74103201-MOC/OPE

Market scan smart meters and smart grids in Russia

Arnhem, 15 March 2013

Authors Wiebe Mulder, Aleksey Nikolaev, Alexander Osadchiev, Svetlana Kleeva

By order of the Dutch Ministry of Economic Affairs

author : W. Mulder
39 pag. 3 Appendices.

reviewed : R.J.F. van Gerwen
released: H. de Heer

KEMA Nederland B.V. Utrechtseweg 310, 6812 AR Arnhem Postbus 9035, 6800 ET Arnhem Nederland
T +31 26 3 56 9111 F +31 26 442 8388 contact@kema.com www.kema.com Handelsregister Arnhem 09080262

CONTENTS

1 INTRODUCTION

The Dutch Ministry of Economic Affairs and the Ministry of Economic Affairs of the Russian Federation have a collaboration agreement that includes smart meters and smart grids.

Primary goal of this market study is to assess commercial smart meter and smart grid activities in the Netherlands and the Russian Federation and identify main companies involved in these activities. It also aims at identifying smart meter and smart grid opportunities for Dutch companies in the Russian Federation, both technology based or knowledge based. This market study can be used for further refining the collaboration between the Netherlands and the Russian Federation, for example a study tour for a Russian delegation to the Netherlands as planned for the second quarter of 2013.

The scope and understanding of smart metering and smart grids tend to vary between different countries and different stake holders. This topic will be discussed separately in this study. As a starting point, smart metering and smart grids in the context of this study include:

- automatic meter reading: remote reading of meter data, meter status and power quality data;
- advanced metering infrastructure: allowing two-way communication between the meter and consumer appliances at one side and central ICT-systems of service providers at the other side;
- advanced tariff structures e.g. real time pricing and critical peak pricing;
- demand response mechanism including "vehicle to grid" services for electric vehicles.

This study is a first exploration of opportunities (quick scan), not an in depth, detailed market study. It contains a general description if the Russian Electricity market and smart meter and smart grid developments (chapter 2), idem for the Dutch market (chapter 3) and an assessment of opportunities for Dutch organizations (chapter 0). It includes a list of Dutch and Russian companies and institutions involved in smart meters and/or smart grid (appendix A and appendix B).

Initially out of scope but additionally required was the question of opportunities to provide services regarding refurbishing district heating with (micro)cogeneration. An additional section is added.

This study is based on a review of publically available material and an interview with an important stakeholder, the Russian Energy Agency. This interview is included in appendix C and the results are used throughout the report.

2 DESCRIPTION OF THE RUSSIAN MARKET

2.1 General description of the Russian electricity market

Nowadays the electric power industry of Russia encompasses about 600 power plants each with a capacity of more than 5 MW. Total installed capacity of power plants in Russia is 218,145 MW. The installed capacity of the existing power plants by type of generation is shown in Figure 1.

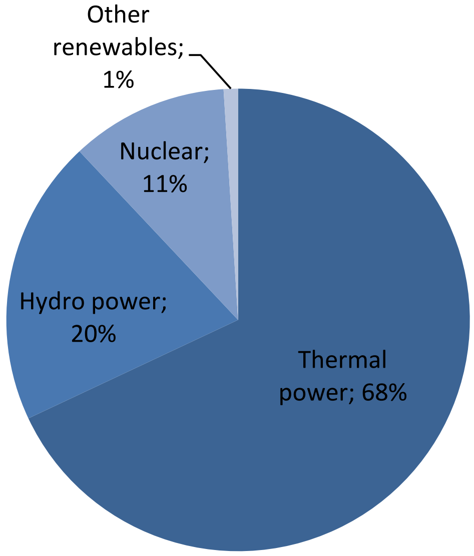

Figure 1 Generation capacity in Russia[1]

The power sector is a basic sector of the Russian economy which provides electricity and heat for the Russian population needs as well as to the Commonwealth of Independent States (CIS) and other foreign countries. Sustainable development and a reliable operation of the power industry mostly determine the country's energy security and are important factors in its successful economic development.

Primary energy use in Russia is 7,987 TWh[2]. The heating sector consumes around one-third of Russia's primary energy[3], which is 2,662 TWh. The electric power consumption in the power system of Russia in the year 2012 was 1,016.3 TWh, an increase of 1.6% compared to the consumption in the year 2011[4].

---

[1] Ministry of Energy of Russian Federation

[2] Energy in Europe, http://en.wikipedia.org/wiki/Energy_in_Europe

[3] International Energy Agency, World Energy Outlook 274 (2011)

[4] Electric Power consumption in Russia, http://www.smartgrid.ru/novosti/v-rossii/potreblenie-elektroenergii-v-ees-rossii-v-2012-godu-uvelichilos-na-16/

Figure 2 gives and overview of the electricity consumption of some major countries in the world, compared to Russia. Electricity consumption in Russia is expected to increase significantly, up to 50-80% in 2030.

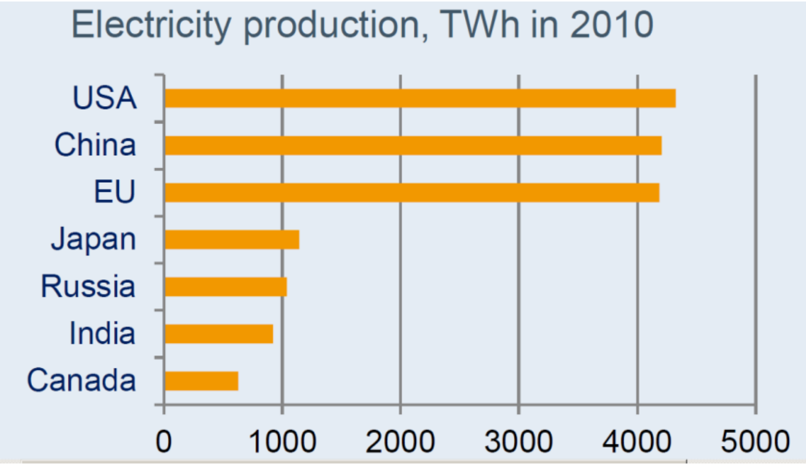

Figure 2 Overview of electricity production in the world[5]

The forecast for generating capacities up to 2020 is:

- hydropower plant 47 GW (20.6%) up to 57-59 GW (18.3-19.7%);
- nuclear power plants 24 GW (10.5%) up to 35-41 GW (12.1-12.9%);
- other renewable power plant (excluding large hydro) with 2.2 GW to 25.3 GW[6].

Russia has been reforming its electricity supply sector for ten years and during this restructuring phase the industry state regulation system has been changed, a competitive electricity market has been formed and new companies are established. The main goals of the energy sector reforms were an investment friendly business environment, competition in electricity generation and a reduced role for the government in the electricity supply sector with prices expected to be driven by competition.

Main recent changes of electricity supply sector in Russia are:

1. Established OJSC "Concern Rosenergoatom" which represents a unified generation company that owns and manages nuclear power plants of the Russian Federation. Rosenergoatom Concern OJSC operates as a subsidiary of JSC Atomenergoprom.
2. All backbone (transmission) networks are under the control of Federal Grid Company of the Unified Energy System (FGC UES). All of the Russian transmission grid (above 110 kV) is synchronized, including synchronization with adjacent countries like Ukraine and the Baltic countries. Federal Grid Company is the operator and manager of Russia’s unified electricity

[5] Smart Grids – Finnish-Russian Technology Platform Report, Finnode FP00005572 dated 31-05-2012

[6] Russian State Ministry of energy, Policy and regulatory base, http://minenergo.gov.ru/activity/vie/policy_and_legal_framework/ dated 2012.

transmission grid system, including high voltage transmission lines, and holds the status of a natural monopoly.

The Company's assets include more than 124,000 km of transmission lines and 854 substations with more than 322 GVA of 35-750 kV transformer capacity. Based on the length of transmission lines and installed transformer capacity, Federal Grid Company is the largest electricity transmission company in the world. It maintains and develops the grid system and supervises grid facilities and infrastructure in 73 Russian regions, covering a territory of 13.6 million square kilometers. Its customers are regional distribution companies, electricity suppliers and large industrial enterprises.

3. System operator of the Unified National Electric Grid is the United Dispatch Office, OJSC. This company is responsible for e.g. frequency control, voltage control, relay protection and dispatching of generation and consumption[7].
4. Distribution networks are integrated in the Interregional and Regional Distribution Grid Companies (IDGC) Holding. JSC IDGC Holding, a company operating in the electricity sector of the Russian Federation, comprises interregional and regional distribution grid companies (IDGCs/RDGCs), research and development institutes, design and construction institutes, and construction and sales entities. Ninety-seven subsidiaries of IDGCs/RDGCs are based in 69 constituent entities of the Russian Federation. IDGC Holding is the leader in the Russian market in terms of technological innovations in the electricity distribution grid sector. The Company places special emphasis on such issues as energy conservation, energy efficiency, international cooperation, environmental protection, and occupational safety[7].

An interesting episode of the Company's strategic development as part of its International Cooperation Concept is the signed agreement between Electricité Réseau Distribution France ERDF and IDGC Holding to transfer Tomsk Distribution Company to the France-based electric utility's management, effective from March 1, 2012[8]. The French management is expected to focus on the adoption of efficient management methods and technological solutions.

Other internationally implemented projects include:

- taking an effective part as an observer in the work of the Electric Power Council of the Commonwealth of Independent States;
- IDGC Holding's and all interregional and regional distribution grid companies' becoming members of CIRED (International Conference on Electricity Distribution) in June 2012;
- carrying out the Energy Twinning target-oriented technological program jointly with the USA, Canada, France, and Germany;

[7] Smart Grids – Finnish-Russian Technology Platform Report, Finnode FP00005572 dated 31-05-2012

[8] IDGC Holding, ERDF and IDGC Holding to strengthen cooperation http://www.holding-mrsk.ru/eng/press/news/detail.php?ID=4206

- siting the manufacture of Chinese high-tech electric grid equipment in the Russian Federation;
- and building a network of electric vehicle charging stations for the recharging of Japanese-made electric cars in and near Moscow[9].

5. Functions and assets of regional dispatch offices have been transferred to the System Operator of Unified Energy System OJSC. System Operator structure:
    - 7 branch offices – integrated dispatch departments;
    - 59 branch offices – regional dispatch departments;
    - 5 enlarged branch offices managing large regions of Russian Federation;
    - Subsidiary Company “Scientific and Technical Centre of the Unified Energy system”[10].
6. Due to the reforming process generation assets were organized into two types of interregional companies: 6 wholesale generating companies (WGCs) and 14 territorial generating companies (TGKs). WGCs combine power plants specializing mostly only in electricity power production. TGKs include mainly thermal power plants producing both electricity and heat. Five of the six WGCs were formed on the basis of thermal power plants and one (RusHydro) – on the basis of hydro power assets.

One of the main reform goals was to create a favorable environment to attract private investments into the sector. This goal was already successfully achieved during the initial public offerings (IPOs) of generating, distributing and repair companies, initially controlled by state-owned JSC RAO UES. In contrast, state control becomes stronger in areas of natural monopolies (Federal Grid Company and UES System Operator).

While establishing the energy strategy of Russia for the period up to 2030 (which was approved by decree N° 1715-r of the Government of the Russian Federation dated 13 November 2009) current results of the energy strategy of Russia for the period up to 2020 realization (this strategy was repealed on 13 November 2009) were assessed and represented below:

The period from 2003 till 2009 was characterized by faster growth of electricity demand than it was expected, due to the higher rate of the Russian economy growth. Meanwhile new power capacities commissioning in the sector were behind the strategy forecast and did not fully satisfy the needs of the growing economy. During this period the first phase of the electricity supply sector reform was completed - OJSC "Concern Rosenergoatom" established as company which owns NPPs, state-owned company RAO UES was liquidated and a group of independent companies was created.

Competition in the electricity market started and a more favorable tax regime has been set up for the oil and gas industries. Thus, most of the guidelines stated in the energy strategy of Russia for the

[9] IDGC Holding, http://www.holding-mrsk.ru/

[10] SO-UES, http://so-ups.ru/

period up to 2020 have been implemented with the use of all the mechanisms provided for by the state energy policy. Nevertheless, the qualitative results projected for the first phase of the energy strategy of Russia for the period up to 2020 implementation have not been fully achieved, namely the setting up a base for stable and progressive development of the energy sector, including:

- establishing a coherent and approved legal and regulatory framework, creating highly competitive energy markets with fair trade principles;
- completing the conversion of the related sectors of the economy to a new level of energy efficiency;
- transition from the leading role of the fuel and energy system in the economy of the country to the function of an effective and stable supplier of energy resources for the needs of the country's economy and population.

The strategic objective of innovation and scientific-and-technical policy in the energy sector is to set up a sustainable national innovation system in the energy sector providing the Russian fuel and energy system with highly efficient domestic technologies and equipment (including smart grid), as well as innovative scientific and technical solutions necessary to maintain the country's energy security.

Among the priorities of the electric energy industry the following 2030 State Energy Strategy goals should be noted:

- developing highly integrated intelligent backbone transmission and distribution networks of new generation (smart grids) in Russia's unified energy system;
- developing power electronics along with devices based on it, especially various types of network controlling devices (flexible alternating current transmission systems, FACTS);
- developing a highly integrated information and management system of operational dispatch management working in real time mode with expert decision-making systems;
- designing automated electricity demand controlling systems[11].

Electricity consumption varies per region. In densely populated areas, the share of commercial/residential electricity use is larger than in sparsely populated areas. Figure 3 gives an overview of the electricity consumption average for the whole of Russia and for Moscow.

[11] ConsultantPlus, Decree N° 1715-r of the Government of the Russian Federation dated 13 November 2009

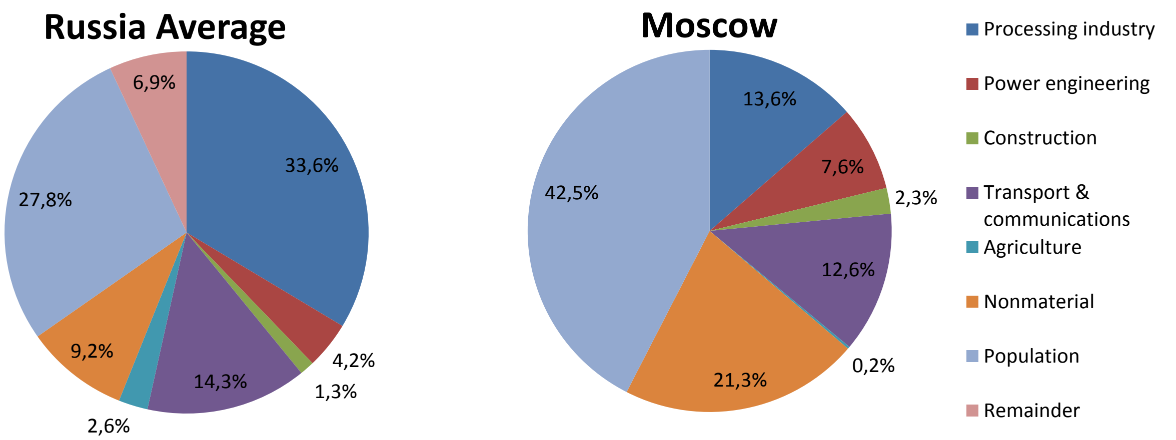

Figure 3 Electricity consumption in Russia[12]

Pricing strategies are rather complicated in Russia and vary per region[12]. For "public" retail customers (dwellings, public institutions) energy prices are capped by a tariff limit from the Regional Energy Commission. The cap is based on average wholesale prices and average income of the population in the region. Russia has a day-night tariff system for retail customers but aims at a 4 zone tariff system. Small enterprises buy on the retail market based on whole sale prices and profit margins from the supplier and the grid company. Wholesale prices seem low in Russia (15-21 EUR/MWh[13]) but there is also a capacity charge for buyers on the wholesale market (average 3000 EUR/MW).

Consumers are billed on a monthly basis. They are required to submit meter data to the (distribution) company every month. The company is required to check the actual meter registers once every year.

2.2 Smart meters and smart grids in Russia

National policies on smart meters and smart grids

Russia is pursuing the State policy of innovation activity in the electricity sector. This applies to energy efficiency, renewable energy and smart grids. It is stated in the Energy Strategy of Russia for the period up to 2030[14]. The strategy aims at ensuring high energy, economic and environmental efficiency in the production, transport, distribution and demand of electricity. (Smart) meters and accounting systems should be installed at all participants of electricity market and thermal power in power plants and substations, in enterprises, and with the year 2012 in accordance with the Federal law № 261-FZ dated 23.11.2009[15]. This law does not explicitly state that the meters installed must be

[12] Smart Grids – Finnish-Russian technology Platform Report, Finnode FP00005572 from 2012-05-31

[13] Russian electricity market, Current state and perspectives, VTT 2009

[14] ConsultantPlus, Decree N° 1715-r of the Government of the Russian Federation dated 13 November 2009

[15] Federal law of Russia, № 261-FZ, Energy saving and increasing of EE, dated 23.11.2009

smart meters, focus is on having each grid connection metered and billed. This law also requires the Russian Energy Agency to develop a smart grid Initiative/Roadmap[16].

[16] http://www.usea.org/sites/default/files/event-presentations/Russian%20Smart%20Grid%20Exchange%20Visit%20Agenda_Final.pdf

Table 1 Smart meter and smart grid related legislation in Russia

Goal	Legal requirements and other requirements
Promoting the development of regional energetics based on newest technology.	Energy strategy of Russia for the period up to 2030.
Installation of (smart) meters and accounting systems by 2012 and developing a Smart Grid Initiative / Roadmap.	Federal law № 261-FZ, Energy saving and increasing of energy efficiency, dated 23.11.2009.
Using of smart equipment and systems with recommended technical characteristics	Russian Federation Ministry of Energy, Approval of Methodological Recommendations regarding technical characteristics of account electrical energy smart equipment and systems, Order # 86, dated 22 March 2011. Set of standards (GOST are Russian standards): • IEC 62056 (IEC62056 is a set of standards for Electricity metering) • GOST R IEC 61107-2001 (Direct local data exchange describes how to use COSEM over a local port) • GOST R 52320-2005 (Electricity metering equipment (AC) – General requirements, tests and test conditions) • GOST R 52322-2005 (Electricity metering equipment (a.c.) – Particular requirements – Static meters for active energy - classes 1 and 2) • GOST R 52323-2005 (Electricity metering equipment (a.c.) – Particular requirements – Static meters for active energy - classes 0.2 S and 0.5 S) • GOST R 52425-2005 (Electricity metering equipment (a.c.) – Particular requirements – Static meters for active energy - classes 2 and 3) • GOST 7746-2001 (Transformers of current – common requirements) • GOST 1983-2001 (Transformers of voltage – common requirements) • GOST 22261-2001 (Transformers of voltage – measuring) • GOST R 51317.4.3-2006 (Electromagnetic compatibility of technical equipment. Radio-frequency electromagnetic field immunity. Requirements and test methods).

In this study, no regional energy policies regarding smart grids were identified. It seems that smart grid related regulations are mainly made on a national level.

Important drivers and focus areas.

Examples of important drivers and focus areas are:

1) Increasing grid reliability and quality

In some regions of Russia, supply of electricity, especially at peak times, could not keep up with this demand, resulting in poor power quality. Increasing consumption of electricity in the industry, for heating, communication, lighting and entertainment requires ever higher levels of reliability.

Unreliability of old power plants and worn-out equipment leads to a need to keep inflated backup capacity. The current level of Russian electricity network reliability is 0.996. In the Energy Strategy it is stated that the reliability should be increased to 0.9990–0.9997[17]. It is not clear from this study when this level should be reached. Pilot projects identified do not provide quantification for the increase in grid reliability.

2) Accommodating decentralized generation

The increase in efficiency and reliability of the grid is expected due to the replacement of boiler houses with gas-turbine based cogeneration. The potential volume of this replacement is about 175 GWt. This value is comparable with the current capacity of all Russian power plants. Opportunities to take advantage of improvements in technology to resolve the limitations of the electrical grid have become apparent. The limitations are due to the fact that in case of distributed generation (change of electrical energy supply direction) it will be necessary to have another type of electrical network. According to the Energy Strategy, additional distributed generation should be about 20% of common energy production[17]. This is typically grid improvement and not a smart grid opportunity as perceived for instance in the Netherlands (see section 4.1).

3) Integration of renewables

The Energy Strategy mentions renewable energy and local energy resources as developing technologies for renewable energy utilization, as well as multi-functional energy systems for autonomous energy supply to consumers in regions not connected to centralized energy supply networks. This is linked to introducing efficient technologies for electricity grids and heat supply on the basis of renewable energy.

[17] ConsultantPlus, Decree N° 1715-r of the Government of the Russian Federation dated 13 November 2009.

The current network infrastructure is not built to allow for many distributed feed-in points, and typically even if some feed-in is allowed at the distribution level, the transmission level infrastructure cannot accommodate it. Smart grid technology is a necessary condition for a large share of renewable electricity on the grid for this reason.

4) Reduce energy losses

The current network infrastructure doesn't have good protection from non-technical losses. Non-technical losses in electricity distribution include mainly electricity theft, but also losses due to poor equipment maintenance, calculation errors and accounting mistakes. Losses are more than 10% of the total domestic supply[18]. Smart metering is one of the decided solutions of this problem. According to Federal Grid Company (FGC) data, smart grid technology will allow the reduction of the energy losses in the grids of all voltage levels by about 25% which would mean the savings of 34-45 TWh per year[19].

5) Deferred or avoided investments in central generation and in transmission and distribution capacity

The development of smart grids could reduce the need for new generation capacity. The investment required for refurbishment and construction of new distribution and transmission lines could be considerably reduced. To reduce demand during the high cost peak usage periods, communications and metering technologies inform smart devices in the home and business when energy demand is high and track how much electricity is used and when it is used. It also gives utility companies the ability to reduce consumption by communicating to devices directly in order to prevent system overloads.

Current problem in the Russian grid is however its age. More than half of the grid components (transformers, overhead lines) are above permitted operation time[20]. On one hand this means that basic replacement of current assets might have priority over smart grids, on the other hand it provides opportunities to start with a fresh, smart grid oriented approach, giving smart grids a head start.

6) Energy savings

Energy savings by smart grids are commanded by Energy Law 261 (Table 1). Pilot Projects by the President's Commission for Technological Development of Russian Economy aim at reducing energy consumption of Russia's GDP by 40% by 2020 through measures promoting energy saving, improving

---

[18] http://www.iea.org/stats/electricitydata.asp?country_code=RU
[19] FGC, Smart Grid, dated 17 June 2010, http://www.fsk-ees.ru/eng/public_relations/media_coverage/?ELEMENT_ID=8856&sphrase_id=304505
[20] Smart Grids – Finnish-Russian technology Platform Report, Finnode FP00005572 from 2012-05-31

energy efficiency and improving legal environment. The greatest potential for energy saving is concentrated in the public sector and utilities.

7) Distribution grid management

FGC (Federal Grid Company) does not provide any data on whether the General Scheme of Siting of Energy Facilities for the period until 2020 can be altered to take into account possible optimization using smart grid technology, but academic institutes are less restrained. According to their estimates the development of smart grids could reduce the need for new generation capacity by 22 GW. The investment required for refurbishment and construction of new distribution and transmission lines could be reduced by almost 37 billion EUR if the new grid is built with new technologies in mind[21].

Current status of implementation of smart meters and smart grids

One of the important smart grid implementation directions in Russia is the implementation of demand management systems. The Russian Ministry of Energy has developed Methodological Recommendations for technical characteristics of smart equipment and systems which should be used for electrical energy metering and billing[22] (see Table 1). In this document the specifications for Smart Meters and Smart Metering systems were defined. The standardization of Methodological Recommendations for technical characteristics of smart equipment and systems is not completed yet. There is a necessity for a Smart Meter Centre that can assist in in design, purchase and implementation of smart meter and smart grid equipment.

The Russian Ministry of Economic Development introduced the Technology Platform "Intelligent Electric Power System of Russia". It allows for active participation in shaping the market of intelligent power services and occupying leading positions in it. It is an instrument to stimulate smart grid developments but does not seem to include funding of participants or projects.

---

[21] FDG, Grid becomes smarter, http://www.fsk-ees.ru/eng/public_relations/media_coverage/?ELEMENT_ID=8821&sphrase_id=301493

[22] Russian Federation Ministry of Energy, Approval of Methodological Recommendations regarding technical characteristics of account electrical energy smart equipment and systems, Order # 86, dated 22 March 2011.

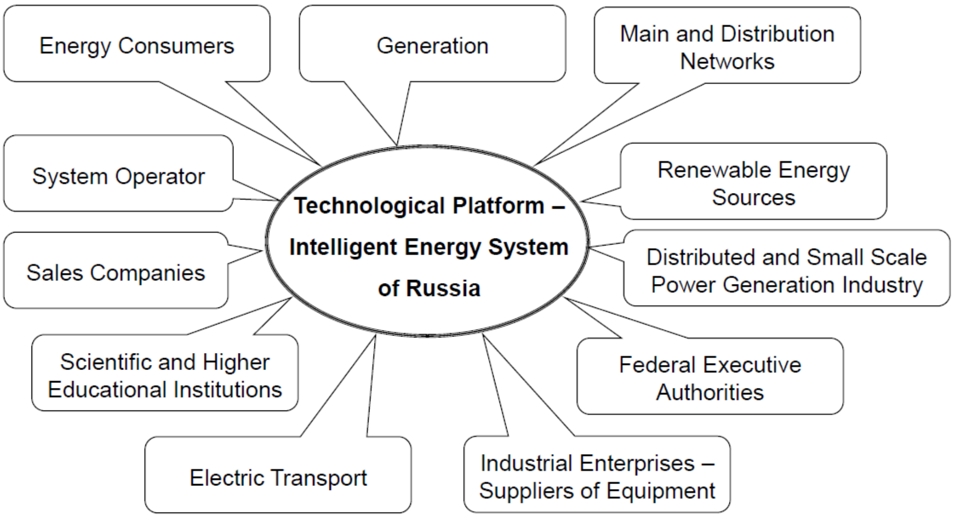

Figure 4 The TP Intelligent Energy Systems of Russia[23]

Pilot projects

Figure 5 shows four smart grid projects that are identified in this study and two areas where the high voltage grids are restructured and modernized. Although not a smart grid project in the "Dutch sense", literature considers these two high voltage grid restructuring projects as smart grid projects[23] [24].

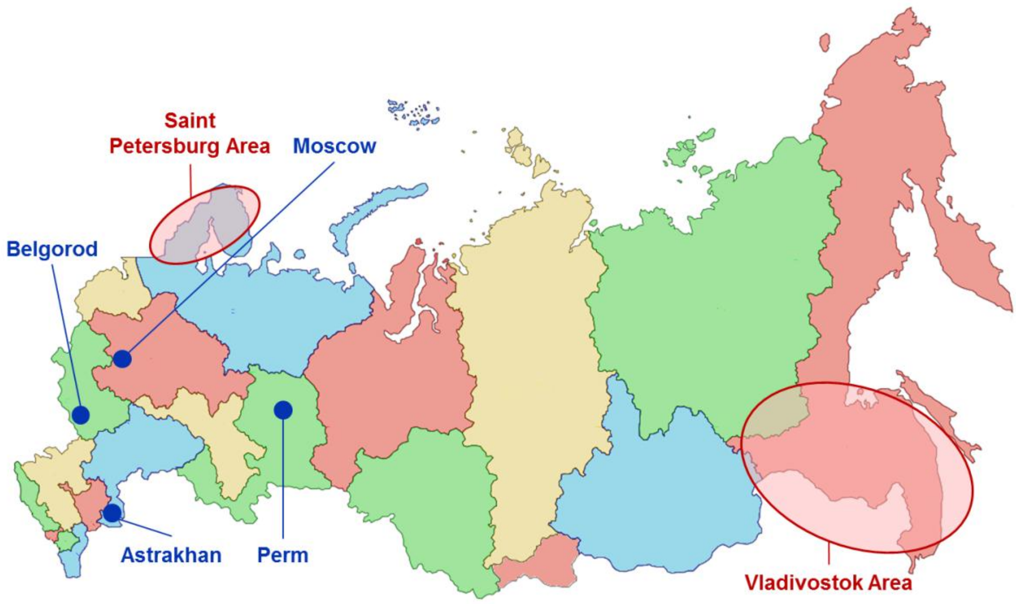

Figure 5 Identified smart grid and (HV)grid restructuring projects

[23] Smart Grids – Finnish-Russian technology Platform Report, Finnode FP00005572 from 2012-05-31

[24] Smart meters in Astrakhan region, ashttp://www.smartgrid.ru/novosti/v-rossii/astrahanskaya-oblast-razvivaet-napravlenie-smart-metering/

The two high voltage grid restructuring projects consists of modernization of the transmission grid. They are initiated and funded by the Federal Grid Company of the Unified Energy System (FGC UES). It includes the installation of digital substations and reactive power control. Main goal is to increase the reliability of the transmission grid.

The first smart grid project is actually a smart meter project. It is the project in the city of Perm. Five pilot projects (President's Commission for Technological Development of Russian Economy) are in progress in Perm, two of them are related to future smart grids implementation: "Calculate, Save and Pay" and "Smart Account" as a part of the "Smart Metering". Main goals of this project are:

- building experience;
- develop financial mechanism for smart meter projects;
- develop codes and standards;
- identify required changes in legislation and propose new legislation.

This project includes replacement of more than 50,000 meters by smart meters. It is funded by federal budget, IES holding and the local distribution company Permenergo. The share of the local grid company in this project is approximately 9 MEUR. The meter functionality includes 4-6 tariff registers, remote controlled power switch, power quality registration and communication by power line carrier. Meters installed are from Russian, French and North American manufacturers.

The second project is in the city of Belgorod. This Smart City project includes:

- ”Smart metering” and ”Smart accounting” – systems of electric energy charge and metering in real-time;
- ”Reliable grids” – reconstruction of distribution grids;
- ”Smart street lighting” – intelligent systems of street lighting;
- ”Smart House” – automatic consumers' control.

Goal of the Smart City project in Belgorod is to increase reliability of power supply, reduce grid losses and reduce cost of electricity for consumers. The Belgorod Smart City project is funded by the distribution company, the Belgorod region and by the federal government, based on Federal Law 261 (see Table 1).

Almost 40,000 meters will be installed. The smart meter installed is a Neiron meter with GSM communication. It includes functionality of limiting the available power in case of defaulting and a display for feedback of the electricity consumption during the previous 24 hours to the consumer.

Distribution grid reliability is increased by installing new equipment such as step-up transformers and automatic reclosers.

The third example is from the Astrakhan region. According to energy companies, in the period 2011-2012, smart meters are already installed in more than 4,900 domestic connections, 520 in the industrial sector, as well as 713 in high-voltage substations. All devices are remote connected: 2.4 thousand data transfer devices were installed.

The last example of a smart grid projects is from Moscow. It aims at developing an electric vehicle charging infrastructure in the Moscow City. It is run by the Moscow United Electric Grid Company. This MOESK-EV project includes installing 24 normal charging stations and 3 fast charging stations[25] in 2012. Goal is to demonstrate the prospects for electric transportation. Further installations will follow. Estimated investments for the next three to five years is 38 – 50 million EUR[26]. There is no mentioning of using intelligent control to avoid peak loads or vehicle-to-grid applications.

[25] http://revolta.ru/en/press-center/press-releases/582-ev-fast-charging-stations-available-in-moscow

[26] http://en.rian.ru/business/20120228/171589075.html

3 DESCRIPTION OF THE DUTCH MARKET

3.1 General description of the Dutch electricity market

The Dutch energy market is one of the most extensively liberalized markets in Europe. Of the major European energy companies, RWE (owner of Essent), Vattenfall (owner of Nuon), Eon, GDF and DONG are active as a producer. Eneco and Delta are energy companies owned by Dutch authorities. After the liberalization of the market dozens of new entrants (energy suppliers without their own generation capacity, such as Greenchoice and NLE) entered the market.

Most electricity in the Netherlands is generated by five large-scale generation companies – GDF Suez, E.On-Benelux, Essent/RWE, Nuon/Vattenfall and EPZ – while the remainder is generated decentrally or imported. The proportion of decentrally installed capacity in the Netherlands is very high compared to other countries. Much of this capacity is attributable to cogeneration plants in industry and greenhouse cultivation. Sustainable generation capacity in the Netherlands consists of solar PV, wind, water (hydropower) and biomass. These sources provided 9% of electricity consumed in 2010[27]. In 2011 this percentage was 10%[27]. In 2010 2.5% of the consumed electricity in the Netherlands was imported. The total amount of consumed electricity in 2010 was 120 TWh[27]. About 31% of this amount was traded on the APX-ENDEX exchange.

Average monthly peak prices on wholesale markets in 2009 and 2010 were between 54 and 118 EUR/MWh and average monthly base load prices were between 18 and 49 EUR/MWh[27]. For small end consumers the average electricity rate (including regulatory energy tax and VAT) was 0.27 EUR/kWh in 2010 and 0.26 EUR/kWh in 2011. Specifically for households these prices were 0.01 EUR/kWh lower in both years[27].

TenneT is the transmission system operator of the high-voltage electricity grid, Gasunie transport services B.V. (GTS) is the national transmission operator in the Netherlands. GTS is responsible for the management, operation and development of the gas transport system in the Netherlands. There are eight companies responsible for managing the regional distribution, which are mentioned in Table 2. The total length of the electricity grids of the TSO and the DSOs in 2010 was 310,000 km.

[27] Energy in the Netherlands, 2011

Table 2 Distribution system operators[28]

Distribution system operator	Gas connections	Electricity connections
Cogas Infra en Beheer BV	138,000	53,000
Delta Netwerkbedrijf	187,000	207,000
Endinet BV (Alliander company)	451,000	109,000
Enexis BV	2,056,000	2,631,000
Liander NV (Alliander company)	2,232,000	2,948,000
RENDO Netbeheer BV	102,000	32,000
Stedin BV	1,946,000	2,054,000
Westland Infra Netbeheer BV	52,000	55,000

In 2011, the average duration of grid outage for a household was 23 minutes and 43 seconds. The reliability of the electricity supply in the Netherlands is high compared to other countries, according to figures from European regulators. The average availability of electricity is 99.996%. In most other European countries, the power outage duration per household is easily more than twice as high as in the Netherlands[28].

The electricity consumption in the Netherlands is build up as follows:

- Residential households 24 TWh
- Small commercial 11.5 TWh
- Commercial consumption 26.0 TWh
- Greenhouse consumption 9.3 TWh
- Industry consumption 28.1 TWh
- Interconnection export 10.6 TWh
- Heavy industry consumption 7.0 TWh

Table 3 provides an overview of domestic energy consumption in the Netherlands.

Table 3 Key figures of energy consumption of Dutch households in 2010[28]

Household item	Data
number of inhabitants	16,615,500
number of households	7,429,500
natural gas consumption per household (m^3)	1,563
electricity consumption per household (kWh)	3,480

In 2011, 10% of Dutch households and businesses switched to another energy supplier. In 2004 - the year when the whole electricity market was liberalized, the switching rate was around 6%. So there

[28] Energy Trends 2012

has been a significant increase. The switching rate is an important indicator of the dynamics in the market. It shows the extent to which suppliers manage to persuade customers to switch. In addition, suppliers are also trying to retain their existing customers with attractive offers. In order to measure the success of liberalized market, it is especially important to measure the overall customer satisfaction. Research by the NMa shows that 98% of customers are neutral to very satisfied with the services of its energy supplier.

An increasing number of energy suppliers have come with their own applications for smart energy. For example there is the remotely controllable thermostat via a smart phone. Other devices help to provide a more detailed insight in energy consumption, for example, with a display or the computer or tablet. Most of these applications use the standardized "consumer port" of the smart meter[29].

3.2 Smart meters and smart grids in the Netherlands

The current energy politics of the European Union form an important accelerant for the introduction of intelligent metering systems. The most important regulations are:

- EU directive 2005/89/EC lays down measures to safeguard security of electricity supply and infrastructure investments. Article 5 mentions the "*encouragement of the adoption of real-time demand management technologies such as advanced metering systems*".
- EU directive 2006/32/EC: "*if technically possible, financially reasonable and proportionate in relation to the potential energy savings, final customers for electricity, natural gas, district heating and/or cooling and domestic hot water are provided with competitively priced individual meters that accurately reflect the final customer's actual energy consumption and that provide information on actual time of use."*
- EU directive 2009/72/EC (Third Energy package) states that 80% of all consumers should be equipped with intelligent metering systems by 2020 if the assessment (per country) of all long term costs and benefits for the markets and consumers is assessed positively. In the Netherlands DNV KEMA performed a costs benefit analysis in 2010 on behalf of the Ministry of Economic Affairs of which the outcome was positive.

This means that within a time frame of less than ten years a transition towards the deployment of intelligent metering systems for electricity and gas will occur. In the Third Energy Package of the EU it is also mentioned that active participation of consumers in the market for electricity supply should be supported.

Regarding smart grids, EU directives less explicit. The European Commission (EC) set up the smart grids Task Force (SGTF) by the end of 2009. The SGTF reached a consensus on policy and regulatory directions for the deployment of smart grids. The SGTF has also issued key recommendations for

---

[29] Smart meter standards: Dutch Smart Meter Requirements (DSMR), version 4.0, http://netbeheernederland.nl

standardization, consumer data privacy and security. Based on these results, during 2011 the EC has adopted a Communication on smart grids, issued a Mandate for smart grids standards to the European Standardization Organization and created an Inventory of smart grid projects and lessons learned in the EU. The EC has also issued Guidelines for conducting cost benefit analyses of smart grids projects in 2012.

Important drivers for smart grid implementation in the Netherlands are the integration of renewables and the accommodation of distributed generation. Some nations have other drivers, such as increasing the grid reliability, however as the Netherlands already have a very reliable electricity grid, this is not the main driver for smart grids.

In the Netherlands the Taskforce Intelligent Grids was established in 2009 to come up with a widely supported vision and action program on smart grids. Also the Intelligent Grids Innovation Program (Innovatieprogramma Intelligente Netten, IPIN)[30] was established as part of the Energy Innovation Agenda. The goal of this Program is to accelerate the introduction of intelligent grids. In twelve pilot projects learning experiences are created with regard to new technologies, partnerships and different kinds of cooperation. The results of these pilots help to solve key issues on smart grids, for example on consumer requirements, new business cases and legislation. Based on the IPIN pilot projects in the Netherlands, the results of the societal cost benefit analysis that CE Delft and DNV KEMA performed in 2011[31] can be fine tuned in the future.

In 2011, several consortiums were formed to jointly develop pilot projects for smart grids and to implement these in 2012-2013. Netbeheer Nederland has a project group smart grids. Some 30 companies have joined forces in the Smart Energy Collective (SEC) which began with the design of pilot projects with business users and households, five sites in total. Several regional initiatives and partnerships have been established, such as New Energy Business Community (North Netherlands), Smart Energy Regions (North Brabant), subgroups of the kiEMT foundation (Gelderland and Overijssel), Smart Energy Technologies & Systems (Twente), Amsterdam Innovation Motor and Utrecht Sustainability Institute. It is remarkable that SMEs are especially strongly represented in the regional initiatives.

In recent years many concrete projects and initiatives have been developed by a broad spectrum of companies, research institutions and governments. For example, PowerMatching City in the district Hoogkerk in Groningen is the first live demonstration project in Europe, which attracts visitors from around the world. Lessons learned from this kind of demonstration projects are that the alignment of electricity to intermittent energy supply of sources such as solar panels and wind turbines is attractive. By switching boilers, washing machines, freezers, charging of electric vehicles or committed energy

---

[30] http://www.agentschapnl.nl/programmas-regelingen/proeftuinen-intelligente-netten

[31] http://www.rijksoverheid.nl/documenten-en-publicaties/rapporten/2012/03/30/maatschappelijke-kosten-en-baten-van-intelligente-netten.html

storage the demand can be shifted/influenced. One way of applying demand response is by introducing price incentives, i.e. variable pricing tariffs. Due to network optimization it is recommended that prices cannot only change temporarily but also locally. Energy management should not only take place on a neighborhood scale, but also on a building level.

Electric vehicles (EVs) can possibly play a large role in matching supply and demand. On the one hand the simultaneously charging of EVs requires a high electrical capacity, which could cause overloaded transformers. In this case smart grids can better coordinate the grid load. On the other hand the batteries of EVs could potentially be used to absorb peaks in the grid ("vehicle to grid"). Furthermore heat pumps (including thermal storage) could be used to cheaply heat or cool by heating and cooling at low electricity prices. Also micro-CHPs could play a role in this case and smart grids could enable a virtual power plant when these micro-CHPs are clustered. In some cases laws and regulations form a barrier, for example when implementing price differentiation and the control thereof and in the case of privacy issues. Furthermore it turns out that in almost all demonstration projects, grid operators are involved as well. As most demonstration projects were initiated with government subsidies, a scaling up of the activities still comes with a relatively high level of vulnerability.

Government plans mention that in 2012 and 2013, 450,000 households will have a smart meter installed by the distribution network operator. These households mainly concern new buildings, renovation projects and people who have requested to have a smart meter. The EU target is that by 2020, 80% of all households have a smart electricity meter installed. Privacy and security of the smart meter have been anchored in the law. Starting point is that the consumer can decide who has access to the measurement data. If the smart meter is used, the energy supplier can read the secured meter data remotely to capture the meter readings. This information will only be used for this purpose. The customer may at any time choose to turn of this administrative function of the smart meter.

Summary of offered services

Companies in the Netherlands offer diverse innovative products and services with respect to smart grids. For instance, new business models, back-office systems, and smart energy meters. These companies include engineers, IT and energy companies, grid operators, and consultancy firms. They are start-ups as well as established companies operating worldwide. In appendix B an overview of these companies is given.

In the field of engineering and development there are various companies that offer products ranging from charging stations for EVs, transform stations, electricity meters to products for failure detection, remote monitoring, switching, distributing and protecting electrical energy on low and medium voltage level. But also products which are interesting for households are offered such as the Femtogrid Solar System that can be installed at residential and small commercial rooftops, and energy management systems such as in-home energy control and demand response products. Nedap Energy Systems and NXP Semiconductors are examples of two Dutch manufacturers active on the smart grid domain. The first offers fully integrated energy management systems for use at home and the latter delivers ICT-based hardware for various sorts of smart meter and smart grid solutions.

Furthermore, many IT services have been developed as well: network management tools for EV charging facilities, such as billing, support and authorization, automation solutions for energy management and substation automation. Other IT related services that are offered comprise exchange trading, central clearing & settlement, data distribution services, benchmark services, ruggedized routers and switches to handle the most demanding substation environments, geographic information systems (GIS), control software, software required for virtual power plant operation and the telematics infrastructure for electric vehicles.

Also IT consultancy in the field of smart meters and smart grids is offered by various companies, which offer solutions for smart metering and related processes such as the allocation and reconciliation, settlement, (wholesale) trade, billing and process optimization and implementation projects in general.

Other consultancy offerings focus on technical, financial, policy and regulatory advice, such as the development of policy and strategy documents, grid modeling and implementation, power quality, distributed generation and electricity storage, (vendor) due diligence, but also include testing and verification services of smart meters, transformers and other smart components, such as smart cards.

Most energy suppliers and DSOs and the TSO in the Netherlands are active in smart meter and smart grid developments. They have there own development projects or participate in joint pilots and demonstration projects with other stakeholders in the smart grid and smart meter sector. The same holds for the knowledge institutions mentioned in appendix B: they focus on research with regard to smart grids and do so by their self, but also in cooperation with relevant actors in the smart grid, through joint projects.

To improve the cooperation of the knowledge institutions and related companies between Russia and the Netherlands, Nuffic, the Dutch organization for international cooperation in higher education, has recently started up the Living Lab Energy Russia Initiative. The focus of the Living Lab Energy is on the role of gas, gas technologies and infrastructures in load balancing at micro and meso level. Horizontal chain integration of electricity and gas infrastructures at these levels maximizes their ability to compensate and strengthen one another, resulting in optimal meeting of demand. The general objectives of the Living Lab are to[32]:

- improve the international learning experience of students by carrying out real-life research;
- get access to an international network of universities with industry support targeting a specific knowledge theme;

[32] http://www.nuffic.nl/en/news/latest-news/living-labs-a-new-profiling-instrument-for-universities-of-applied-sciences

- provide a bilateral platform for education and research, industry and government from both countries to work together and create added value for the professional practice.

4 OPPORTUNITIES FOR DUTCH ORGANIZATIONS IN RUSSIA

4.1 Differences in smart grid definitions

As mentioned in the introduction (chapter 1) the scope and understanding of smart metering and smart grids tend to vary between different countries and different stake holders. Based on this study, it is clear that definition of smart grids perceived for Russia is different from the “Dutch” definition.

In the Netherlands, smart grids relate to low and medium voltage grids. Smart grids consist of an “intelligent layer” added to the existing (physical) grid helping to improve utilization of this grid and to realize additional services. Smart grids always involve interaction with the consumer. It is the flexibility in consumer load (and generation) that is used to provide services on the generation market or capacity services to the local grid company. Smart meters are considered a just part of smart grids and there are different opinions on the level of “smartness” of a Dutch smart meter[33].

The Dutch Taskforce Intelligent Grids defines smart grids as: innovations in and around energy grids focusing on an affordable, reliable and sustainable energy system in the future and enabling and enhancing:

- Demand side response from end users;
- Connection and integration of electric transport, RES, DER and storage;
- New products, services and markets;
- Flexibility of the energy system;
- Moderation of investments in infrastructure and generation;
- Reliability of the energy supply.

The concept of smart grids in Russia differs from that in the Netherlands. For instance, smart grid scope includes the transmission grid, e.g.

- advanced forecasting and the activation of consumers;
- optimization of emergency automation;
- automation of maintenance.

In Russia it seems there are three interpretations of the smart meter/ smart grid concept:

1. Active transmission grid management (Federal Grid Company),
2. Reconstruction and upgrade current distribution grid to allow distributed generation, improve grid reliability and two way information exchange,
3. Implementation of demand response (end users, including tariff systems) in order to decrease prices and increase grid reliability (adaptive controls and dispatch of payloads).

---

[33] De rol van slimme meters in slimme netten, rapport 74100818-MOC/OPE 12-00287, DNV KEMA, 25 juni 2012

The concept of smart grid in Russia is broader and evidently does not always include the end user of energy. Grid improvement projects, using new grid equipment (automatic reclosers, step-up transformers, static VAR compensators) that are basically all within the scope of the grid company, are also considered smart grid projects. Smart grids include automatic meter reading and advanced metering infrastructure.

The demonstration projects show, that smart grid projects in Russia are not limited to grid improvement projects by the transmission or distribution grid company. Some projects also include interaction with the consumer, e.g. to realize energy savings. The smartness required from a Dutch perspective (driven by high penetration of local renewable energy sources (solar wind) and a high penetration of advanced technologies like micro-CHP, heat pumps and electric vehicles) seems to be not viable for Russia in the near or intermediate future.

4.2 Relation to the Dutch "Top Team" activities

In 2011 the Dutch government assigned 9 Dutch Top Team activities. These are areas where the Netherlands are potentially strong worldwide. One of these areas is the energy sector. Goal of the Top Team Energy is to stimulate innovation in order to decrease the cost for reduction of CO_2-emissions and stimulate the development and utilization of renewable energy sources[34].

Within the Top Team Energy, 7 themes are defined that will be handled by 7 Top Teams for Knowledge and Innovation (TKI). One of these TKIs is the Innovation Team Smart Grids. This TKI focusses on three "layers" in smart grids:

- physical infrastructure: grid balancing technology;
- virtual infrastructure: open standardized data platform;
- services infrastructure: open standardized services (creation) platform.

Additionally two sets of innovation topics that link to all of the three layers are defined:

- institutional innovation: with a focus on avoiding regulation barriers;
- social innovation: with a focus on business models and end user behavior.

Figure 6 shows the (expected) development in smart grids in the Netherlands.

[34] http://www.top-sectoren.nl/energie

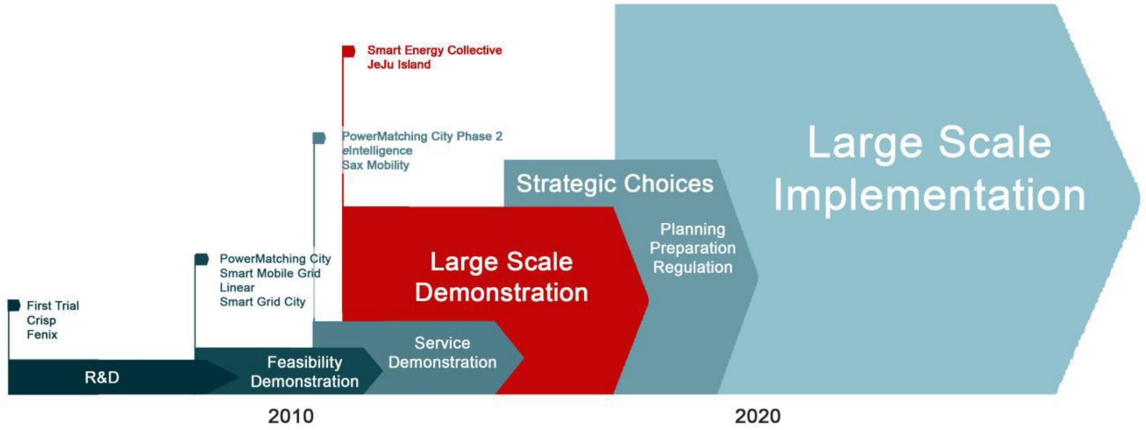

Figure 6 Expected development of smart grids in the Netherlands[35]

From this study, it can be concluded that the actual activities in Russia do not fully comply with the activities of the Innovation Team Smart Grids. The smart grid activities in Russia seem to be focused on a more basic level of implementation of new grid technology, smart metering and the beginning of realizing demand response mechanism and energy awareness for end consumers.

4.3 General impression of the smart meter - smart grid market

Generally the Russian Energy Strategy is oriented for modernization. It courses towards a fully liberalized electricity market. Currently there is a technological gap regarding smart grid implementation in Russia (about 10 years in comparison with best available technologies). The number of smart grid pilot projects seems limited. There are no (extensive) standards for smart grid technologies as developed in Europe and there is no national technological center for smart grid technologies. There is no national strategy for smart grids yet.

Important legislation regarding smart grids is Federal Law nr 261 that states that (smart) meters and accounting systems should be installed at all participants of electricity market and thermal power in power plants and substations, in enterprises, and with the year 2012. It also requires REA to develop a Smart Grid Initiative/Roadmap

Important to realize is that more than half of the Russian grid is past its permitted operation time. Given the expected growth in energy demand, many grid projects (replacements and new capacity) are expected. This might provide opportunities to review the current grid design approach and start with a smart grid view in mind.

---

[35] Top Team Energy, Innovation Contract Smart Grids, February 15th, 2012, http://www.top-sectoren.nl/energie

Important perceived drivers for smart grids are on a relatively basic level:

1) Increasing grid reliability and quality
2) Accommodating decentralized (renewable) generation
3) Reduce grid losses
4) Defer or avoid investments in the distribution grid and in in central generating capacity
5) Energy savings
6) Distribution grid management

The required services and products in Russia for coming years seem quite basic. There is probably no immediate need for e.g. sophisticated load strategies for electric vehicles or heat pumps but more for basic, practical knowledge of upgrading the grid, implementing remote meter reading, integration of decentralized generation and basic demand side management by multiple tariff systems and remotely reducing the allowed load through a smart meter (e.g. defaulters).

On a national level there is need for a national smart grid strategy and a guide or a road map for smart grid technology applications for different market participants (networks, generation, large consumers, residential sector and electric vehicles).

Interesting is the area of standardization. Early standardization of smart meter and smart grid functionalities, communication protocols et cetera will help to develop an open and competitive smart meter and smart grid market reducing cost and increasing smart meter and smart grid project quality and effectiveness.

4.4 Perceived smart grid opportunities for the Dutch industry

As mentioned before, the relation of perceived Russian smart grid activities with the Top Team Energy / Innovation Team Smart Grid activities is limited. Russia is probably many years behind in the implementation of smart meters and smart grids. It seems that there are opportunities to provide services regarding best practices of implementation of smart meters and distribution grid management, developing road maps and standardization. Dutch experience could be valuable for Russia, but the Netherlands is not the only country that acquired experience in this field, so there will be competition.

Smart grid activities seem to be mainly initiated by the transmission grid company (Federal Grid Company of the Unified Energy System, FGC UES) and the distribution grid companies, joined in the JSC Interregional and Regional Distribution Grid Companies (IDGC) Holding. They seem to be the companies to approach for smart grid opportunities. The role of the national government (including Russian Energy Agency) in smart grid implementation seems limited to the development of legislation, the Smart Grid Initiative/Roadmap development and the coordination of the Technology Platform “Intelligent Energy System of Russia” (TP IES) but this needs further study.

During this study, smart grid related activities from foreign countries in Russia are noticed:

- FINPRO, the national trade, internationalization and investment development organization in Finland, issued a Smart Grids – Finnish-Russian Technology Platform Report;
- In at least one Russian smart metering project a USA manufactured meter (Echelon) is used. Also, a Russian-American Smart Grid Partnership Initiative was organized in November-December 2010. A Russian-American project started which is aimed to investigate factors influencing smart grid technology developments in Russia and America: legislative regulation, market structure, customer focus;
- The French Company ERDF temporarily manages one of the distribution companies in the IDGC Holding. In at least one Russian smart metering project, a French smart meter (Sagem) is used.
- The many electric cars in the MOESK-EV project are made in Italy and Japan.

Table 4 summarizes the perceived opportunities for smart meters and smart grids, based on the market scans for Russia and The Netherlands.

Table 4 Perceived opportunities for smart meters and smart grids

Sector	Perceived opportunities
Manufacturing	• Smart meter equipment (e.g. meters, modems, concentrators, home energy management systems) • Grid equipment to maintain power quality (e.g. active VAR compensators)
Engineering / Development	• Energy awareness equipment for domestic and commercial use in the better developed areas (e.g. smart sockets, smart thermostats, energy displays, web applications)
Consultancy / (ICT)services	• Developing of smart grid road maps • Advisory service on the incorporation of smart meter / smart grid functionalities in the electricity market model • Advisory service on smart meter / smart grid legislation and development of smart meter / smart grid standards • Testing of smart meter / smart grid equipment (e.g. protocol testing) • Development and implementation of energy metering meter data management and billing systems • Development and implementation of SCADA-systems • Risk management services • Training and education

Sector	Perceived opportunities
Energy companies / grid companies	• Selling smart meter / smart grid experience (best practices) • Selling distribution grid management knowledge (best practices)
Knowledge institutions	• Helping develop a smart grid expertise center

4.5 Opportunities for services regarding district heating and (micro)cogeneration

Traditionally, Russia has a large share of district heating for industrial and residential applications. It is the largest in the world, serving 92% of the urban areas and 20% of the rural areas[36]. This suggests that most residents do not have a natural gas grid connection. The share of CHP with regard to the total production is high (Figure 7).

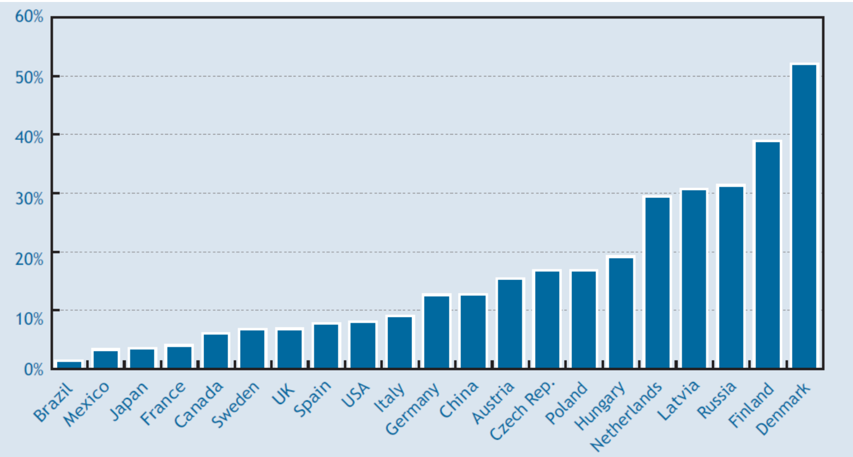

Figure 7 CHP share of total national power production[37].

The Law on Energy efficiency 261 of November 2009 includes several sections relevant to the residential heating sector[38]:

- obligation to install heat meters;
- financial solutions for meter installation;
- revision of heating norms;
- long term tariffs.

[36] Modernizing residential heating in Russia: End-use practices, legal developments and future prospects Energy Policy, Vol 42, March 2012

[37] Combined heat and Power, evaluating the benefits of greater global investments, IEA 2008

[38] Modernizing residential heating in Russia: End-use practices, legal developments and future prospects, Energy Policy, Vol 42, March 2012

About half of the district heating is served by combined heat and power units (CHP), the other half is served by heat-only boiler houses (HOBH). Most CHP and HOBH is gas fired. Figure 8 shows the share of heat consumption for different sectors in Russia.

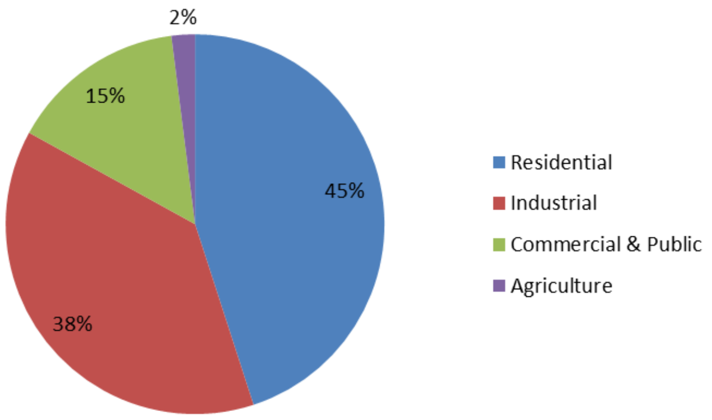

Figure 8 Share of heat consumption in Russia[37].

District heating demand is declining, due to decreasing demand from industry and the emergence of more local decentralized heating solutions, based on small boiler houses or heat pumps for (individual) buildings. This emergence of local solutions is partly due to the low quality of service of large district heating. It is estimated that almost 70% of the district heating fixed assets require replacement, largely due to the ageing of the infrastructure and generation units[39]. Generally, low efficiency coal- and gas fired units are used and the transmission losses are estimated at 20-25% as compared to 5-10% for Western countries. District heating is owned by municipalities that lack financial resources to invest in CHP systems[40]

This short scan suggests that there is much work regarding refurbishing district heating grids and replacement of large CHP units. This seems, however, a rather common service in a very competitive energy market that will probably be dominated by large energy companies and gas turbine manufacturers.

Small scale district heating (one or several buildings) seems to be a competitor most likely because of lower investments, lower grid losses and better quality of service. It is not sure what will be the competitive advantage of the Netherlands in field as other countries (e.g. Finland) have far more recent experience. Individual (micro)CHP solution require a local gas grid connection and data

[39] Modernizing residential heating in Russia: End-use practices, legal developments and future prospects, Energy Policy, Vol 42, March 2012

[40] District Heating/CHP Opportunities and Challenges in Russia and CIS, Arto Nuorkivi, 2011, http://www.iea.org/media/workshops/2011/platformrussia/Nuorkivi.pdf

suggests that local gas grid density is low, due to large penetration of district heating, so this market might be limited.

APPENDIX A: LIST OF RELEVANT ORGANIZATIONS IN RUSSIA

See attached spread sheet

APPENDIX B: LIST OF RELEVANT ORGANIZATIONS IN THE NETHERLANDS

See attached spread sheet

APPENDIX C: INTERVIEW REPORT RUSSIAN ENERGY AGENCY

Interview with Mr. Konev Alexey (KA), Director of Innovations of Federal State Institution "Russian Energy Agency" of Russian Ministry of Energy

Questions and answers

1. How do you rate the current status of smart meters and smart grids in Russia?
KA: We're now at the initial phase; there is no national strategy for smart grid, fixed terminology and standards. Additionally there is lack of analytics.

2. What are in your opinion the important drivers for smart meters and smart grids in Russia?
KA: In my opinion main drivers are costs reductions and energy security and power quality improvements.

3. What is needed in Russia for a successful implementation of smart meters and smart grids?
KA: National Strategy in this area approved at least by Russian Ministry of Energy or additional section in the current Russian Energy Strategy approved by the Russian Federation Government.

4. What opportunities do you see for foreign companies and institutions to contribute to the implementation of smart meters and smart grids in Russia?
KA:

a. Review and analytic reports containing:
   - worldwide situation;
   - main trends;
   - what are the economic effects of the smart grid implementation? how these effects can be estimated/assessed at the planning and design phase?
   - which priority directions are developing now?
   - What are the most effective technologies?
   - Information about approved/reliable technology providers/suppliers.

b. Formation of standardization program in this area;

c. Development of a Guide or a Road map for smart grid technologies application for different market participants (networks, generation, large consumers, residential sector, electric vehicles).

5. What are in your opinion the most important smart metering and smart grid pilot projects in Russia?
KA:

- Smart City project, Belgorod (JSC Interregional Distribution Grid Companies Holding and IDGC of Center).
- Smart metering pilot project in the Perm city (JSC Interregional Distribution Grid Companies Holding and IDGC of the Urals).
- Electric vehicle infrastructure development in the Moscow city (Moscow United Electric Grid Company)

- Digital substation (JSC R&D Center for Power Engineering)

6. What are the experiences with current smart metering and smart grid projects (especially the ones mentioned in the report)?
   KA: What I would like to note is that Russia has created a great tool to promote the ideology and smart grid technology a Technology Platform “Intelligent Energy System of Russia” (TP IES). TP IES coordinator is the Russian Energy Agency (REA) and our co-initiator is Russian Federal Grid Company. Today the total number of IES participants is 166 companies. Main IES 2011-2012 projects are:
   - Testing ground “Digital substation” created on the basis of JSC R&D Center for Power Engineering
   - Pilot projects as first elements of complex Smart Grid Implementation Strategy already started (additional to those in the previous question):
     a. Electric vehicle infrastructure development in the Moscow city, within territory supported by JSC “Moscow United Electric Grid Company”;
     b. Smart Grid implementation at Elginsky coal complex;
     c. Energy storage system development (up to 50 MWt).
   - Russian-American project started which is aimed to investigate factors influencing smart grid technologies development in Russia and America: legislative regulation, market structure, customer focus.
   - Russia represented by TP IES (REA) becomes a participant of the International Energy Agency (IEA) Implementing Agreement for a Co-operative Programme on Smart Grids (ISGAN).
   - Program for commercial metering technology development based on smart metering for the period up to 2020. Program is approved by the Russian Energy Ministry order #173 of 10 May 2011.
   - REA developed concept of creating smart metering system of JSC “Moscow United Electric Grid Company”.

Thus it was a good start and we will proceed in 2013. We plan to develop communications and strategy investigation program, perform investigations and development of other projects, and cooperate with federal companies and innovation clusters.

7. What impact do you think smart grids will have on grid reliability?
   KA: It’s obvious that Smart Grids will lead to more reliable grid. As positive effects of Smart Grids I can mark next ones:
   - reducing the risk of system’s failure;
   - Increase of generation facilities economic efficiency due to “flexible” management and due to increased coefficient of efficiency of equipment;
   - Power system stability enhancing against natural disasters;
   - Increase of renewable and distributed generation share;
   - the ability of consumers to participate in the supply management and sell energy generated by own equipment to the market/grid;
   - Innovative renewal of energy industry;
   - development of small-scale power plants in the area of decentralized energy supply through more efficient use of local energy resources;
   - Reduction of transport losses and distribution and sales commercial losses by using demand response, load strategies and smart metering;
   - Increasing capacity of the electric networks;

- Improving the quality of electric power;
- Reducing negative impact on the environment;
- etc.

8. Do you think the use of smart grids for demand response and load strategies for electric vehicles and electric heat pumps will be a big issue coming years in Russia?
   KA: I would not mark out only electric heat pumps and vehicles I would say that usage of smart grids for demand response and load strategies is a significant issue for coming years in Russia.