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Cost Benefit Analysis in the Context of the Energy Infrastructure Package

Authors: Leonardo Meeus, Nils-Henrik M. von der Fehr, Isabel Azevedo, Xian He, Luis Olmos, and Jean-Michel Glachant

Editor: Annika Zorn

Highlights[1]

- Cost Benefit Analysis (CBA) has proven to be a useful tool to support the economic appraisal of important projects in many sectors. In the energy domain, a single CBA method has been proposed at EU level to evaluate and compare electricity transmission and storage projects from different countries, which is unprecedented anywhere in the world.

- The objective of the 10th report of THINK has been to advise the European Commission (DG Energy) on the development of this method in the context of the Energy Infrastructure Package. This brief is derived from that report. We provide recommendations for the scope of the analysis as well as the calculation of the net benefit. We also discuss how the method can be used to rank projects.

- Regarding the *scope of the analysis*, our recommendations are: (1) interaction between projects must be taken into account in the project and baseline definition; (2) data consistency and quality should be ensured; (3) the conventional time horizon is 20-25 years; (4) CBA should concentrate on a reduced list of effects and those should be monetized; and (5) distributional concerns should not be addressed in the calculation of net benefits.

- Regarding the *calculation of the net benefit*, our recommendations are: (6) infrastructure costs need to be disaggregated; (7) the model used to monetize the production cost savings and gross consumer surplus needs to be explicitly stated; (8) a common discount factor should be used for all projects; and (9) a stochastic approach that is consistent with the Energy Roadmap 2050 should be used to address uncertainty.

- Regarding the *ranking of projects*, our recommendation is: (10) the ranking should be primarily based on the monetized net benefit.

- ENTSO-E has already proposed a draft method for electricity projects. We will analyse to what extent this method is in line with our recommendations and will conclude that it is an important step in the right direction. However, improvements could still be made, as proposed in this brief.

1. Policy brief for topic 10 of the EU FP7 funded project THINK.
Project reports available at: http://think.eui.eu.

Florence School of Regulation

The Florence School of Regulation (FSR) was founded in 2004 as a partnership between the Council of the European Energy Regulators (CEER) and the European University Institute (EUI), and it works closely with the European Commission. The Florence School of Regulation, dealing with the main network industries, has developed a strong core of general regulatory topics and concepts as well as inter-sectoral discussion of regulatory practices and policies.

Florence School of Regulation
Robert Schuman Centre
for Advanced Studies

European University Institute
Villa Malafrasca
Via Boccaccio 151
50133 Firenze - Italy

Contact FSR coordinator:
Annika.Zorn@eui.eu

Introduction

The European Commission estimates that about €200 billion needs to be invested in electricity and gas infrastructure in order to achieve the 2020 energy and climate objectives. There is a risk that almost half of this expected investment will be too late or not at all. The aim of the Energy Infrastructure Package is therefore to accelerate the development of selected projects by: (1) facilitating their permit granting process; (2) providing an enhanced regulatory treatment for these projects; and (3) providing EU financing assistance for the selected projects that are important to achieve the EU energy objectives, but which are not commercially viable.

The Energy Infrastructure Package has established a process to identify Projects of Common Interest (PCIs) in priority corridors and areas[2]. First, promoters nominate their projects to the Regional Groups which will be set up for each corridor or area. Member states and the European Commission will then rank the proposed projects in each Regional Group based on individual Cost Benefit Analyses (CBA). Finally, the European Comission will adopt an EU-wide list of projects based on the regional lists.

The Energy Infrastructure Package has also introduced a procedure to develop a CBA method for electricity and gas which promoters will be required to use when they nominate their projects. The ENTSOs are expected to propose a method, and ACER, the European Commission and member states will provide opinions on these methods. The ENTSOs will then review the method and finally the European Commission will then approve it. ENTSO-E has already proposed a draft CBA method in anticipation of this procedure.

In this Policy Brief, we will focus on electricity (i.e. transmission lines and storage). We will provide recommendations for the scope of the analysis as well as the calculation of the net benefit of electricity transmission and storage projects. We will also discuss to what extent the ENTSO-E proposal is in line with our recommendations. We will recommend how the method should be used to rank projects, but do not discuss the other uses that have been foreseen for the CBA method in the Energy Infrastructure Package (i.e. cost allocation and regulatory incentives for infrastructure investments).

2. The priority electricity corridors include Northern Sea offshore grid, North-South electricity interconnections in Western Europe, North-South electricity interconnections in Central Eastern and South Eastern Europe, and the Baltic Energy Market Interconnection Plan in electricity.

Cost benefit analysis

We first define the scope of the analysis, to then discuss how the net benefit of transmission and storage projects should be calculated in the context of the Energy Infrastructure Package.

Scope of the analysis

Project & baseline definition

The purpose of CBA is to evaluate the economic effects of adding a project to a forecasted future, i.e. the so-called baseline. Therefore, scoping the analysis starts with the definition of the project and the definition of the baseline.

1. Interaction between projects must be taken into account in the project and baseline definition

In network industries, projects typically interact, i.e. they can be (1) complementary, or (2) competitive. Complementary projects should be dealt with in the definition of projects, i.e. they should be considered as a single project. Competitive projects should be dealt with in the definition of the baseline. Each project should be evaluated against two baselines (one with and one without all proposed projects) to detect competing projects.

The ENTSO-E proposal ensures that only projects that significantly contribute to the common goal of increasing the capacity on a certain border can be grouped. However, the objective should be to group together projects which are complementary in terms of their net benefit, i.e. the net benefit of both projects together is higher than the sum of the net benefit of the individual projects. Project promoters should be made responsible for providing evidence on the complementarities between investments that are proposed as a single project.

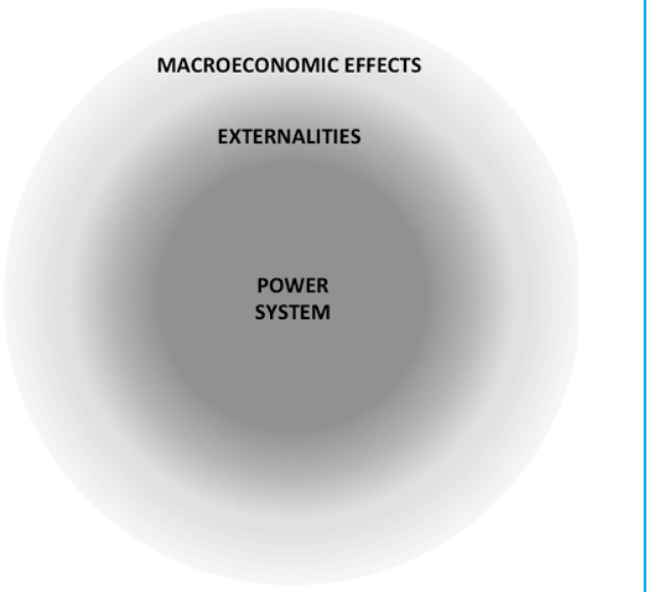
2. Data consistency and quality should be ensured

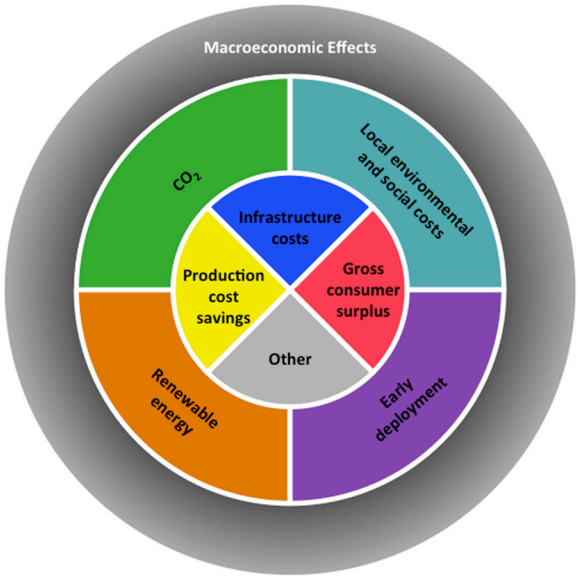
A public consultation is a good way to ensure the quality of the data that will be used in the baseline. ENTSO-E has already proposed such a consultation to validate the data, following the current practice in the context of the Ten Year Network Development Plan. It is also important to ensure the consistency of the scenarios with the Energy Roadmap 2050, which we will discuss along with the calculation of the net benefit.

3. Conventional time horizon is 20-25 years

There is a trade-off between capturing longer-term effects and increased uncertainty. The ENTSO-E proposal is already in line with the convential time horizon.

Box 1: Comprehensive list of effects (own depiction)





Effect mapping

The economic effects of developing electricity transmission or storage projects include (1) the impact on the power system, as well as the effects beyond the system, i.e. (2) externalities and (3) macroeconomic effects. The impact on the power system can be categorised into production versus consumption effects, infrastructure costs and other market benefits, such as improved competition and liquidity. The externalities are related to the impact of these projects on greenhouse gas emissions, renewable energy, local environmental and social costs, and the early deployment of innovative transmission or storage technologies (Box 1).

4. CBA should concentrate on a reduced list of effects and those should be monetized

There are several effects that can be disregarded for different reasons: (1) *macroeconomic effects*, such as economic growth and employment effects, are relatively similar for most projects so they will not significantly affect their ranking; (2) infrastructure investments can result in a more efficient dispatch of power plants so that *greenhouse gas emissions* are reduced. However there is a carbon price so this effect has been internalised in the production cost savings; (3) infrastructure investments can also reduce the spilling of *renewable energy*, which will reduce the renewable energy capacity that needs to be installed to achieve the 2020 renewable energy target. In other words, considering greenhouse gas emissions and renewable energy as a seperate effect would imply double counting.

There are also effects that can be dismissed for most projects, with exceptions: (1) infrastructure costs include *local environmental and social costs* because promotors have to do an environmental impact assessment and take measures to fullfill certain requirements, although the visual impact of a project for instance is not yet covered by these regulations; (2) *early deployment benefits* have also already been internalised in the infrastructure costs as there are several EU programs to support innovative infrastructure projects, although there can of course be exceptions in innovative projects that have received relatively limited support; (3) *other market benefits* are relatively similar for most projects and are usually very small compared to other relevant effects. Exceptions could be projects that significantly change the market structure in an isolated area.

To sum up, there remain three effects that should be monetized for all projects, i.e. (1) infrastructure costs, (2) production cost savings and (3) gross consumer surplus. There are additional effects which may be relevant to specific projects and indicators should be used to identify these projects and to justify additional analysis to monetize also these effects. This can be the case for projects with an exceptional visual impact (e.g. projects in densely populated, protected or tourist areas) or for projects that significantly change the structure of a market (e.g. projects in isolated areas) or for projects that are exceptionally innovative (e.g. first of a kind projects, such as offshore infrastructures).

The ENTSO-E draft proposal lists seven benefits to be considered for all projects. A distinction is made between effects that are to be monetized, i.e. "*social-economic welfare*" and "*varia-*

tion in losses", and effects that are to be quantified as additional indicators, i.e. "*improved security of supply, RES integration, Variation in CO_2 emissions, Technical resilience/system safety and flexibility*". If projects are then ranked based on the monetized net benefit in combination with these indicators, it implies an implicit monetization of effects that have not been monetized explicitly. Such an implicit approach is less transparent and allows for subjective judgment.

Distributional effects

5. Distributional concerns should not be addressed in the calculation of net benefits

The economic analysis of efficiency gains from infrastructure projects should be done without consideration of distributional effects. If there are concerns, they should be resolved with explicit political decisions by relevant authorities. The European Commission could for instance use regional quotas when defining the EU-wide list based on the regional lists.

The ENTSO-E draft proposal does not explicitly discuss distributional effects, but it does refer to the EU Regional Policy Guide. The guide proposes the use of social discount rates, which implies that the rates of developing countries are higher because they have a higher economic growth outlook. As a result, the projects of these countries will be ranked lower than projects with similar benefits in developed countries, which exacerbates distributional concerns. Below, we argue in favor of using a common discount factor for all projects.

Calculation of the net benefit

Monetization

6. Infrastructure costs need to be disaggregated

There should be a predefined list of cost components that promoters are required to report separately. The list of items proposed by ENTSO-E can be the starting point, but the costs incurred for mitigating environmental or social impact of the project should also be presented separately and included in the total project expenditure.

7. The model used to monetize the production cost savings and gross consumer surplus needs to be explicitly stated

There is no single model that adequately captures all the production cost savings and gross consumer surplus of all transmission and storage projects. It is therefore important that the assumptions of the model are clearly explained to allow for a proper interpretation of the CBA results. The choice of the model should also be coordinated with the data validation process of the baseline.

The draft ENTSO-E proposal leaves certain modeling choices to the Regional Groups, while also providing some model specifications.

ENTSO-E has proposed a minimum consideration of technical characteristics of power plants ("*efficiency rate and CO_2 emission rate*") and a minimum geographic scope ("*all member states and third countries on whose territory the project shall be built, all directly neighbouring member states and all other member states impacted by the project*"). Note that Regional Groups may choose a sophisticated model, for instance including more detailed technical characteristics of power plants. It will therefore be important to coordinate these modelling choices with the data validation process for the baseline.

ENTSO-E has also proposed an indicator to estimate the changes in the volume of energy non-served during contingency periods i.e. "*security of supply*". ENTSO-E referred to the lack of reliable data across Europe as the reason not to monetize this effect. The CEER has already provided guidelines on how these values should be established at a national level, and an intermediate solution could be that a value is agreed upon as part of the data validation process for the baseline.

Inter-temporal discounting of costs and benefits

8. A common discount factor should be used for all projects

Projects of Common Interest will have a similar regulatory treatment and might also be eligible for EU financial support. The label can also improve the confidence of potential investors and thereby facilitate access to capital. These projects are therefore likely to have similar access to capital so that a common discount factor should be used for all projects. The factor should be agreed upon through open consultation, together with the parameters of the baseline.

The ENTSO-E draft proposal is partially in line with this recommendation because there is a single discount rate for every region. However, ENTSO-E also proposes to follow the EU Regional Policy Guide, which would exacerbate possible distribution concerns across regions.

Uncertainty

9. A stochastic approach that is consistent with the Energy Roadmap 2050 should be used to address uncertainty

The Energy Roadmap 2050 already provides possible extreme scenarios for the future that are consistent with the EU energy

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and climate objectives. Based on these scenarios, a stochastic approach should be followed to capture the robustness of projects across these possible futures, which would result in a net benefit distribution.

The ENTSO-E draft proposal already refers to the use of multiple scenarios and the use of sensitivity analysis, but not yet a stochastic approach. Nevertheless, it has already been implemented by several TSOs in Europe for electricity infrastructure projects. We argue that this approach should be adopted at EU level and be consistent with the scenarios of the Energy Roadmap 2050.

Ranking projects

10. The ranking should be primarily based on the monetized net benefit

The method we recommend above is a stochastic approach that calculates a net benefit distribution against two baselines, i.e. one with and one without all proposed projects. However, to rank projects we need a single monetized value. This value could be obtained by taking the mean value of the net benefit distribution of a project against one of the baselines, but adjustments might then be needed for (1) competitive projects and (2) uncertainty.

The first issue is with competitive projects. If the ENTSO-E draft proposal were to be followed, the initial ranking would be based on the baseline with all proposed projects included. If two competitve projects are proposed and ranked against this baseline, they will be ranked low and both could even exhibit a negative net benefit, even if developing one of them could be strongly beneficial. To identify these kinds of cases, the baseline without the proposed projects could be used. However, if the ranking were based on the baseline excluding all other proposed projects, we would have the opposite problem. Competitive projects would both be ranked high, even in cases where it is only beneficial to develop one of them. In other words, there is no perfect baseline and adjustments to the initial ranking may be needed regardless for competitive projects.

The second issue is one of uncertainty. Even though the initial ranking is based on the mean value of the net benefit distribution of projects, policy makers (depending on their risk averseness) might wish to adjust the ranking of projects which exhibit a significantly different risk profile to the average project.

Conclusion

The draft method proposed by ENTSO-E is an important step in the right direction, however improvements could still be made, as proposed in this brief. It should also be considered a success in itself that a single CBA method has been proposed at EU level to evaluate and compare electricity transmission and storage projects from different countries as this is unprecedented anywhere in the world.