



METHODOLOGIES USED BY REGULATORS TO EVALUATE INVESTMENT PROJECTS AND INVESTMENT PLANS

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Electricity Working Group



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Introduction

This project is a complement to the MEDREG project on “Regulation and Investments: Solutions for the Mediterranean Region” and is in line with the MEDREG Strategy 2020-2030 which states that investment conditions in the Mediterranean need to be improved, not only by developing innovative financing instruments but also on the regulatory and economic side. The MEDREG Infrastructure Investments Report published in May 2015 provides a vision on existing and planned energy infrastructures in the Mediterranean region, including key information on obstacles and challenges to develop them. The objective of this project is to draw lessons from the European experience in terms of investment planning and cost control which could help improve investment in the Mediterranean region.

In terms of methodology, the principle is to focus on:

- The feed-back from experience in EU Mediterranean countries regarding ten-year network development plans (TYNDPs);
- Questions and challenges in Northern countries: assessment of pros and cons of TYNDPs, in particular regarding the evaluation of projects’ benefits;
- Dominant issues regarding electricity network and interconnection development in Mediterranean countries.

A second stage will consist in preparing proposals especially on the following aspects:

- Network planning and supply/demand scenario development in Southern countries;
- Cost and benefit analysis for mature investment projects in line with the MEDREG project on “Regulation and Investments: Solutions for the Mediterranean Region”.

Scope of the project

The purpose of this report is to analyse what tools can be used by regulatory authorities to evaluate investments carried out by transmission operators. The challenge consists in checking the relevance of costs and project management and, more generally, to identify infrastructure gaps (congestions for example) justifying new investments and to assess the added value of new projects proposed by TSOs. In this area, the EU has implemented a new approach to network planning with the publication every two years of a Community wide Ten Year Network Development Plan (TYNDP). This process is mirrored at regional and national levels with the aim of ensuring the coherence of TSOs’ investments within the EU. This project aims at highlighting the pros and cons of the European approach which is also progressively followed by ECRB countries. This analysis could help identify regulatory tools which could be generalised in the Mediterranean countries keeping in mind that there is no one-size fits all approach.

Chapter 1. Network development plans, European experience

With the implementation of the latest regulations in Europe, new tools have been designed aiming at making infrastructure development easier and more efficient. Since the EU intends to achieve the single energy market, it has been looking for a better coordination of decisions among member states with two main concerns: avoiding that a country would not carry out investments which are useful or even necessary for its neighbours, and avoiding that projects involving several operators would not be achieved due to a lack of cooperation. The EU TYNDP have thus got an increasingly

important role as the main coordination tool between the European TSOs. It is expected to deliver, every two years, a vision of mid to long term system development and a shared methodology to assess the value of potential investment projects.

1. Investment in electricity systems, recent dynamics

The electricity chain is made of several different kinds of complementary elements that allows to bring power from the various generation means down to the final consumers. Electricity systems are thus combining physical assets (power stations, cables, converters, etc.) and coordination means, namely information systems which help ensure that production fits demand at any time. In non-competitive systems, the management of the electricity chain is, in general, centralised both in short and long term. That means that a single entity is responsible for allocating efficiently the energy flows, in particular by regulating generation according to location, volumes and potential network constraints. In a longer term, this entity contributes to identifying and managing investments by determining where new assets are needed. In many countries, all these activities were operated by vertically integrated monopolies. In Europe, distribution was often operated by local companies while most of the upstream parts of the chain (production and transmission) were operated by a single company at a national or regional level. In such cases, electricity systems were considered as a tool serving energy policy choices. France well illustrates this with the development of nuclear power at large scale, which was allowed by the monopoly of EDF.

In the European energy legislation, the directives adopted since 1996 aimed at developing competition in electricity markets, thus radically modifying the structure and functioning of the power industry. Two dynamics have been at stake for the past two decades:

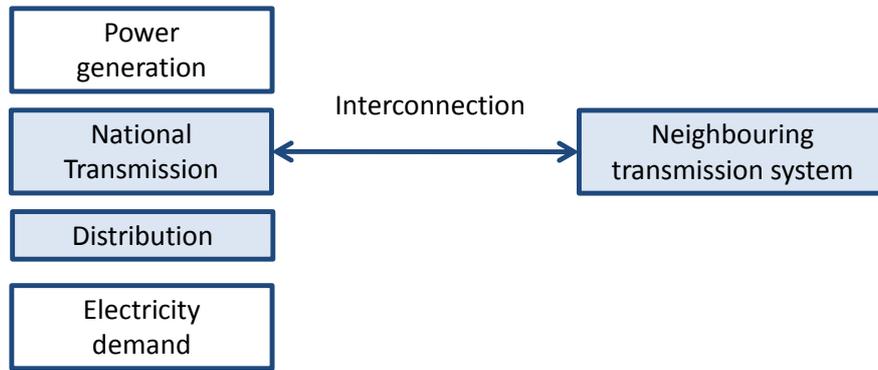
- The implementation of third party access to essential facilities, namely network infrastructures;
- The development of cross-border interconnections to help create a single European electricity market.

Competition development led to splitting the electricity chain among different activities, namely generation, transmission and distribution. The three successive legislative packages have consisted in unbundling the electricity chain with the priority of ensuring the independence of transmission from production and energy commercialisation. The third directive in particular, requires the transmission operators to be fully independent in terms of management and investment decisions. As a consequence, generation and transmission cannot be jointly developed since decisions to develop additional power generation should result from decisions of companies competing in the market.

In sum, liberalisation has led to de-centralised investment decision-making, thus requiring the TSOs that they adapt the transmission system to the needs of the market in a non-discriminatory way. Concretely, investment decisions from TSOs have to be based on an aggregated perception of the future evolution of the various elements of the electricity value chain (see Figure 1) including:

- the identification of existing congestions within the national systems and at borders;
- The necessary developments of infrastructures according to the future development of demand and supply;
- The development of an integrated market, requiring the interconnection capacities between Member States to be increased.

Figure 1. The electricity value chain



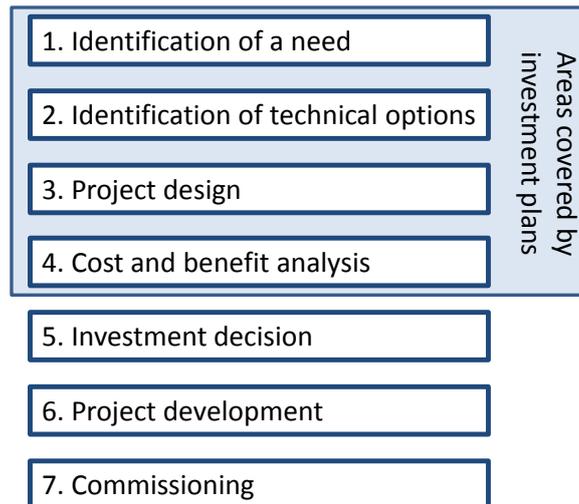
Behind investment planning, it is necessary to develop scenarios which help identifying the need for infrastructure development. The scenarios summarise the three dimensions mentioned above, but also refer to energy policy orientations. The supply/demand scenarios allow evaluating different interconnection capacity scenarios and elaborate cost and benefit analyses to judge the relevance of projects.

2. Generic steps of investment in electricity infrastructures

Investment in electricity infrastructures is a complex task which has to be included in a long time frame. Project development is a several year process which starts by the identification of a need. This need can come from the inclusion of new generation, internal problems of congestion, demand development or increase of interconnection capacity. In this respect, the market design can be an important parameter as in the EU, where there is a clear objective to develop cross-border market integration. The aim is to facilitate energy flows between Member states to move from national markets to a single European market and, thus, enlarging the choice for consumers and reinforcing security of supply through international solidarity. Cross-border investments are particularly challenging because they require a very good international cooperation at all steps, from the design phase to the commissioning.

The Figure 2 summarises the successive steps of an investment process, considering that, among the tasks, permitting and financial closure are important aspects which impact both the timing and the technical choices. Since there is at least seven years between the identification of a need and the commissioning phase and assets have a very long life duration, the analysis of the likely evolution of market trends is crucial. Investment decisions have to rely on scenarios reflecting the possible trends on supply and demand and, in well-developed competitive markets, trends on future market prices. Investment plans are supposed to gather all the relevant information to identify the additional needs for infrastructures, to select projects as well as determining their value.

Figure 2. Investment process



a. Regulators’ role in investment in the EU

Electricity systems have to be split between the regulated and the competitive activities. Transmission is regulated, which means that activities of TSOs are subject to the control of regulatory authorities. Regulated activities see their costs covered through tariffs of use of the infrastructures, these tariffs being either directly determined by regulators or determined by TSOs under the scrutiny of regulators. As far as investment is concerned, any new asset opens a right for cost recovery and remuneration of invested capital. The role of regulators is thus to control that costs are efficient, i.e. they correspond to costs of an efficient operator (investment is needed, costs are reasonable and project is delivered in due time). Regulators are also involved in investment planning processes, checking in particular that TSOs’ investment plans are aligned with the general interest and are non-discriminatory. They have to check that national and European investment plans are coherent. Regarding cross-border interconnections, another aspect relates to the evaluation of investments based on scenarios of supply and demand as well as the assessment of the potential value of new investments. In this respect, when electricity price is an important variable used to assess the value of projects, the way transactions are organised and prices are formed, namely the “market design”, is very important. That concerns notably the relationship between the evolution of generation capacity and of transmission capacity, and their influence on mechanisms such as “market coupling”.

b. North-South differences

In the European Union, electricity systems are highly meshed and may be considered as relatively mature, meaning that supply and demand match to a large extent in a context of low growth of consumers’ needs. As a result, infrastructure development mainly consists in reducing congestions and developing cross-border transmission capacity, with the objective of achieving the single electricity market and allowing the large scale integration of renewable energy sources. In Southern and Eastern Mediterranean countries, the context is generally significantly different: electricity need grows at a high pace and interconnections’ role remains very limited, as shown in the MedReg investment report and the MEMO report. In addition electricity systems’ management is often centralised, with a single company operating national systems from production to distribution. This organisation looks similar to the past European one, which rationale came from the strong increase of demand and, thus, giving priority to large investments upon issues like economic efficiency. Besides, the implementation of EU legislation in each Member State leads to splitting electricity

companies between network and commercial activities. In this perspective, decisions regarding the development of production and transmission are supposed to be taken separately. However, from a regulatory perspective, the validation of investments will require evaluating their accuracy in terms of technical relevance and cost levels. Regulators have to check that investment proposals are efficient, which could involve assessing the potential complementarities with neighbouring countries and looking at properly combining generation and transmission when relevant.

In the EU, the European and national investment plans include market mechanisms within the evaluation of investment needs (simulations of wholesale price formation is a key input).

In southern and eastern Mediterranean countries, when power exchanges are not developed, the evaluation of projects cannot be based on market prices. Alternative approaches should thus be developed including security of supply or substitution effects between power generators. The concept of TYNDPs could serve a rigorous determination of investments and determining a hierarchy between projects to focus in priority on investments delivering the highest value.

3. Ten year network development plans, EU legislation

The current European approach to investment planning is based on the third legislative package, later completed by the Infrastructure Package (Regulation 347/2013). The legislative framework delivers important guidelines for the energy market, including methodologies to evaluate investments in a pan-European perspective. The current European legislation combines the TYNDP (published every two years) and yearly national infrastructure development plans. These plans have to be coherent in terms of projects and data/information

The directive 2009/72/EC deals essentially with national TYNDPs. In its article 22.1, it states that *“every year, transmission system operators shall submit to the regulatory authority a ten-year network development plan based on existing and forecast supply and demand after having consulted all the relevant stakeholders. That network development plan shall contain efficient measures in order to guarantee the adequacy of the system and the security of supply.”* *“The ten-year network development plan shall in particular: indicate to market participants the main transmission infrastructure that needs to be built or upgraded over the next ten years; contain all the investments already decided and identify new investments which have to be executed in the next three years; and provide for a time frame for all investment projects.”*

At a national level, when elaborating their ten-year network development plan (TYNDP), the TSOs shall make reasonable assumptions about the evolution of the generation or supply, consumption and exchanges with other countries. It also states that the regulatory authorities shall consult all actual or potential system users on the TYNDP in an open and transparent manner. The regulatory authorities also need to examine whether the ten-year network development plan covers all investment needs identified during the consultation process, and whether it is consistent with the non-binding Union-wide TYNDP. The regulatory authority shall also monitor and evaluate the implementation of the ten-year network development plan, and approve it.

According to the EU regulation 714/2009, the ENTSO-E (The European Network of Transmission System Operators for Electricity, established by this regulation) shall adopt and publish a Union-wide network development plan every two years. The Union-wide network development plan includes the modelling of the integrated network, scenario development, a European generation adequacy

outlook and an assessment of the resilience of the system. This plan must build on national investment plans and, regarding cross-border interconnections, on the reasonable needs of system users and integrate long-term commitments from investors. It must also identify investment gaps, notably with respect to cross-border capacities.

A particularity in Europe was the setting up of the Agency for the cooperation of energy regulators (ACER) in 2011, in which all EU regulators play an important role. With regard to investment ACER delivers an opinion on the national and European TYNDP in order to ensure consistency and may make recommendations to the regulators and ENTSOE. Moreover, ACER “should contribute to the implementation of the guidelines on trans-European energy networks and monitors the implementation of these guidelines”.

4. Lessons from the latest ENTSOE’s TYNDP

The most recent EU wide network development report was published by ENTSOE in December 2014. The 2014 TYNDP has led to many debates in terms of methodology, which was largely due to a new role: assessing the benefits of projects candidate to be considered as “Project of Common Interest”. This category has been created by the guidelines on trans-European energy networks adopted in 2013. A particular attention was thus given to the supply and demand scenarios used to determine the value of projects, in a context where the trends have been revised downwards because of the economic crisis and the improvement of energy efficiency. The question about the trust in scenarios is at the heart of the current developments within ENTSOE, which is preparing the simulations for the 2016 TYNDP.

a. Methodology

The existing framework splits the responsibilities between different actors and makes them work together through different steps. Community-wide development plans are combined with regional plans offering a better granularity and highlighting in particular regional specificities, and national development plans (NDP). TSOs make their NDP considering demand and supply evolution on one hand, existing and planned investments on the other hand. NRAs check the national development plans and make sure they are consistent with the European plan, which ENSTOE draws by considering Member States projections. There is a continuous dialogue with the market. This scheme requires a high-level of coordination, both at national and European level, and aims at ensuring the coherence of TSOs’ investments across the EU. It requires sharing some common objectives and the support of strong institutions.

The network development plan encompasses several dimensions, being both a report on the current and future state of the network and a prospective tool exploring the possible futures of the energy system through different scenarios. Network studies analyse the network ability to support future energy flows. TSOs select some hours which represent a critical state of the system and make a network review. Each network review is then featured by its technical robustness, the losses observed, its flexibility and its contribution to the capacities increase. The analysis combines the current status of the network and the possible new investments, with their different characteristics (which can include inter alia the location, technical features, possible commissioning date, estimated cost range...). The report depicts visions of the network at a horizon of 3 years, 10 years and 15 years and potentially even more.

In the latest version of the TYNDP, ENTSOE has developed 4 scenarios based on different energy policy orientations. These scenarios and simulations have been used in the evaluation of projects.

b. The role of scenarios in the 2014 TYNDP

The scenarios used by ENTSOE have been built in order to encompass possible futures, the time horizon chosen being 2030 in the TYNDP 2014. ENTSOE's scenarios have been developed in collaboration with stakeholders in order to cover a large scope of possible trends. In that sense, as stated in the 2014 ENTSOE TYNDP, *"the Visions are less forecasts of the future than selected possible extremes of the future so that the pathway realized in the future falls with a high level of certainty in the range described by the Visions"*.

These visions have been differentiated accordingly to two axes:

- The trajectory toward the EU Energy roadmap 2050 which targets a strong increase of RES and of energy efficiency: two scenarios (visions 3 and 4) assume a regular pace from now until 2050 towards the energy roadmap objectives while two others (visions 1 and 2) assume a slower development of RES before an acceleration after 2030 in order to meet these objectives.
- The consistency of the generation mix development strategy: two scenarios (Visions 1 and 3) are based on a bottom-up approach, which consists in the collection of scenarios built by national TSOs based on national energy policies and national specificities. The two other scenarios assume a top-down approach, namely more optimised approach at a European level.

These two axes raise two fundamental questions in Europe. The first axis acknowledges the very ambitious European objectives, in terms of renewables development, energy efficiency or carbon mitigation. These objectives can be met via different ways, which leads to some uncertainty regarding the intermediate 2030 steps, thus justifying the combination of several scenarios. The second axis represents the degree of cooperation between countries. Even if this axis still lacks of a clear definition in the TYNDP 2014, it highlights the difficulty to formally include coordination within the definition of national energy policies (in terms of security of supply, way to meet European objectives...) and the role that the network has or can play in order to facilitate this cooperation.

ACER acknowledged in its opinion on the TYNDP 2014 the utility of different scenarios to better represent the possible evolution of the energy system. However, using different scenarios when assessing the relevance of a project raises the question of how to deal with different results: what is the most relevant one? A conservative approach would only consider investing in the case of a positive return for all scenarios. A probabilistic approach would give a ponderation of the scenarios according to their probability of realization, but determining probability of occurrence is largely subjective. The choice made by the European Commission for the selection of projects of common interest in 2015 has been to only retain two scenarios (vision3 and 4) which are said by ENTSOE to be compliant with the European objectives set by the European Commission for 2050¹.

c. The debates on scenarios

Others approaches could be possible. The fundamental question is how to make the best investment decision, in other words how to maximize the likelihood that selected projects actually add value for

¹ The way two different scenarios are said compliant with the same objectives is not explained by ENTSOE.

the community in a highly uncertain future. Two main dimensions are questioned here: the quality of the scenarios and the way the decision is made. These two questions are linked in some way, as the decision should be based as far as possible on the less subjective part of the scenarios. As it is very difficult to forecast energy prices in the future, the analysis should give a predominant importance to the physical flows justifying the investments, focusing for example on the complementarity of generation means. Price differentials should be kept as a means to compare scenarios while never forgetting that they result from the design of market retained as assumption (capacities markets, mechanism of subsidies assumed for renewables energies...).

The quality of scenarios has been largely debated in the ACER's opinion on the TYNDP 2014. Numerous weaknesses of the scenarios result from the difficulties to anticipate what the degree of integration of national policies in Europe will be, and the role interconnections should play to facilitate this integration. For example, the existence of production overcapacities has been acknowledged in almost all scenarios of the TYNDP 2014. These overcapacities can in part be explained by the methodology retained in the TYNDP, which assumes that each country has enough capacities to cover its consumption. However, interconnections have a major role to play in the way countries cover peaks of demand and thus assure a good level of security of supply. Hence, there is a recursive process between assessing a good level of interconnections and defining a set of assumptions on production which needs to be clarified.

Another important question for the coordination of investments in production and networks assets is the arbitrage between both decisions. The large scale development of renewables exacerbates the need to arbitrate properly between investing in transmission in order to reduce the surplus of energy in one location, and investing locally in production if transmission is too costly. This is crucial to avoid that the TYNDP selects in priority transmission projects resulting from the foreseen development of production without affecting the costs of such reinforcements to the assets which would trigger them. In the 2014 TYNDP, the way the costs of the reinforcement of the networks are taken into account in scenarios assessment has not been explained. This question is central when assessing the credibility and the costs associated with scenarios presenting a large increase of renewable energy production. In the TYNDP 2014 for example, the locations of possible renewable generation sources were too vague in scenario 4 to allow carrying out network studies, thus reducing the credibility of this scenario. More generally, assumptions used to build the 2014 TYNDP were not transparent enough. The result was that interpreting the numerical estimations of collective benefits in various scenarios was very difficult.

Nevertheless, the TYNDP is a process in constant improvement. During the preparation of the 2016 TYNDP, ENSTOE has insisted on the importance of understanding the outputs of the TYNDP. It thus elaborated a sequential approach that allows assessing the cross effects of some changes in terms of generation and interconnection (recursive process between markets studies and network studies) instead of a tool functioning like a "black box". This serves the need for transparency, which is essential when making an investment decision. The TYNDP 2016 include several improvements concerning, notably, the relations between bottom up and top down scenarios, peak load shaving, the allocation of renewables in Europe in order to take into account the best location to produce and optimization of thermal power plants to avoid overcapacities taking into account the contribution of interconnections. The TYNDP 2016 also sees the introduction of a best estimate scenario at five years, which should reduce the uncertainties attached to the evaluation of projects.

Chapter 2. Case studies

1. France

Following the transposition of the EU directive 2009/72/EC, the energy legislation in France obliges the French TSO, RTE, to elaborate every year a ten year network development plan, which is indicative and non-binding. The French energy code stipulates that it should be established on the basis of existing supply and demand as well as reasonable assumptions regarding the development of production, consumption and exchanges at cross-border interconnections. The national TYNDP also builds upon regional analyses relating to the inclusion of renewable energy sources and the results of the process driven by the Ministry of energy called “*programmation pluriannuelle de l’énergie*”. In sum, this exercise is essentially based on the assessment of the physical developments of the French electricity system taking into account orientations of energy policy. It aims at identifying capacity gaps and congestions which should be eliminated.

Concretely, the principle is to gather all the relevant information allowing TSOs and market players to make appropriate investment decisions in a system where the TSO does not have a direct influence on producers’ decisions. The objective is to promote cost-effective investments. Thus, the TYNDP is used to steer the discussions between the regulator and the TSO; data provided by the TSO indeed has to be challenged to reduce the potential asymmetries of information. The scenarios are used as an indication of possible evolutions of the system, but are only considered as a decision tool among others. Recent experience has shown, for example, that demand forecasts had to be revised downwards regularly.

a. Reference scenarios

The network study realized on a 15/20 years prospect aims at ensuring that the decisions made goes along with long term concerns. The analysis regarding the 10 years horizon considers the priority developments. Projects are referenced so that market participants are aware of *possible* projects, but all projects included in the ten-year network development plan will not necessarily be implemented. In addition, in France, the electricity TSO publishes a 3 year development plan, which includes the projects which will be implemented on the short-term. This study makes sure the project is adapted to the needs and provides a forecasted implementation date.

The future of the energy system is modelised through different scenarios, which are designed by using different hypothesis for the key variables of the energy system (power demand, generation mix, energy costs...). These scenarios allow evaluating the benefits that new projects could bring, and how these evaluations vary under different hypothesis. The results are also provided in the development plan. These scenarios need to be compliant with EU energy policy goals. In practice, RTE uses the scenarios provided by ENTSOE, with sometimes a few adjustments to test different developments in neighbouring countries.

b. The role of the regulator

Legally speaking, CRE has to provide an opinion on RTE’s ten year development plan once it is finalized; verifying in particular that it actually covers the investment needs, but does not have to be formally involved in the preparation of the development plan. In practice, CRE services are involved at working level, with regular exchanges with RTE’s team, providing provisional views early in the drafting process. This interaction allows CRE to be aware of various methodological aspects and

feeds the CRE opinion on recommendations to be implemented in the next development plan. In this exercise, CRE challenges all the aspects of the plan, including the assumptions behind scenarios, the modelling methodology, the projects presented (do they deal with the relevant constraints) and the consistency with the Union-wide ten-year development plan (methodology, hypothesis). The regulator is also required by law to consult network users. CRE takes due account of stakeholders' responses to check whether the plan correctly reflects actors' needs. If needed, the regulator can ask more detailed studies or results, including outside the development plan process.

In France, for major projects, the regulator can carry out its own analysis (possibly with the help of external consultants) of the estimated costs and benefits of a project, thus checking that the benefits indeed exceed the costs. The regulator tests the different projects according to different scenarios of supply and demand as well as different network configurations.

c. Approval of projects and implementation

The analysis and decision-making process leading to an investment includes several additional steps, which allow for a deeper understanding of a given project, compared to the broader overview of possible projects presented in the development plan.

The way the implementation is finally approved can vary: in electricity, every year, the regulator approves the annual expenses of the TSO (for all projects at the same time), and incentive schemes for major projects can be granted on a case-by-case basis. The incentive schemes consist in deciding that a project deserves a specific additional remuneration of capital expenditures. In general, these projects increase interconnection capacities and are considered as a priority. This additional remuneration is generally capped and only applies to "efficient costs", to steer investors to an efficient project management. Penalties can also be considered in case of undue delay.

During the implementation, although the regulator does not intervene directly in the operational decisions, it monitors the progress made and the costs incurred. After the commissioning of the project, the regulator checks whether the incurred costs can be considered as the costs of an "efficient TSO", and therefore how the TSO should be remunerated. When an incentive scheme is granted, the regulator also takes into account the actual parameters to determine the TSO's remuneration.

2. Italy

In Italy, the electricity transmission service is a state monopoly granted to the TSO by the **Ministry of Economic Development (MED)**, which is the subject in charge for the electricity system security.

Since 2004 Terna, the Italian TSO, operates according to the ownership unbundling regime, certified by **AEEGSI, the Italian National Regulatory Authority**.

The Italian Network Code concerning transmission, dispatching, development and network security, sets forth the objectives pursued by Terna, such as operational security, reliability, efficiency and supply continuity. The adequate development of the Transmission National Network (TNN) is one of the means to achieve those goals.

According to the legislative decree (93/11) transposing in the Italian legislation EU directive 2009/72/EC, electricity market scenarios on a 10 years' time span are defined by MED coherently

with the National Energy Strategy (NES) elaborated by the Government. Sound renewable sources development (target at 2020: 35%-38%; target at 2050: 60%) and full integration of the Italian market within the pan-European market are two of the main objectives set out by the NES. Based on electricity demand forecasts, the abovementioned scenarios are used by MED to assess the need to develop transmission infrastructures.

Within the 31st January of each year, Terna submits to MED a TYNDP for approval. In order to approve this plan, MED has to take into account the opinion of affected Regions and the assessment carried out by AEEGSI on the basis of its own valuation criteria and of the results of a public consultation procedure. AEEGSI is in charge of monitoring the implementation of the TYNDP and can impose to Terna to put in place investments foreseen in the plan but not yet realized.

The TYNDP pinpoints transmission infrastructures to be built up or reinforced in order to cope with existing and expected criticalities and grid congestions.

Moreover, Terna each year submits to MED, AEEGSI and the Regions a report on the state of the network, highlighting criticalities and congestions.

a. TYNDP's structure and elaboration process

The TYNDP describes the framework, objectives and criteria underpinning the process of network planning at the national and pan-European level and provides also an explanation of forecasted scenarios, priorities and expected results of implementing the plan.

Furthermore, the plan is complemented by the description of the following topics:

- The legal and regulatory framework including the most recent provisions;
- The main occurrences in the electricity system and in the market in the last years;
- The methodology of Cost Benefit Analysis and environmental sustainability analysis applied to the investment projects.

The overarching process followed by Terna to elaborate the TYNDP is arranged in 5 main steps:

1. Definition of the objectives (e.g. security and quality of the transmission service, congestion reductions, integration of renewables into the grid)
2. Analysis of mid-term and long-term scenarios (e.g. legal framework, strategic targets outlined by the energy policy, energy demand and supply development)
3. Identification of development needs (e.g. constraints on renewables to be removed, cross border exchange to be increased)
4. Definition of development interventions (e.g. new lines to be constructed, existing lines to be repowered, storage facilities to be installed)
5. Final output: list of interventions, Cost Benefit Analysis (CBA), timing, costs and expected results

b. The role of the regulator

As previously stated, AEEGSI is tasked with assessing the TYNDP and issuing an opinion addressed to MED.

According to the Strategic Framework for 2015-2018 approved by AEEGSI in January 2015, with regard to infrastructure development two main strategic objectives are pursued:

1. Harmonization of cross border infrastructure regulation to the European regulatory framework;
2. Selective regulation for infrastructure investments.

The latter objective implies that only investments exhibiting systemic benefits and strategic relevance are positively appraised.

Actually, following the market liberalization in 1999, many different regulatory phases occurred. In the first phase (2002-2003), electrical infrastructures were deemed adequate if compared to consumers' needs, and efficiency was the main issue. For this reason price cap regulation was the reference model. In the second phase (2004-2007), the transmission grid needed to be reinforced, as the black out in 2003 made evident. Extra-remuneration based on higher rate of return on invested capital was the main leverage for incentivizing investments. In the third phase (2008-2011), the issue of quality of service has been addressed through pilot projects. Finally, in the fourth phase (2012-2015) incentive mechanisms have been streamlined, in order to avoid overlapping and to better focus on highly strategic investments.

All in all, while in the previous phases a strong reinforcement of the grid was needed, at the present the major enhancements have been already realized and only specific interventions are required. Since the approach of the next phase will be output-based, new metrics to measure the performance are required and new procedure to assess whether issues have been properly tackled, have to be developed. In this regard, AEEGSI will take into account also the recommendation of ACER on incentives for projects of common interest and on a common methodology for risk evaluation (27 July 2014).

With reference to the specific objectives of network development, it should be noted that cross border interconnections need to be reinforced, as well as some internal critical lines structurally congested need to be repowered. Investments are also required to accommodate the energy from renewable sources, paying mainly attention to the problems entailed by intermittent generation. In fact, installed capacity of wind and solar power plants reached in 2014 about the level of 28 GW, thereby major challenges for the safe management of the grid are expected. In particular, in order to keep power flows duly balanced the TSO is required to have access to new intervention tools such as storage facilities. However, storage facilities are still characterized by high-risk level because their technology is not yet mature. AEEGSI with decision 574/2014 set out some preliminary rules in order to foster the integration of storage systems into the national electricity system.

Furthermore, in order to accelerate the realization of priority infrastructures, AEEGSI put in place an incentive mechanism whereby the TSO is awarded with a premium or has to pay a penalty according to the progress made in implementing each project. AEEGSI verifies periodically the achievement of programmed milestones.

With decision 446/2014 AEEGSI defined criteria and procedures to evaluate structural investments related to Project of Common Interest characterised by high-risk level.

As a general rule, if high benefits for the system as a whole are envisaged, the Italian Authority is keen to support investment projects and to incentivize their realization through additional remuneration with respect to the base case.

c. Approval of project and implementation

Once approved by MED, the TYNDP goes into operation and the related costs are recovered along with all other costs incurred in the provision of the transmission service, according to the tariff methodology set forth by AEEGSI.

As stated by the law, the tariff system designed by AEEGSI has to be "certain, transparent and based on predefined criteria". Furthermore, the tariff system has to promote competition and efficiency, make the electricity service available to all citizens across the country and harmonize the opposite interests of customers and regulated undertakings.

As of 2016, a new regulatory period for the transmission service will start and AEEGSI is carrying out a consultation procedure proposing innovations in regulation.

Currently, the length of the regulatory period for transmission services is 4 years, but AEEGSI is proposing to increase it by 2 years, in order to strengthen the stability of the regulatory framework, to foster the predictability of future revenues and consequently to reduce the risk of long term investments.

With regard to cost recovery, so far a hybrid regulatory approach has been adopted: only operational costs have been subject to efficiency mechanisms (price cap), while capital costs are recovered according to a rate-of-return mechanism. AEEGSI is now taking into consideration the opportunity to switch to an alternative approach based on total expenditure. This way it will be possible to jointly address the efficiency issue and the network development issue.

It is commonly acknowledged that one of the main drivers of the investment decision-making process is the rate of return on invested capital. The methodology so far applied by AEEGSI in all regulated activities is based on the WACC formula; however the parameters entering the formula can differ among activities. The new proposal envisages the unification of all parameters but two: the parameter measuring the specific risk of each activity (the so called beta) and the parameter representing the financial structure (the ratio between Debt and Equity). This way all investment projects will be treated on an equal basis and the remuneration will differ only because of risk considerations (different risk factors).

Furthermore, in the implementation phase particular attention is paid to the respect of the milestones foreseen for each project in the time table.

3. Spain

The methodology and criteria used to evaluate investments in electricity infrastructure projects is described in different pieces of the Spanish regulatory framework, the most important ones are the following:

1. Act 24/2013 of the electricity sector²
2. Royal Decree 1955/2000³
3. Royal Decree 1047/2013⁴

² http://normativa.cnmc.es/documento.asp?id=LE0000519509_20150712.html

³ http://normativa.cnmc.es/documento.asp?id=LE0000062490_20131231.html

The infrastructure planning where the methodology to develop gas and electricity infrastructures is included is published in the Ministry web site:

<http://www.minetur.gob.es/energia/planificacion/Paginas/Index.aspx>

With regard to the methodology for evaluating investments, the regulatory framework in place in Spain to evaluate and incentivize investments is based in the following tools:

- A long term network development plan which contains all the transmission infrastructures to be developed in the following years. The last one covers the period 2015 – 2020. This mandatory Plan is produced periodically and its compliance is supervised annually. The Plan is developed with the collaboration of a wide spectrum of stakeholders, taking into account estimated demand and pre-established security of supply criteria, informed by the NRA and approved by the Government. The inclusion of a project in this Plan, after a proposal made by the promoter, is a pre-requisite for starting the permitting phase. All the projects included in the Plan are built according to the schedules established in this Plan.
- A regulated economic regime is established for the infrastructures included in the Plan. It recognizes the cost of investments, operation, maintenance and consequently a regulated rate of return during the working life of the infrastructures. The transmission assets revenue is established based on the arithmetic average of the actually incurred cost (based on audited cost) and the cost calculated using the unit (standard) investment costs. CAPEX and OPEX are paid. Payments to promoters start two years after the infrastructure has been commissioned and it is included in the regulated assets base. Therefore, there is no risk for promoters when recovering the investments.
- A settlement procedure: transmission assets revenue reconciliation. According to the regulated asset base, the infrastructures built every year (which determine the revenues to be paid to the TSO) and the demand forecast, the Ministry establishes the TPA tariffs in order to recover these (and other) costs. The whole income from TPA tariffs goes into a settlement procedure whereby the NRA order payments to the TSO according to their investments included in the asset base. If deviation between tariff incomes and acknowledged costs occurs, this deviation is included in tariffs calculation in the following year.

Taking into account the regulated economic regime in force, there is no risk for promoters not to recover investments. Promoters know in advance that any infrastructure included in the Plan will be authorized. They also know approximately to what extent their investments and operational costs can be covered (based on unit standard investment cost) and what their investment rate of return will be.

4. Portugal

The Portuguese legislation sets the main principles guiding network planning process, defining which documents should be published«, by whom, when and who should be included in the process.

⁴ http://normativa.cnmc.es/documento.asp?id=LE0000519635_20141213.html

According to the Portuguese legislation, the network planning process includes two main documents: a) an annual document describing the main technical aspects of transmission network as of December 31st of previous year, including existing and recently commissioned network elements, such as lines and substation equipment, and also describing relevant operation data; b) the national ten year network development plan (TYNDP).

The legislation defines that the Portuguese TSO shall elaborate every two years, in odd years, the national TYNDP, on the basis of the existing transmission network described in annual summary report, and also the current and forecasted demand and generation scenarios, published by the Government in its Security of Supply Monitoring Report (RMSA).

The TSO shall submit the draft TYNDP to the Government competent authority responsible for energy issues, who should assess it and check if it meets all the needs on issues such as security of supply, both on generation and demand side, and also meets national energy policy targets, no longer than 30 days. If not, TSO shall be asked to amend the draft Plan according to the requests sent by competent authority in the following 30 days.

The competent authority shall then submit the draft proposal to the National Regulatory Authority (ERSE) who should held a public consultation to all interested stakeholders during not less than 30 days before issue his non-binding considered opinion including all comments received during public consultation within another 30 days. The opinion shall be sent both to TSO and to Government competent authority.

In its opinion the NRA may request the TSO to amend the draft Plan mainly in case it does not meet in an adequate and efficient way, those investment needs identified during public consultation, namely regarding the promotion of competition, or if it is not in line with community TYNDP.

Following the content of the considered opinion submitted by NRA, including all replies to public consultation, the TSO shall amend the draft plan within 30 days and submit it in his revised version to the Government competent Authority.

a. Scenarios

The elaboration of the national TYNDP by the TSO shall use as guidelines relevant scenario data included in the Security of Supply Monitoring report to be published by the Government competent authority responsible for the energy sector, namely data on current and expected demand and generation, both conventional and based on renewable energy sources.

The Report aims at assessing issues on matters such as network operational security, balance between demand and generation for the first 5 years (including interconnections) and expected variations over the following 10 years (report has an horizon of 15 years).

In order to cover different possible situations in the Future, the report includes sensitivity analysis over a base scenario, both on demand side (above and below) and on generation side with some delay or cancelation of commissioning dates for new generation units and decommissioning for existing ones.

Regarding European wide TYNDP, and its bottom up scenarios for 2030, vision 1 and 3, both visions have been elaborated based on Government report, so the bottom up visions reflects the scenarios that have been simulated by TSO. For all other 2 visions Top-down visions, especially for vision 4, the Plan may need to be reviewed every 2 years as vision 4 is an extreme vision and may never occur.

b. Other role of regulator on planning process

Besides the roles described above on the planning process, the legislation sets as a NRA duty the task to issue a binding opinion on monitoring the implementation of the national TYNDP on issues such as project scheduling, budget, and project commissioning for and each project included in the national TYNDP.

Finally the NRA also has the obligation of assuring the consistency of national and regional plans with TYNDP and to cooperate with ACER in order to identify any inconsistency and if necessary to amend the National TYNDP or if it the case, to identify any projects that have been cancelled or have been already commissioned.

5. Turkey

In Turkey the regional development targets, load forecasts, supply-source points in transmission systems need to be determined cautiously and conveniently since the transmission systems are the spine of the electricity systems. Investments in transmission facilities are very expensive, time-consuming and their operation has a great effect on the economies of countries. Consequently, the transmission system in Turkey is state owned not privatized as the other transmission systems in some countries.

a. Approval of investment plans and projects of TSO

In Turkey, transmission system is state-owned and carried out by Turkish Electricity Transmission Corporation (TEİAŞ). Therefore, unlike the distribution system investment plans -which are presented by private companies to the Regulator, approval of transmission system investment plans is much simpler and strict, when compared to the distribution.

, TEİAŞ presents investment plans to the Energy Market Regulatory Authority (EPDK) with the “Transmission System Usage and System Operation Tariffs Calculation and Implementation Procedure” and after detailed examination the investment plans are approved by the Board along with the tariffs and assent of EPDK. In 2014, the fourth and last investment and tariff period of TEİAŞ was approved by the Board of EPDK for three years starting from 01/01/2015.

b. The problems faced by TSO during the implementation of the investments

The distribution (DSO) companies present their investment plans only to EPDK and investment purchases of these private companies are made according to their EPDK-approved-purchase and sale procedures plans. But since TEİAŞ is state-owned, its investment plan approvals take some time due to the high costs for the implementation of the TSO investment projects and the detailed evaluation that the Ministry of Developments need to perform.. In addition its investment purchases are also made according to the Public Procurement Law, therefore actualization of investments is delayed due to long tender duration. Consequently, to manage the whole investment budget, TEİAŞ requires a well-designed planning process prepared in advance.

c. Studies and reports made by TSO

Many studies are performed by TEİAŞ to guarantee the adequacy of the system and the security of supply. Electricity Market Law (EPK) No: 6446 demands preparing of a 5-Years Generation Capacity

Projection, 20 Years-Long Term Electricity Energy Generation Development Plan and 20 Years-Turkish Electricity Energy Demand Projection. Some reports are prepared, some are in development but basically there are two prominent and detailed studies made by TEİAŞ which give important signals to market participants about the investment requirements and the system capacity needs in the next years: “*Generation Capacity Projection*” and “*Turkish Transmission System Regional Demand Forecast and Grid Analysis Study*”.

d. Generation capacity projection

In 2009, Turkish Electrical Energy 10-Year Generation Capacity Projection (2009-2018) Report was prepared by TEİAŞ according to the authorization on preparing a 10-Year Generation Capacity Projection and submitting it for approval of EPDK within the framework of the EPK No: 4628 and the Grid Code to guide the market participants by using demand projections estimated by Ministry of Energy and Natural Resources (ETKB).

The report was updated in 2010 to cover 2010-2019 periods, in 2011 to cover 2011-2020 periods, in 2012 to cover 2012-2021 periods and in 2013 to cover 2013-2017 periods.

The last report has been published in 2014 which is covering 2014-2018 periods. EPK No: 6446 determined the period of generation capacity projection for the next 5 years. The goal of the law and the aim of the report are to lead market participants about the future capacity, energy demand and required investments. In this report, reference (base), high and low demand series were calculated according to the macro-economic targets which are prepared by ETKB.

In the report it is expressed how the installed capacity and energy demand of the system will be met by the end of 2018 year. The report analyses the ways and methods that the demand is served by the current capacity; capacity that will be built or predicted to be in operation in a secure way. Also possible reserve capacity is considered. The study also tries to determine when there will be an energy deficit and this will show investors the period of time when new investments are required.

e. 2013-2022 Years Turkish transmission system regional demand forecast and grid analysis study

A master plan study has been made by TEİAŞ for the years of 2013-2022 to analyze short-medium-long term needs of the transmission system. The main goal was to observe the development of transmission system in the future, to present possible production and consumption projections related to the transmission system and contribute to the TEİAŞ investment plans. The master plan study used three data sources (studies): Regional demand forecast, production projection and transmission system development plan. Summarizing the results of the study, following periods are determined to foresee the future of the transmission system:

- **First 5-Years Period (2013-2017):** In this period, urgent investments are predicted to be made in short term. Most of these projects are in TEİAŞ’s investment program. In master plan study, these investments are evaluated on regional base and mostly related to the 154kV system.
- **Second 5-Years Period (2018-2022):** In this period, reinforcements to the 400kV transmission system are predicted to be made in the medium term regarding to the regional demand forecast, production station and facility investment scenarios.

In the long run, TEİAŞ tries to manage its investment plans according to the provisions in its transmission license. It takes into account the opinions and projections of the system users as well as it makes regular notifications about its investment plans to the users who try to make their production facility and/or grid investment plans.

6. Albania

In Albania the costs of network operation and of infrastructure investment should be recouped via regulated network charges. So the adequate capital cost is part of the revenue requirement for the companies. But as mentioned above, the lack of liquidity brings the reduction of investment for the short period of the time. So the regulator looks for a proper balance between the efficient level of investments and price. ERE has approved, based on the “Regulation for approving investment plan” priority investment for regulated company to ensure reliability of supply, to meet the service standards linked to technical and/or regulatory requirements, for example the obligation to connect or to fulfill specific reliability standards.

Such investments are for the network extension or network replacement and investments needed to meet the change in load and production patterns. Also we take into account the transmission investments which are forecasted to reduce congestion and enhance market competitiveness by increasing both the total supply that can be delivered to consumers and the number of suppliers that are available to serve load or investment needs may come as a result of legal obligations/ changes.

Network investments are assessed and included ex-ante in the regulatory asset base and this assessment is linked with the procedure for approving the application from the companies based on the analyses cost-benefit. Under this approach the regulator agrees ex-ante on the capital expenditures allowed to be included in the regulatory asset base (RAB).

As above explained, at the start of the regulatory period the company is asked to provide the regulator with an overview of its intended investments during the next regulatory period. Furthermore, by capitalizing OPEX, the company can further inflate its RAB and consequently earn higher returns. The regulator make a judgment of which investments are efficient/ or priority needs and what we have included in the RAB. In order to have e correct judgment, ERE use business plans, cash flow, monitoring of investments realized for the previous and actual period or engineers' reports and studies on cost-benefit analyses.

At the end of regulatory period the regulator compare the provision and actual capital expenditure at each period and depending on the price control, the regulator may decide to review and adjust the realized investments at the end of the regulatory period. In case actual investments are lower than the targeted one, then prices are accordingly adjusted downwards. In continue we adjust the capital costs such as depreciation and return on invested capital.

Chapter 3. Lessons learnt from the case studies

While the approach towards network planning varies from country to country, key similarities emerge, especially in the European Union where the European legislation has led to adopting the same principles among the Member States. Network planning first requires a definition of the key

objectives (such as security of supply or integration of renewable energy sources) to be met by the transmission system operator(s). The purpose of the network development plan should then be to translate these objectives into concrete infrastructure needs, both present and future, notably by considering various possible scenarios regarding the evolution of generation and demand. The elaboration of network development plans can be challenging, as it involves not only the transmission system operator(s), but builds on objectives and/or processes defined by law, and usually has to be approved by a Ministry and/or the Regulatory Authority. It thus requires a strong interaction between the operator and the public authorities, each in their respective responsibilities and capabilities, so as to increase over time the quality of network planning in terms of transparency, efficiency and resilience.

Such approach has to start from a diagnosis about the state of the existing system and the identification of its weaknesses and infrastructure gaps. In Europe, assessing the state of the system associates technical parameters (congestions, risks for the resilience of the network, etc.) and economic parameters (market design and “value” of projects). This assessment serves as a background framework for the identification of projects that would successfully fulfil the needs. The principle of cost and benefit analysis is a way to monetize the interest of a given project, facilitating decision making and selecting projects. This approach, however, may be difficult to apply to other regions, in particular where systems are less meshed/less mature.

1. Approach to investment planning and control in the studied EU member states

The institutional frameworks of EU member states studied in this report present a common general method regarding infrastructure planning, including the regular preparation of a national investment plan as well as the verification of its coherence with the EU wide ten-year network development plan prepared by ENTSOE. The central role of ENTSOE’s plan shows that the creation of the single market is among the main drivers for investment. In the EU, stakeholder consultation also plays an important role: interested parties are offered the possibility to comment the TSO proposals, facilitating the assessment of the quality or usefulness of projects from a market perspective.

However, the case studies highlight some differences: the role of national regulatory authorities differs. In France, the NRA is responsible for analysing and validating investment programs while, in Italy, Spain and Portugal, the Ministry in charge of energy is the entity which, in the end, validates investment decisions after NRAs have provided an opinion on the investment project.

Regarding cost recovery and efficiency control, EU member states studied have a “cost plus” regulation for capital expenditures (i. e. cost recovery plus remuneration of capital) and include some elements of incentives on operating expenditures. In Italy, the incentive regime is even stricter, with a system awarding the TSO a premium or imposing a penalty according to the progress made in implementing each project. This aims at pushing the TSO to commission the new infrastructure as soon as possible and at the lower cost.

Cost control plays an important role since the TSOs are independent. This situation leads to asymmetries of information which have to be corrected through transparency measures such as cost publication. Some of the studied NRAs are also responsible for fixing the weighted average cost of capital (WACC) which determines the rate of remuneration of CAPEX. Such determination requires a careful audit of TSOs accounting systems and capital structures.

The EU approach reflects a very high level of maturity of electricity systems. In fact, networks are much developed, which means that the principal orientations regarding network planning focus on the development of interconnections and the integration of renewable energy sources. This is influenced by the geography of the EU where the proximity with neighbouring countries is much higher than in many other Mediterranean countries.

2. Specificities of non-EU countries studied

The examples of Turkey and Albania show that the issue of the development of the electricity network includes a higher political dimension. Indeed, TSOs are state-owned and still under a strict control of the government. That can be explained by the fact that the relative need for infrastructure development is higher than in the EU. Another aspect is the relatively lower opportunities for interconnection development which can be explained by geographical factors (the density of surrounding networks is low or neighbouring systems may not be reliable enough) and the fact that, often, there is no framework for developing a market beyond the national boundaries.

Conclusions

The comparison of the case studies regarding the methodologies used by regulators to evaluate investment projects and investment plans has shown that all regulators are somehow involved in the process. The experience of the EU regulators shows that the assessment of these projects and plans shall be based on a solid expertise regarding the evaluation of methodologies and scenarios used by the TSOs, both in the national investment plans and for the TYNDP developed by ENTSO-E at the European level. While the EU legislation has led to common principles and standards and also to a progressive harmonisation of regulators' powers with regard to investments, in the non-EU countries examined the governments still play an important role. In the EU, the market integration project is facilitating the coordination of grid development among the countries and the development of interconnections. In non-EU countries the situation is slightly different, regarding in particular the need for infrastructure development and the relatively lower opportunities for the development of interconnections.