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Smart Grids and Networks of the Future - EURELECTRIC Views

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WG Smart Grids / Network of the Future

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Environmental Leadership
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Social Responsibility
Transparency, ethics, accountability

May 2009

Smart Grids and Networks of the Future -

EURELECTRIC Views

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Working Group
Smart Grids / Networks of the Future

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1. EXECUTIVE SUMMARY

Upgrading the current European electricity grid with 'smarter' technologies is one of the key priorities in the effort to overcome the infrastructural and operational challenges posed by the newly-adopted EU energy-climate legislative package with its triple targets for the year 2020. The European Union has been moving towards deregulation of the electricity markets for the past decade, with the consequent need to ensure the reliability and quality of energy supply while adapting the structure and processes to take on board the new market approach and new legal obligations, integrating renewable energy sources (RES) into the system and increasing the efficiency of electricity transmission and distribution in order to limit the grid tariffs.

The EU's triple commitment to reducing CO_2 emissions by 20%, sourcing 20% of its total energy (transport, heating & lighting and electricity) from renewable sources and improving energy efficiency by 20%, all by 2020, represent a considerable challenge for the energy sector of today. For the electricity grid, the triple commitment is even more challenging as it means that approximately 35 % of all electricity will be generated from renewable sources. In addition, more electricity applications will appear in the future, such as the electrical vehicles and heat pumps coming into use today. This will have a considerable impact on the electricity grid.

EURELECTRIC is pleased to see that the European Commission has recognised the role of 'smart grids' in reaching the goals of the energy-climate package in its recent Green Paper on Energy Networks. European electricity networks will have to cope with the ambitious sustainability targets set by the EU policy makers, adding new items to the mission of Transmission System Operators (TSOs) and Distribution System Operators (DSOs), which has traditionally been to secure network reliability and quality and, more recently, to act as market facilitators. Smart grids are a way to equip system operators with the necessary tools to contribute to the 2020 objectives.

A smart grid is an electricity network that can intelligently integrate the behaviour and actions of all users connected to it -generators, consumers and those that do both - in order to efficiently ensure sustainable, economic and secure electricity supply. A smart grid, involving a combination of software and hardware allowing more efficient power routing and enabling consumers to manage their demand, is an important part of the solution for the future.

Smart grids will function bi-directionally, thus enabling the integration of small and large scale renewable and distributed energy production. However, with the current infrastructure, it will not be possible to add all the renewable and other distributed power generation to the grid, as it was not built for this purpose.

The European Commission published in February 2009 new proposals to boost the use of smart technologies to combat climate change. Smart grid technologies are indeed a must to enable promising technologies that are important contributors to CO_2 reduction plans, to be fully exploited. Many member states are facing an acute need to upgrade or replace their ageing power grids, while at the same time the European Commission argues that market liberalisation and the interconnections required to integrate the markets provide an opportunity to upgrade energy infrastructures.

EURELECTRIC stresses the need for a predictable and transparent regulatory framework for the European electricity market, we view an appropriate return as a basic prerequisite for investment, and we also recommend harmonising rules across Europe as far as possible. We call upon governments and regulatory authorities to work together towards an optimised business model for all parts of the value chain, from generators to consumers, so as to minimise total costs. The current economic crisis provides extra motivation to accelerate the process, because electric grid infrastructure is the 'backbone of the economy' and as such, one of the best places from which to kick-start the recovery. Regulators need to take appropriate measures to support the development of smart grids, allowing a fair rate of return when DSOs contribute to meeting efficiency and RES targets. These measures should lead to generally lower energy bills for customers.

EURELECTRIC wishes to underline that Regulators need to provide incentives to DSOs for their involvement in R&D work and for the development and deployment of new technologies supporting smart grids. These incentives should be further increased.

Based on a survey among EURELECTRIC members, this paper seeks to set out the state of play on the smart grids environment, the nature of the distribution grid and networks development businesses in European countries. It includes details on drivers for smart grids, networks development, investments, new services expected from DSOs, active grid management, smart metering and regulation.

Our aim is that electricity distribution business representatives will be able use this paper as a point of reference and valuable information source in making comparisons between companies. It may also prove useful in discussions with regulators, legislators and other authorities, and aid the sharing of best practice and thus help to improve efficiencies. The survey and this resulting paper are not in any way intended as a full benchmarking study. Rather, they provide a context for understanding the similarities and differences between companies and the level of implementation of the smart grids concept in Europe.

It is likely that reviewing the data will lead to further collaborative work, which will promote better understanding of the situation and the issues. It is also our hope that policy makers reading this report will realise how challenging, time consuming and costly it will be to make the networks 'smart' enough to accommodate the new distributed generation technologies and at the same time exploit the capabilities of Demand Side Management (DSM) so as to both achieve high levels of efficient use of energy and meet the EU targets. At the same time the reader will understand that energy companies need to experience and appreciate the benefits of smart grids through real deployment projects in order to better assess the technical and economic opportunities, challenges or threats. Such projects will serve to prove the proposed technologies and offer guidance for the required investment policies and the crucial incentives that the regulators must provide.

SMART GRIDS AND NETWORKS OF THE FUTURE -
EURELECTRIC Views

***Preliminary definition**: A Smart Grid is an electricity network that can intelligently integrate the behaviour and actions of all users connected to it -generators, consumers and those that do both - in order to efficiently ensure sustainable, economic and secure electricity supply.*

2. INTRODUCTION

Smart Grids is a new concept for electricity networks across Europe. The electricity industry is looking forward to the rising challenges and to the opportunities expected to bring benefits to all stakeholders and society as a whole. The initial objectives of "Smart Energy Networks" are to increase the efficiency and to maintain safety and reliability of the European electricity and gas system and networks, e.g. by transforming the current electricity grids into an interactive (customers/operators) service network, and to remove the technical obstacles to the large-scale deployment and effective integration of distributed and renewable energy sources as required by the recently adopted Renewables Directive.

3. THE ROLE OF FUTURE ELECTRICITY NETWORKS

Efficient electricity transmission and distribution systems are a fundamental requirement for providing European citizens and companies with an essential energy source and meeting the demands of the 21st century. The need to strengthen Europe's electricity networks, meet growing electricity demand, support rational use of energy, develop a trans-European electricity market and integrate more distributed sustainable generation resources, including renewable sources, presents major challenges. The role that future electricity network design and investment will play in achieving wider EU energy policy objectives is decisive. To that end, the networks technologies will be the key enabler for the wider and deeper penetration of distributed low-carbon generation. EURELECTRIC encourages the European Commission and Member States to give attention to electricity networks and their future role in this respect.

4. EURELECTRIC SURVEY AND ANALYSIS

Reflecting this situation, EURELECTRIC decided to collect information on the current level and future development of Smart Grids-specific activities in electricity DSOs in Europe. Comments, analysis, observations, conclusions and - as far as possible – an interpretation based on this data should create value for EURELECTRIC members as this can be used as one source for developing strategies on how to cope with this new situation.

EURELECTRIC believes that monitoring the current status of implementation of the Smart Grids concept, specific technologies and activities by DSOs in different Member States could be of interest for further investigations and future projects.
In a survey conducted within the EURELECTRIC structure, members of the Working Group on Distribution Smart Grids were asked to provide information on the "Present Status and Prospects of Smart Grids Implementation in Distribution Companies" and to define the main aspects of their experience with this issue. As different countries are at different stages of liberalisation and have different regulatory structures and objectives, it is rather difficult to make direct comparisons between different Smart Grids practices. However, a number of common topics emerge from the comments received.

4.1. Objectives of the EURELECTRIC survey

The main objectives of the EURELECTRIC survey on the "Present Status and Prospects of Smart Grids Implementation in Distribution Companies" are:

- To improve understanding of the current operating framework of electricity distribution networks
- To describe the smart network characteristics in each member country.
- To provide information on the scope, characteristics and present degree of innovation in the electricity distribution networks and business.
- To provide a first impression of the expectations of the DSOs and grid owners on the deliverables through the implementation of the Smart Grids concept and businesses.

In order to achieve this aim, data on the Smart Grids concept and practical implementation in distribution companies have been collected and summarized. This data collection gives a first idea of what Smart Grids really means in many European countries. In order to create more value for EURELECTRIC members, comments on the data and analysis of surveys have been added. Further, observations regarding the data are included. Finally conclusions are drawn and some views and guidance on interpreting the data are given.

4.2. Type of responding DSOs

The survey is based on data provided by 30 DSOs from 16 European countries. This may be perceived as a rather small number of DSOs compared with the total number of existing DSOs in Europe. However, the large majority (90%) of the respondents of the questionnaire represent large European DSOs.
30% of the respondents are urban DSOs and almost three quarters are mixed urban-rural. In terms of voltage level, 73% of responding DSOs are operating networks with voltage above 20 kV and 80% are operating networks with voltage below 20 kV. A part of the responding DSOs are operating networks at both voltage levels.

Type of DSO	%
Large DSO (>100,000 customers)	90
Rural DSO	17
Urban DSO	30
Mixed urban-rural DSO	73
Voltage level: =<20 kV	80
Voltage level >20 kV	73

Table 1. Type of responding DSOs.

There are about 500 DSOs in the Nordic countries out of which the large DSOs are supplying about half of the customers. It might be harder for small DSOs to handle Smart Grid issues, especially due to the complexity of roles and regulation of the present electricity market. To mitigate future risk concerning small DSOs attitudes, the national energy /electricity associations have a very important role to play.

4.3. Drivers for Smart Grids

The EURELECTRIC survey shows that the application of the Smart Grids concept can improve customer service. This result gives rise to the question whether the respondents think that the whole Smart Grids concept needs to be applied or only a component of it, “smart metering”.

Smart Grids is felt to be a necessity for the integration of distributed generation, renewable energy sources and plug-in (hybrid) cars into the electricity grid. Utilizing Demand Side Management (DSM) for improvements in overall system efficiency (such as avoiding investments in peak generation) and customer tariff systems with incentives is a driver. Respondents see ageing assets as an opportunity for investments in end-of-life electricity grid renewal. However, progress in technology is a big driver and at the same time may be regarded as an opportunity for future developments (Fig. 1).
In addition, increasing flexibility in network operation (Distribution Management System - DMS, etc.) as well as optimisation between economic issues including profitability & regulation schemes and technical related aspects like investments & network operation are significant drivers.

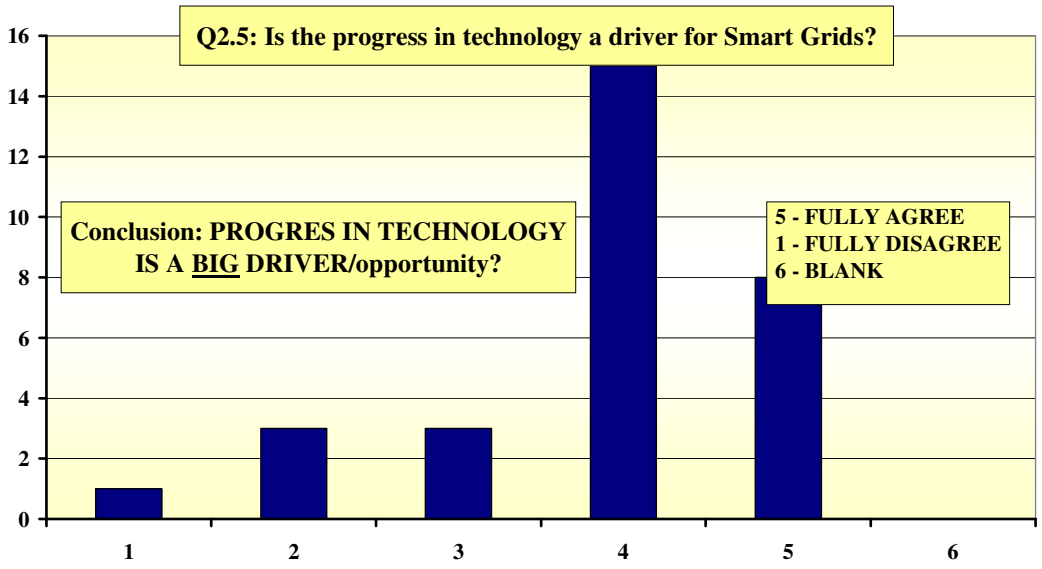


Figure 1. Drivers for Smart Grids - progress technology.

The questionnaire does not focus on the difference drivers between city-grids and country-side grids. As an example, in the electricity grids in Sweden, there is an increase of total load and number of customers in big-city areas and in regional centre areas. In most other areas, the population is decreasing, mostly meaning less load and less utilization of existing grid. In the other hand, most of the Distributed Generation (DG) is located to country-side areas. So the drivers will be different in different kind of areas, depending on population trends and localisation of DG.

4.4. New Services expected for DSOs

In principle, DSOs support DSM in facilitating customer awareness at the efficient use of electricity. However, the exact role DSOs have to play in this respect is not clear to all respondents and needs further discussion.

EURELECRIC analysis shows that the DSO may have a role in facilitating the real time balancing of the network. However, not all survey responses support this view.

Telecommunication and IT services are business activities outside the traditional (regulated) business of electricity networks. Most of the survey participants do not expect DSOs to enter these markets in the future (Fig. 2).

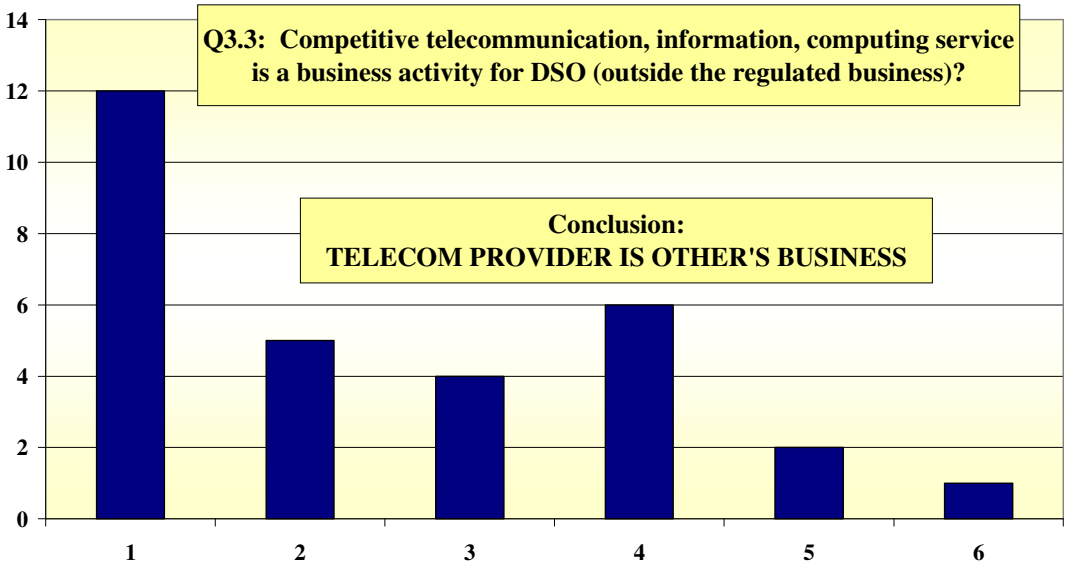


Figure 2. New Services expected for DSOs – Telecom provider.

It is not clear whether DSOs will offer automated load management to residential customers with the introduction of Smart Grid concept that includes active management or that Virtual Power Plants (VPPs), Smart Metering & related services, etc. will change the existing business model. But how this change is going to take place in practice is not clear for the moment. This may depend on the used tariffs evolution and regulatory framework.

Data flows managed by the DSOs will increase as a result of more interaction between the DSO and other stakeholders, but the costs should be carefully justified.

4.5. Network Development

Major changes in Medium Voltage (MV) and Low Voltage (LV) network architecture are not expected by all DSOs. The expected changes will strongly be correlated with the incentive scheme for renewable and distributed generation applied in each country.
Bidirectional flows of electricity at distribution level are expected to still be an exception. The power will flow mainly in the usual top-down direction (from Transmission to Distribution). The power flow from distribution level to the overlying level will only occur on specific spots and for limited durations (ex. rural networks with on-shore wind farms).

Future distribution network operation is still an issue. It can be expected that the MV distribution network will be more and more operated like a transmission network.

Distributed Generation developments will influence future networks investments and the expected installed capacity for DG will be a criterion in network dimensioning (Fig. 3).

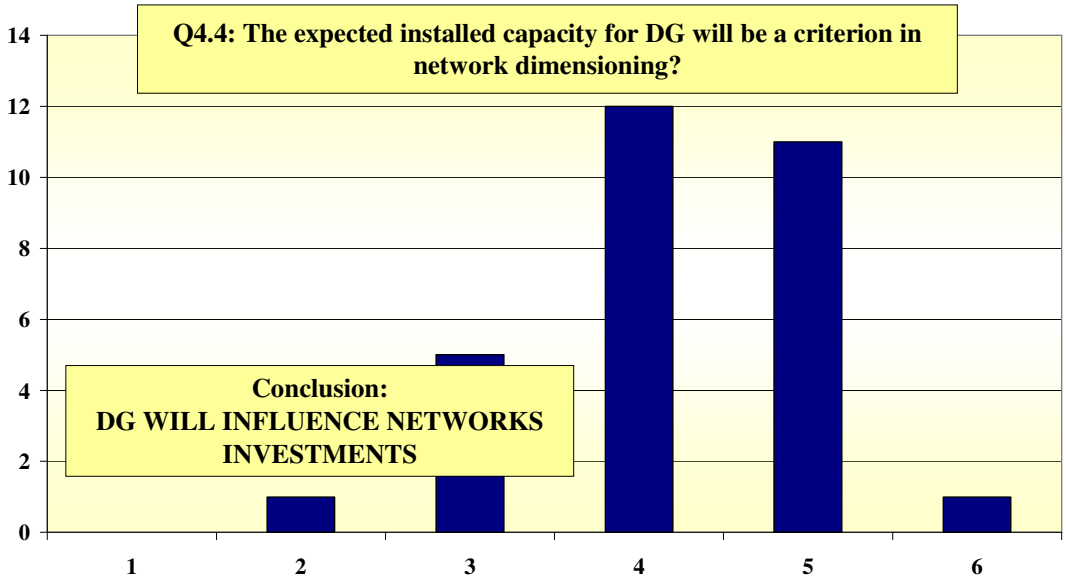


Figure 3. Network development and Distributed Generation influence.

The expected mass introduction of electric plug-in (hybrid) vehicles gives rise to the question what challenges DSOs expect in facilitating the network integration.

Integrating the charging of electric vehicles (EVs) in electricity networks does not require any new technology to be developed, but requires implementation of the existing technology. The existing European electricity infrastructure can be used in most of the countries for charging vehicles. If cars are charged at night even a standard household socket (16 A) would be sufficient. The grid is robust enough to allow a certain number of electric plug-in vehicles (e.g. 10% of market share) to charge simultaneously without any severe impact on the network in off-peak time.

The EURELECTRIC survey shows that electricity distribution network development for plug-in vehicles is not an immediate issue to be addressed. However, more discussion is needed.

Advanced storage devices (batteries, compressed air systems, etc.) are used in some cases in DSOs operation, however, no breakthrough of advanced storage devices in DSOs operation is to be expected. Advanced technologies enabling the island operation of parts of the electricity distribution network are occasionally implemented, but island operation of parts of the distribution network is not yet expected by all DSOs.

Half of the responding DSOs expect electricity demand to increase more than in the previous years despite the increased energy efficiency due to substitution of other sources of energy.
The existing centralised generation mix will still remain the key factor for energy balance. It must be flexible enough and work in parallel with the decentralized power in order to cover the electricity demand.

4.6. Active Management of the Grid

Most DSOs see active management of the grids a complementary solution to network reinforcement. The actual degree of networks automation will increase in order to ensure continuation or even improved quality of services to customers.

The impact of Virtual Power Plants on the power flow is not clear, and nor is the role of DSOs in their "operation".

It is expected that DSOs will have a more prominent role in system security in the future and a role in enabling DG to contribute to the system security. The question is how this should take place in practice.

EURELECTRIC recognises the need for governments and regulatory authorities to work together towards an optimised business model for all parts in the value chain from generators to consumers to minimise total costs.

Smart Grid technologies will allow the grid to better adapt to the dynamics of renewable energy and distributed generation, helping utilities and consumers/producers to meet the quality requirements of the grid and thus facilitate unlimited penetration with all the benefits. Today's electricity grid was designed to ensure power flow from centralized supply sources to fixed, predictable loads; this grid topology and operational logic makes it impossible for the grid to accept input from many distributed energy resources across the grid. And because resources such as solar and wind power are intermittent, the grid will require integrated monitoring and control, as well as integration with substation automation, to control differing energy flows and plan for standby capacity to supplement intermittent generation. Smart Grid capabilities will facilitate bi-directional power flows and monitor, control, and support these distributed resources.

4.7. Network Investment

The results of EURELECTRIC's analysis show that the present replacement rate of assets in DSOs is maintained except for smart metering. Despite the financial crisis, investments in grid and infrastructure remains an attractive option as they offer secure returns in the long-term and demand remains calculable and stable.
There is a significant need for many DSOs to install higher distribution capacity wires and cables for renewables.

At distribution level, the investment issue can be solved at national level; detailed harmonisation between different countries is not strictly necessary. The distribution network (that part of the network with end users connected) should be financed by customer charges incorporated in the distribution tariff for maintenance and refurbishment of the network, but also in part by connection charges related to the development of the existing network. New investment in distribution networks is also needed to comply with demand growth, and the growing share of distributed generation also has a large impact on the expansion of distribution networks [1].

Today in many countries there are no explicit incentives for expansion and modernisation of the distribution networks through the tariff system. On the contrary, the distribution activity is often regulated through a price cap mechanism, with no incentives to encourage quality of service, although there is a system of penalties linked to quality of service.

By reducing peak demand, a Smart Grid may influence the need for additional transmission and distribution lines and power plants that would otherwise be needed to meet that demand. The capability to reduce peak demand via Smart Grid technologies and enabled consumer demand response / load management, can defer or reduce the need to build resources that would be unused much of the time. An added advantage of fully developed Smart Grids is a more effective asset management by using real time system data that can assist to reschedule capital investments by prolonging the life of existing assets.

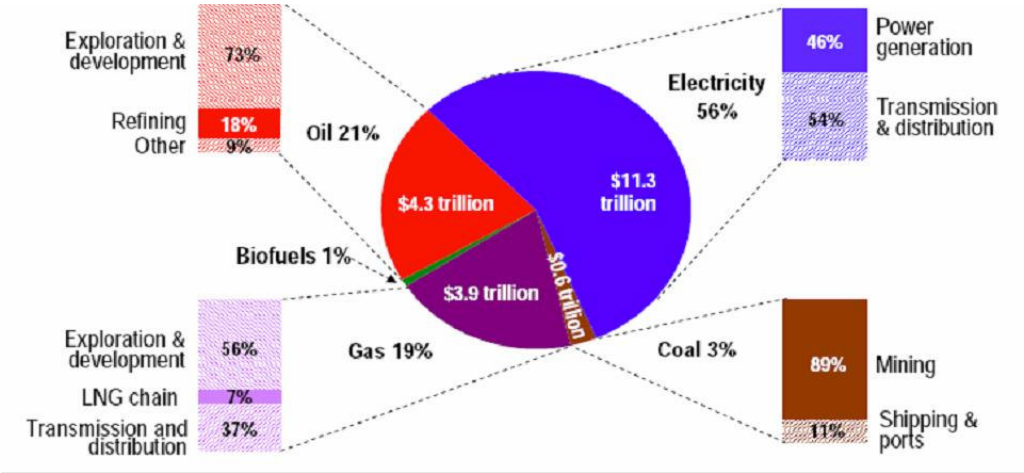


Figure 4. Cumulative Investment in Energy-Supply Infrastructure in 2005-2030.

According to IEA global Cumulative Investment in Energy-Supply Infrastructure in 2005-2030 is about $20.2 trillion (in $2005). More than a half of it ($11.3 trillion = 56%) is expected to be invested in the electricity sector as follows: 46% in Power Generation and 54% in transmission and distribution (T&D). (Fig. 4).

The main challenge remains to look into the future of the electricity business. The widely discussed concept of “Smart Grids” is pointing to new concepts of designing and managing distribution grids in a more decentralised way in the coming decades. In this respect, the European Technology Platform on Smart Grids has defined a set of strategic research areas (RA) that are a priority must for such networks to develop in the coming years:
RA 1 – Smart Distribution Infrastructure (Small Customers and Network Design)
RA 2 – Smart Operation, Energy Flows and Customer Adaptation (Small Customers and Networks)
RA 3 – Smart Grid Assets and Asset Management (Transmission and Distribution)
RA 4 – European Interoperability of SmartGrids (Transmission and Distribution)
RA 5 – Smart Grids Cross-Cutting Issues and Catalysts
Investments are needed to develop these future networks. But in order for any major “paradigm shift” to take place, a new business logic for more decentralised grids is needed, and, more importantly, this must be simultaneously provided for distribution regulation. Undoubtedly, this shift would alter the role of the current distribution system operators.

4.8. Smart Metering

The Council of the European Union formally adopted the third Energy Package in April 2009. The new smart meter provision will require Member States to carry out a cost-benefit assessment within 18 months of entry into force of the new legislation, and then roll out the meters to at least 80% of domestic customers by 2020 - but the 80% will only apply to those customers who have been identified as cost-

efficient to supply with meters. The intention is ultimately a 100% roll out by 2022.

The EURELECTRIC study shows that DSOs will install smart metering devices for residential customers and most DSOs plan to invest in customer awareness initiatives of energy consumption. Smart meters are an essential arm of Smart Grids and the only way of achieving effective demand side management with all the added benefits referred to above.

DSOs may themselves benefit from smart metering systems. The potential benefits come from remote operation, for instance through lower meter reading costs, remote disconnection and connection etc. Other potential benefits result from improved knowledge of physical displacement of energy flows and increased load management capability and so on. In other words, improved data flows and communication may allow DSOs to improve how they run their systems, identify outages quicker and reduce some losses [2].

4.9. The Change

New competences are needed to fill the technological gap between today and tomorrow. There is a need within DSOs to develop competencies for operations in the Smart Grid environment. More customers are becoming producers and are getting greater influence in the electricity market. Although not all DSOs realise this, EURELECTRIC believes that this is subject to further developments. Therefore the trend can generally be acknowledged.

4.10. Regulation – key success factor

Legislators and regulators need to take into account the new tasks of DSOs in contributing to the environmental goals of the European Union ("20-20-20 goals"). They should incentivise DSOs to invest in the most efficient way for the benefit of market participants and the society as a whole. Support for technical research and development could be considered as well. However, the risks associated with new technology are covered only to a limited extent by the existing regulatory framework and more work should be done in order to cover this technological risk (Fig. 5).

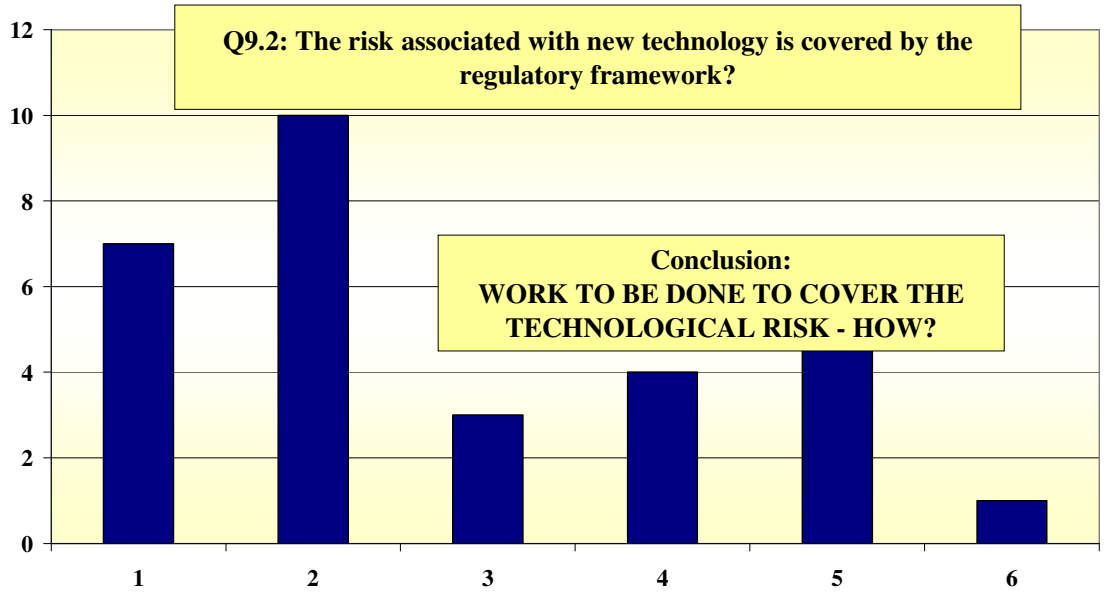


Figure 5. Future Challenges for Distribution Business.

Incentives given by Regulators to DSOs for their involvement in R&D work and for the development and deployment of new technologies supporting Smart Grids should be improved.

EURELECTRIC clearly points out that European electricity networks have to be prepared to cope with the ambitious sustainability targets of EU policy makers. These goals add new items to the existing mission of DSOs which has been to secure an acceptable level of network reliability and quality. The Smart Grids deployment not only includes innovative technologies, standardization, market considerations or the environmental impact but it also considers legislative and regulatory schemes to secure the developments in a timely way [3].
Thus the regulatory regime should give incentives that foster the transformation from the current grid system into a Smart Grid or a comparable concept able to cope with the EU policy goals. If the distribution system operators comply with the targets stated, the regulation system should allow an adequate rate of tariffs for consumers return. The regulatory measures do not necessarily implicate higher network tariff but should primarily enable an optimized use of the current tariff income.

5. EXPECTATIONS AND NEXT STEPS

A Smart Grid presents opportunities for utilities and consumers to benefit from efficient management of energy and advanced technology, equipment and devices. It offers significant opportunities to intelligently manage the fuel resources by potentially reducing the need for additional generation sources, better integrating renewable and non-renewable generation sources into the electricity grid and enabling consumers to better manage their energy consumption.

This document covers the role of DSOs. However, a Smart Grid will require an integrated approach between the DSO and TSO. From the operations perspective the DSO and TSO will have to work together closely in the areas of outages, dispatch, voltage control and power flow control. Further areas for review can include a joint DSO/TSO strategy paper, organisation and systems in the Smart Grid environment, developmnt of people skills and competencies, contestability issues, planning guidelines in a Smart environment, tariffs and customer benefits -regulatory support.

In compiling this document, the expectation is that electricity distribution business representatives can use it as a point of reference in carrying out comparisons between companies in a better-informed way. This may also prove beneficial in discussing with regulators, and may itself aid the sharing of best practice and improving efficiency.
The authors recognise that this survey and resulting paper are not, in any way, a benchmarking study. Rather, they provide the context for understanding the similarities and differences between companies and the level of implementation of the smart grids concept in Europe.

It is likely that reviewing the data will encourage questions, and lead to further collaborative work to promote better understanding. Furthermore, policy makers will see through this report that there is a long way in transforming the networks to being smart enough to accommodate the new distributed generation technologies that are maturing and at the same time exploit to the full the capabilities of DSM to achieve high levels of efficient use of energy to meet the targets set out by the EU. At the same time they will see that utilities need to see and appreciate the benefits of smart grids through real deployment projects that will prove the proposed technologies and formulate the required policies that should be rightly be incentivised by Regulators for the needed investments to take place.

* * *

6. REFERENCES

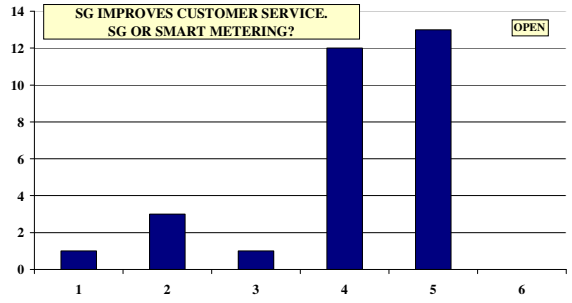
[1] EURELECTRIC Report 2004, "Ensuring Investments in a Liberalised Electricity Sector"

[2] EURELECTRIC's Position Paper, 2008, "Building a European Smart Metering Framework suitable for all Retail Electricity Customers"

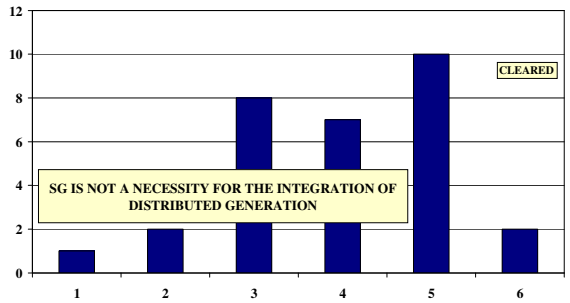
[3] EURELECTRIC Draft Paper on Regulatory framework to incentivise Smart Grids development

Explanation of the x-axis description:
5 – DSO's response is fully in line with the statement in the questionnaire
1 – DSO's response strongly disagrees with the statement in the questionnaire
6 – Blank

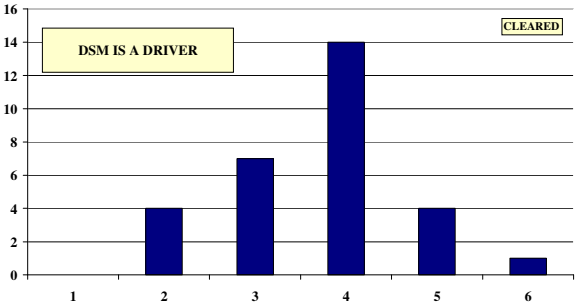
Question 2: Which are the Drivers for SG ?



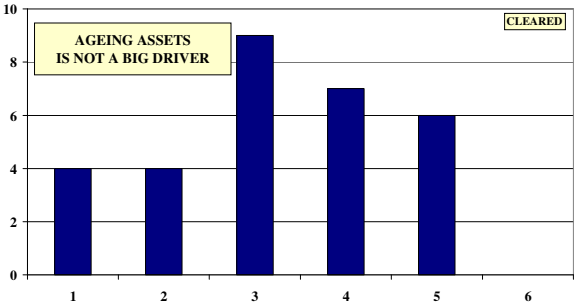
2.1. Improvement of customer service.



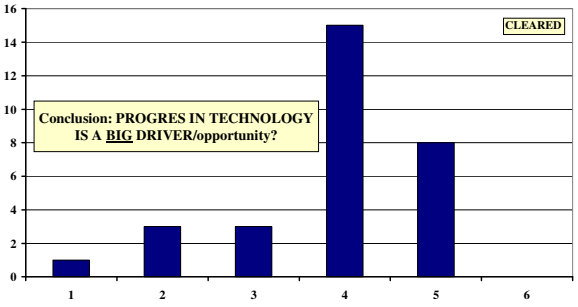
2.2. Integration of Distributed/Renewable Energy Sources, Plug in hybrids cars into the grid.



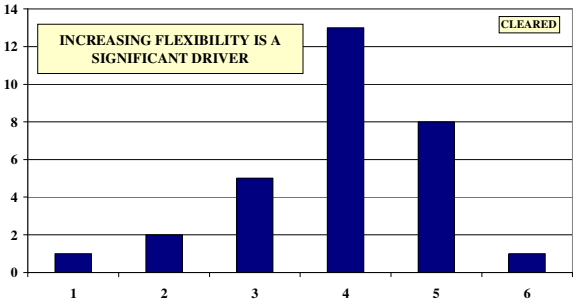
2.3. Utilize Demand Side Management (DSM) for improvements in overall system efficiency (avoiding investments in peak generation) and customer tariff system with incentives.



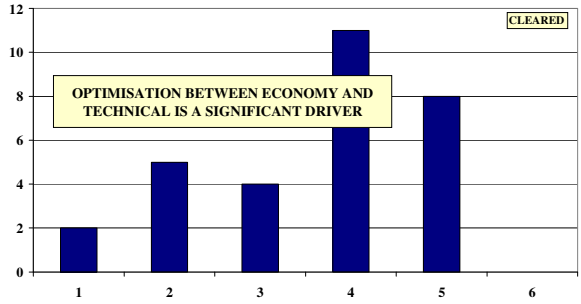
Q2.4. Need for investments in grid renewal



2.5. Is the progress in technology a driver for Smart Grids?

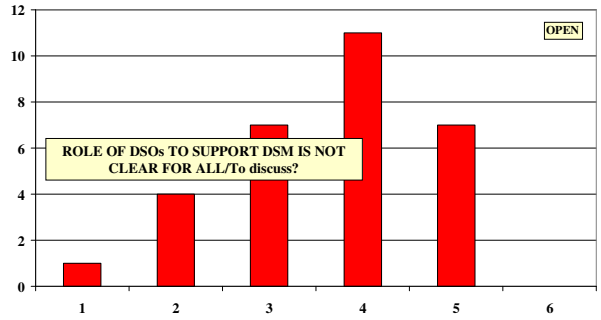


2.6. Increase flexibility in network operation

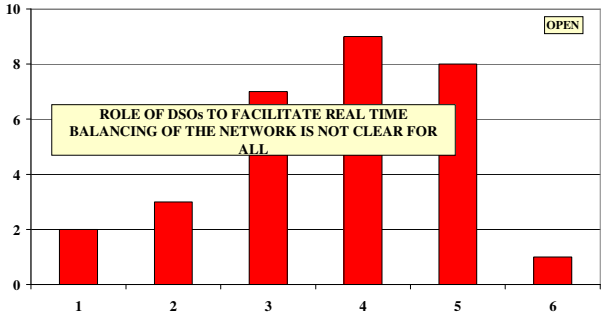


2.7. Optimization between profitability, regulation scheme and investments/operation.

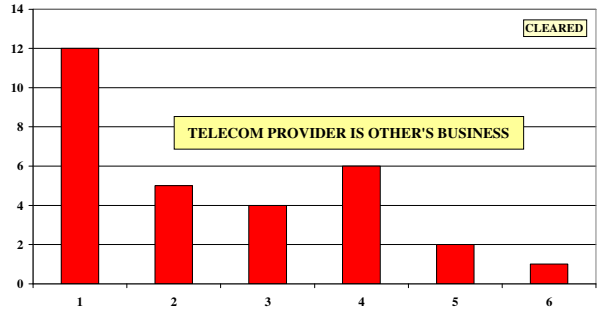
3. New Services expected for DSOs



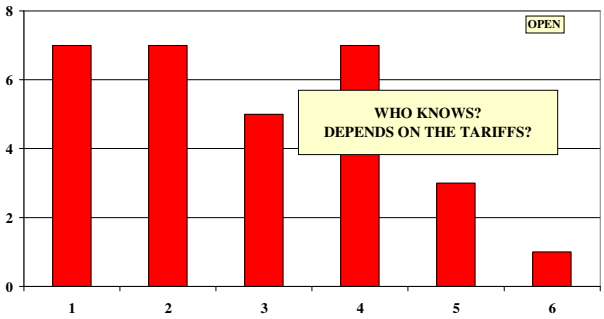
3.1 The DSO supports DSM, in facilitating the customer awareness for the efficient use of electricity.



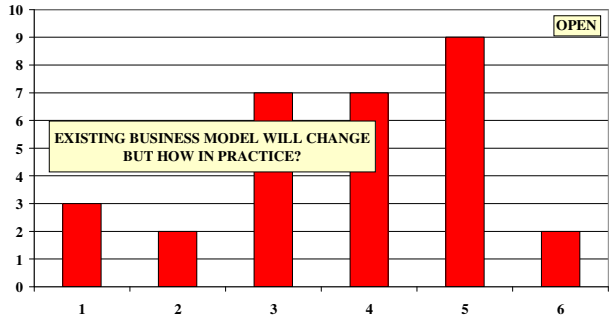
3.2. The DSO has a role in facilitating the real time balancing of the network..



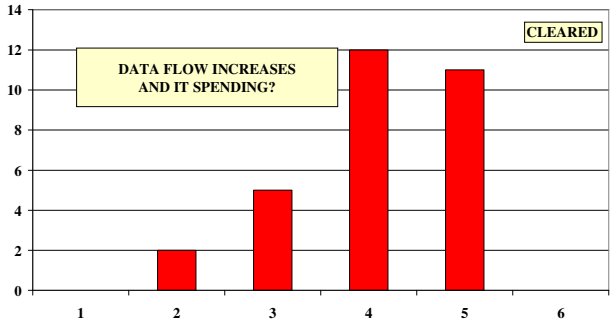
3.3. Competitive telecommunication, information, computing service is a business activity for DSO (outside the regulated business).



3.4. DSO will offer automated load management to residential customers.

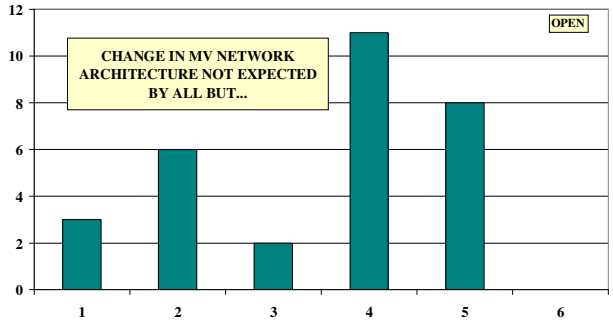


3.5. Introduction of Smart Grid with active management, Virtual Power Plants (VPP's), Smart Metering & related services, etc will need to change the existing business model.

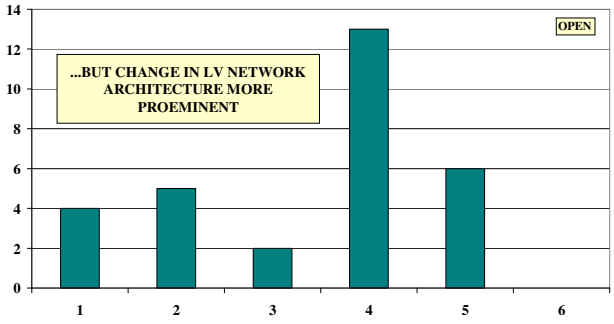


3.6. Data flow managed by the DSO will increase as a result of more interaction between the DSO and other stakeholders.

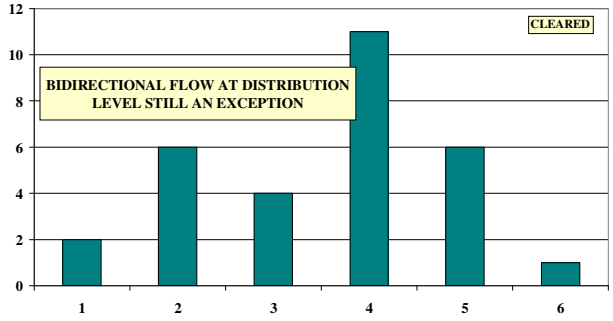
4. Network Development



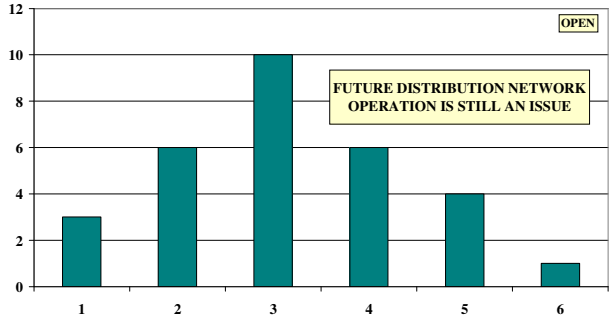
4.1.a. There will be major change in the network architecture for the coming 10 years in M.V.



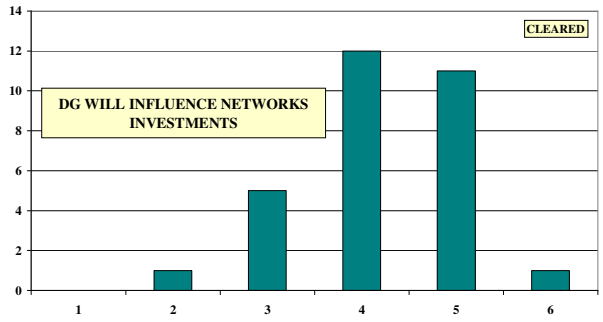
4.1.b. There will be major change in the network architecture for the coming 10 years in L.V.



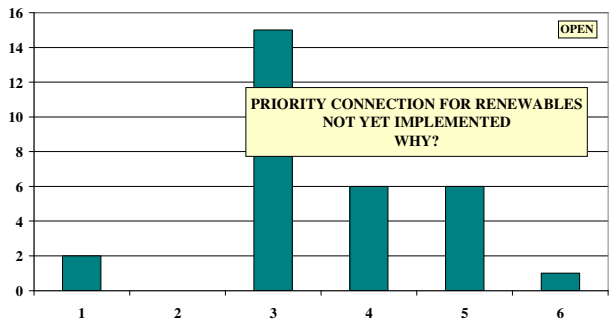
4.2. The power flow will remain in the usual top-down oriented (T to D). (Power flow from distribution level to the overlying level will only occur on specific spots and for limited durations (ex rural networks with on-shore wind farms)).



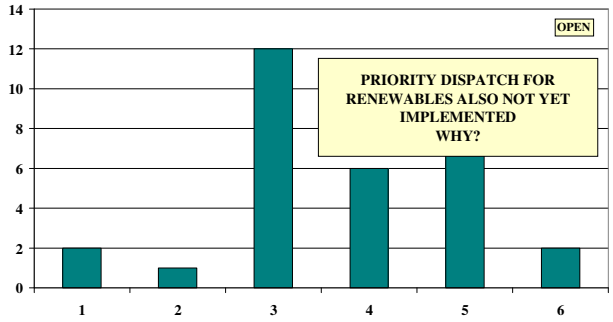
4.3. The distribution network will be operated as a transmission network.



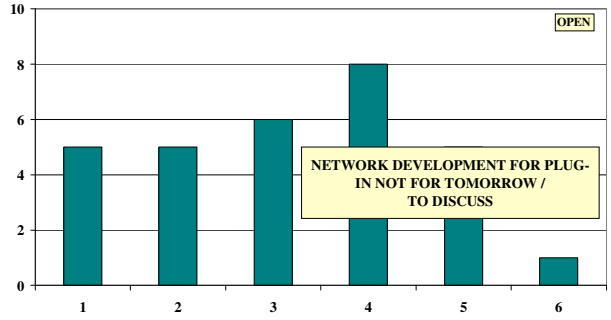
4.4. The expected installed capacity for DG will be a criterion in network dimensioning.



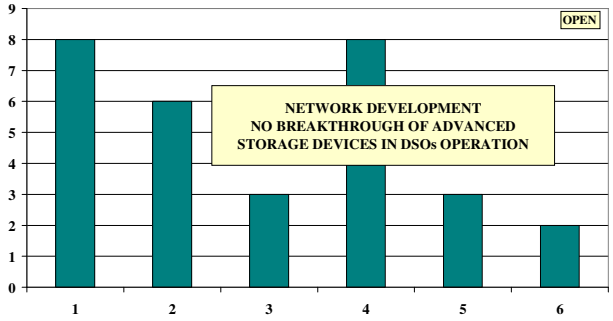
4.5. New renewable generation plants will have priority connection.



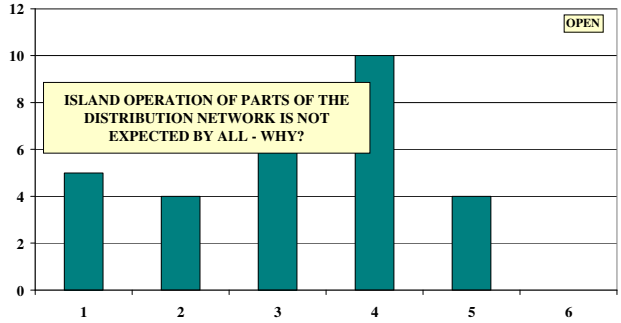
4.6. New renewable generation plants will have priority dispatch.



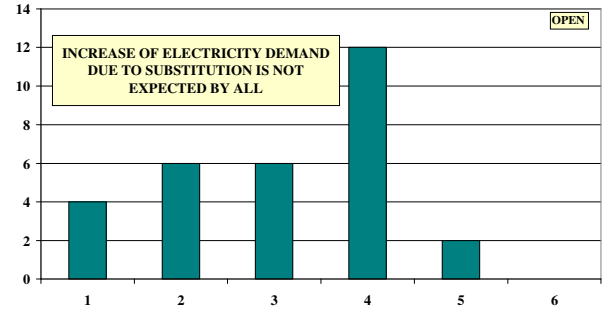
4.7. DSO expects distribution networks development in order to facilitate Plug-in hybrid vehicles.

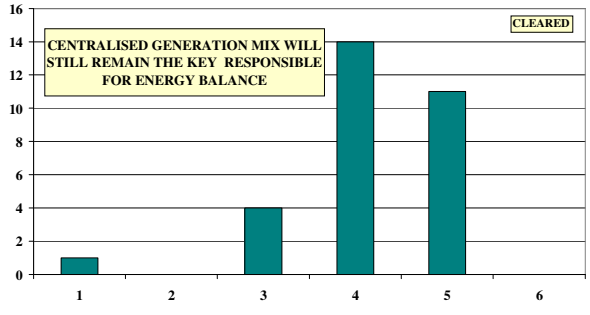


4.8. Advanced storage devices (batteries, compressed air systems, etc.) are used in DSO operation.



4.9. Advanced technologies enabling the island operation of parts of the distribution network are implemented.

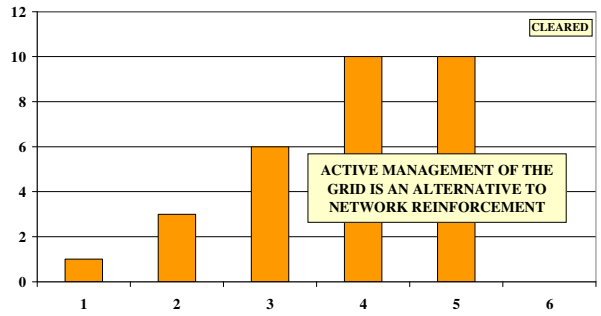




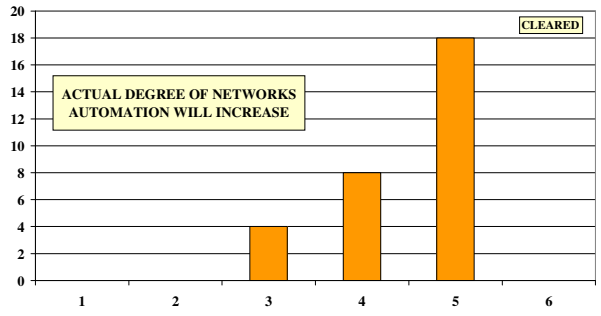
4.10. The electricity demand will increase more than the previous years despite energy efficiency due to transfer from other sources of energy.

4.11. The existing centralised generation mix must be flexible enough and work in parallel with the decentralized power in order to cover the electricity demand.

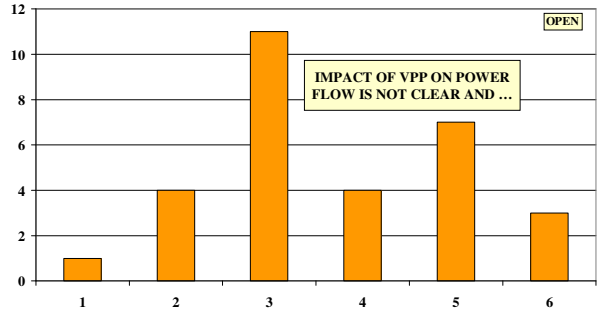
5. Active Management of the Grid



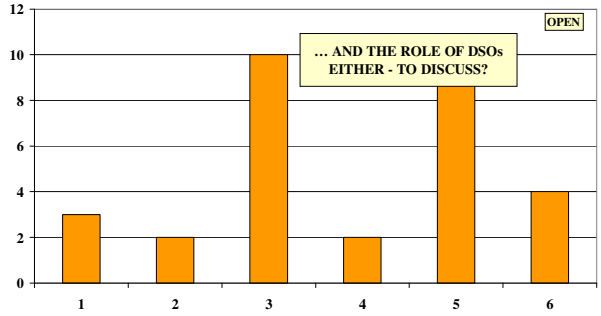
5.1. Active management will provide an alternative to network reinforcement?



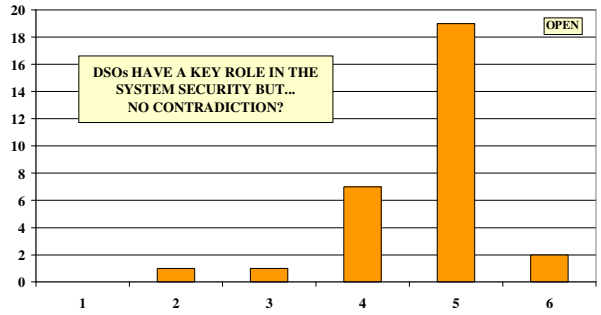
5.2. The actual degree of networks automation will be increased for better quality of service to customers



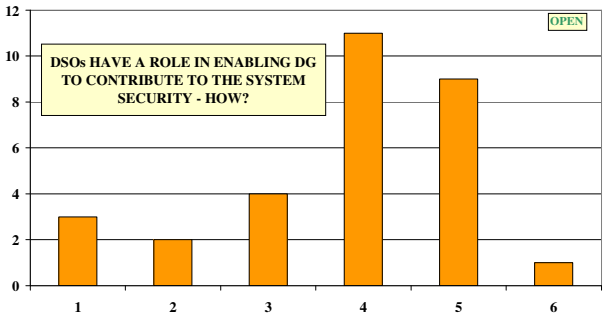
5.3. Virtual Power Plants (VPPs) will have an impact on the power flow.



5.4. The DSO's have a role in facilitating the deployment of VPP's

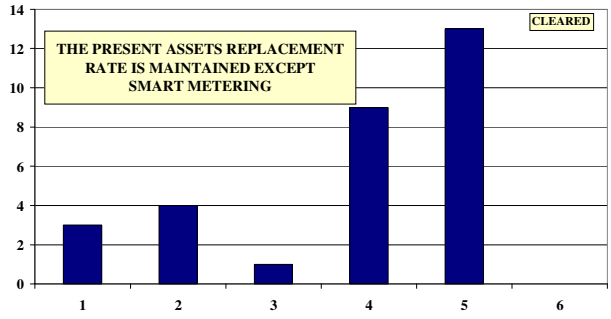


5.5. The DSOs have a role in the system security.

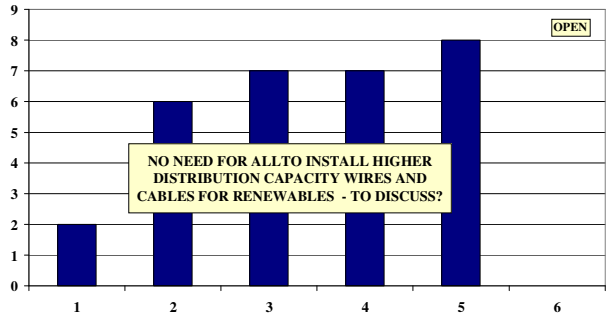


5.6. The DSO have to enable DG to contribute to the system security (with adequate financial rewards).

6. Network Investment

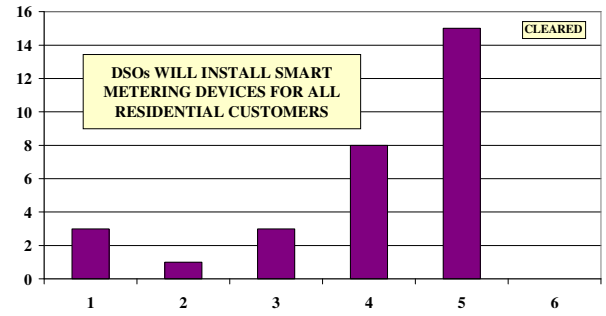


6.1. The present assets replacement rate is maintained except smart metering.

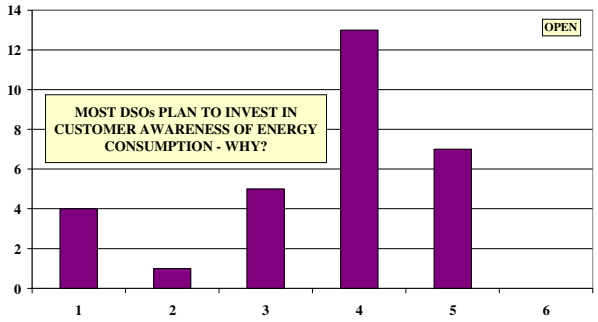


6.2. There is a need to install higher capacity cables for the renewables (voltage quality).

7. Smart Metering

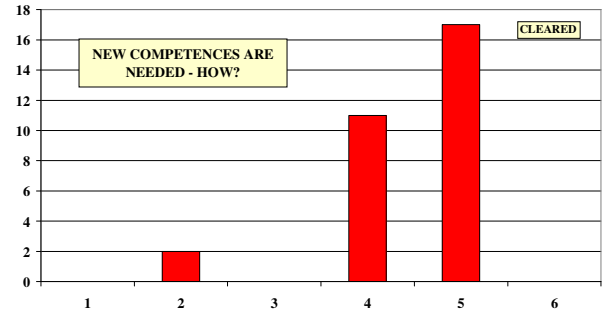


7.1. DSO installs Smart Metering devices to all residential customers.



7.2. DSO plans to invest in order to provide customer awareness of energy consumption.

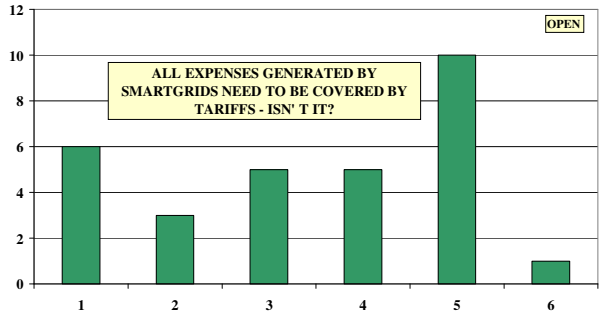
8. The Change



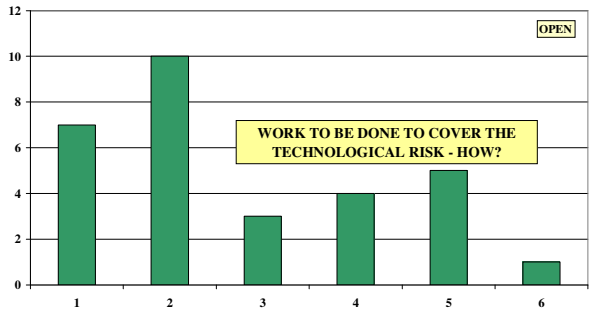
8.1. New competences are needed to fill the technological gap between today and tomorrow.

8.2. More customers are becoming producers and look for increased influence.

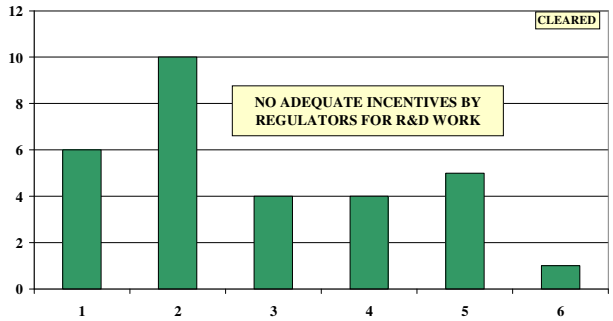
9. Regulation – key success factor



9.1. All expenses generated by SmarGrids are covered by approved tariffs.



9.2. The risk associated with new technology is covered by the regulatory framework.



9.3. Adequate incentives are given by Regulators to DSOs for their involvement in R&D work for the development and deployment of new technologies supporting SG.

ANNEX 2 – QUESTIONNAIRE

SMART GRID (SG) QUESTIONNAIRE
PRESENT STATUS AND PERSPECTIVE OF SG IMPLEMENTATION TILL 2020

(5 = fully agree – 3 = neutral – 1 = fully disagree – if answer is 3, 2 or 1, please comment)

		5	4	3	2	1	Comment
	1. Who are you?	YES				NO	
1.1	- Large DSO (>100,000 customers)						
1.2	- Rural DSO						
1.3	- Urban DSO						
1.4	- Mixed urban-rural DSO						
1.5	Voltage level: =<20 kV						
1.6	Voltage level >20 kV						
	2. Which are the Drivers for SG ?	YES				NO	
2.1	Improvement of customer service						
2.2	Integration of Distributed/Renewable Energy Sources, Plug in hybrids cars into the grid						
2.3	Utilize Demand Side Management (DSM) for improvements in overall system efficiency (avoiding investments in peak generation) and customer tariff system with incentives						
2.4	Need for investments in end-of-life electricity grid renewal (ageing assets)						
2.5	Progress in technology						

		5	4	3	2	1	Comment
2.6	Increase flexibility in network operation (DSM, etc.)						
2.7	Optimization between profitability, regulation scheme and investments/operation						
	3. New Services expected for DSOs	YES				NO	
3.1	The DSO supports DSM, in facilitating the customer awareness for the efficient use of electricity						
3.2	The DSO has a role in facilitating the real time balancing of the network						
3.3	Competitive telecommunication, information, computing service is a business activity for DSO (outside the regulated business)						
3.4	DSO will offer automated load management to residential customers						
3.5	Introduction of Smart Grid with active management, Virtual Power Plants (VPP's), Smart Metering & related services, etc will need to change the existing business model						
3.6	Data flow managed by the DSO will increase as a result of more interaction between the DSO and other stakeholders						
	4. Network Development	YES				NO	
4.1	There will be major change in the network architecture for the coming 10 years a. In M.V.						
	b. In L.V.						

		5	4	3	2	1	Comment
4.2	The power flow will remain in the usual top-down oriented (T to D). (Power flow from distribution level to the overlying level will only occur on specific spots and for limited durations (ex rural networks with on-shore wind farms))						
4.3.	The distribution network will be operated as a transmission network						
4.4.	The expected installed capacity for DG will be a criterion in network dimensioning						
4.5	New renewable generation plants will have priority connection						
4.6	New renewable generation plants will have priority dispatch						
4.7	DSO expects distribution networks development in order to facilitate Plug-in hybrid vehicles.						
4.8	Advanced storage devices (batteries, compressed air systems, etc.) are used in DSO operation						
4.9	Advanced technologies enabling the island operation of parts of the distribution network are implemented						
4.10	The electricity demand will increase more than the previous years despite energy efficiency due to transfer from other sources of energy						
4.11	The existing centralised generation mix must be flexible enough and work in parallel with the decentralized power in order to cover the electricity demand.						
	5. Active Management of the Grid	YES				NO	
5.1	Active management will provide an alternative to network reinforcement						

		5	4	3	2	1	Comment
5.2	The actual degree of networks automation will be increased for better quality of service to customers						
5.3.	Virtual Power Plants (VPPs) will have an impact on the power flow.						
5.4.	The DSO's have a role in facilitating the deployment of VPP's						
5.5.	The DSOs have a role in the system security						
5.6.	The DSO have to enable DG to contribute to the system security (with adequate financial rewards)						
	6. Network Investment	YES				NO	
6.1	The present assets replacement rate is maintained except smart metering						
6.2	There is a need to install higher capacity cables for the renewables (voltage quality)						
	7. Smart Metering	YES				NO	
7.1.	DSO installs Smart Metering devices to all residential customers						
7.2.	DSO plans to invest in order to provide customer awareness of energy consumption						
	8. The Change	YES				NO	
8.1.	New competences are needed to fill the technological gap between today and tomorrow						
8.2	More customers are becoming producers and look for increased influence						

		5	4	3	2	1	Comment
	9. Regulation – key success factor	YES				NO	
9.1	All expenses generated by SmarGrids are covered by approved tariffs						
9.2	The risk associated with new technology is covered by the regulatory framework						
9.3	Adequate incentives are given by Regulators to DSOs for their involvement in R&D work for the development and deployment of new technologies supporting SG						

IDENTIFICATION

Company/Association:	
Country:	
Respondent's name:	
Phone:	
Fax:	
Email:	

Date:

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