MEDITERRANEAN TRANSMISSION SYSTEM OPERATORS

Deliverable 2.3

Guidelines of interconnections cost allocation for the integration of the Mediterranean Electricity System and related operational procedures

EC DEVCO - GRANT CONTRACT: ENPI/2014/347-006

"Mediterranean Project"

Task 2 "Planning and development of the Euro-Mediterranean Electricity Reference Grid "

Med-TSO is supported by the European Union.
This publication was produced with the financial support of the European Union. Its contents are the sole responsibility of Med-TSO and do not necessarily reflect the views of the European Union.

1. Introduction

The objective of this report is to initiate the development of general principles, guidelines and criteria in view of the definition of a methodology for allocation of costs and risks, to be used when assessing the development of international interconnections between power systems within the Mediterranean region, as well as proposing which practical mechanisms could be applied prior to the definition of a consolidated methodology.

It is therefore a first step, focusing more in the different elements necessary for tackling the topic than attempting to give final solutions, which is not straightforward nor is solved when different power systems and electricity markets are in place.

In summary, the document puts forward the basic concepts to take into account, the conceptual reference for assessment (the Cost-Benefit Analysis), a first set of primary reflections on the formulation of costs and risks and preliminary criteria and guidelines, as well as the most relevant open questions about cost allocation of interconnection projects.

In this context, a very valuable contribution of MedReg is greatly recognized, where a number of elements are put forward, and it constitutes a first preliminary common reflection on the subject that should be further developed and more deeply analyzed in the future within next stages of the Mediterranean Project.

2. The Cost Benefit Analysis

As a basic reference in the assessment of the cost allocation issue, the Cost Benefit Analysis brings the primary tool for defining and then assessing the *pros* and *cons* associated to the implementation of a new interconnection transmission facilities. A conceptual simplified classification follows:

- The PROS.- In general, the **benefits** of international interconnections development may be recognized in terms of the consequences of an increase or an improvement of the interconnection capacity among systems, which could be classified along 3 general categories:
  - Better **technical** performance derived from the increase in the security of supply and reliability for the affected power systems, very depending on their operational features[1].
  - **Economic** efficiency, associated to the basically better resulting energy mix and increase in the competition due to a higher interchange capacity and the possibility of sharing ancillary resources (system services) which should lead to reduced energy prices for the end consumer.
  - Higher **sustainability**, mainly coming from the possibility of a more environmentally friendly energy production.

- The CONS.- On the other hand, the "capture" of the potential benefits within the preceding categories has to be confronted with the direct and indirect **costs and risks** associated to the development of the interconnections.

The trade-off of the *benefits* vs the *costs and risks* is carried out through the **Cost-Benefit Analysis (CBA)** and includes assessment of the different components of the previously introduced PROS and CONS, which may be converted into economic terms or left in a more basic non-economic index. In general, risk and uncertainty are detrimental for investment whatever business model may be considered.

The EU approach to assessing interconnection projects consists in simulating the benefits provided by a new interconnection according to different scenarios which are expected to be representative enough of the future conditions where the new asset will operate. The economic evaluation is based on the concept of socio-economic welfare which consists in assessing the generation cost reductions and positive externalities provided by the interconnection. This approach involves developing a reliable model of the system and scenarios accurately describing possible future developments. In the EU, the market design (harmonized market rules in particular) and the level of development of electricity markets make it possible to run competitive models evaluating projects according to wholesale prices (assuming price equals marginal generation costs).

In the wider Mediterranean region, such an approach is much more difficult to be implemented because of the topology of existing systems (for example, in the south of the Mediterranean Region, networks are less meshed and follow the sea shore where the population is concentrated), the lack of reserve margins on the generation side and the sustained increase of consumption in a context of non-competitive organization of markets. The questions about interconnections thus relate more to energy policy issues than market aspects.

Indeed, notwithstanding the recent progress towards global economic and financial integration, national borders in the Mediterranean area still show a significant and negative influence on energy trade. This is particularly the case for South–South electricity interconnections, where a physical connection is already in

[1] There are different kinds of operating modes of interconnections according to the specific situations of the interconnected systems: flow levels in both directions relatively similar, asymmetric flow (a direction is dominant), single flow direction when a system depends on another one for its supplies; and also depending on the usage rules in each interconnection (auctions, bilateral contracts, market-based).

place but the rate of utilization of the existing capacity is rather low. Concerning North–South interconnections, the Spain–Morocco interconnection is the most used interconnection in the Mediterranean region (indeed is the only existing nowadays) for what concerns energy exchange, displaying a significant load factor and consistently exporting excess capacity from Spain towards North Africa. In this specific case, the Moroccan operator, ONEE, is still vertically integrated and uses the interconnection to source electricity in the Spanish market. This is an example of a business model for interconnections in the absence of a competitive market on the buyer's side.

The fact that intra-regional interconnections are not optimally operated shows that interconnection investment in the Southern shore has been mainly driven by considerations related to security of supply rather than to the search for holistic economical savings. It also reveals the persistence of a problem of absence of shared rules among Southern Mediterranean countries. This challenge should be further explored and tackled when discussing viable options for a Mediterranean interconnection methodology. Anyway, a specific methodology based on EU approach has been developed within Med-TSO for the Mediterranean region considering its specific circumstances.

The general approach for the CBA assessment adopted by Med-TSO is based on ENTSO-E current proposal according to the next Figure.

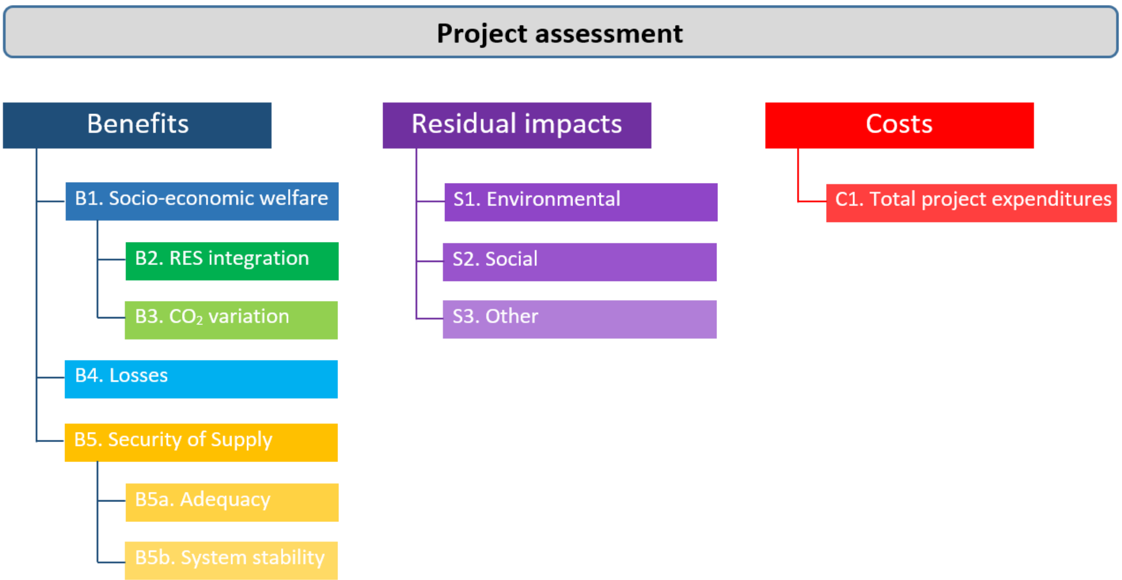

Figure 1: Main indicators of CBA methodology (source: ENTSO-E methodology)

In Annex A this CBA methodology is described in a summarized way. For more details see the Deliverable 2.2.3 (Proposal of a Cost Benefit Analysis Methodology for transmission project assessment).

3. The Allocation of Costs and Risks for interconnections.

While the CBA is aimed to assess, identify and quantify the positive trade-off of interconnection development for the resulting set of systems, the challenge remains on how to distribute and assign the costs –and risks- of this development. The solution of this challenge when applied to interconnections is called **Cross-Border Cost Allocation (CBCA)**.

And if the CBA may already be considered a very complex problem, the CBCA may be even more of a challenge, what justifies that the present document does not pretend to establish a definite methodology but preliminary criteria or guidelines both as a basic stage for future evolution and, if applicable, potential basic rules or mechanisms when tackling the issue in absence of a consolidated methodology.

A general overview of the different contexts perspectives that should be taken into account follows.

a. Institutional and regulatory context and financial analysis

The financing of infrastructures, such as international interconnections, generally requires public intervention, in particular in terms of financing but also rules, procedures, resources or modalities of usage.

The following aspects should be considered:

- Analysis of the regional social, institutional, economic and energy contingencies (including the evaluation of national priority needs).
- Analysis of the different approaches on investment planning and relationship between different actors (authorities, TSOs…).
- Analysis of the roles of the different private (consumers, electric industries) and public (Governments, Intergovernmental Organizations, International Financial Institutions) operators concerned
- Definition of the respective responsibilities in the participation (levels, modalities) to the financing of public infrastructures, considering the objectives and the cost /benefit analysis for each infrastructure. Responsibilities may be different depending on whether financing of interconnection or strengthening of the internal network of a country associated with an exchange capacity increase.
- Analysis of the financial requirement needed for new interconnections
  - Which is the return of investment needed for private investor to build new interconnections?
  - What is the minimum income level required (cap and floor contract?)
  - What are the subsidies level that states could put in the project (subsidies, etc.)?

It is important to note the potential regulatory gaps between countries such as which rules should be posed (market based or not) or the level of unbundling of the operators (both TSOs and Market Operators if any).

In general the decision making parameters should not only rely on the economic calculations as the institutional/political dimension should also be considered.

4. Preliminary considerations for cost allocation of interconnection projects

As relevant references, the current recommendations from ACER[2] and ENTSOE[3] may be taken into account.

In this context, where a consolidated methodology CBA-CBCA is not yet ready, some basic preliminary guidelines could be used in the Mediterranean region, where the following categories could be distinguished:

a) For **interconnections between EU countries** the current methodology in use in Europe should be followed. As general remarks:
   i. There should be few exceptions to the rule that only the two hosting TSOs pay the new interconnection.
   ii. The most frequent case is that each TSO share 50% of the cost but it is also normal that both TSOs may agree some other way of sharing.
   iii. The perimeter of the project whose cost is to be shared generally only includes the direct interconnection facilities (i.e. the cross border and extremities assets), however internal reinforcements could be included when being a critical component contributing to the interconnection development.
   iv. The interconnection capacity of all interconnections will be allocated by market rules, in particular explicit auctions, market splitting and market coupling. All these allocation procedures produce congestion rents, which are allocated 50% to each hosting TSO.

b) For **interconnections between EU countries and Southern or Eastern Mediterranean countries**.
   i. There should be no exceptions to the rule that only the two hosting TSOs/countries pay the new interconnection.
   ii. The most frequent case is that each TSO/country share 50% of the cost but it is also normal that both TSO/countries may agree some other way of sharing (in particular if the distances to the border are significantly different in both sides).
   iii. If the interconnection capacity of the interconnections is allocated by market rules, in particular explicit or implicit auctions, congestion rents will be allocated 50% to each hosting TSO/country.
   iv. If the interconnection capacity of the interconnections is not allocated by market rules, congestion rents will have to be estimated and collected from the users of the interconnection and allocated 50% to each hosting TSO/country.

   As an additional consideration for this category, there can be transmission tariffs for crossing the border and entering/exiting the ENTSOE region. These tariffs could include a contribution to the Inter-TSO Compensation (ITC) mechanism that the TSO from the ENTSOE region collects.

c) For **interconnections between Southern or Eastern Mediterranean countries**.

[2] RECOMMENDATION No 5/215 OF THE AGENCY OF THE COOPERATION OF ENERGY REGULATORS of 18 December 2015 ON GOOD PRACTICES FOR THE TREATMENT OF THE INVESTMENT REQUESTS, INCLUDING CROSS BORDER COST ALLOCATION REQUESTS, FOR ELECTRICITY AND GAS PROJECTS OF COMMON INTEREST
https://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Recommendations/ACER%20Recommendation%2005-2015.pdf

[3] ENTSO-E RECOMMENDATIONS TO ACER AND NRAs ON THE CBCA IMPLEMENTATION. POSITION PAPER
https://docs.entsoe.eu/dataset/entso-e-recommendations-to-acer-nras-on-the-cbca-implementation

Traditional 50%-50% cost allocation could be used, unless some other agreement between the two hosting countries is reached if there are justified reasons for it (in particular if the distances to the border are significantly different in both sides).

Currently, in the Southern and Eastern shore, cross-border exchanges are programmed for security of supply when needed. The purpose of cross-border exchanges in the region is expected to evolve over the coming years in three steps:

1. Security of supply: external support can be provided to cover national demand.
2. Facilitating cross-border trade (beyond the needs of TSOs) for the sake of increasing the social welfare. The international exchange would involve not only TSOs but also market participants (generators, consumers and suppliers). For this purpose, explicit allocation of cross-border capacity would be introduced.
3. Creation of a coupled regional energy market (for example, between the three Maghrebian countries Morocco, Algeria and Tunisia, which operate synchronously interconnected to the European continental power system). In order to achieve this objective, a common energy price formation process must be established with a single algorithm facilitating implicit allocation of cross-border capacities, considering the available exchange capacities as well as common arrangements for access to interconnections.

Elaborating cost and risk allocation principles has to build upon a realistic picture of investment challenges, which are not only of an economic kind. Methodologies used to calculate costs, benefits and risks are not perfect but more or less trustable. As a result, the reflection should not implicitly imply a “deterministic” conception of Cost-Benefit Analyses (CBAs) but be based on a case-by-case approach that includes qualitative aspects and (appropriate comparison) arbitrages between interconnections and other measures.

5. Open questions about cost allocation of interconnection projects

In this context, where a consolidated methodology CBA-CBCA is not yet ready, in addition to the basic principles expressed above, some open questions should be posed and answered in order to advance:

- Two key issues are even more important than CBCA itself :
  - When is a project profitable following cost benefit analysis?
  - When is a project bankable according to criteria of financial institutions?
- How to convince financial institutions of the bankability of the projects?
- How could the bankability of the projects be promoted, considered?
- How could European Union support projects in Mediterranean region? Should these North-South projects be considered as PCIs?
- How to address solidarity in Mediterranean?
- How to address the concern on how users of the interconnection will pay for it?

Regarding the CBCA itself there are specific and concrete questions that should also be addressed:

For interconnections between EU countries and Southern or Eastern Mediterranean countries or for interconnections between Southern or Eastern Mediterranean countries:

- Should only the two hosting countries pay the new interconnection?
- Even if normally each country pays 50% of the interconnection cost, may both countries agree some other way of sharing costs?
- How to allocate the capacity of the interconnections North – South? Through competitive market mechanisms, in particular explicit or implicit auctions?
- How to allocate congestion rents collected in such market mechanisms? 50% to each hosting country or according to the share of costs that was agreed?
- If it is not possible to implement competitive market mechanisms for the allocation of the capacity the interconnections North – South, how should congestion rents be calculated? From the users of the interconnection?

ANNEX A. Summary of Cost Benefit Analysis methodology used in Med-TSO studies

The goal of project assessment is to characterize the impact of transmission projects, both in terms of added value for society (increase of capacity for exchanges of energy and ancillary services between market areas, RES integration, increased security of supply) as well as in terms of costs. In order to ensure a full assessment of all transmission benefits, some of the indicators are monetized, while others are quantified in their typical physical units (such as tons or GWh). A general overview of the indicators is included in the figure below.

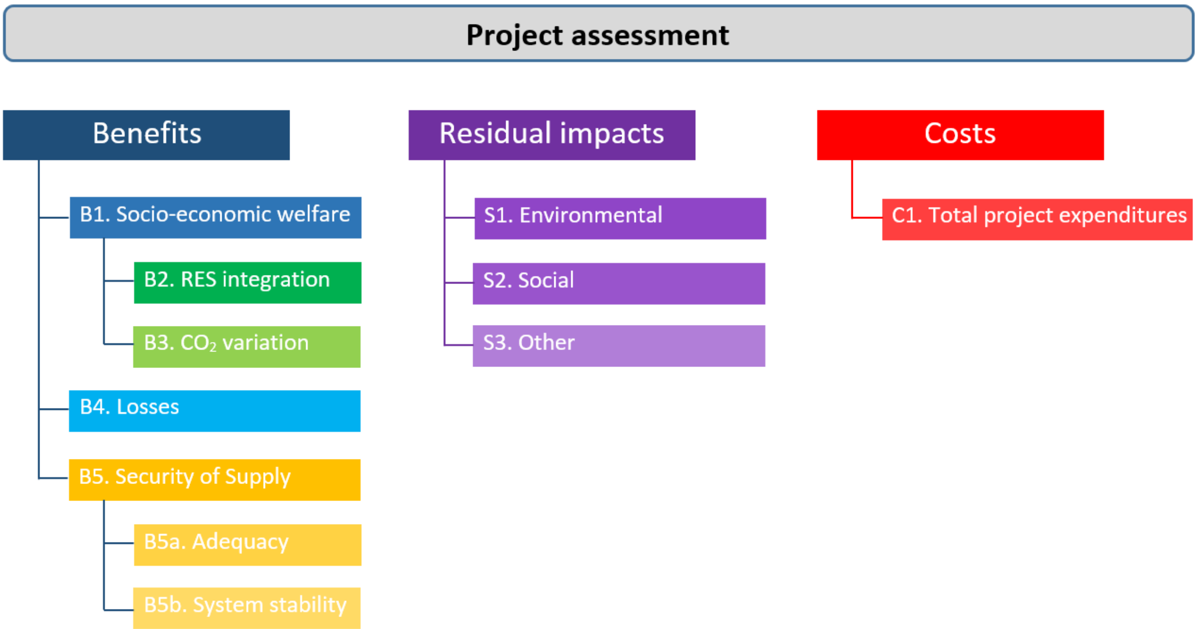

Figure 1: Main indicators of CBA methodology (source: ENTSO-E methodology)

This set of common indicators forms a complete and solid basis for project assessment across the Mediterranean area within the scope of the Mediterranean Project. The multi-criteria approach highlights the characteristics of a project and gives sufficient information to the decision makers.

Benefits are classified and measured as follows:

- **B1. Socio-economic welfare (SEW)** or market integration is characterized by the ability of a project to reduce congestion and thus provide an adequate GTC that ensures increasing NTC so that electricity markets can trade power in an economically efficient manner. SEW is defined as the economic surpluses of electricity consumers, producers, and transmission owners (congestion rent). The most common economic indicator for measuring benefits of transmission investments in planning scenarios is the reduction in total variable generation costs. The Market studies has produced for each interconnection project studied a SEW gain, expressed in M€ per year, which corresponds to the gains generated in proportional production costs throughout the simulated system.

  Changes in SEW must be reported for each project and for a given scenario. In addition to the overall socio-economic welfare changes, the SEW changes that are the result of integrating RES and that are the result of variation in CO_2-emissions must be reported separately:
  - Fuel savings due to integration of RES;
  - Avoided CO_2 emission costs.

- **B2. RES integration**: Support to RES integration is defined as the ability of the system to allow the connection of new RES plants and unlock existing and future "green" generation, while minimizing curtailments. Although this indicator is economically accounted for in the calculation of SEW (a variation of the RES integration will result in a variation of the energy from conventional sources and thus affect the system costs.) the RES integration is one key target and is therefore displayed separately so the volume of integrated RES (in MW or MWh) must be reported in any case.

- **B3. Variation in CO_2 emissions** is the characterization of the evolution of CO_2 emissions in the power system due to the project. It is a consequence of B1 and B2 (the unlocking of generation with lower carbon content). Although this indicator is economically accounted for in the calculation of SEW (a variation of the CO_2 emission and the resulting change in emission costs will affect the system costs.), the CO_2 indicator is one key targets and is therefore displayed separately (in tons).

- **B4. Variation in losses** in the transmission grid is the characterization of the evolution of energy losses in the power system due to the project. It is an indicator of energy efficiency. In order to calculate the difference in losses (in MWh) attributable to each project, and the related monetization, the losses have to be computed in two different simulations with the help of network studies, one with and one without the project.

- **B5a & B5b. Security of supply**

  Adequacy to meet demand characterizes the project's impact on the ability of a power system to provide an adequate supply of electricity to meet the demand, taking into account the variability of climatic effects on demand and on forecasts of renewable energy sources production. The calculation is done first in expectation of avoided annual energy not supplied. The unit is MWh per year. The tool used for this evaluation operates with an internal failure valuation parameter, which is calculated for each country as the GDP divided by the electricity consumption. Thus, a "cost" of failure in k€ per MWh is obtained for each country. However, in many countries, there is an official value of the EENS used in planning studies, which of course differs from the standardized value used in the market study. This is why it is preferable to consider the project profit for EENS in MWh per year.

  System stability characterizes the project's impact on the ability of a power system to keep a stable and reliable supply of electricity taking into account the possible occurrences of system disturbances and faults. The assessment of system stability typically requires significant additional modelling and simulations to be undertaken for which the supporting models would be required. The studies are by their nature complex and time consuming and challenging to include within the Euro-Mediterranean region at this stage. Anyway it could be practical to include a qualitative assessment based on the technology being employed in different factors: transient stability, voltage stability and frequency stability

Costs are classified and measured as follows:

- **C1. Total project expenditures** are based on prices used by each TSO and rough estimates on project consistency (e.g. km of lines). For each mature project, the cost (and corresponding uncertainty range) should be reported, including all items. Costs for losses are not part of the total project expenditure, as the losses are reported separately by the indicator B4. The level of information about expected project costs depends on the status of the project. Therefore, reporting of costs shall be done using the best information available, whilst ensuring consistency of assumptions and thus comparable cost figures.

External impacts

As far as environmental and social mitigation costs are concerned, the costs of measures taken to mitigate the impacts of a project should be included in the project cost (indicator C1). Some impacts may remain after these mitigation measures are implemented. These external impacts are accounted for by and included in indicators S1, S2, and S3. This split ensures that all measurable costs are taken into account, and that there is no double-accounting between these indicators.

- **S1. Environmental impact** characterizes the project impact as assessed through preliminary studies, and aims at giving a measure of the environmental sensitivity associated with the project. It can be expressed in terms of the number of kilometers that the routing of an overhead line or underground/submarine cable may run through environmentally 'sensitive' areas. This indicator only takes into account the residual impact or a project, i.e. the portion of impact that is not fully accounted for under C1. A qualitative analysis may also be used in case the analyzed project is not sufficiently mature.

- **S2. Social impact** characterizes the project impact on the local population that is affected by the project, as assessed through preliminary studies, and aims at giving a measure of the social sensitivity associated with the project. It is expressed in terms of the number of kilometers that the routing of an overhead line or underground/submarine cable may run through socially sensitive areas, such as areas of high touristic interest. This indicator only takes into account the residual impact of a project, i.e. the portion of impact that is not fully accounted for under C1. A qualitative analysis may also be used in case the analyzed project is not sufficiently mature.

- **S3. Other impacts**; this indicator lists the impact(s) of a project that are not covered by indicators S1 and S2, after potential mitigation measures defined when the project definition becomes more precise. These impacts may be positive or negative and will be included as a list in the assessment results. Impacts that are accounted for by indicators S1 or S2 shall not be included.

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