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Overview of Electricity Distribution in Europe

Summary from Capgemini's 2008 European benchmarking survey

Point of View by Philippe Chanel

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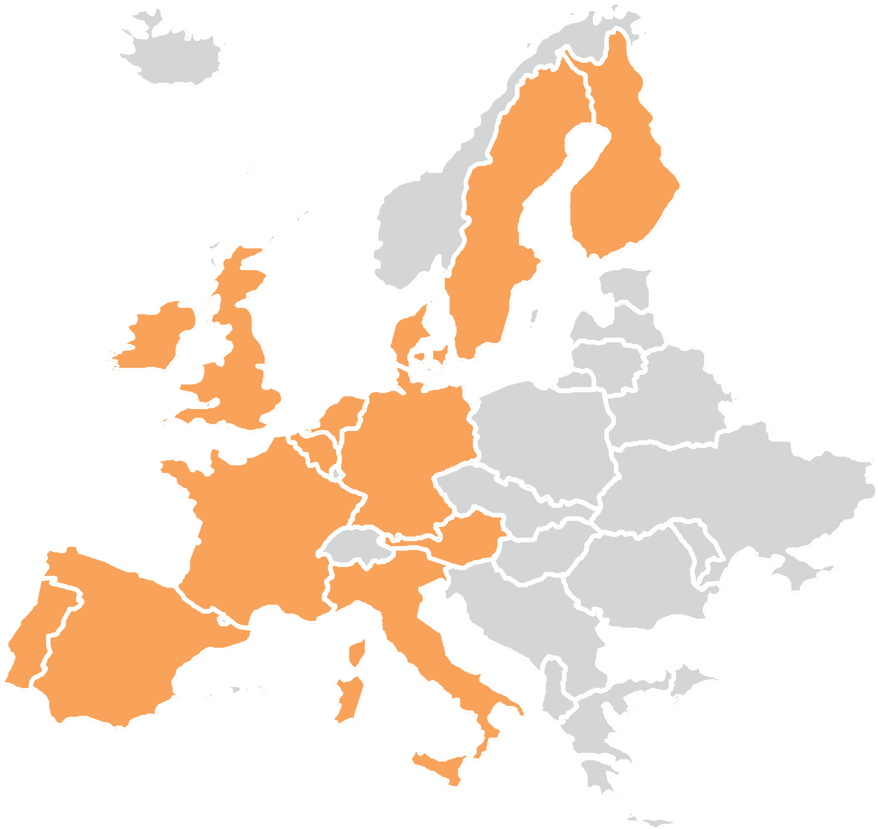
Introduction

This point of view presents the results of a multi-client study on the cost efficiency of European electricity distribution carried out by Capgemini between November 2007 and February 2008, based on 2006 cost data. The participants in this survey are 46 Distribution Network Operators (DNOs) or regional units in 13 countries of EU-15. They account for 1,084 TWh/year of power consumption (35% of total electricity consumption across EU-25 and 44% of electricity distributed across EU-15) delivered to 110 million customers (44% of total EU-25 electricity connected customers) and their networks cover an area of 1,438,000 square km (36% of total EU-25 area).

Figure 1: Map of Participating Countries



This document, prepared by Capgemini's Utilities Strategy Lab in cooperation with ADéquations, a French-based econometric modeling consultancy, comprises two parts:

- Part 1: provides an overview of the Electricity Distribution business in Europe
- Part 2: presents performance results of the DNOs who participated in the Capgemini distribution study at an aggregated level, from two different angles:
  - From a quantitative (econometric) perspective, in order to benchmark the participating DNOs against their cost efficiency;
  - From a qualitative (managerial) perspective, in order to analyze managerial contribution to cost performance.

An appendix presents a summary of the methodology used in developing the benchmarking survey.

Table 1: The List of Participating DNOs

Country represented	Name of DNO
Austria	BEWAG Netz GmbH KELAG Netz GmbH WIENENERGIE Stromnetz GmbH ENERGIE AG Oberösterreich Netz GmbH LINZ STROM Netz GmbH
Belgium	SIBELGA IMEA IMEWO INTERGEM IVEKA IVERLEK SIBELGAS GASELWEST
Denmark	DONG Energy : 2 DNOs
Finland	FORTUM Finland
France	EDF – Réseau de Distribution : 8 distribution areas SORÉGIES Réseau de Distribution
Germany	Netzgesellschaft Ostwuerttemberg GmbH Anonymous DNO LEW Verteilnetz GmbH
Ireland	ESB Distribution
Italy	ENEL Distribuzione
The Netherlands	ENECO Netbeheer
Portugal	EDP Distribuçao
Spain	ENDESA Distribución Eléctrica : 5 distribution areas
Sweden	FORTUM Sweden FORTUM Stockholm
United Kingdom	Central Networks East Central Networks West Scottish Power Distribution Scottish-Power Manweb EDF Energy – EPN EDF Energy – SPN EDF Energy – LPN

European Electricity Distribution Market Overview

Fundamentals of electricity distribution across Europe

Over recent times, the electricity industry value chain in Europe has undergone notable changes. In addition to markets opening for competition across and within borders, the biggest change imposed is the unbundling of retail and distribution activities. In Europe, under the European Commission Directives, the networks must now be operated by separate entities, clearly separated from the suppliers of electricity. For this survey, a DNO is defined as:

- An enterprise that operates, or at least manages, network operations and a majority of the customer related activities, and is subject to regulatory control,
- In some countries, DNOs can also be engaged in competitive businesses as long as the use of the system is guaranteed in a transparent, objective and non-discriminatory manner,
- DNOs are required to provide a level playing field to all system users.

An existing common structure is a consequence of the “uniform” nature of the activity and obligations placed on DNOs across Europe by the European Commission. However, many variations still exist in the activity and cost perimeters defined for DNOs by regulatory schemes across different countries.

The different treatment of DNOs in relation to ownership of distribution network, regional taxation, municipal obligation policies and regulatory environment, as well as contestability within a given service, contributes to a more complex and heterogeneous picture of DNOs across Europe. The differences that stem from such country-specific conditions at a European level are discussed below.

DNO discrepancies across Europe

The ownership of a distribution network is not a common feature in Europe

The difference between owning and operating a network is significant as it introduces a further layer of interaction between the different players within the distribution business. As a consequence, different incentive schemes and reward structures need to be introduced to ensure that the internal and regulatory objectives can be delivered by an agent on behalf of the owner or licensee. Some examples of the differences in the European countries are provided below:

- In relation to network ownership, distribution operators hold concession contracts with the municipalities in France (on medium and low voltage levels) or in Portugal (for low voltage)
- The DNO may hold a leasing contract with an asset manager (usually the parent group) which is the case for some German and Austrian DNOs
- The DNO may have adopted a different business model such as using an outsourcing solution for a part of its business. As an example, many Belgian DNOs source most of their activities from a common external distribution activities provider. Some other companies outsource a significant part of their activity to subsidiaries within the parent group (e.g. France and Denmark). Such a business model is usually adopted due to the associated opportunities to leverage economies of scale.

Table 2: Electricity Distribution Core Business Segments

Asset management	Network operation	Customer relations
• Strategic Planning • Financial management • Investments • Maintenance policy • Procurement of services • Performance management • Revenue management	• Network planning • Engineering & construction • Connection and installation • Network control and management • Maintenance and work management • Metering	• Billing • Customer Inquiry • Customer dialog • Information • Claims • Call center

Regional Taxation and Municipal Obligation Policies create different operating conditions

The tax systems and municipality obligations, which are very different from one country to another, induce substantial differences in the level of costs. In some countries, these costs are negligible (e.g. in Sweden, Austria and Finland) whereas in others they are significant (e.g. in Germany, France and Belgium).

Differences in regulatory environments can lead to differences in the accrued cost

Some regulatory authorities expect distribution companies to incur the financial costs of electrical losses. The majority of our sample (two thirds of the DNOs) have to buy energy to compensate for physical losses in the network or imbalances in the

"Balancing Groups." 11 companies do not bear the cost of electric losses. These are in the UK, Ireland, Spain and Portugal, where compensation is done directly at a supplier level. The costs for transmission network access are sometimes directly invoiced to the suppliers (e.g. in Spain and Portugal).

Contestability of a service

Regulatory differences have led to some significant differences between countries with some elements of a "traditional" DNO being opened to competition. Some of these include metering, provision of new connections, and even ownership of the embedded network. Examples include:

- Meter reading in the UK is deemed to be a cost borne by suppliers
- In the UK, Denmark, Germany and Italy, a small number of new customer connection activities are open to competition.

Operated Voltage in the distribution networks

There is a large diversity of operated voltage levels (i.e. boundary between transmission and distribution) for electricity distribution companies in Europe, with some DNOs partly operating high voltage networks (where high voltage is more than 50 kV; medium voltage between 50 and 1 kV), while others operate only in low and medium voltage levels.

Broadly speaking there are countries where:

- The DNOs operate a large range of network voltage levels below a transmission system which only include very high voltage systems. This is the case in the UK (distribution companies operate networks from 132 kV to LV), in the Netherlands where the main utilities operate the regional networks, as well as in Portugal, Ireland and Italy.
- The DNOs only operate medium and low voltage networks because:
  - HV regional networks are operated by transmission regional companies. This is the case, for instance, in Sweden, Norway or, sometimes, Germany;
  - HV regional networks are operated by a "large" transmission system operator. This is the case in France and Belgium (in France the boundary between TSO and DNO stands above the transmission–i.e. distribution substations, while in Belgium the boundary is below).

Number and Size of DNOs

The number of DNOs from one country to another can vary a lot, which implies large differences in their size. There is also a wide variety of operating environments. Some small DNOs only operate in very urban areas whereas others operate only in a rural environment.

Table 3: Indicative Number of DNOs per Country and DNO Concentration

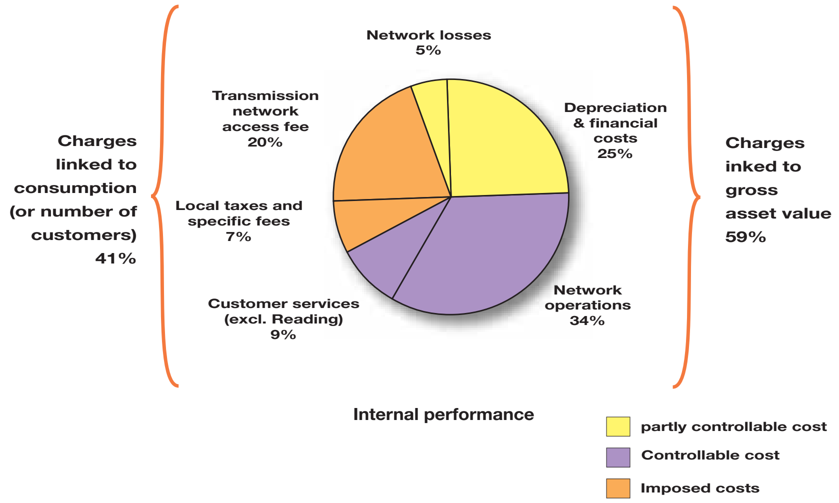
Country	Number of DNOs and Concentration
Austria	About 130 DNOs. The largest delivers approximately 15% of consumption.
Belgium	30 operators of different size. The largest contributes about 10% of distributed electricity.
Denmark	107 distribution network companies. The largest group delivers energy to a third of customers
Finland	89 operators. The largest represents about 15% of delivered energy.
France	Approximately 150 DNOs but the largest equates to 95% of consumption.
Germany	About 800 operators but 4 major groups. The largest represents approximately 25% of consumption.
Ireland	A single DNO delivers 100 % of consumption.
Italy	The largest operator accounts for 85% of consumption. 182 DNOs account for the remaining 15%.
The Netherlands	7 major DNOs are directly connected to the transmission network.
Portugal	The largest delivers almost 100% of total consumption.
Spain	About 300 operators registered in 2006 with 5 majors DNOs. The largest delivers approximately 40% of total consumption.
Sweden	180 DNOs which are mostly owned by majors groups.
United Kingdom	14 DNOs of similar size. Three of the largest supply 31% of consumption.

Key findings from Capgemini's European electricity distribution performance benchmark

An econometric model was used in order to adjust the impact of a DNO's structural characteristics and non-controllable variables, and to enable a comparison between different DNOs. Through the model, it is explained how each cost factor influences cost differences and how the DNOs' "true cost" can be estimated. As a consequence, the short term performance of DNOs is compared, and each is ranked according to its cost efficiency.

In order to identify current performance improvement initiatives, responses of DNOs regarding managerial issues such as outsourcing, performance management and customer activities were analyzed.

Figure 2: Average Cost Structure of the DNOs in the Sample



Key findings based on the econometric model surrounding the DNOs' performance results

Full cost comparison and allocation

If we only compare gross DNO costs per delivered MWh, the full unit cost varies from 9€/MWh to almost 57€/MWh, i.e. in a proportion from 1-6 among operators that were compared. But this would be a very simplistic comparison approach because beneath these differences, environmental factors lead to very different infrastructure needs, from one area to another.

The structure of this full cost can be significantly different from one DNO to another because of differences in the scope of the costs falling into the account and the very different levels of pass-through costs (transmission access charges, taxes and similar fees).

For the average DNO, 59% of annual costs are linked to the value of assets including depreciation, financial cost and network operations. 41% of annual costs are linked to the volume of net delivered energy or the number of customers (i.e. transmission access fee, costs for network losses and customer services). The costs considered as controllable by the DNO (network operations, customer services and management) represent about 43% of the gross average DNO cost (blue part in figure 2). Our cost efficiency comparison focuses on the controllable part of costs. It takes into account differences in cost structures by evaluating appropriate cost drivers and applying adjustments to incorporate the effects of operating environment on costs.

Among the various environmental cost factors taken into account (see appendix), density of consumption appeared to be a highly influential cost factor. As a result, distribution costs can be increased by more than 100% due to differences in consumption density ranging from the network operator with the highest density to the one with the lowest.

Costs Efficiency Comparison

After incorporating all adjustments to make the costs comparable, as per figure 3, the actual performance of the DNOs vary in the proportion of less than 1 to 2, where the most efficient DNO has an index of 100 and the least efficient an index of 183.

The comparison is done as if all the DNOs in the sample operated the same average network, (which would remove differences in the imposed and inevitable cost factors), and on the basis of the controllable operating costs.

These relative efficiency levels were split into two components: network operating costs strongly linked to the value of network assets, and customer services and management costs strongly linked to the number of customers connected to the network. Each DNO's efficiency was assessed on the basis of each of these cost categories.

Figure 3: Internal performance of each DNO on a Reference Network (100 = best practice)

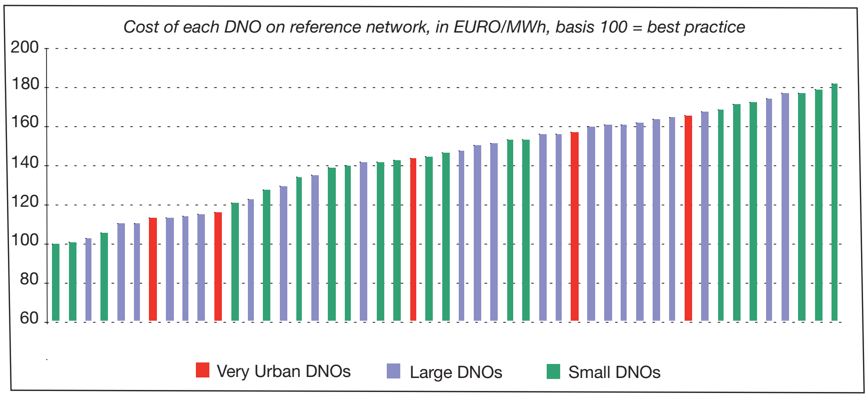
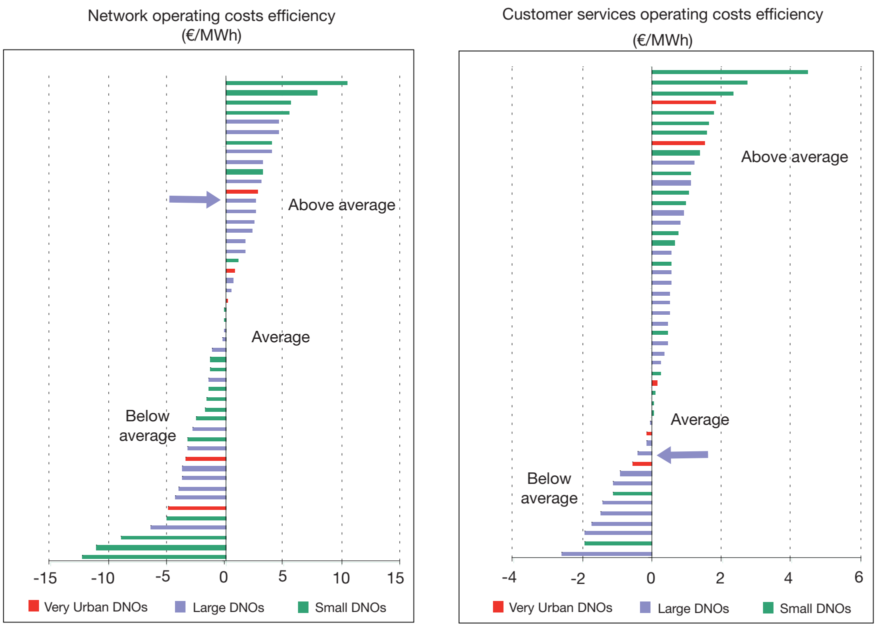


Figure 4: Relative performance of each DNO on network operation and customer operation



There are large differences in the network and customer operating costs between DNOs. The least efficient DNO could improve its full cost by 40% if its operating costs were at the same level as the most efficient DNO.

Sample of other findings from the relative performance results

Meter reading costs

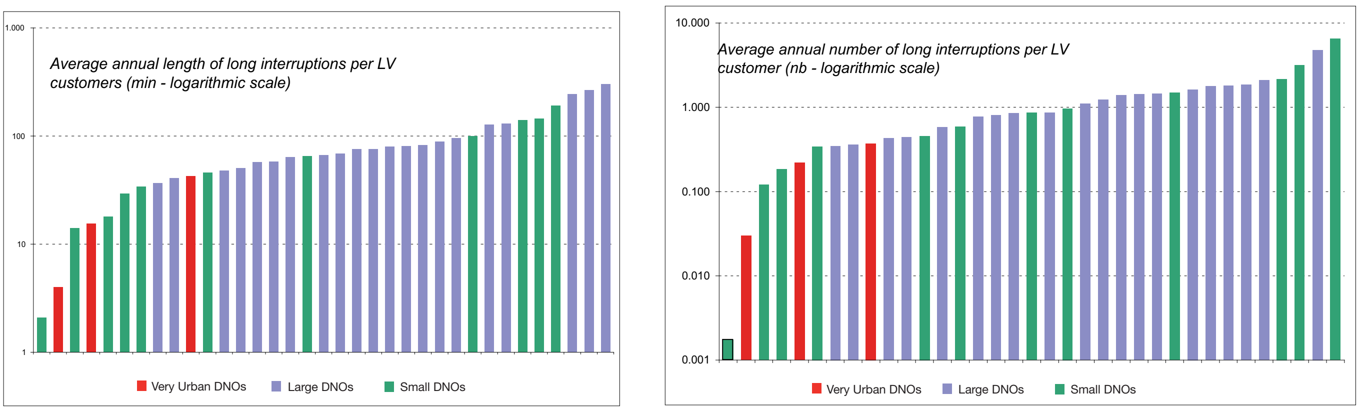
The costs incurred from meter reading differ largely: the non-weighted average cost of meter reading per customer is 5€; however, this varied between less than 1€ and more than 11€ in the sample. Discrepancies in meter reading costs can be due to the frequency of meter reading and the way the reading process is managed.

The DNOs in the sample that had implemented smart meters had the lowest meter reading costs. There is potential to reduce reading costs for DNOs who still have not included smart metering as part of their operations.

Network Losses

The DNOs do not share the same level of cost for electrical losses compensation (when these costs appear in their accounts). This is either due to differences in the rate of losses (influenced, for example, by differences in the scope of operated voltage levels and the size of network) or differences in the unit cost of electric losses (influenced, for example, by the regulatory incentives for loss minimization).

Figure 5: Annual average number and length of supply interruptions for Low Voltage customers



The average cost per company calculated for the DNOs which bear these costs is 53 €/MWh lost, and the average rate of losses is 5.9%.

Quality of Supply
There is a significant degree of variance between the DNOs in their quality of supply, measured by the duration and frequency of supply interruptions.

The overall non-weighted average duration of long interruptions (more than 3 minutes) is 86 minutes for Low Voltage (LV) customers and 63 minutes for Medium Voltage (MV) customers in a year.

The overall non-weighted average frequency of long interruptions for LV customers is 1.24 interruptions and 0.97 interruptions for MV customers in a year.

Key findings based on managerial survey responses regarding performance improvement initiatives

Investment management
DNOs' investment management decisions typically revolve around investing in load-related assets, asset replacement, quality of supply, meter replacement and IT.

We observed large differences between distributors in terms of invested euros per million euros of assets in present value. This can naturally be a result of past investment decisions; however, some other reasons such as the quality of supply targets, generation capacity connected to the distribution network, and regulation, can also influence the level of a DNO's investment.

Not all DNOs invest optimally on replacement (i.e. according to their stated urgency for replacement), which can put at risk the safety of their ageing assets. Meter replacement is the most common cause for regulatory investment. It demands DNOs to consider the best ways to create value from large investments in new meters.

Around 40% of the DNOs engage in international sourcing; however, more than half of them still have not tapped the benefits of purchasing globally.

Figure 6: Share (%) of Network / Customer Activities Outsourced

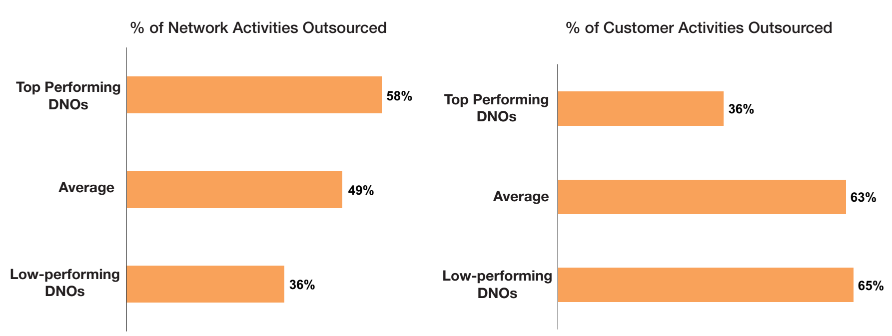
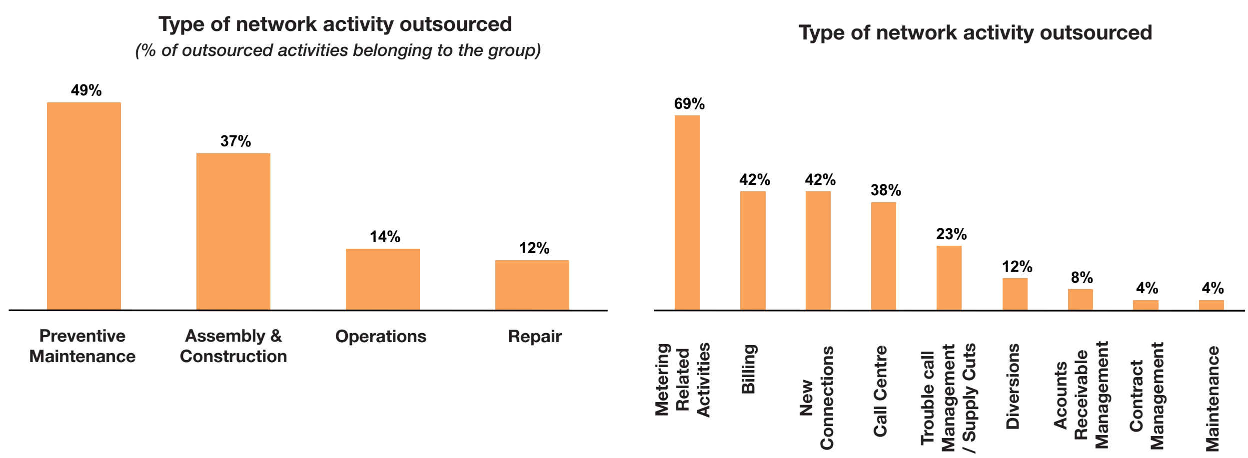


Figure 7: Type of functions outsourced (Network /Customer operations)



Outsourcing

Highest performing DNOs tend to outsource more of their network activities and less of their customer activities than their lower-performing peers. (see figures 6 and 7 page 9)

Customer related activities

The level of quality of service varies distinctly between the DNOs. Because there are many indirect benefits of improving customer satisfaction levels, all DNOs should become more motivated to make investments to improve customer satisfaction.

A small group of DNOs have embraced sophisticated communication tools for customers such as online self meter reading.

Perfomance management

Most DNOs are involved in performance management initiatives—73% have got Annual Efficiency Targets and 50% have implemented a Continuous Improvement Program.

There are areas for improvement in the implementation of performance management initiatives of some DNOs because of variances in the cost efficiency results.

Demand Side Management

Already, 42% of DNOs are involved in Demand Side Management (DSM) activities.

DSM system technology may require new investment and new ways to communicate with customers (e.g. call centers, communication and effective marketing to attract customers to take part in the programs). The leading DNOs have implemented carefully planned strategies to introduce sophisticated DSM services.

More involvement in DSM offers an opportunity for DNOs to improve their long-term economic performance. This is through better consumption efficiency that leads to less network-related investment.

DSM is an important part of energy efficiency and as such can significantly assist in the overall European agenda to combat climate change by lowering energy consumption.

Figure 8: Comparison of Customer Service Activities within DNOs

	Highest value ⟷ Lowest value	
Cost per customer (excluding meter reading, PPP* adjusted)	50€ — 28€ Average — 7€	• Even when excluding the most extreme results, the variation of cost per customer between the DNOs is very large • Variation may be concerned with differences in activity perimeter or disparities in the level of efficiency in customer management activities
Average access time to connect a new voltage custumer	55 days — 16 days Average — 2 days	• Several DNOs appear to be hugely more efficient in connecting new customers than others • These variations could be partly due to the interpretation of the question (in a 2005 benchmarking study by CEER the variation was as large as from 1 day to 4 months)
Time commitment for responding to supply failure	18h — 4.30h Average — 0.50h	• Average of 4.3h is aligned with the findings of CEER which suggest that the time commitment is around 3-6h • However, as this is one of the most critical "Moments of Truth" between the customer and distributor, it is worth investing in making improvements for those DNOs which response time is higher than the average
Average time the DNO completes a meter reading of a low voltage customer in a year	7 times — 2 Average — 0.01 times	• One meter reading per year appears to be average according to other benchmarking studies • Nevertheless, leading DNOs have started to use smart metering which allows continuous meter readings and avoids manual work • Smart metering may therefore allow more acurate billing, reductions in the metering costs and better demand side management

* A PPP (Purchasing Power Parity) exchange rate equalizes the purchasing power of different currencies in their home countries for a given basket of goods. It is often used to compare the standards of living between countries.

Source: Council of European Energy Regulators (CEER), Third Benchmarking Report on Quality of Electricity Supply (2005)

Appendix: Methodology

Definition of DNO Performance

For the purpose of this study, we have defined DNO performance to represent the distributor's cost efficiency in terms of those elements of cost that the business has some degree of control over. This consists of the customer and network management costs. The short-term factors of these controllable costs constitute the relevant scope of comparison. They include meter reading, customer and network management operations as well as electrical losses.

Controllable factors can be correctly compared and measured only after several adjustments to normalize costs are applied. First, all structural (long-term) factors are adjusted. This includes environmental conditions and network characteristics such as consumption density, network density in this report network density is referred to as network adjustment, and local operating environment (mountains, urban areas, etc.). Secondly, cost factors which depend on outside parties are adjusted. This comprises lengths of underground cables against overhead lines, taxes and similar fees, and transmission network access charges. Lastly, network perimeter differences (i.e. different boundaries between distribution and transmission networks) and the scale of activity is taken into account.

The costs for electrical losses compensation or the depreciation and financial costs could be part of the measured efficiency. However, they will be compared separately.

DNO Performance Benchmarking

Which DNOs perform relatively better than others? How can a DNO's internal performance be measured? Is it possible to compare performance when DNOs vary largely by size, regions they operate in, and consumers they serve?

In order to make a relevant comparison of the DNOs' costs, we needed, firstly, to adjust each DNO's costs to correct differences that stem from structural characteristics and non-controllable short-term factors. This included a correction to the main external cost drivers (operating environment, consumption density and rate of underground/overhead lines) leading to an assessment of the relative level of network assets.

Secondly, we looked at the DNOs' short-term performance. We classified the collected distribution cost items into six main categories (network operating expense; customer activity expense; depreciation and financial cost; cost from network loss; taxes and similar fees; transmission access fees) and compared the different controllable cost categories (network operation; customer services; network losses compensation). Some of these costs depend on the amount of network assets while other costs are directly attributable to numbers of customers or the distributed energy. Operating costs were also corrected from differences between countries that stem from Purchasing Power Parity rates.

Finally, we mapped all the cost adjustments on a graph to illustrate in more detail how each cost factor explains the cost differences between the DNOs. Thereby, we were able to rank each DNO according to its efficiency and estimate if there is an opportunity for improvement in its performance.

DNO Segmentation

In order to analyze the different characteristics of the DNOs, we divided them into three peer groups. These groups include:

- Small or medium-sized rural, semi-urban DNOs: Deliver less than 10 TWh / year, with a consumption density less than 10 GWh / km^2 (with an average of 0.5 GWh / km^2) and deliver energy to less than 1 million customers. In our sample, there were 20 operators or regional units in this category
- Very urban DNOs: Their size is less than 1,000 km^2 with a consumption density greater than 10 GWh / km^2 (with an average of 35 GWh / km^2). In our sample, there were 5 operators in this category.
- Regional and nationwide DNOs: Deliver more than 10 TWh a year and cover an area of more than 1,000 km^2, delivering energy to more than 1 million customers. Their average consumption density is 0.8 GWh / km^2. In our sample, there were 21 operators in this category.

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Utilities Strategy Lab

The Utilities Strategy Lab is a global network of sector-specific consultants and research specialists dedicated to generating insights into the Utilities industry. Lab activities include:

- Research points of views on emerging industry trends and topics,
- Continuous review of the Utilities Market (e.g. the European Energy Markets Observatory is published once a year since 2001, providing hundreds of data points and insight-rich analysis),
- Client specific strategic research and analysis.

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- Econometric and statistic analyses which lead to the development of costs explanation models and efficiency assessment, known and recognized at the European level;
- International benchmarking (of costs, tariffs, performances, modes of regulation systems...).