EFFICIENCY ANALYSIS ON ELECTRICITY DISTRIBUTION COMPANIES: A PRAGMATIC AND MEANINGFUL APPROACH TO DETERMINE THE TRUE COST DRIVERS OF UTILITIES

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SUMMARY

A benchmarking method, initially built upon the costs structure analysis of regional transmission units in France, was transposed to the electric distribution business to assess efficiency at the regional level and to compare European distribution utilities. The method has been tested on a sample of almost a hundred EDF distribution units over a period of 2 years with conclusive results.

The purpose is to identify and quantify the effects of the main cost drivers responsible for the formation of distribution costs and, therefore, to explain the cost differences between different operating units within the same network or between different networks (countries or utilities).

Firstly, the distribution costs are classified into several categories such as network operating expenses, depreciations, costs from network losses, taxes and similar fees… Some parts of these costs depend on the amount of assets, while other costs are directly linked to the number of customers or the distributed energy.

As a second step, an estimation model defines the standard quantities of network assets that should be built in order to deliver an certain amount of energy in a specified area. The model takes account of the differences in load density, the rate of overhead/underground lines, and investment costs differences dues to local environment.

INTRODUCTION

Most often, benchmarking surveys are applied to determine the possible and relative inefficiency of a company, and from this to target lower allowed revenues. Nevertheless, these methods fail to catch the influence of environmental factors, and the scope of cost drivers that can explain their differences in operating or capital costs. This paper describes a new approach designed to explain the differences of distribution cost between two companies or regional units, and to highlight the mechanisms of the cost formation.

The exercise of DNO cost comparison in order to draw some conclusions on the potential improvements of performances can traditionally be classified in four main categories [1]:

(1) "Engineering" approach consists in rebuilding either standard networks, or a model of actual networks, to calculate standard costs or technical performances standards, with the aim of comparing them with the actual costs or technical performances. This analysis is based on an important set of data. It is the current base of the electricity distributors' efficiency assessment scheme in Sweden [2] and is also used in Spain [3].

(2) "Accountant" approach consists in organizing the annual costs of the DNO in order to lead to a breakdown of the costs by origin (network costs, customer services costs, overheads…) or by separated activities (network maintenance / metering…). Expertises and internal data banks are used to define the factors that can explain these costs and the way in which they may influence them.

(3) "Cost function" approach consists in testing economic models of formation of costs starting from statistical data bases. It supposes that the studied activities obey to an identifiable and similar cost function. Companies optimizing this function constitute the reference frame for the improvement of the others. This approach calls upon the methods named COLS or SFA [4].

(4) "Non parametric" approach, generally called DEA (Data Envelopment Analysis), is based on a direct comparison between the resources used by the compared companies and the volume of produced goods or services, without making particular assumption on the cost function. This approach is very widespread today in European countries (ex: Netherlands, Norway, Finland). It does not need a large amount of data but it needs an important sample of comparable companies to evaluate the true performance gaps [4].

The method described in this paper is a combination of the three first normative approaches described above.

STRUCTURING DISTRIBUTION COSTS AND SETTING FUNDAMENTALS OF THE MODEL

Finding an appropriate distribution cost structure

The purpose of the approach is to explain the full distribution cost differences between operators expressed in €/MWh, or €/customer, and to highlight the mechanisms that infer the distribution costs.

Distribution costs are split into homogeneous cost categories in order to consider the following constraints:

- comparing costs that are comparable, by separating the costs incurred by activities which can be different from one DNO to another (ex: customer management), and consequently that may hinder the comparison,

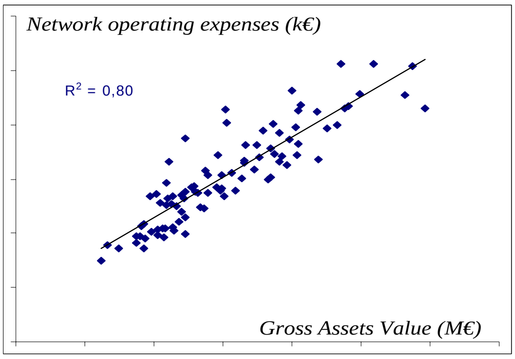
- separating costs that are controllable by the DNO (ex : operating exp.) from non controllable costs (ex: taxes),
- bundling the cost categories that are explained by the same cost driver.

Following these requirements, six main cost segments were defined. Correlation analyses allowed classifying them according to the most appropriate cost drivers:

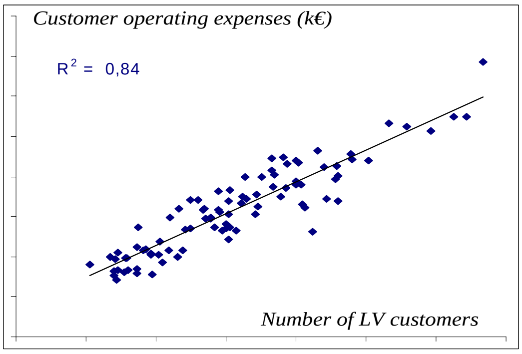
- network operation expenditures and depreciations [1] that are mainly explained by the value of network assets,
- expenditures on customer services and management (including metering) that are mainly linked to the number of the connected customers,
- transmission access fees and costs for network losses that are mainly explained by the amount of delivered energy,
- taxes and similar fees.

Consequently it is natural to start by comparing at first each cost category with the most appropriate explaining factor.

(Fig. 1) Expenses on the network are correlated with the gross revaluated assets (sample of local EDF distribution units):



(Fig. 2) Expenses for customer services and management are correlated with the number of LV customers (sample of local EDF distribution units):



Note: to simplify the presentation of the model, we assume that expenses that are linked to the number of customers can be correlated to the delivered energy as well.

1 Financial costs are also correlated with asset values, but they are out of the scope of French local units' comparison.

Using assets values to take account of long term factors and operating environment

As shown above, a significant part of the distribution costs depends on the network assets value.
Assets values may be expressed in terms of gross replacement assets values (millions € invested) which can be split into:

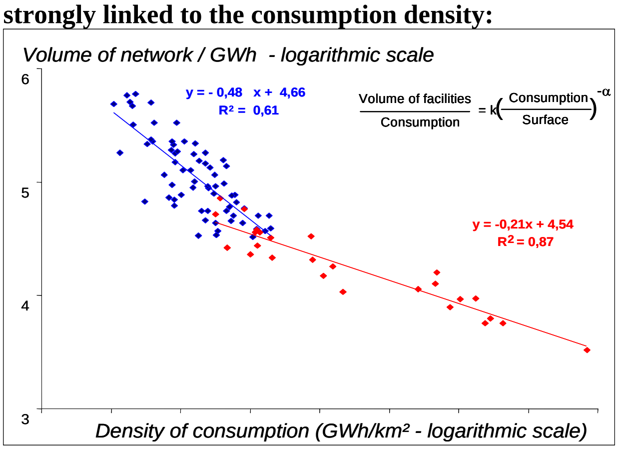
- aggregated assets in volume giving an indicator on the volume of network that has been built in order to satisfy the consumption need in the area of operation,
- the weight of underground cables in the total network assets, providing an indicator for comparing degrees of line burial,
- aggregated construction costs of facilities measuring the effect of the local environment characteristics on costs (mountain, urbanization…).

These 3 costs factors will be included in the model as long term factors that explain the effect of the network structure on the distribution costs.

Explaining the relative levels of asset volume to assess the effect of consumption density on costs

The first asset factor (the aggregated assets volume), expresses quantities of electrical facilities (lines and transformers) that have to be built for ensuring the delivery of required energy. In other terms assets in volume mainly depend on the width of the covered area and the amount of delivered energy that is to say on the consumption density.

(Fig. 3) Network assets related to the consumption are strongly linked to the consumption density:



This correlation arises from a law studied in theoretical conditions and by network simulation [5] that can be formulated in the following way:

$Ai = A_0\, Ci^{\alpha}\, Si^{1-\alpha}$, or $Ai/Ci = k\,(Ci/Si)^{\alpha-1}$ and $Ai/Si = k\,(Ci/Si)^{\alpha}$

Where C is the delivered energy, S is the area covered by the network and A is the amount of network assets.

This theorical equation assumes that the distribution of load density in the concerned area S is homogeneous. Moreover, it assumes that investments in capital are only driven by load growth. Thus it does not take accounts of differences in quality level requirements from one area to another.

Theoretically, α should be equal to -1/3. But the above graph shows relations with a different coefficient value for local units dominated by urban areas and for those dominated by rural areas.

Actually, this formula must be regarded as determining a minimal volume of facilities making possible to deliver energy on a covered area under a certain level of quality. It also implies the respect of the different electro-technical constraints (voltage level requirements, acceptable maximum load). This explains why :

- in rural areas, "pure" voltage drop constraints lead to a higher coefficient α (theoretically -0.5),
- in urban areas, "pure" maximum intensity constraints lead to a lower coefficient α (theoretically -0.25).

This relation assessed with the appropriate coefficients, will allow calculating the effect of density consumption on asset volumes that is to say on the distribution costs (as a large part of distribution costs is correlated with assets).

The gap between the regression line and the actual asset level of the DNO will allow assessing the volume of network that is not explained by the consumption density. It gives an indicator of the DNOs performance in terms of relative volume of implemented assets (we called it network adjustment effect).

Overall structure of the model arising from the above analysis

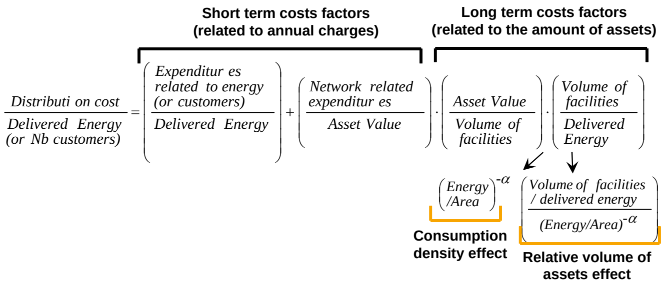
The previous analysis consisted in describing the distribution costs structure by the following three steps:

- structuring the annual charges and associating them with the appropriate cost drivers,
- explaining network costs from an asset values analysis,
- explaining asset values by separating construction costs and asset volumes, and linking asset volume with consumption density.

Therefore, the comparison of the expenses level per kWh supplied can be split into three components:

- expenses per asset unit, for all costs that are linked to network operation,
- expenses per delivered energy unit, for all costs that are linked to the number of customers,
- assets per consumption unit.

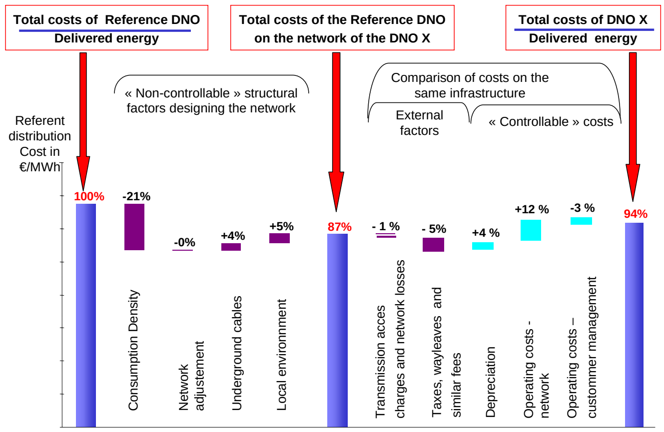
As a matter of fact, the costs assessment model can be summarized by the following equation:



It leads to a natural structuring of electricity distribution costs which consist in separating two categories of factors that explain the formation of costs:

- short-term factors which affect costs for a given quantity of facilities. They correspond to the costs categories divided by their corresponding cost driver,
- long-term factors which affect the quantity of network facilities. They correspond to the factors arising from the assets value analysis.

(Fig 4) And finally the model gives the possibility to assess how each cost factors presented above come to explain the cost difference between DNOs:



Note: the effects in % explaining the cost gap are to be multiplied with each others in order to find the cost difference.

Such an explanation of distribution cost gaps between DNOs can give a clear picture of the factors explaining a ranking of the DNOs according to their efficiency.

FROM COSTS COMPARISONS TO RELATIVE EFFICIENCY ASSESSMENT

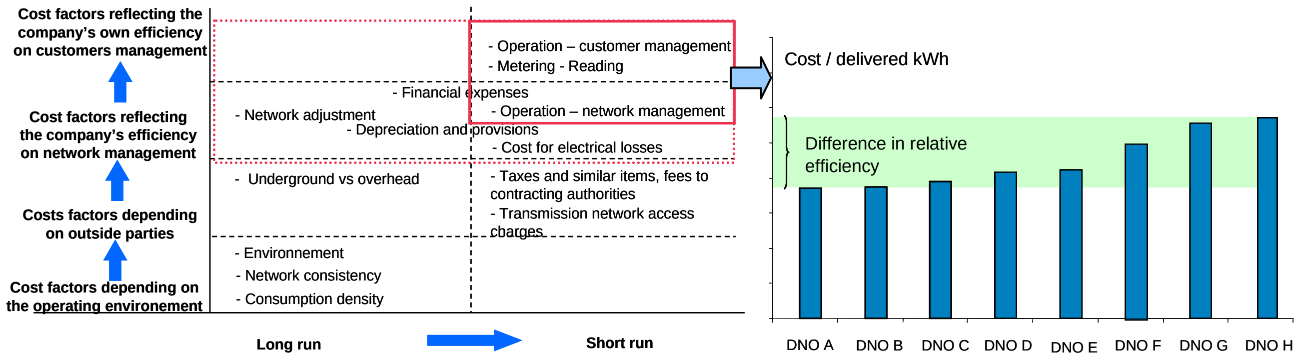
In this type of benchmark, it should be taken into account that DNOs costs can be influenced by external factors that incur non controllable costs. These are for instance: taxes and similar fees or transmission network access charges.

The ability to focus on controllable costs owing to the distribution cost breakdown presented above, gives the opportunity to compare the internal performance of DNOs and to assess their potential for cost improvement.

However, the first step towards such an assessment is to reach an agreement on the cost item that should be taken into consideration for the performance measurement. A large definition of economic internal performance of DNOs could be given by the dotted line rectangle in the chart below. A narrower definition only includes the operating costs (full line rectangle below). The shape of this model allows then an easy ex-post shift of this definition.

Moreover a special focus can be carried out on some categories of controllable costs. For instance, network operating costs can be analysed in terms of staff volume, labour cost and outsourcing.

(Fig 5) Once the scope for internal performance settled, the efficiency ranking of DNO is easy:



Note: "Network consistency" takes account of the effect on costs of the difference in the voltage levels operated by the DNOs, as in international comparisons.

CONCLUSION

The method has been tested on a sample of almost a hundred EDF distribution units over 2 years period. This method has as well been applied to international comparisons. It appeared to be simple in use, robust and transparent. It came along with a clear understanding of the causes of major cost gaps among DNOs. The French and international benchmarking operations have shown the benefits of such an econometric method:

- Flexible use: application to regional units, utilities or countries,
- Modularity: differentiates "short-term" and "long-term" performances,
- Upgradeability: takes account of increasingly targeted explanatory factors.

Moreover, a fundamental difference makes the quality of this approach when compared with other benchmarking methods: it does not care about hazardous expertise because it is only built from the observed statistic relations that define the way each cost driver affects costs. The expertise only arrives afterwards to validate the meaning of the observed relations. France was a very favourable ground of investigation in the first step towards the building of a complete distribution cost model. This made possible to develop and "fine tune" an econometric model explaining the formation of the costs.

Among its possible fields of application, mention could be made of the following:

- internal control of operating costs and investment expenses and following the improvement of productivity through the years,
- comparison of the DNO relative cost levels, taking into account the variety of the operating environments and of the activities and costs perimeters,
- setting efficiency improvement targets with an appropriate cost drivers approach,
- improving the dialogue with the regulation authorities motivated by a better cost drivers transparency.

Finally one must stress improvements of the model in the following fields that have not been presented in this paper:

- taking account of the effect on the costs of the relative scales of activity,
- improved estimate of the effect on cost and network of the rural vs urban character of the operation area.

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