Methodology to support the CapEx allocation in a global scenario with multiple companies, ENEL case study.

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ABSTRACT

The network and investment planning (N&IP) is a challenge in terms of the technical and economic sustainability; therefore, to define in short-medium term the amount of CapEx by investment reasons, in line with the business development and financial strategy is a key success factor.

The state of art shows that there are different methodologies and tools that support this challenge; like asset management and distribution management system, which have different modules and functionalities, that let to address different stages of N&IP process, and with the methodology of "benefit-cost analysis" is possible to handle the investment prioritization.

However the N&IP process can turn more complex if the financial strategy must be implementing in a global context with more than one company, that implies different: countries, regulatory frameworks, historical investment path, planning criteria, knowledge stage, investment reasons of CapEx, stages of development on systems, etc;

INTRODUCTION

At the end of the year 2014 Enel's group began a transformation of its businesses according to a new strategy that would allow be more efficient through the simplification of their structure, with the aim to get different benefits such as operational synergies, more flexibility, governance simplification, to do focus on local markets, among others.

The reorganization involved the creation of the "Global Business Line Infrastructure and networks" in order to separate the distribution energy business from the others, and to be able of management the business of each country from a centralized vision.

One of the objectives of the Global Business line I&N is to addressing the global strategies including those of optimizing the allocation of CapEx between the different countries where Enel is present in distribution business.

The main challenge to quantify the optimal CapEx in each company that allow to allocate the CapEx in the companies with the bigger needed and the greatest value creation is the different stage of development of each company that may be represented in these two aspects:

The first is the different local contexts: each company has a different regulatory framework, macroeconomic context, stages of development on systems, knowledge stage, historical investment path, etc.

And the second is the different technical aspects: each company has a different local planning criteria, investment reasons of CapEx, network age, types of distribution systems design (Radial, Loop, Network), property of different levels of the T&D chain, types of electrical infrastructure (Aerial, Underground / Hybrid, GIS, Conventional) among others.

The main works that have been advanced are the definition of common methodologies, procedure and criteria in order to guarantee the global alignment, as well as the development of a "decision tool" to support the decision maker.

DEFINITION OF THE TECHNICAL CLASSIFICATION CRITERIA FOR INVESTMENTS

The first step in order to ensure a homogeneous and symmetrical perimeter for each company was to homogenize the different investment reasons of CapEx that each company had.

The different investment reasons represent homogeneous groups of activity which are the basic budgetary elements through whom industrial budgets are constructed and proposed.

Customer management	Quality of service	Technical & environmental regulations
Network load adaptation	Technological adaptation	Other investments
Public lighting	Loss reduction	Etc.

Table 1 – Main investment reasons.

DEFINITION OF THE NETWORK PLANNING CRITERIA

Another step was to define the technical and economical criteria to be adopted when network planning is developed.

This also include the period where the works proposed solve the criticalities detected, the planning horizon is closely related to the technical-financial strategy and is a variable that affects the required CapEx.

The developed works included the definition of the main steps of the process starting off the identification of the network criticalities (N condition, N-1 Condition, the expected network load conditions, the network generation conditions, etc), the definition of the solution alternatives according with the different standard solution, and the methodology to select the best alternative.

The planning criteria allow defining homogeneously the works in the network to be scheduled in the multi-year investment plan.

DEFINITION OF THE CRITERIA FOR MULTIYEAR CAPEX OPTIMAL IDENTIFICATION

Once the investment reasons have been homogenized and the network planning criteria have been described, the next step was to describe the specifications concerning to the construction and representation of investment and plans in the distribution network by each company belonging to the Enel's group.

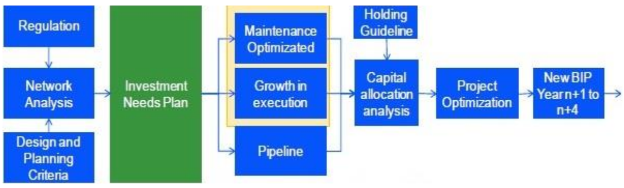

Figure 1 – Main phases of the process.

In order to of fulfilling The ENELs strategy, the CapEx allocation on the different companies will be carried out in two main categories each one with a different methodology of prioritization and allocation.

The overall investment need in terms of investment reasons will be divided and classified in "Maintenance and Growth" plans.

Growth category: The investments associated with the growth of the distribution companies.

Maintenance category: The investments associated with the "maintaining" / "replacing" network assets in order to ensure the operation of the company's distribution system.

The state of the art reference to "asset management" as the best tool to the CapEx allocation process in these cases:

"…Electric utilities are very capital intensive businesses, and thus an asset-centered approach is appropriate, particularly when the financial performance of its investment (money spent on the assets) is a key business driver…" [1].

"...Having standardized practices for asset management could significantly increase the trust and transparency around asset management and investment decisions..." [2].

However implementing an asset management system would require a certain level of maturity of all companies that allows a homogeneous and symmetrical analysis of the companies. Since the levels of development of the companies are diverse, a "decision tool" that works from KPIs constructed with the best available information is been developing [4][1], and allows a homogeneous and symmetrical analysis of the companies.

"DECISION TOOL" TO SUPPORT THE MAINTENANCE CAPEX ALLOCATION

Through the concept called DA (Decision Aiding) [3][2] was built a "decision tool" that take like inputs:

- The Maintenance CapEx available to the group.
- The technical-economical KPIs.
- The optimal investment requested by each company for each "investment reason".

Finally, the "decision tool" delivers the amount proposal of CapEx by companies, in line with the technical KPIs and the financial and business strategy.

<u>"KPIs CapEx" Vs. optimal CapEx</u>

The principle of operation of the "decision tool" is based on the construction of a "KPIs CapEx" by each "investment reason" that with the better information available represents in the best way the CapEx required.

Once the "KPIs CapEx" have been built for each "investment reason" and by each company, these will be used as a comparison point of the Maintenance CapEx requested as "Optimal CapEx" by each company.

$$KPIs\ Capex_n\ _{Vs}\ Optimal\ CapEx_n$$

To facilitate the comparison between the different companies all the "KPIs CapEx" for the same investment reason are normalized in the same way that is done in the system in per unit.

In the same way is done with the CapEx requested by each company.

$$\sum_{1}^{n} Norm\_CapEx\_KPI_{n,i} = 1$$

[1] In complex scenarios with "high levels of uncertainty and decision complexity..." is suggested to use models to support the decision making process, page 27.

[2] "*Decision aiding is the activity of people using models (not necessarily completely formalized ones to help to obtain elements of responses to the questions asked by a stakeholder in a decision process...*", page 20.

Where:

- $Norm\_CapEx\_KPI_{n,i}$: "KPIs CapEx" normalized for the company *n* and the "investment reason" *i*.
- n: Number of companies.
- i: a particular investment reason.

Simulation module for adjustments in the CapEx

The module was constructed with the objective of answering the following question:

For a certain amount of CapEx or a defined available Maintenance CapEx to the group: How much is the maintenance CapEx to allocate in each company, which allows supporting the technical sustainability?

The way of distributing variations in the maintenance CapEx available is carried out by a single "investment reason" for all the different companies that requested CapEx for that "investment reason".

Available CapEx = **Fixed CapEx** +/- **"Adjusted" CapEx**

Figure 2 – Conceptual adjustment scheme.

- Available CapEx: Is the CapEx available to be distributed among the different companies.

- Fixed CapEx: Is the sum of the CapEx of each company that will not be adjusted and will remain fixed.

- Adjusted CapEx: It is the sum of the CapEx of each company that will be adjusted using the $Norm\_CapEx\_KPI_{n,i}$.

Conditions without redistribution: If for a given "investment reason":

$CapEx\ Available = \sum_1^n CapEx\ Requested_n$ And, $Fixed\ CapEx_n = 1 \quad \forall\ n$ (I.e for all companies)

Then: The CapEx allocated is the same requested for each company.

Conditions with 100% redistribution: Otherwise if for a given "investment reason":

$CapEx\ Available = \sum_1^n CapEx\ Requested_n$ And, $Fixed\ CapEx_n = 0 \quad \forall\ n$ (I.e for all companies)

Then: The CapEx is allocated is the corresponding proportion of the "KPIs CapEx" that was normalized.

Conceptualization of "KPIs CapEx"

In order to built KPIs that represents in the best way the CapEx required and given the limited information conditions: reports homogeneous were defined with the technical information necessary; and the KPIs were defined from the point of view of three components considered as the most representative:

- Size infrastructure: the size of the infrastructure was built with the information of Network consistency.

- Magnitude of criticality: Two companies can have the same size, but the infrastructure of one can be new while the other may presents many problems.

This component allows focusing on companies with higher network criticalities, in order to be able to carry them to the expected average performance.

- Cost function: Based on the information of a cost benchmark made between companies, a cost vector was calculated that allow incorporating into the KPI a signal associated to the cost difference that the same technical action could have in the different companies.

$$CapEx_{KPI} = (A * KPI\ Size\ infrastructure + B * KPI\ Magnitude\ of\ Criticality) * Cost\ Funtion$$

Each "KPIs CapEx" is constructed from the linear combination of KPIs "size of infrastructure" and "Magnitude of criticality", and then is homogenized by the cost function.

The weights (*A; B;*) of each KPI of the linear combination are defined by the expert judgment, it represents an essential input for a "decision tool" that works on complex scenarios like the Enel's one. [5]

In order to exemplify how a "KPIs CapEx" is built, will be detailed some examples of the KPIs that are the source for calculating the "KPIs CapEx".

Examples of some source KPIs for "KPIs CapEx"

KPI: Capacity Deficit for N condition DCn

For the purpose of the example will only be described the component associated with the network infrastructure belonging to the "MV Network" and with the Criticalities associated to the scenario described in the "Network Planning Criteria" as N condition.

DCn is calculated as follows for each N condition criticality:

$$DCn = Dsp - Csp$$

Where:

Dsp: Maximum load of the analyzed network section, measured in MVA, (n+5) forecast, N condition, without considering any work already scheduled in the plan (SP = "sin proyectos" = without a project).

Csp: Maximum capacity of the analyzed network section, measured in MVA, (n+5) forecast, N condition, without considering any work already scheduled in the plan.

The maximum capacity Csp always refers to the analysed scenario, and it corresponds to the load limit used as a reference in the criticality threshold definition, for MV feeders is the feeder rated power (corresponding to the line rated maximum current) in N condition.

These KPIs is calculated for the year n+1 and for the year n+5, the latter represents the accumulated indicator of period n + 1 to n + 5.

KPI: Number of failures (Year n-1)

This KPI is calculated for MV and LV Network, for their calculation must be taken into account the events that have a time interruption higher than 3 minutes, belonging to category without notice, and the associated by all causes (included force majeure) with or without localization.

CONCLUSIONS

- The development and implementation of a structured and homogeneous methodology to support the CapEx allocation in a global scenario with multiple companies is primary and essential.

- A "decision tool" that support, based on the available homogeneous information, a qualitative comparison from the technical-economic point of view of the companies has been built.

- The "decision tool" allows simulating the way of distributing variations in the maintenance CapEx, starting from quantitative and homogeneous information of the companies, supporting the decision maker which keeps a key-role in the process.

- The accuracy of the tool depends on the feasibility of having KPIs that have a high correlation with the need for maintenance CapEx.

- Having a KPI that reflects the life conditions of the infrastructure would represent an option that increases the accuracy of the model.

- Due to scale effects on the infrastructure of the companies being analyzed, it would be convenient to subdivide large companies into sub-companies with more homogeneous scales, in order to make an analysis under more homogeneous conditions.

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