explanatory variables -i.e. transport prices and frequencies-.

As example, the next figure represents in both the Atlantic and the West-Mediterranean markets the variations in the modal share between the 'road only' and the 'maritime-road' options referred to variations in the differences of price. As shown in the figure, the maritime services in the Atlantic must do a higher effort in price to get the same share as in the West Med. This result is consistent with the real situation, with the motorways of the sea network in the Atlantic not as developed as in the West Mediterranean and needing higher distances so as to get a significant reduction in price compared to the 'road-only' alternative.

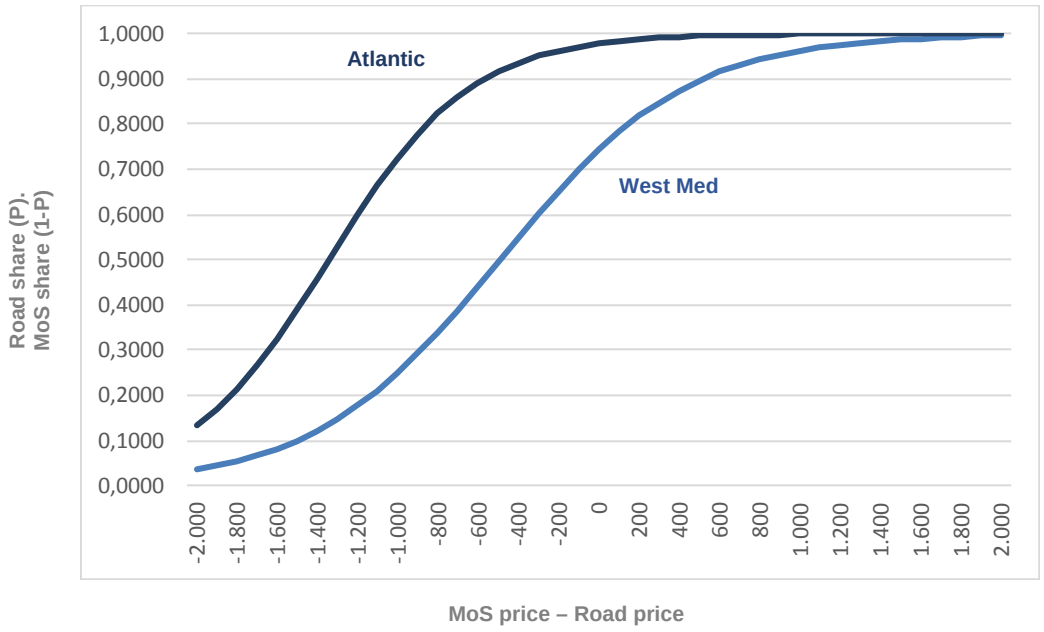

Figure 6.- Road/MoS sharing (%) vs price gap (€). Atlantic and West Mediterranean

Moreover, another interesting outcome from the calibrated models is referred to the values of demand elasticity to price for the maritime services in each area (Atlantic and West Mediterranean), as shown in the next figure:

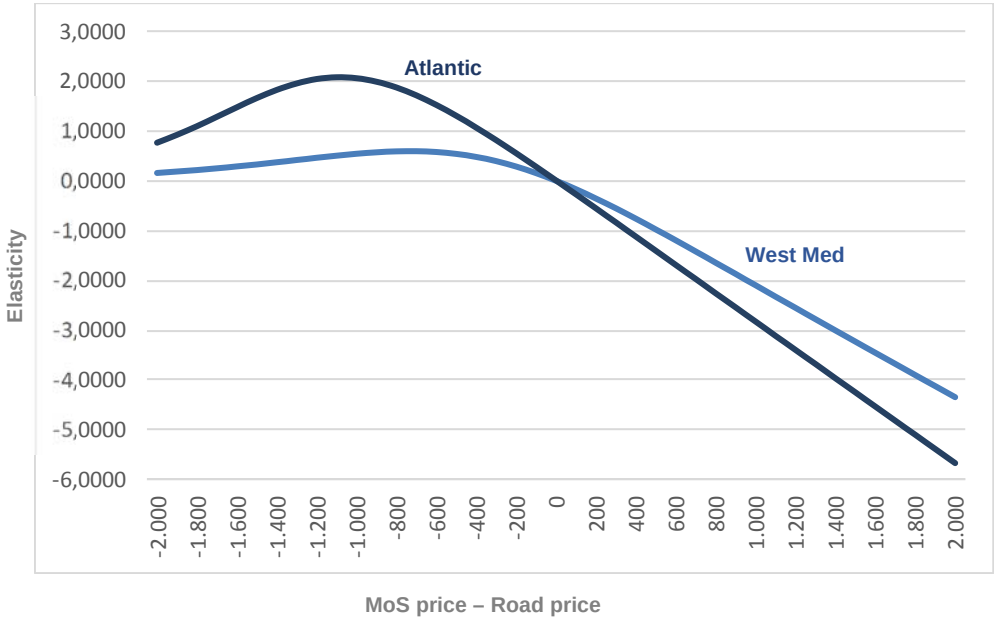

Figure 7.- Elasticity of the Road/MoS sharing to price gap. Atlantic and West Mediterranean

An immediate outcome of the calibrated models is that the motorways of the sea in the Atlantic are much more sensitive to price than in the Mediterranean. This is relevant to the case of eco-incentives, as this higher elasticity will bring also higher shifts in the Atlantic for the same value of the eco-incentive.

The last step for the complete transport modelling tool is the design and calibration of the route assignment model. Amongst other aspects, this model is intended to replicate the share between different lines per O-D pair -considering the complete door-to-door transport relation-. A complete description of the designing and calibration process will be included in the final report of the MAE study. However, for the purposes of this preliminary report some features are described below.

The design of the model follows the same approach as in the modal choice model and is based in a logit formulation.

The main explanatory variables used to replicate the sharing between the maritime lines are the sea rates -maritime price-, the frequency and the distance between the centroid of each zone and the port where the maritime service is calling.

As for the maritime prices, which play a significant role in the model, the information is taken from different sources, including direct queries to maritime operators. However, real prices are always subject to a lack of transparency. Differences in prices between accompanied and non-accompanied units have been considered, when available, by using averages depending on the actual performance of the line. As an estimate, maritime prices are giving unitary prices

for the maritime leg (including port dues) that are below 1 € per unit-km. Moreover, as part of the market analysis it has been observed that it is possible to run a line in market conditions with competitive prices compared to the 'road-only' alternative with vessels occupancies over 50%. Nevertheless, this is considered a minimum threshold. As for the eco-incentive calculation, a 70% occupancy has been considered in average.

The lines used for the calibration are the following:

West Mediterranean:

- Barcelona-Genoa
- Barcelona-Civitavecchia
- Barcelona-Livorno/Savona
- Valencia-Salerno
- Valencia-Livorno/Savona

Atlantic:

- Bilbao/Santander-Zeebrugge/Amsterdam/Rotterdam
- Bilbao/Santander-Reino Unido
- Gijón-Nantes
- Vigo-Nantes
- Leixoes-Zeebrugge/Amsterdam/Rotterdam
- Lisboa/Setúbal/Sines-Zeebrugge/Amsterdam/Rotterdam

Some of these lines do not exist at this time. Some of them existed in the past. However, it is considered that they could reasonable operate in the targeted market for the MAE case study as of 2020.

All in all, as a result of the 4 steps modelling exercise, a complete modelling transport tool has been calibrated. The goodness of the calibration is considered acceptable under statistical parameters.

The following tables compare the observed and the estimated data in both the West Mediterranean and the Atlantic regions.

The figures are quite similar in both markets. Moreover, in the case of the West Mediterranean, it must be noticed that the model is replicating quite well the observed values in the period 2008-2010 that included the effect of the Italian Ecobonus, along with the decrease in transport from the financial crisis. This final consideration runs for the quality of the calibration.

The modelling tool is therefore ready to estimate the future, including trend scenarios and simulated scenarios such as the implementation of eco-incentives measures.

AÑO	TOTAL	Solo carretera	Autopista del Mar	LINEA 1 BCN-GEN	LINEA 2 BCN-CIV	LINEA 3 BCN-LIV	LINEA 4 VAL-SAL	LINEA 5 VAL-LIV
2008	**8.931**	**5.757**	**3.174**	1.113	875	488	524	174
2009			**2.687**	468	1.090	493	394	243
2010	**8.318**	**5.631**	**2.687**	341	1.189	451	445	262
2011			**3.290**	437	1.126	636	425	666
2012			**2.771**	181	1.010	506	364	710
2013			**2.805**	67	1.189	395	398	756
2014			**3.266**	29	1.281	473	541	943
2015			**3.840**	69	1.350	780	635	1.006
2016			**3.410**	30	1.282	662	600	836
2017			**3.711**	32	1.384	715	660	920

Table 1.1.- Observed values. West-Mediterranean. 2008-2017 (x 1000 tones)

AÑO	TOTAL	Solo carretera	Autopista del Mar	LINEA 1 BCN-GEN	LINEA 2 BCN-CIV	LINEA 3 BCN-LIV	LINEA 4 VAL-SAL	LINEA 5 VAL-LIV
2008	**8.978**	**5.796**	**3.182**	1.125	815	496	415	331
2009	**8.095**	**5.425**	**2.670**	604	990	521	308	247
2010	**8.318**	**5.388**	**2.930**	410	1.276	621	338	285
2011	**8.297**	**5.079**	**3.218**	474	1.154	853	269	468
2012	**7.812**	**5.134**	**2.678**	214	1.146	535	273	511
2013	**7.601**	**4.875**	**2.726**	74	1.104	576	371	600
2014	**7.794**	**4.456**	**3.338**	86	1.345	660	501	747
2015	**8.116**	**4.261**	**3.855**	83	1.540	706	658	868
2016	**8.492**	**4.806**	**3.686**	83	1.371	705	657	869
2017	**8.917**	**5.085**	**3.833**	84	1.456	715	704	873

Table 1.2.- Estimated values. West-Mediterranean. 2008-2017 (x 1000 tones)

AÑOS	TOTAL	Solo carretera	Autopista del Mar	LÍNEA 1. BIL/SAN-ZE/AM/RO	LÍNEA 2. BIL/SAN-UK	LÍNEA 3. GIJON-NANTES	LÍNEA 4. VIGO-NANTES	LÍNEA 5. LEIXOES-ZE/AM/RO	LÍNEA 6. LIS/SET/SIN-ZE/AM/RO
2004			**317**	106	115		96		
2005			**349**	113	128		108		
2006			**378**	119	136		122		
2007			**676**	362	176		138		
2008			**903**	460	287		156		
2009			**1.120**	674	295		151		
2010	**32.594**	**30.946**	**1.648**	933	519	34	162		
2011			**1.317**	420	447	299	151		
2012			**1.233**	335	458	288	153		
2013			**1.227**	281	441	297	169	39	
2014			**1.264**	245	500	170	166	184	
2015			**1.088**	109	488		266	225	
2016			**1.255**	113	558		313	271	
2017			**1.502**	258	587		336	321	

Table 2.1.- Observed values. Atlantic. 2004-2017 (x 1000 tones)

AÑOS	TOTAL	Solo carretera	Autopista del Mar	LÍNEA 1. BIL/SAN-ZE/AM/RO	LÍNEA 2. BIL/SAN-UK	LÍNEA 3. GIJON-NANTES	LÍNEA 4. VIGO-NANTES	LÍNEA 5. LEIXOES-ZE/AM/RO	LÍNEA 6. LIS/SET/SIN-ZE/AM/RO
2004	28.037	27.708	328	114	138		76		
2005	29.395	29.029	366	124	150		91		
2006	31.339	30.927	412	154	151		107		
2007	33.513	32.942	571	338	145		88		
2008	34.021	33.235	786	474	196		116		
2009	31.445	30.458	987	645	217		124		
2010	32.369	30.687	1.682	967	511	26	177		
2011	32.795	31.460	1.334	483	483	241	128		
2012	31.869	30.524	1.344	272	565	315	193		
2013	31.550	30.315	1.235	218	503	288	173	54	
2014	32.481	31.281	1.200	205	488	131	202	173	
2015	33.966	32.937	1.030	142	458		236	194	
2016	35.563	34.401	1.162	176	530		247	209	
2017	37.361	35.859	1.503	299	646		312	245	

Table 2.2.- Estimated values. Atlantic. 2004-2017 (x 1000 tones)

The tool is set up in excel format for easy use and understanding, including all the supporting tables. The excel file is included as part of this document, together with a short user's manual.

The complete report of the designing and calibration exercise, together with the market analysis, will be included as part of the final report of the MAE study.

Ultimately, these calibration exercises are considered as a relevant contribution to the market analysis of the Mediterranean and Atlantic Core Network Corridors.

Shipowners' perspective tool

The main goal of the MAE case study, taken as example of the common EU approach to eco-incentives measures, is stimulating the shipowners for a greener maritime transport operation.

When the eco-incentive is directed through demand, as proposed, the calibrated modelling transport tool will show how the eco-incentive scheme contributes to secure and streamline the multimodal transport chain using the maritime services. This is, by the way, one other important objective towards the further development of the sustainable freight transport service component of the TEN-t.

However, the ex-ante analysis should demonstrate to what extent these eco-incentives are attractive enough, in market conditions, for the shipowners to go for a green action, which typically will produce higher costs, both operational and/or capital costs -depending on the green action that is taken-. Anyhow, the MAE case study forces the shipowner to incur direct costs on a green action to

be eligible to the eco-incentive. This eligibility criterion is aimed at minimizing deadweight effects as well as to secure compliance with the state aid rules.

Moreover, the intensity of the eco-incentive given to the user of the maritime service is proportional to the environmental merit achieved exclusively by the green action -without considering any modal shift effect-. The eco-incentive scheme is intended therefore to stimulate green actions with the higher positive impact possible -aiming beyond the strict compliance with the coming environmental regulation affecting the maritime navigation by 2020-.

The shipowners' perspective approach is aimed at assessing to what extent the 'indirect' effects brought to the shipowners -as a result of the eco-incentive- minimize the financial impact of the additional costs they need to incur for the green action. Thus, closing the circle of the ex-ante analysis. To that aim, the tool estimates some of the main cashflows and financial parameters that any maritime operator would probably consider when facing a decision on a green action.

The methodological approach follows a very practical vision playing only with the relevant concepts of a typical operating account in a shipping line and targeting the main financial outputs that are usually considered to assess decisions in the business environment. Moreover, the tool brings the main outcomes that the eco-incentive scheme needs to prove its performance, including those referred to the backing principles of the common approach regarding the maximum intensities of the state aid. This is relevant since the 2004 maritime guidelines on state aids would apply to the shipowners as indirect beneficiaries -e.g. this was the case for the Italian Ecobonus-.

The main features of the tool are summarized below.

As mentioned, the tool replicates basic concepts of a standard account for a shipping line and is prepared to introduce on both hands the additional CAPEX and OPEX related to the greener action and the additional incomes -so called indirect benefit- induced through demand as a result of the corresponding eco-incentive. The induced demand -i.e. the additional units- is taken from the transport modelling tool whereas the 'indirect benefit' to the shipowner is calculated as the net contribution to the vessel from the additional units -i.e. excluding port costs-.

The profile of the line is also relevant to the analysis. The following table summarizes some of the main parameters, as considered for the tool. Ultimately, the main impacts come from fuel consumption.

Nautical miles	Distance from port of origin to port of destination
Lane Meters	Freight capacity of the vessel
Vessel average speed	Average operational speed of the vessel in the service
Vessel power (kW)	Total main engine (propulsion) power
Number of vessels	Number of vessels servicing the line
Departures (sailings)	Total annual departures (from both ends, for all participating vessels)
Fuel type / consumption	Total annual fuel consumption (tones)

Table 3.- Shipping line profile. Main parameters. Shipowners' perspective tool

Another critical parameter is the fuel price, which is also considered as a variable in the tool and will take his value depending on the fuel type -HFO, MDO/ULSHFO, LNG, etc.-

In case on greener actions based on capital costs -i.e. investments-, the investment itself is of course a relevant input together with the rate of interest and the residual value of the investment. In this regard, the tool gives the possibility to include the weighted average cost of capital (WACC) and the residual value of the investment depending on its lifetime.

The duration of the indirect benefit is also a relevant input to the purposes of the analysis and will depend on the duration of the eco-incentive itself. Initially, a 5 years period have been considered for the ex-ante analysis. Anyhow, the tool gives the possibility to introduce variations in the duration.

Based on the previous inputs, the tool brings the following main outputs.

In the case of green actions based on capital investments, the tool estimates the net present value (NPV), the internal rate of return (IRR) and the payback of the investment -number of years needed to pay the investment- with the following assumptions.

It is assumed, as example, that a business decision such as investing on a new LNG vessel is not taken against a 'do nothing' scenario but against an investment on a new vessel running with conventional fuel (using any abatement technologies and/or low sulphur fuels to comply with 2020 limits). Therefore, and following the example, the approach for the MAE case study is assuming that the decision on a new vessel is a market decision and not a green action by itself, whereas the goal of the eco-incentive scheme is stimulating the shipowner for the extra-investment that will bring a greener performance of the vessel. Somehow this is the same approach followed by the Commission when setting what is

eligible for the EU funding under the current CEF envelope regarding green actions.

In this regard, the tool is considering only the additional investment incurred by the green action. Moreover, it is conceived to compare the scenarios with and without eco-incentives as a means of assessing to what extent the shipowners would see in this scheme a catalyst for their decisions on greener shipping.

The tool is aimed also at providing outputs regarding the intensity of the indirect benefit to the shipowners.

By one hand, with regards to the green actions based on capital investments, the tool estimates the ratio between the indirect benefit to the shipowner and the investment. In a way, this ratio gives an idea of the co-financing rate that the shipowner could expect for his investment from the eco-incentive scheme. This ratio gives a good understanding of the attractiveness that the eco-incentive measure would bring compared to other possible means of getting the EU support to the green action.

Moreover, the tool estimates the indirect benefit to the shipowner referred to the operational costs of the line, per year. As mentioned before, this is an important outcome to assess the compliance of the eco-incentive scheme with the state aid rules applying to the maritime transport, including the 2004 and 2008 interpreting guidelines. In this regard, the MAE case study assumes that the shipowners would be considered by the Commission as indirect beneficiaries of the eco-incentive scheme following the same approach of the Commission's compatibility assessment to the Italian Ecobonus program on the occasion of the extension of this program for the year 2010.

Ultimately, in the case of greener actions that are not directly based on capital investments, the tool does not provide any particular indicator at this stage. The main reason for that lies in the fact that the effects of such actions are more difficult to estimate. As example, a greener action based on a reduction on the speed could lead to the need for an additional vessel to keep the frequencies of the maritime service (thus incurring direct costs either). This would have an impact on the operating costs of the line, although more difficult to estimate.

Nevertheless, some of the indicators that have been described before would also be applicable to these cases.

The shipowners' perspective tool is set up in excel format for easy use and understanding. The excel file is included as part of this document, together with a short user's manual.

Simulation scenarios

The tools, developed *ad hoc* for the MAE case study, have been conceived, designed and calibrated to simulate the effects of the eco-incentive measure in the targeted market and to assess how much the measure would contribute to the main goal -i.e. greener shipping-.

This methodological approach would be easily transferable to other goals and targeted markets at any EU region by just adapting/creating the relevant tools for the particular case that allow the simulation exercise which is the main purpose of the ex-ante analysis.

Either way, the simulation exercise should always run with the same basic approach, that is comparing scenarios with and without the application of the eco-incentive measure.

Moreover, the simulation exercise requires that the definition of the scenarios is based on the variables used for the designing of the tools.

Ultimately, the scenarios for the simulation exercise should be relevant to the context under analysis and selected in a way that the critical aspects to the viability of the eco-incentive measure are addressed.

Following this approach, the following two scenarios are selected and compared in the MAE case study (both as of 2020):

Base Scenario (conservative): All lines switch from HFO to MGO/ULSHFO fuel to comply with the IMO 0,5% sulphur cap. The environmental merit is very limited, and no eco-incentive is given to the users. On the other hand, the higher cost of the fuel lead to an average 12% increase in sea rates that is applied to all users from day one (estimated for all lines as a 50% fuel price increase x 24% weight of fuel over the total costs of the line).

Green Scenario: All lines switch to LNG vessels from day one. Sea rates are maintained. The environmental merit is the highest possible, including at ports (auxiliary engines running also on LNG), and all users receive the maximum eco-incentive.

Further these two scenarios, the following considerations apply to the simulation exercise:

- The comparison of these two scenarios would bring the most demanding scenario for the public support to the eco-incentive scheme in terms of public funding, which is a relevant outcome of the ex-ante analysis.
- The lines that are considered for simulation as part of the targeted market are the same that were considered for the calibration of the transport modelling tool.
- The duration of the eco-incentive scheme is 5 years, from 2020 to 2024.

- Global mobility grows according to the available official GDP projections per each zone, and a 2% annual as a default.
- To measure the environmental merit and calculate the eco-incentive, it is assumed an average occupancy rate of 70% for the vessels.
- Market is mature and no new lines are considered as a result of the eco-incentive measure, not in particular in the green scenario. As previously mentioned, the aim of the eco-incentive is not developing the market. In the event of capacity constraints, it is assumed that the maritime service will adapt to demand by increasing the frequency (when frequency is 3 departures per week or below) or the capacity of the vessels (when frequency is over 3 departures per week).
- The prices of the maritime and the road transport are expressed in constant values of 2016.
- Road transport is mostly EURO VI in 2020, starting with an average external cost ratio of 0,11 €/v.km in 2020 and reaching the level of 0,10 €/v.km as of 2024, based on the assumptions of the external cost calculator.

Simulation and results

With the eligibility criteria, the tools and the scenarios, as described, the simulation exercise is carried out in the targeted market, for the West Mediterranean and the Atlantic regions.

In first place, the lines running on the simulation are described to estimate the environmental merit per each line related to the greener action on the green scenario (i.e. all switching to LNG). As a result, the corresponding eco-incentive per line is calculated.

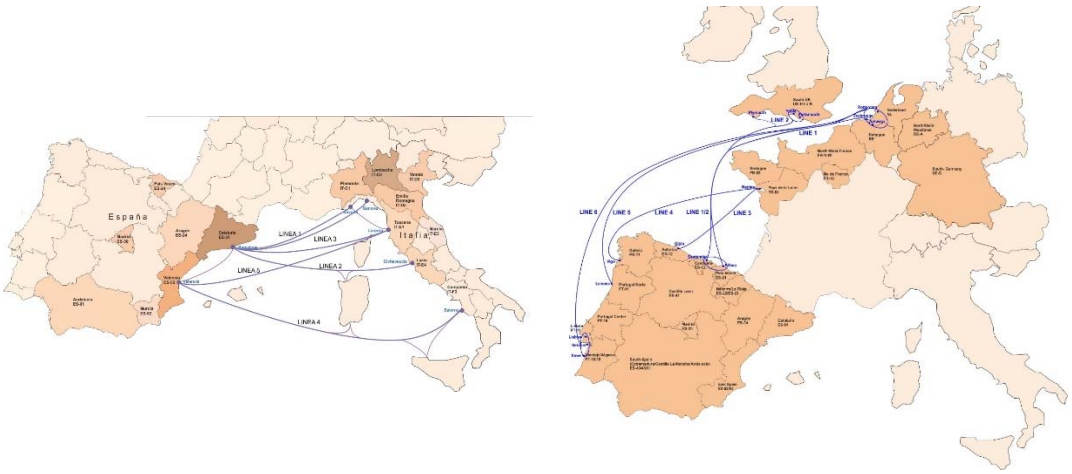

Figure 8.- MoS considered for simulation. West Mediterranean and Atlantic regions.

The main data needed to estimate the environmental merit in each line are summarized in the next tables, featuring some of the key parameters.

The sea distance and the road distance -i.e. saved from the 'road only' alternative-' per line, in nautical miles (NM) and kilometers (KM). The lower the maritime distance is compared to the road distance, the better to the environmental merit. This is a kind of 'geographical merit' (GEO) that runs for the overall environmental merit of the line. As shown in the tables, this factor is between 65% and 75% in the West Mediterranean, whereas for the Atlantic it ranges from 55% to 114%.

The type and the capacity of the vessels -i.e. lane meters (LM)-, as well as the number of vessels (#V) and the average passenger (PAX) and new vehicles (VEH) volumes of the line, are also relevant to the estimation of the environmental merit per freight unit. As described in the eligibility criteria, only trucks (TRUCKS) are eligible and therefore only their share on the total external costs of the vessel shall be estimated. To do so, passengers and new vehicles are converted into trucks equivalent (TRUCKSe) that can be added to the actual trucks. This way, the vessel emissions can be distributed by the total trucks equivalent so as to keep a fair share from the total external costs of the vessel on the actual trucks.

Finally, the average speed of the vessels, which has a great influence in the environmental performance of the line, needs to be considered.

The tables show the values that have been considered for the simulation, based on real performances and/or estimations. Anyhow, the external cost calculator tool is well design to enable each line to introduce different data, if needed. By doing so, the tool would recalculate the environmental merit of the line and the corresponding eco-incentive per unit.

ROUTE	VESSEL	#V	NM	KM	GEO	LM	PAX	VEH	OCC LM	SPEED	TRUCKS	TRUCKSe
Barcelona-Civitavechia	CRUISE X	2	439	1.298	65%	3.050	400	50	70%	24	142	191
Barcelona-Livorno	EUROCARGO ALEXANDRIA	2	382	1.053	70%	3.810	0	0	70%	18	178	178
Barcelona-Genoa	FANTASTIC/MAJESTIC	1	347	885	75%	2.250	100	12	70%	19	105	117
Valencia-Salerno	EUROCARGO SALERNO	2	710	1.939	70%	3.810	0	0	70%	18	178	178
Valencia-Livorno	EUROCARGO VALENCIA	2	534	1.374	75%	2.550	0	0	70%	18	119	119

Table 4.1.- MoS considered for simulation in the WESTMED. Estimated performance of the lines.

ROUTE	VESSEL	#V	NM	KM	GEO	LM	PAX	VEH	OCC LM	SPEED	TRUCKS	TRUCKSe
Bilbao-Zeebrugge	RORO	2	675	1.139	114%	2.300			70%	19	107	107
Santander Portsmouth	FERRY	1	537	1.135	91%	1.780	300		70%	19	83	113
Gijon-Nantes	VISENTINI	1	271	951	55%	2.110	200	50	70%	19	98	127
Vigo-Nantes	SUARVIGO	2	475	1.344	68%	1.542		250	70%	18	72	114
Leixoes Zeebrugge	RORO	3	844	1.866	87%	3.050			70%	14	142	142
Lisbon Zeebrugge	RORO	1	1020	2.099	93%	2.300			70%	15	107	107

Table 4.2.- MoS considered for simulation in the ATLANTIC. Estimated performance of the lines.

With the characterization of the lines is then possible to introduce the values in the external cost calculator, returning the values of each corresponding eco-incentive per unit -based on the environmental merit of each line as described in the eligibility criteria-.

The following figure presents the results per line in the green scenario -all lines switched to LNG-, and organized from the higher to the lower values of the eco-incentive as returned by the external cost calculator. The color of each bar is representing the speed of the vessels, from the higher (darkest) to the lower (lightest), as one of the most influential parameters

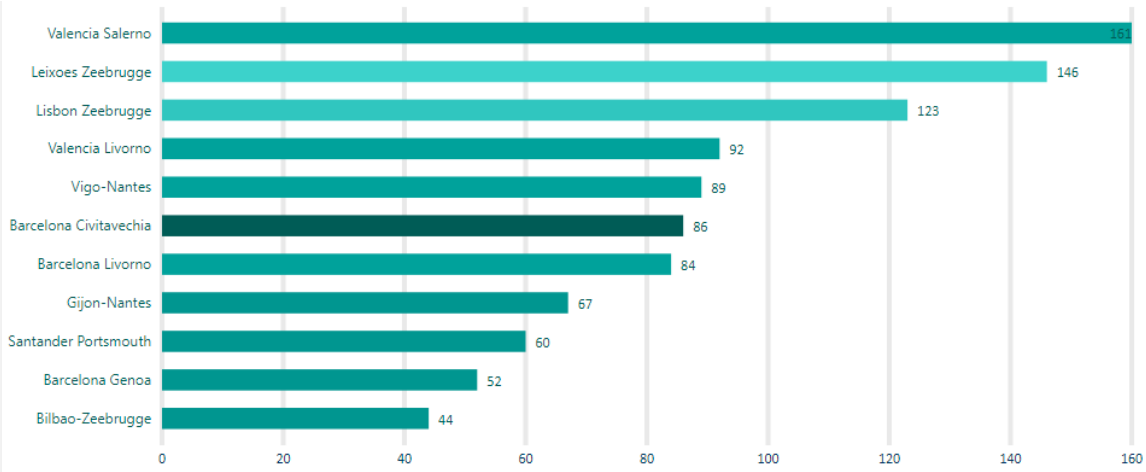

Figure 9.- Eco-incentive per line (€/unit). Green scenario (LNG). The darkest color means higher speed of the vessel according to the estimated performance of the line

The differences between the estimated values of the environmental merit per line are due mainly to the following reasons: the maritime distance -greater distances produce higher savings- together with the GEO factor -the distance 'shortcut' of the maritime leg compared to the 'road-only' alternative-, the vessels capacity -economy of scale- and the vessels average speed -higher speed implies higher emission levels-. This way the Valencia-Salerno line services the largest maritime distance in its market, with a 30% distance saving compared to the 'road-only alternative- and it is operated by the largest vessel (3.810 lane meters) at 18 knots. On the bottom of the table, the Bilbao-Zeebrugge -discontinued some years ago- suffers from the GEO factor as the route must round the peninsula of Brest, navigating more distance than the road alternative.

These values of the eco-incentive per line and per unit are the ones that would be granted to the users -i.e. trucks- of each maritime service in case all vessels servicing the lines were running on LNG.

From the users' perspective, this eco-incentive can be simulated as if the maritime operator would grant a discount in the sea rate for the same amount. In this regard, it is worth remembering that this is only for simulation purposes and that the green scenario, as described, is assuming that the sea rates remain unaltered after the green action.

Line	Region	Eco-incentive (€/unit)	Discount (%)
Valencia Salerno	West Med	161	23
Leixoes Zeebrugge	Atlantic	146	12
Lisbon Zeebrugge	Atlantic	123	10
Valencia Livorno	West Med	92	13
Vigo-Nantes	Atlantic	89	12
Barcelona Civitavechia	West Med	86	12
Barcelona Livorno	West Med	84	12
Gijon-Nantes	Atlantic	67	11
Santander Portsmouth	Atlantic	60	7
Barcelona Genoa	West Med	52	10
Bilbao-Zeebrugge	Atlantic	44	4

Table 5.- Eco-incentive per line and estimated discount over the actual sea-rates. Green scenario (LNG)

Bearing in mind this consideration, the table includes the estimated values of the eco-incentive and the corresponding discounts over the actual sea-rates.

Following this approach, the values of the eco-incentive, which are different for each line, are introduced in the calibrated transport modelling tool as a reduction of the maritime price. Being the maritime price one of the explanatory variables in the designing of the calibrated logit models -i.e. modal choice and route assignment-, the tool will return the new demand volumes per year for the 'road only' alternative and for each of the lines.

The simulation works in a way that the two scenarios -base and green- are compared, as already mentioned. Therefore, the effects on the targeted market that are due to the eco-incentive measure are actually the relative effects between the two scenarios.

On the other hand, the main effects that are measured as a direct result of the simulation exercise using the modelling tool are described below.

In first place, the overall external cost savings in the targeted market due to the eco-incentive measure. By overall it is meant not only the savings coming from the greener performance of the maritime services -which is the main goal of the scheme-, but also the additional savings coming -as a consequence- from the

modal shift that is induced by directing the eco-incentive through demand. The results will demonstrate that the main savings are not coming from modal shift, as road is running on EURO VI. Nevertheless, modal shift happens and will contribute to optimize the performance of the multimodal logistics chain, which is also on the backing principles of the common EU approach that MAE study is proposing to the further development of the sustainable freight transport services.

Another outcome are the new volumes for the 'road only' alternative and for the motorways of the sea option, including the shares for each of the lines considered in the analysis. This result is measured in number of units, using an average ratio of tones per unit based on observed values. This ratio, as observed, is slightly higher in the motorways of the sea compared to the 'road only' -e.g. an average 17 ton/unit compared to 19 ton/unit in the Atlantic MoS and 21 ton/unit in the West Med MoS-. This fact is taking into consideration that road operators that are using regular maritime services as part of his logistics tend to optimize the loads of their trucks. In other words, it proves that multimodal transport, which requires a more mature logistics, leads to a more resource efficient transport, which is the reason why multimodality deserves a primary attention within the sustainable freight transport services policy at EU level. On the other hand, the modelling tool gives also the possibility to simulate increases in the maritime prices, leading to modal back shift effects, such as in the base scenario where a 12% increase of the sea rates is considered, as described before.

Another relevant effect for the purposes of the ex-ante analysis is the total amount of eco-incentives that is mobilized by the scheme. This amount represents the total direct benefits to the users of the maritime services. Moreover, it gives an estimation of the level of funding that the eco-incentive scheme would need in the event of an implementing action. As mentioned before, with all lines running on LNG from day one the green scenario used for the simulation secures a reasonable approach to the maximum funding needs on the targeted market in the current technological context -where LNG would be the greenest action possible-. Either way, this outcome of the ex-ante analysis is considered to be very relevant to assess the funding availabilities from the public administrations (both national and EU level).

Ultimately, the simulation gives the possibility to estimate the 'indirect benefits' that the eco-incentive scheme would bring to the shipowners. By comparing the two scenarios -the green scenario which induce a modal shift, and the base scenario leading to a modal back shift effect- it is possible to estimate the demand and the corresponding incomes that the scheme would contribute to secure in each line. This 'indirect benefit' will be introduced in the shipowners' perspective tool to assess the contribution of such benefit to the shipowners' financial perspective regarding the green scenario.

Following the previous considerations, the results of the simulation are summarized below for both the West Mediterranean and the Atlantic regions. The results are presented for the complete 5 years period (2020-2024).

West Mediterranean

Running the simulation on the green scenario, the users of the maritime services would receive an eco-incentive ranging from 161 €/unit to 52 €/unit depending on the line. The main reasons for this wide range have been already explained. These values of the eco-incentive per line are simulated in the modelling tool as discounts over the sea rates.

ALTERNATIVE 1 GREENER (LNG)										
						Price incentive (%)	10	12	12	23	13
						Ext. Saving (%)	82	82	85	85	85
	Total	**Road**	**MoS**	**Ports**	**LINES**	**BCN-GEN**	**BCN-CIV**	**BCN-LIV**	**VAL-SAL**	**VAL-LIV**
Units (x1000)	-25	-129			104	1	33	17	32	22
Externalities (x1000€)	290.430	18.466	271.964	-8.336	280.300	29.274	113.304	34.309	57.907	45.506
Direct Benefit (x1000€)	98.324									
Indirect Benefit (x1000€)	58.892					343	19.131	9.035	17.770	12.614

Table 6.- Simulation of the green scenario. All lines switching to LNG and all users receiving an eco-incentive. Aggregated effects for the period 2020-2024. West Med.

Following the main goal of the eco-incentive scheme, the greener actions on the maritime leg lead to a significant improvement in the environmental performance of the motorways of the sea, which brings an external cost saving of 272 M€.

Moreover, thanks to the eco-incentive induced by the greener action, freight operators are attracted to the motorways of the sea resulting in 129.000 trucks shifted off the roads in the five-year period. This effect brings an additional 18,5 M€ external cost saving resulting in an overall 290,4 M€ saving for the transport system. This value is already estimating the external costs incurred by the shifted trucks when accessing ports through urban areas, following to the design of the external cost calculator.

The cost of the action is 98,3 M€, which become direct benefits to road haulers, while shipowners benefit from additional incomes of 58,9 M€ for the additional trucks shifted to their lines.

ALTERNATIVE 2 CONSERVATIVE (MGO)										
						Price incentive (%)	-12	-12	-12	-12	-12
						Ext. Saving (%)	38	38	46	46	46
	Total	Road	MoS	Ports	LINES	BCN-GEN	BCN-CIV	BCN-LIV	VAL-SAL	VAL-LIV
Units (x1000)	20	111			-91	-2	-38	-17	-11	-23
Externalities (x1000€)	132.716	-15.725	148.441	6.851	141.590	13.596	52.622	18.777	31.691	24.904
Direct Benefit (x1000€)	-67.572									
Indirect Beneft (x1000€)	- 51.313					- 691	- 22.231	- 9.340	- 5.999	- 13.051

Table 7.- Simulation of the base scenario. All lines switching to low sulphur fuels to comply with 2020 cap and increasing by 12% their sea rates. No eco-incentive is given to the users. Aggregated effects for the period 2020-2024. West Med.

In the base scenario, with all vessels switch to MGO/ULSHFO fuels to comply with the 0,5% sulphur cap by 2020, there is also an improvement in the environmental performance of the motorways of the sea which brings a total external cost saving of 148,5 M€, much lower than in the green scenario. This could be, by the way, a good estimation of the expected savings devoted to the implementation of the Directive (EU) 2016/802 on the targeted market by 2020 -i.e. the 'Regulation merit'-.

However due to the higher cost of such fuels, the lines increase their sea rates by 12% over current prices, leading to a modal back shift effect measured at 91.000 units off the motorways of the sea. This units are converted into 111.000 additional trucks back on the road due to the observed lower average net loads of the units using the 'road only' alternative, as explained before. This modal back shift effect leads to an increase of the external costs measured at 15,7 M€. As a result, the overall external cost savings in the base scenario is 132,7 M€.

No eco-incentive is given to any user in this scenario. Conversely, due to the increase of the sea rate, the users that remain at the motorways of the sea would have to assume an increase of 67,6 M€ in their costs. Moreover, the indirect benefits to the shipowners are negative as a result of the loss form the (back) shifted units (51,3 M€)

As mentioned, the goodness of the eco-incentive measure has to be assessed by comparing the two scenarios.

DIFFERENCES

	Total	Road	MoS	Ports	LINES	BCN-GEN	BCN-CIV	BCN-LIV	VAL-SAL	VAL-LIV
Units (x1000)	-45	-240			195	3	71	34	42	44
Externalities (x1000€)	157.714	34.191	123.523	-15.187	138.710	15.679	60.682	15.532	26.216	20.601
Direct Benefit (x1000€)	165.897									
Indirect Beneft (x1000€)	110.205					1.033	41.362	18.376	23.770	25.664

Table 8.- Relative effects comparing the green scenario and the base scenario. West Med.

Both scenarios induce external cost savings in the transport system. The base scenario due to a 'Regulation merit' and the green scenario due an 'environmental merit' based on a greener action that goes beyond the limits of the Regulation and is stimulated by the eco-incentive scheme. Therefore, the fair contribution of the eco-incentive measure to sustainability in the targeted market should be the difference between the external cost savings in the two scenarios, measured at 157,7 M€, of which 123,5 M€ come directly from the improvements on the environmental of the maritime leg whereas 34,2 M€ come from the addition of the modal shift effect in the green scenario and the modal (back) shift effect in the base scenario -i.e. effects with opposite signs-

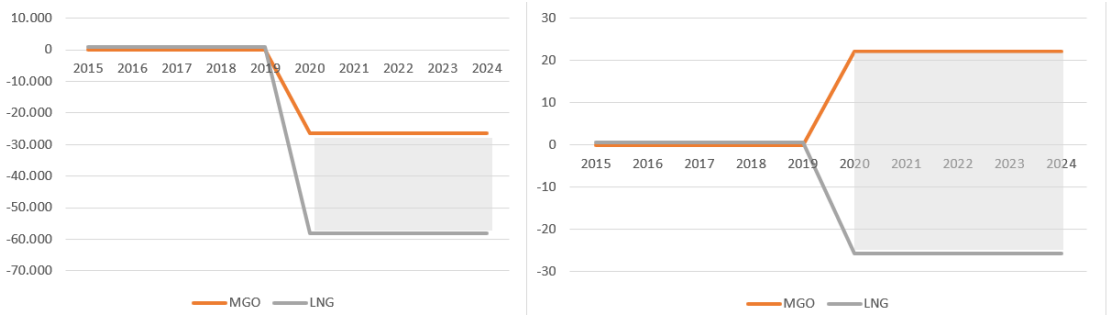

Figure 10.- Relative impacts on total external cost savings (left) and modal shift (right) comparing the green and the base scenarios. Costs (€ x 1000). Volumes (units x1000). West Med.

This 34,2 M€ also mean 240.000 trucks off the roads throughout the five-year period under analysis. This would definitively contribute to reduce road congestion in the Mediterranean Corridor, and particularly through main bottlenecks such as the Pyrenees and the Alps. Thus, proving how incentivizing sustainable freight transport services can contribute to the priorities of the Corridor and can also complement major infrastructural measures.

To estimate the direct benefits on the users of the maritime services two opposite effects shall be considered again. In the green scenario, all users will be given the eco-incentive. In the base scenario, all users will see an increase of 12% in the maritime price. Adding both effects -with opposite signs- the direct benefits to the users as a result of the eco-incentive scheme reaches 165,9 M€.

The same happens with the indirect benefits to the shipowners, having two effects with opposite signs in each scenario. In this case, however, the addition of such effects (leading to 110,2 M€) would not be that fair being the shipowners the promoters of the greener action. In this case it is more consistent to keep as indirect benefit devoted to the eco-incentive scheme just the 58,9 M€ they would get in the green scenario.

Ultimately, the cost of the measure, granting all the previous effects, would be 98,3 M€.

In terms of market share, with no action taken, the 'road only' traffic would grow by 29% during the five-year period -part coming from global mobility based on GDPs, part coming from the modal back shift effect- and the market share of the motorways of the sea would drop from 31% to 26%. In reverse, the eco-incentive measure would contain the increase of 'road only' traffic to 15% and the motorway of the sea share to 33%.

The slight difference between the total mobility in the scenarios with and without incentive is due to the observed lower average net loads of the units using the 'road only' alternative, as already mentioned.

	CURRENT 15-19				WITH ECO-INCENTIVE ALL LNG 20-24				WITHOUT ECO-INCENTIVE 20-24			
	TOTAL	ROAD	MoS	share	TOTAL	ROAD	MoS	share	TOTAL	ROAD	MoS	share
WEST MED	496	344	152	31%	595	397	198	33%	604	445	160	26%
Increase over current					20%	15%	30%	3%	22%	29%	5%	-4%

Table 9.- 'Road only' and MoS volumes (units x 1000) and shares (%). Observed (2015-2019) and Simulated values for the base scenario and the green scenario (2020-2024). Annual average values. West Med.

Then, with the estimated indirect benefit to the shipowners per each of the lines considered in the simulation is possible to carry out the final assessment of the eco-incentive scheme from the shipowners' perspective. To that end, the shipowners' perspective tool has been calibrated for the MAE example, by introducing on the one hand the estimated indirect benefit and on the other hand the operational and the additional investment costs resulting from the greener action -all vessels in all lines running on LNG- compared to the base scenario.

The following considerations apply to the assessment.

The indirect benefits, previously described, are estimated based on the additional incomes to the shipowners coming from the volumes secured to the maritime services by the eco-incentive scheme considering only the modal shift effect -green scenario-. For this calculation, the actual sea rates per unit are considered for each line, excluding the associated port costs that the additional/secured units should paid anyhow.

The estimation of the additional investment to switch to LNG follows the same approach that is typically used in the CEF program regarding eligibility. Therefore, the proposed estimation reflects the difference between the investment cost for the vessel running on LNG and the investment cost for the same vessel running on conventional fuels. Moreover, the number of vessels of the line are also taken into account. Ultimately, the calculation uses DNV-GL latest estimations as a

reference -i.e. an incremental investment of 600 €/kw to 840 €/kw for an LNG powered vessel-.

	BCN-GEN	BCN-CIV	BCN-LIV	VAL-SAL	VAL-LIV
	Barcelona Genoa	Barcelona Civitavechia	Barcelona Livorno	Valencia Salerno	Valencia Livorno
Line details	Mediterranean Sea	Mediterranean Sea	Mediterranean Sea	Mediterranean Sea	Mediterranean Sea
Fuel saving per trip	9.311 €	19.812 €	9.334 €	22.876 €	17.384 €
Induced modal shift	1 K units	33 K units	17 K units	32 K units	22 K units
Unit net contribution	400 €	580 €	540 €	560 €	580 €
Indirect benefits	342.549 €	19.130.713 €	9.035.129 €	17.770.427 €	12.613.527 €
Unit investment	23.362.069 €	29.913.793 €	15.172.414 €	18.103.448 €	18.103.448 €
Incremental LNG inv.	23.362.069 €	59.827.586 €	30.344.828 €	36.206.897 €	36.206.897 €
cost of LNG Kw	667 €	598 €	702 €	754 €	754 €
Annual fuel saving	2.904.954 €	12.362.770 €	2.912.153 €	7.137.159 €	5.423.849 €
Indirect benefit/investment	1%	32%	30%	49%	35%
Indirect benefit/operation	1%	8%	7%	13%	13%
WITH NPV	29.602.216 €	79.797.641 €	6.301.793 €	49.755.647 €	28.498.696 €
IRR	11%	25%	11%	26%	19%
Payback	14 years	5 years	14 years	6 years	7 years
WITHOUT NPV	5.712.920 €	64.441.166 €	-1.198.004 €	35.571.241 €	18.247.189 €
IRR	11%	20%	7%	19%	14%
Payback	14 years	7 years	NEVER	7 years	9 years

Table 10.- Contribution of the eco-incentive measure to the financial result of the green action in the West med (per line).

The fuel costs, at the time of the calibration exercise, is measured at 643 €/ton for the low sulfur conventional fuel -MGO or alternatively ULSFO- whereas the LNG fuel is set at 472 €/ton -based on a 25 €/MWh for the molecule and a 5 €/MWh for the logistics-.

The operational profile of the vessel (speed, distance and frequency) remains unaltered and is taken or estimated from real operations.

The weighted average cost of capital (WACC) is simulated at 8% and the residual value of the investment at 5%, based on market common values.

Following these considerations, the shipowners' perspective tool is prepared to assess the contribution of the eco-incentive scheme to the shipowners' willingness to switch to the greener action by comparing the financial impact of the additional investment in the cases with and without eco-incentive measure. The relevant outcomes for the particular case of LNG green actions in the West Mediterranean for the targeted market are summarized below.

The main contribution of the eco-incentive scheme to the shipowners is as a catalyst of the investment decision. By benefiting from the scheme, they would see their paybacks reduced and the returns of the investments would be significantly increased -50% in average-. In one case the scheme would be critical to the viability of the investment.

Another key outcome is also that the indirect benefit to the shipowner referred to the total operational costs of the line is in all cases below the 30% -far below in all cases-. This result contributes to the consistency of the eco-incentive measure with the state aid rules as interpreted by the 2004 Maritime guidelines.

It is also interesting assessing the contribution of the indirect benefit to the additional investment, with values ranging from 32% to 49%[1]. This could be interpreted as a co-financing rate from the shipowners' perspective, placed above the typical 20-30% rates of the CEF work programs for the freight transport services and motorways of the sea priorities -a sort of leverage effect on the EU funding-.

Ultimately, the fact that the eco-incentive measure is contributing, by definition, to minimize the risk of demand, makes reasonable thinking that this scheme could grant the shipowners with better access to EU financial instruments for their green actions. This would improve the financial results for the shipowners creating a sort virtuous circle by contributing on the other hand to the use of financial instruments aimed at increasing the leverage effect of the EU budget.

Atlantic

Following the same approach with than in the West Mediterranean, the results for the simulation in the Atlantic are presented below.

Running the simulation on the green scenario, the users of the maritime services would receive an eco-incentive ranging from 146 €/unit to 44 €/unit depending on the line. The main reasons for this wide range have been already explained. These values of the eco-incentive per line are simulated in the modelling tool as discounts over the sea rates.

ALTERNATIVE 1 GREENER (LNG)											
						Price incentive (%)	4	7	11	12	12	10
						Ext. Saving (%)	76	76	76	76	77	70
	Total	Road	MoS	Ports	LINES	BIL/SAN-ZE/	BIL/SAN-UK	GIJON-NANTES	VIGO-NANTES	LEIXOES-ZE/	LIS/SET/SIN-ZE/
Units (x1000)	-19	-157			138	10	22	18	22	43	23
Externalities (x1000€)	226.726	30.685	196.042	-13.475	209.517	40.973	62.481	18.824	38.845	34.910	13.484
Direct Benefit (x1000€)	49.813										
Indirect Benefit (x1000€)	105.275					7.839	13.693	8.204	11.272	37.574	26.692

Table 11.- Simulation of the green scenario. All lines switching to LNG and all users receiving an eco-incentive. Aggregated effects for the period 2020-2024. Atlantic.

[1] The Genoa-Barcelona line is not considered in this analysis. Most of the route is not eligible (Tangier-Genoa) leading to results that are not consistent

Following the main goal of the eco-incentive scheme, the greener actions on the maritime leg lead to a significant improvement in the environmental performance of the motorways of the sea, which brings an external cost saving of 196,0 M€.

Moreover, thanks to the eco-incentive induced by the greener action, freight operators are attracted to the motorways of the sea resulting in 157.000 trucks shifted off the roads in the five-year period. This effect brings an additional 30,7 M€ external cost saving resulting in an overall 226,7 M€ saving for the transport system. This value is already estimating the external costs incurred by the shifted trucks when accessing ports through urban areas, following the design of the external cost calculator.

The cost of the action is 49,8 M€, which become direct benefits to the road operators, while shipowners benefit from additional incomes of 105,3 M€ for the additional trucks shifted to their lines.

ALTERNATIVE 2 CONSERVATIVE (MGO)											
	Price incentive (%)	-12	-12	-12	-12	-12	-12				
	Ext. Saving (%)	32	32	32	32	34	27				
	Total	Road	MoS	Ports	LINES	BIL/SAN-ZE/	BIL/SAN-UK	GIJON-NANTES	VIGO-NANTES	LEIXOES-ZE/	LIS/SET/SIN-ZE/
Units (x1000)	19	152			-133	-24	-31	-17	-16	-29	-17
Externalities (x1000€)	71.743	-29.033	100.776	13.066	87.710	17.051	26.002	7.834	16.166	15.453	5.203
Direct Benefit (x1000€)	-56.863										
Indirect Beneft (x1000€)	-120.543					-21.318	-22.961	-9.268	-10.614	-31.922	-24.460

Table 12.- Simulation of the base scenario. All lines switching to low sulphur fuels to comply with 2020 cap and increasing by 12% their sea rates. No eco-incentive is given to the users. Aggregated effects for the period 2020-2024. Atlantic.

In the base scenario, with all vessels switch to MGO/ULSHFO fuels to comply with the 0,5% sulphur cap by 2020, there is also an improvement in the environmental performance of the motorways of the sea which brings an external cost saving of 100,8 M€, much lower than in the green scenario. This could be, as already mentioned, a good estimation of the expected savings devoted to the implementation of the Directive (EU) 2016/802 on the targeted market by 2020 - i.e. the 'Regulation merit'-.

However due to the higher cost of such fuels, the lines increase their sea rates by 12% over current prices, leading to a modal back shift effect measured at 133.000 units off the motorways of the sea. This units are converted into 152.000 additional trucks back on the road due to the observed lower average net loads of the units using the 'road only' alternative, as explained before. This modal back shift effect leads to an increase of the external costs measured at 29,0 M€. As a result, the overall external cost savings in the base scenario is 71,7 M€.

No eco-incentive is given to any user in this scenario. Conversely, due to the increase of the sea rate, the users that remain at the motorways of the sea would have to assume an increase of 56,9 M€ in their costs. Moreover, the indirect

benefits to the shipowners are negative because of the loss form the (back) shifted units (120,5 M€)

As mentioned, the goodness of the eco-incentive measure must be assessed by comparing the two scenarios.

DIFFERENCES

	Total	Road	MoS	Ports	LINES	BIL/SAN-ZE/	BIL/SAN-UK	GIJON-NANTES	VIGO-NANTES	LEIXOES-ZE/	LIS/SET/SIN-ZE/
Units (x1000)	-37	-309			272	34	53	35	38	71	40
Externalities (x1000€)	154.983	59.718	95.266	-26.541	121.807	23.922	36.479	10.990	22.679	19.457	8.280
Direct Benefit (x1000€)	106.676										
Indirect Beneft (x1000€)	225.817					29.157	36.653	17.473	21.886	69.496	51.153

Table 13.- Relative effects comparing the green scenario and the base scenario. Atlantic.

Both scenarios induce external cost savings in the transport system. The base scenario due to a 'Regulation merit' and the green scenario due an 'environmental merit' based on a greener action that goes beyond the limits of the Regulation and is stimulated by the eco-incentive scheme. Therefore, the fair contribution of the eco-incentive measure to sustainability in the targeted market should be the difference between the external cost savings in the two scenarios, measured at 155,0 M€, of which 95,3 M€ come directly from the improvements on the environmental of the maritime leg whereas 59,7 M€ come from the addition of the modal shift effect in the green scenario and the modal (back) shift effect in the base scenario -i.e. effects with opposite signs-

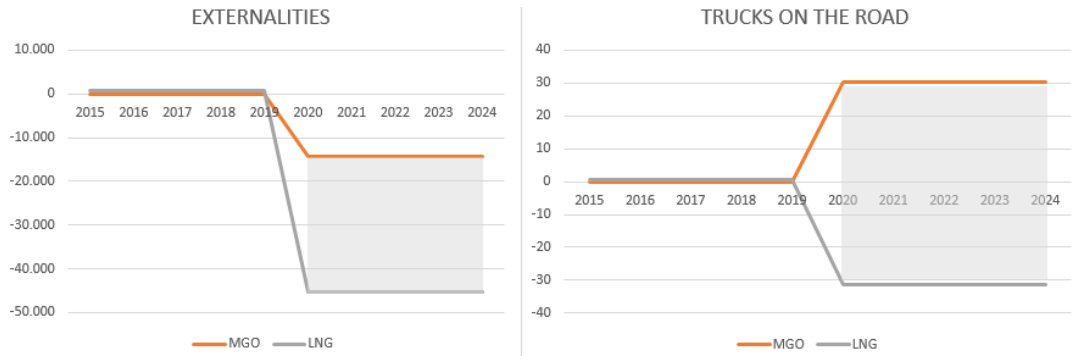

Figure 11.- Relative impacts on total external cost savings (left) and modal shift (right) comparing the green and the base scenarios. Costs (€ x 1000). Volumes (units x1000). Atlantic.

This 59,7 M€ also mean 309.000 trucks off the roads throughout the five-year period under analysis. This would definitively contribute to reduce road congestion in the Atlantic Corridor, and particularly through the Pyrenees. Thus, proving how incentivizing sustainable freight transport services can contribute to

the priorities of the Corridor and can also complement major infrastructural measures.

To estimate the direct benefits on the users of the maritime services two opposite effects shall be considered again. In the green scenario, all users will be given the eco-incentive. In the base scenario, all users will see an increase of 12% in the maritime price. Adding both effects -with opposite signs- the direct benefits to the users as a result of the eco-incentive scheme reaches 106,7 M€.

The same happens with the indirect benefits to the shipowners, having two effects with opposite signs in each scenario. In this case, however, the addition of such effects -leading to 225,8 M€- would not be that fair being the shipowners the promoters of the greener action. In this case it is more consistent to keep as indirect benefit devoted to the eco-incentive scheme just the 105,3 M€ they would get in the green scenario.

Ultimately, the cost of the measure, granting all the previous effects, would be 49,8 M€.

In terms of market share, with no action taken, the 'road only' traffic would grow by 21% during the five-year period -part coming from global mobility based on GDPs, part coming from the modal back shift effect- and the market share of the motorways of the sea would remain in the current 3%. In reverse, the eco-incentive measure would contain the increase of 'road only' traffic to 18% and raise the motorway of the sea share to 5%.

The slight difference between the total mobility in the scenarios with and without incentive is due to the observed lower average net loads of the units using the 'road only' alternative, as already mentioned.

	CURRENT 15-19				WITH ECO-INCENTIVE ALL LNG 20-24				WITHOUT ECO-INCENTIVE 20-24			
	TOTAL	ROAD	MoS	share	TOTAL	ROAD	MoS	share	TOTAL	ROAD	MoS	share
ATLANTIC	2.218	2.146	73	3%	2.676	2.538	138	5%	2.684	2.600	83	3%
Increase over current					21%	18%	89%	2%	21%	21%	14%	0%

Table 14.- 'Road only' and MoS volumes (units x 1000) and shares (%). Observed (2015-2019) and Simulated values for the base scenario and the green scenario (2020-2024). Annual average values. Atlantic.

As for the exercise on the West Mediterranean, the estimated indirect benefit to the shipowners per each of the lines considered in the simulation leads to the assessment of the eco-incentive scheme from the shipowners' perspective.

	BIO-ZBR	SAN-PMT	GIJ-NAN	VGO-NAN	LEX-ZBR	LIS-ZBR
	Bilbao-Zeebrugge	Santander Portsmouth	Gijon-Nantes	Vigo-Nantes	Leixoes Zeebrugge	Lisbon Zeebrugge
Line details	Atlantic	Atlantic	Atlantic	Atlantic	Atlantic	Atlantic
Fuel saving per trip	16.188 €	12.960 €	7.372 €	11.509 €	17.129 €	20.642 €
Induced modal shift	10 K units	22 K units	18 K units	22 K units	43 K units	23 K units
Unit net contribution	765 €	612 €	446 €	509 €	883 €	1.172 €
Indirect benefits	7.838.936 €	13.692.791 €	8.204.422 €	11.271.814 €	37.574.383 €	26.692.211 €
Unit investment	18.103.448 €	26.315.789 €	15.172.414 €	15.172.414 €	18.103.448 €	18.103.448 €
Incremental LNG inv.	36.206.897 €	26.315.789 €	15.172.414 €	30.344.828 €	54.310.345 €	18.103.448 €
cost of LNG Kw	754 €	658 €	702 €	843 €	724 €	724 €
Annual fuel saving	5.050.652 €	2.021.721 €	2.300.087 €	5.386.389 €	5.344.146 €	2.146.794 €
Indirect benefit/investment	22%	52%	54%	37%	69%	147%
Indirect benefit/operation	5%	23%	14%	15%	19%	30%
WITH NPV	20.956.322 €	5.123.801 €	14.522.347 €	32.852.529 €	29.565.724 €	24.753.280 €
IRR	16%	11%	22%	22%	17%	34%
Payback	9 years	13 years	5 years	5 years	6 years	3 years
WITHOUT NPV	14.444.700 €	-6.074.107 €	7.944.104 €	23.778.924 €	-643.537 €	3.583.278 €
IRR	13%	5%	14%	17%	8%	10%
Payback	12 years	NEVER	10 years	8 years	NEVER	14 years

Table 15.- Contribution of the eco-incentive measure to the financial result of the green action in the Atlantic (per line).

The same considerations as described for the West Mediterranean apply to the assessment in the Atlantic.

Following these considerations, the shipowners' perspective tool is prepared to assess the contribution of the eco-incentive scheme to the shipowners' willingness to switch to the greener action by comparing the financial impact of the additional investment in the cases with and without eco-incentive measure. The relevant outcomes for the particular case of LNG green actions in the Atlantic for the targeted market are summarized below.

The main contribution of the eco-incentive scheme to the shipowners is again as a catalyst of the investment decision. By benefiting from the scheme, shipowners would see reduced the paybacks of their investments and the returns of such investments would be increased significantly -with the IRR placed above 20% in some cases-. In two cases the scheme would be critical to the viability of the investment.

In all cases, the indirect benefit to the shipowner referred to the total operational costs of the line is compliant with the 30% limit as interpreted by the 2004 maritime guidelines on state aid rules. Moreover, it must be noticed that the indirect benefit in the Atlantic, due to the higher demand elasticity resulting from the calibrated model, is significantly higher than the eco-incentive -more than double-. On the other hand, the eco-incentive is aimed at being co-financed by the EU funding, to which the state aid rules not apply. Therefore, the ratio comparing the real incentive over the operational costs would be clearly placed below 30% in all cases.

It is also interesting assessing the contribution of the indirect benefit to the additional investment, with values over 50% in most cases. As mentioned for the West Mediterranean, this could be interpreted as a co-financing rate from the

shipowners' perspective placed above the typical 20-30% rates given by the CEF work programs in the sustainable freight transport services and motorways of the sea priorities -a sort of leverage effect of the EU funding-.

Ultimately, the same consideration that was made for the West Mediterranean cases applies to the Atlantic case, regarding the contribution of the eco-incentive scheme to the further development of EU financial instruments, by means of reducing the risk of demand -by definition-.

Aggregate results

The main results are summarized below in aggregate for both the West Mediterranean and the Atlantic regions in the complete five-year period.

As a main outcome, the eco-incentive measure proves its ability to trigger greener actions in the maritime leg within the targeted market -which is remembered it was the main goal of the measure-.

PERIOD 20-24							
	ECO-INCENTIVE (a)	GREEN ACTIONS (b)	EXT. SAVINGS (c)	IND. BENEFITS (d)	Effect 1: b/a	Effect 2: c/a	Effect 3: d/a
WEST MED	98.324	162.586	157.714	58.892	1,7	1,6	0,6
ATLANTIC	49.813	180.454	154.983	105.275	3,6	3,1	2,1
TOTAL	148.137	343.040	312.697	164.167	2,3	2,1	1,1

Table 16.- Main effects of the eco-incentive measure (€ x 1000). West Med and Atlantic.

In particular, and considering the green scenario for the MAE example -all lines switching to LNG-, the eco-incentive scheme would clearly improve the financial conditions to trigger 343,0 M€ green investments in market conditions

As a result, an overall 312,7 M€ external cost savings would be attained, of which 218,8 M€ would come directly from the green actions -improving the environmental performance of the maritime leg- whereas 93,9 M€ would be additional savings by securing 550.000 trucks off the roads from the West Med and Atlantic corridors.

It must be noticed that 27,9 M€ out of the total 312,7 M€ external cost savings are due to a net reduction of 820.000 tons of CO_2 emissions -based on the assumptions of the external cost calculator tool- which means reducing by 27% the emissions of CO_2 in the targeted market.

All in all, the cost of the measure for the public funding would be 148,1 M€ -i.e. the total amount of eco-incentives received by the actual and potential users of the maritime services during the five-year period-. This would be the budget aimed at EU co-financing following the common EU approach.

The leverage effect of the eco-incentive measure is positive by all concepts and higher in the Atlantic, due to a higher elasticity to the incentive from the road freight operators in that region explained through the calibration exercise of the modelling tool -which is interpreted with the meaning that the motorways of the sea in the Atlantic are less developed and have therefore a higher growth potential-.

On the legal aspects, the intensity of the public support compared to the operational costs of the maritime services would be compliant with the applicable state aid rules -a needed update of the 2008 Motorways of the Sea guidelines should bring compatibility to the 5 years period on duration. This is not considered to be an issue as long as the proposed approach finds the EU support-.

In terms of the EU funding, the eco-incentive scheme for the MAE study case would entail a budget need ranging from 30 M€ to 44 M€ for the five-year period depending on the co-financing rate -from 20% to 30%, according to the typical values considered by the CEF envelope for the sustainable freight transport services and motorways of the sea priorities-. The remaining budget would have to be complemented by the Member States, according to the co-responsibility principle as proposed for the common EU approach. Therefore, it would be up to each Member State to decide if and how to allocate this budget in the event of an implementing action following the proposed approach.

Anyhow, and for the particular case of the MAE case study, the eco-incentive scheme would bring 343,0 M€ investments on greener actions with a total EU funding of 44 M€, representing a 13% co-financing rate. The same investments could end up taking 102,8 M€ from the EU funding within the current approach of the CEF work programs -using as example the 30% co-financing rate in the motorways of the sea priority-. To that end, of course, the Member States involvement is essential.

G. SCHEME'S POSSIBLE IMPLEMENTATION APPROACH

Proving the positive impacts of the eco-incentive measure, by means of the ex-ante analysis, is one of the backing principles for the common EU approach as proposed.

Nevertheless, the effectiveness and further viability of the scheme would depend also on how the measure is implemented. This is also relevant to the compliance with some other principles of the common EU approach. In particular, those related to the need of minimizing the risk of fraud, the need to minimize additional bureaucracy, the need to demonstrate the performance achieved by the scheme as well as the need to adequately address the consistency with the operational structures of the EU funding program to which the scheme is submitted.

Furthermore, a good design of the procedures affecting the beneficiaries -both direct and indirect-, the timings, the data needs, the supporting technologies, etc. is essential for the eco-incentive scheme to be effective in a market environment.

To that extent, MAE study is issuing, as part of its final report, a preliminary analysis on a possible design for the implementing process of the MAE case study, both for the administrative and the technological aspects.

This analysis makes use of the experienced achieved in the Italian ecobonus program, which already implemented direct incentives to the users of the motorways of the sea. MAE is a different approach in many ways, bringing a greener performance of the maritime services to the upfront of the measure and thus introducing the need for different procedures. Nevertheless, it keeps the directing of the eco-incentive through demand which entails similar procedures as regard the users.

The analysis is aimed at a first approach to the key implementing aspects of the scheme, related basically to the entities involved, the relevant procedures -timings, registration, boarding events collection, route monitoring, payments, etc.-, backing technologies -system architecture, compatibilities with NSW and MRV systems, transactional files, databases, reporting, etc.-. Also, the analysis describes the main legal aspects that should be addressed prior to any implementing action, such as the binding contracts with the scheme beneficiaries -both direct and indirect-, the possibility to take data from NSW and THETIS MRV databases or the limitations from data protection regulation.

Moreover, this preliminary analysis is assuming that CEF is the EU funding program to which the eco-incentive scheme is submitted.

So as to get an idea of the proposed approach, some of these aspects are briefly described below

The implementing process of the eco-incentive could be outlined in two main separates diagrams. By one hand, the procedures that need to be completed to secure the funding -both EU and national-. And on the other hand, once the funding is secured, the processes involving the implementing of the eco-incentive measure itself.

On the first hand, the procedure to the awarding of the EU funding would be the usual one in CEF. To that extent, the work programs should incorporate as eligible the proposed common EU approach to eco-incentive measures. As for the national funding, the procedure implies the approval on the national budgets as well as the assessment on the compliance with state aid rules. In this regard, it is emphasized that the 2008 Motroways of the Sea guidelines should be updated to the CEF standards regarding the maximum duration and intensities of the EU funding. The ex-ante analysis for the MAE case study simulates a 5 year period for the eco-incentive measure which would meet current CEF standards

as well as it would equal the maximum duration as interpreted for the rail transport -leading also to a level playfield for all modes of transport.

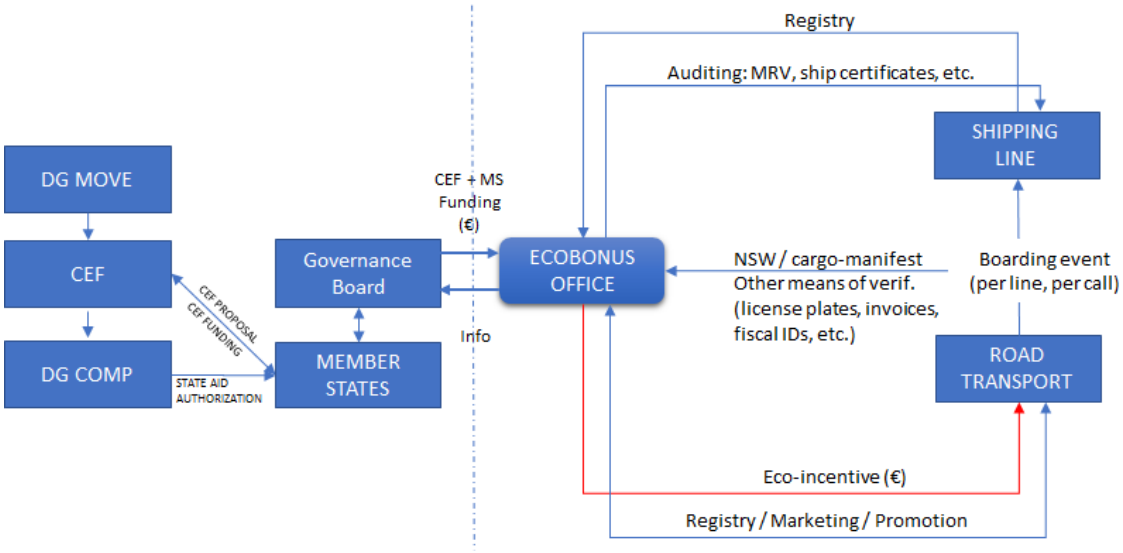

Figure 9.- Possible implementing chart for the eco-incentive scheme through CEF. MAE study case

Moreover, the Member States' co-responsibility in the implementation of the scheme is also secured -this is a requirement of the common EU approach, as proposed-. In fact, according to the CEF structure, the Member States would submit the eco-incentive scheme proposal and would be responsible for its implementation in case of award.

Ultimately, to streamline this part of the process, it would be possible to coordinate from the Commission the awarding process for the EU funding and the state aid authorization process, being both linked through their respective assessments.

Regarding the implementation of the eco-incentive scheme -once the funding is secured-, one of the most relevant procedures refer to how the beneficiaries shall be granted access to the program features.

To that extent, a 'dual call mechanism' approach is proposed for the MAE case study. The first call would be addressed to the shipowners while the second would be addressed to the actual and potential users of the maritime services.

With the first call, the ship owners would register in the scheme's managing platform and submit the candidate lines for benefiting from the scheme. In doing so they shall produce evidence of the green actions that they have taken therein

to improve the environmental performance of their lines -it is emphasized that this is the main goal of the eco-incentive measure-.

Only the lines that are running at the time of the call would have the possibility to submit into the program. New lines starting after the launching of the call would have to wait to the next call for shipowners to be submitted. The calls for the shipowners are proposed to be annual on a five year total duration of the eco-incentive scheme.

At registration, the shipowners will provide all the information needed to assess the environmental merit of the line using the external cost calculator tool. The assessment shall also include the compliance with the eligibility criteria, as described. As a result of the assessment, the list of lines deserving an eco-incentive and the values of such eco-incentives -per unit- will be published so as to inform the actual and potential users of these lines. On a yearly basis, following each call for the shipowners, a new list of lines with the corresponding eco-incentives per unit will be published.

After the publication of the first list, the call for the actual and potential users of these lines could be opened. With this call, the users that are eligible according to the eligibility criteria may be registered in the program and shall produce evidence of the boarding events on relevant declarations. Unlike the call for shipowners, and in order to minimize additional bureaucracy, this call for the users of the maritime services could possibly remain open for the complete period of the eco-incentive scheme (e.g. 5 years).

Proving the boarding event is the most critical process to approve the payment of the eco-incentive as well as one of the more important ones in terms of minimizing the risks of fraud. Moreover, the process itself should not prevent the users and/or the shipowners to benefit from the program as a result of an excessive bureaucracy. Following these considerations, this process could be addressed by the coordinated use of three main sources: the user declaration, where all data related to the boarding event shall be requested; the shipowners' -through the transport invoices- and; the cargo manifest declared through the National Single Windows. Combining these sources of information, all main transport facts related to the boarding event could be cross-checked, such as the equipment type and license plate, the fiscal ID of the user, the date and time, etc.

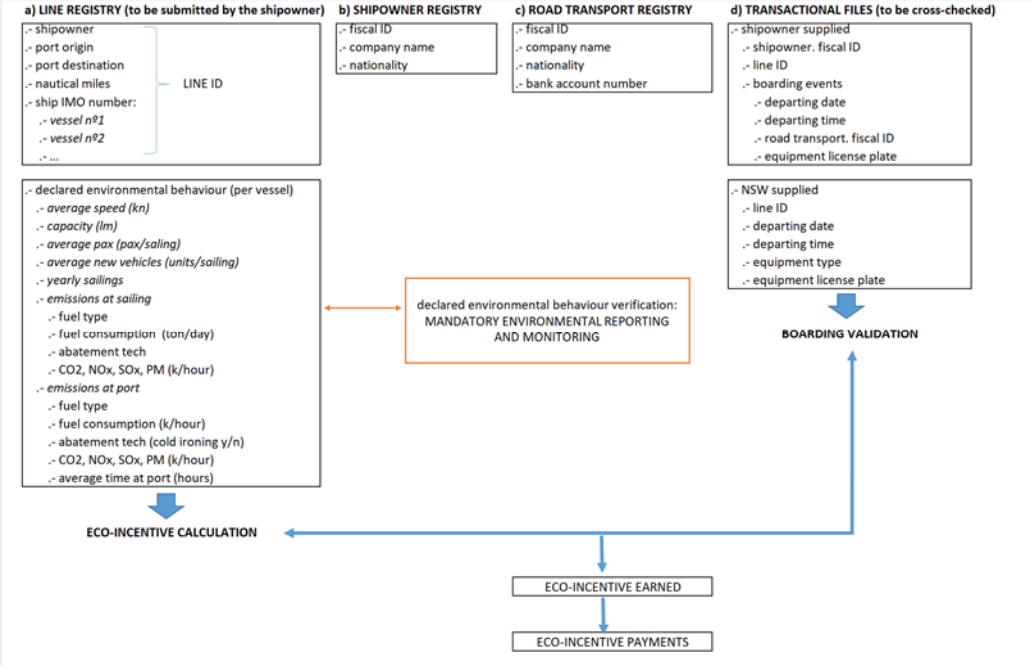

Figure 10.- Possible data request at registration and transactional files. MAE study case

Some investigation has been made on the possibility of using this approach and some issues have been identified that could be reasonable solved in the event of moving to real implementing actions. Therefore, the approach is valid at this preliminary stage. As example, registering license plate data in the cargo manifests is not mandatory, according to the current NSW regulation. However, it is possible to include it on a voluntary basis. Moreover, Member States could address this particular aspect to the work in progress for the further development of the European single window.

Another relevant check concerns to maritime services in order to control that the lines keep the same environmental performances that were used to assess the environmental merits and to calculate the corresponding eco-incentives.

Therefore, the shipowners could be asked to provide the relevant information to make these checks. Moreover, this exercise could also be cross-checked with other sources of information, such as the official THETIS MRV data base and the AIS.

Ultimately, MAE study ends at a very preliminary stage with regards to the administrative and technological implementing aspects of the eco-incentive scheme. Nevertheless, as a result of the analysis, the proposed approach for the MAE case study is seen as possible.

The main ideas of this approach have been presented in this preliminary document and will be included further in the Final documentation of the MAE action.

H. CONCLUSIONS AND NEXT STEPS

MAE study ends at proposal level regarding twofold.

On the one hand, it outlines a common EU approach to eco-incentives measures for the further development of sustainable freight transport services in the EU transport system, opened to any region and mode of transport.

On the other hand, it delivers a possible application of the common approach taking as example the motorways of the sea market in the West Mediterranean and the Atlantic regions.

At a preliminary stage, the study proves the viability of the approach as well as the positive impacts of the example.

However, these outcomes are based on different assumptions that need broad consensus at all levels to move forward with real implementing actions.

On the institutional level, the validation of the common approach by the Commission, the Member States and the Parliament is essential so as to provide the legal basis for such actions, particularly with regards to its eligibility through the CEF work programs and its consistency with state aid rules. The ongoing negotiations for the next CEF2 Regulation (2021-2027), together with the regular meetings of the CEF and TEN-t Committees bring the appropriate contexts to debate on the interest of the approach and to work further on the consensus at this level.

Moreover, the further needed amendment on the 2008 Motorways of the Sea guidelines could be the right place to uptake the approach regarding state aid rules, based on the assumptions of the MAE example.

Further to the common approach, the ex-ante analysis that has been carried out as example takes also different assumptions which are subject to validation.

First and foremost, the assumptions related to the external cost calculator tool, which are critical to assess the environmental merits and to calculate the eco-incentives. These assumptions refer to emission factors and monetization values from the road and maritime transport socio-environmental performances in the targeted market and are based on existing references up to date.

These assumptions should be confronted in particular with the ongoing revision of the Commissions' 'Handbook on External Costs of Transport', once it is published.

Also, the calibrated transport modelling tool, which is essential to the impact assessment of the eco-incentive measure, incorporates some assumptions for the calibration exercise, due to the lack of available data. And although the

calibration is considered valid from the statistical point of view, it could be further improved by providing additional data.

As for the shipowners' perspective tool, again, different assumptions have been taken regarding the additional investments, the fuel prices, the main financial parameters, etc. which would worth a feedback from the industry.

Ultimately, also the scenarios considered for the assessment incorporate assumptions that might be revised if needed (e.g. the 12% increase in the sea rate as a result of the higher cost of MGO by 2020 in the base scenario, as described).

In summary, MAE study is aimed at proposing a new approach to eco-incentive measures towards sustainable freight transport services based on different assumptions and criteria that need further consensus before moving to real implementing actions.

This document has been drafted to facilitate the understanding of the objectives and outcomes of the MAE project as well as to invite everyone that could be interested to provide feedback on the different aspects behind the proposed approach and the ex-ante analysis that has been delivered as example.

Any contribution can be addressed to the following address:

mae.project@puertos.es

P.D. As part of this preliminary report three excel files are included with a version for dissemination of each tool -namely, the external cost calculator, the calibrated transport model and the shipowners' perspective-. A short user manual for each tool is also included (in pdf format). This information is available in the following link:

https://www.dropbox.com/sh/7fmcr2nfvyytt6y/AAB-v9iJ0uK8TGaw-lSHqCP3a?dl=0