

SMART GRID MARKET ANALYSIS: GERMANY

1 Executive summary

The German energy transition has developed from mainly focusing on promoting an increased production of renewable energy towards focusing on system integration of renewable energy. In this context, smart grids have a significant role for the success of the so-called Energiewende. In contrast to classical engineering which Germany is world leading in, this is an area where input from foreign innovative companies is welcome. Focus areas where Swedish companies can contribute the most are above all net stability, ICT and e-mobility. Smart metering is an area that is very much in the political focus right now and the roll out is still to come. However, due to complex regulation and specific technical requirements it is not recommended to start engagement in Germany within this area.

Germany is Sweden's biggest trading partner and Sweden has an excellent reputation in Germany as regards innovation. Thus, business opportunities for Swedish smart grid companies in Germany can overall be regarded as good. Nevertheless, it has to be born in mind that Germany is a very developed market which is characterised by strong competition and requires unique products with a clear USP and a good communication to get the message across. Swedish smart grid companies have to prepare well for a successful market entry. The best way to contact German actors is to approach existing networks, institutions and initiatives.

Table of Contents

1	Executive summary	1
2	Introduction	3
3	Electricity market	4
4	Regulation.....	11
5	Commercial and political development.....	12
6	Smart grid developments.....	17
7	Challenges	24
8	Opportunities for collaboration and key stakeholders	26
9	Conclusions	33

2 Introduction

This report is written on behalf of the Swedish Smart Grid Forum. Germany is one of the focus markets in the export strategy of the forum. The report addresses the Swedish smart grid companies and other stakeholders. The purpose is to help the companies to get an overview of the smart grids market in Germany and support them in their decision if they are to enter the German market or not. The report's focus lies therefore on the political and juridical background, the market structure, prioritised areas and existing German-Swedish relations. Based on this report there is also a promotion plan that presents concrete actions to be taken towards German stakeholders, potential clients and partners to enable as many companies as possible to enter the German market successfully and a timeline for the years 2018 and 2019.

3 Electricity market

3.1 Key actors

3.1.1 Utilities, TSOS and DSOS

In total there are ca 90 electricity generating companies, 906 grid operators, 130 electricity traders and 1200 electricity suppliers in Germany. As regards district heating there are ca 540 district heating producers, district heating grid operators and district heating suppliers (5/2017) on the market.¹

In union with the provisions for the EU internal energy market and regulated by the *EnWG* the supply and the transmission and distribution of energy must not lie in the hands of the same company (unbundling). Thus, there are now four independent Transmission System Operators (TSO) in Germany: [Tennet TSO](#), [50Hertz Transmission](#), [Amprion](#) and [TransnetBW](#). Their control zones are the following.

Tennet TSO, 50Hertz Transmission, Amprion and TransnetBW control zones



Source: Bundeszentrale für politische Bildung

Figure 1 Tennet TSO, 50Hertz Transmission, Amprion and TransnetBW control zones

¹ Statista

The distribution grid accounts for 98% of the German grid. As regards the distribution grid operators (DSO) 20% of them have a market share of 60%. For most of them one of the major energy companies in Germany is their majority shareholder. Vattenfall's subsidiary in Berlin, Stromnetz Berlin GmbH, ranks 4th in Germany.

Distribution grid Operators in Germany, 20 companies with market share of 60%



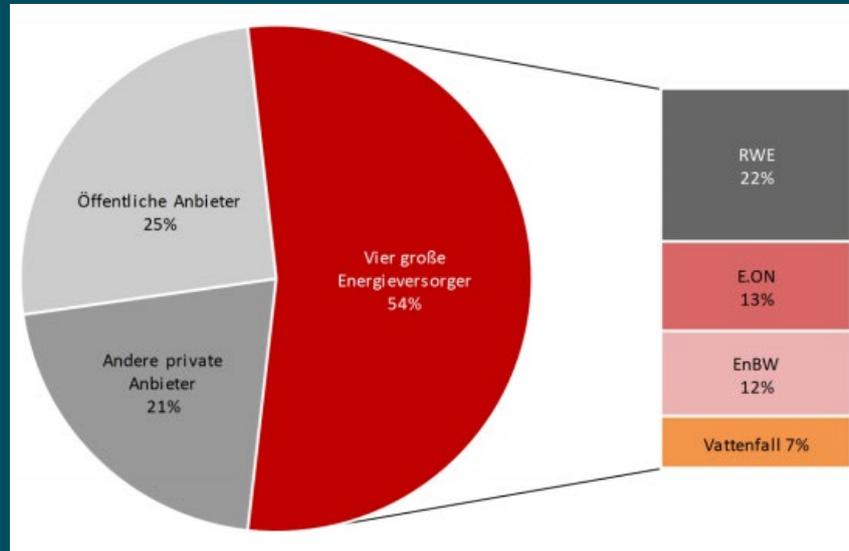
Source: Germany Trade & Invest, www.gtai.com

Figure 2 Distribution grid Operators in Germany

All these big DSOs are unbundled according to *EnWG*. Nevertheless, there is an exception rule. DSOs with less than 100.000 customers do not have to be unbundled. This means, that 90% of all DSOs fall within this de-minimis-rule and are integrated with energy supply at the same company, mostly municipal utilities.

Among the 90 German electricity producers there are four major companies: E.ON, RWE, EnBW and now EPH, that bought the generation capacities of Vattenfall in Eastern Germany. None of them is state owned. The year 2016 has been remarkable as regards the “big 4”. At the same time as Vattenfall sold its generation capacities both E.ON and RWE have been restructured: E.ON separated its fossil fuel assets into a separate company, Uniper, and RWE, on the other hand, transferred renewables production into the subsidiary company Innogy. Formerly, the major four used to have a very high market share, up to 80%. This has changed. As regards conventional energy generation their market share lies at 54% (2016):

Ownership shares in the German power market



Source: monopoly commission, special report: energy 2017, October 2017

Figure 3 Ownership shares in the German power market

RWE has a market share of 22%, E.ON of 13%, EnBW of 12% and Vattenfall has divided its share in half (7%). Next to the former “big 4” it is the municipal utilities (*Stadtwerke*) that are the most important players in the market. Their market share is 25%. There are about 1000 of them in Germany. Thus, the public sector is active on local level.² As regards renewable energy the market is characterised by many upcoming green suppliers.

3.1.2 State Actors and Agencies

Since the beginning of March there is a new government in place, again a grand coalition between the Christian democrats (CDU) and the social democrats (SPD). Old and new chancellor is Angela Merkel (CDU). As regards smart grids the coalition treaty between CDU and SPD states that smart grids and smart meter technology are part of a sustainable energy generation. A federal program “smart model regions” shall come into place and cities and regions shall be supported to take part in the smart cities initiative of the EU.

Two German ministries will mainly responsible for energy questions. Energy as a department lies in the Federal Ministry of Economics and Energy (*Bundesministerium für Wirtschaft und Energie, BMWi*). For energy

² Statista

research, however, the Federal Ministry of education and research (*Bundesministerium für Bildung und Forschung, BMBF*) is responsible. The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (*Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, BMUB*) is coordinating all activities in relation to climate protection. As regards electro mobility the Federal ministry of Transport (*Bundesministerium für Verkehr, BMV*) is in charge. Additionally, the new government has created a department for digitalisation which is embedded in the Federal Chancellery.

As Germany is a federally structured country, there are 16 federal states with their own governments. They have their own budget, are independent to initiate their own projects and can prioritise different focus areas.

16 federal states of Germany



Source: www.weltkarte.com

Figure 4 16 federal states of Germany

Other public players are the German energy agency (DENA), founded in autumn 2000, which describes itself as “Germany’s centre of expertise for energy efficiency, renewable energy sources and intelligent energy systems”, that brings “together partners from politics and industry across all sectors.” DENA sits in Berlin. In addition, there are several agencies on state level such as the Berlin energy agency (Berliner Energieagentur) or the energy agency NRW (Energieagentur NRW).

Another federal player within energy is the Federal Network Agency (Bundesnetzagentur) for Electricity, Gas, Telecommunications, Post and

Railway, which “promotes effective competition in the regulated areas and ensures non-discriminatory access to networks.”

3.1.3 Research and Development

Research environment in Germany is very diverse and unique in its structure. There are universities, universities of applied sciences, non-university research institutes, companies and federal as well as federal state (*Länder*) institutions. In total there are about 1000 publically financed institutions. The institute-profiles are as follows:

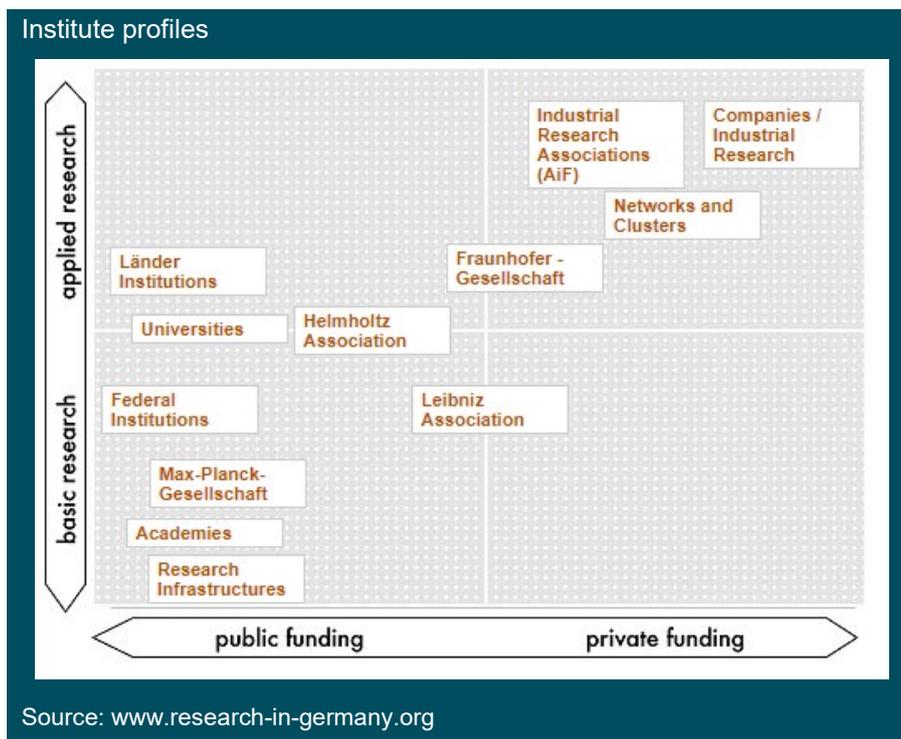


Figure 5 Institute profiles

As regards smart grids universities, research clusters, company research and two of the major institutions are of special interest. There are about 400 universities in Germany. At some, there are special chairs financed by the local utilities and dedicated to a certain area, such as the E.ON Energy Research Center in Aachen (RWTH), the chair for energy trading in Duisburg-Essen, sponsored by RWE, or the energy partnership of EnBW with the Karlsruhe-Institute of Technology (KIT).

Germany’s federal ministries fund approximately 40 federal R&D institutions. Here, *acatech* – the National Academy of Science and Engineering – is most interesting as it has a focus on energy and resources amongst others. As a working academy, *acatech* supports policymakers and

society with expert scientific opinions and forward-looking recommendations. *Acatech* can be compared to the Swedish IVA. The German federal states and municipalities act as well as research funding bodies and operate several research institutes that support state research activities. There are more than 150 institutes in total covering a broad range of research areas.

As regards research institutions the Fraunhofer Institute is by far the most important. It is the largest organisation for applied research in Europe. It conducts research under contract for industry, the service sector and public administration and also offers information and services. In total, there are 69 institutes and research facilities at different locations and different focus areas. 18 of the Fraunhofer institutes deal with different topics in the field of energy research all over Germany. Together, they created the Fraunhofer Energy Alliance, one of the largest energy research organisations in Europe.

Another important research institution is the Helmholtz association, which hosts inter alia the research institute Jülich (*Forschungszentrum Jülich, FZ Jülich*). *FZ Jülich* serves as project sponsor for several German energy projects promoted by the state.

Research cluster are often driven in public private partnerships (PPP). Here, research and concrete projects often go hand in hand and the purpose of these clusters is both research and networking. One of these clusters is energy research NRW (*Cluster EnergieForschung.NRW*) in Germany's biggest federal state Northrhine-Westfalia, which is driven by the energy agency NRW.

Industry financed investments are very important in Germany, they account for more than two thirds of research funding. Here, it is mostly applied research, next to the above mentioned university collaborations. A special focus lies on environmental research, resource-efficient production and new materials. "In Europe, Volkswagen, Daimler and Robert Bosch are the top three companies when it comes to R&D investment. German companies take five out of the six top places and 24 of the top 100 in the European ranking of corporate research spending." ³

³ www.research-in-germany.org

4 Regulation

4.1 Juridical background

The most general law as regards energy is the **Energy sector-Act** (*Energiewirtschaftsgesetz, EnWG*).

Four more specific laws are supposed to set the course for phase two of the energy transition.

The **Underground cable-Act** (*Erdkabelgesetz*), end of 2015, gives priority to underground cables instead of electricity pylons for newly planned transmission paths. This prolongs the building time, but meets the demands of the citizen.

The **Power market-Act** (*Strommarktgesetz*) from summer 2016 opens for an increasing renewable energy share and competition. At the same time regulations for a capacity reserve as a safety net for the new power market have been created.

The **Digitising the energy transition-Act** (*Gesetz zur Digitalisierung der Energiewende*) also from summer 2016 sets the start signal for smart grids, smart meter and smart home in Germany. Most important elements of the new act are the obligation for the smart meter rollout with a pre-defined pricing model according to consumption and regulation as regards data communication and security (see below).

Early 2017 came a reform of the **Renewable Energy Sources-Act** (*Erneuerbare Energien Gesetz, EEG*) into force which marks a paradigm shift: the promotion of renewable energy has become more competitive and market oriented. The EEG is the key instrument for an annual quantitative steering and for bringing renewables closer to the market. From now on the feed-in tariffs for electricity from wind, solar or biomass are no longer adopted by the state, but are instead for the most part determined through technology specific tendering in the marketplace. This shall also reduce the constant rise in prices for the end consumer. Facilities with less than 750 kW are not included in the tendering regulation. This means, that about 80% of the newly build installations will be tendered. The maximum capacity to be newly built within the different technologies is capped by so-called tendering corridors.

5 Commercial and political development

5.1 Die Energiewende

5.1.1 Political background

“The energy transition is our pathway into a future that is secure, environmentally-friendly, and economically successful. We have decided to fundamentally alter Germany’s energy supply: away from nuclear energy and fossil fuels and towards renewable energy”, this is how the German federal ministry for economic affairs and energy defines the German *Energiewende*. This project encompasses several aspects: the nuclear power phase-out until the end of 2022, a renewable energy share of gross electricity consumption of 80%+ and a reduction of greenhouse gas emissions by 80-95% by 2050 (climate protection plan, adopted November 2016). At the same time energy efficiency is to be risen significantly.

German Energy Concept (2010), main objectives

Climate protection measures	2020	2050
GHG cuts vs. 1990	-40%	-80%
Renewable share of...	2020 (2025)	2050
Total energy consumption	18%	60%
Electricity consumption	35% (40-45%)	80%
Heat generation	14%	60%
Energy efficiency measures		
Increase in energy productiveness		2.1% p.a.
Reduction of energy consumption		-50% (2050 vs. 2008)
Reduction of electricity consumption		-25% (2050 vs. 2008)
Renovation rate		2% p.a.
Reduction of energy consumption for transportation		-10% (2020 vs. 2005) -40% (2050 vs. 2005)

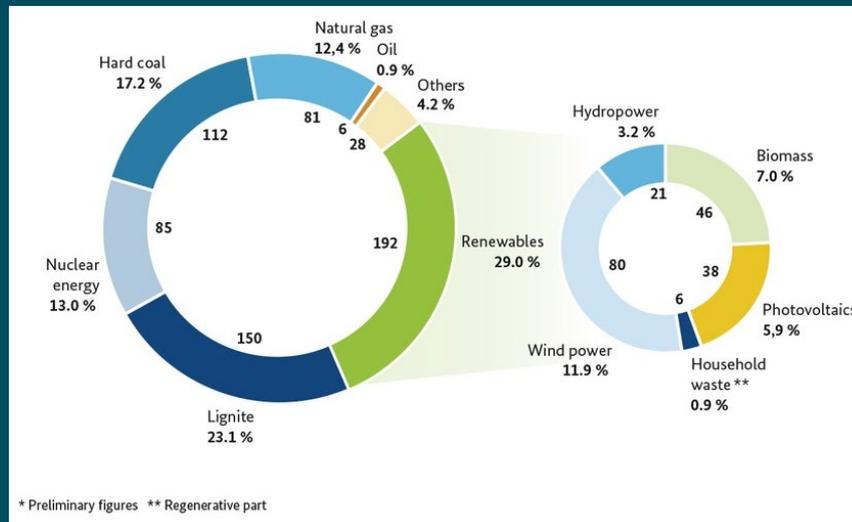
Source: Germany Trade & Invest, www.gtai.com

Figure 6 German Energy Concept (2010)

In spite of good progress in this process it is still a long way to reach these goals. The intermediate goal of reducing greenhouse gas emissions with 40% until 2020 will according to latest reports not be reached. A minus of 30%-37.5% depending on different studies is realistic.⁴

⁴ Agora, Umweltbundesamt, Federal government etc.

The gross electricity generation in 2016



Source: BMWi

Figure 7 The gross electricity generation in 2016

After lignite and hard coal, renewables, therefore represent the biggest generation source. Hereby, wind power has with 11.9% the biggest share.

Thus, as regards pillar one of the *Energiewende*, electricity production, Germany has come far within the alteration of the energy supply. This has been “phase one” of the energy transition. Now, the biggest challenge lies in focusing on the other two pillars, distribution and storage. The most used catchphrase in this context is the necessary system integration of renewable energy. Another challenge is so-called integrated energy which means the incorporation of the three sectors power, heat and transport into one integrated energy systems. This is the focus of “phase two” of the energy transition. Elements of phase two are load levelling, peak shaving, demand site management - and smart grids. As regards transport, energy consumption is supposed to be reduced by 40% until 2050 and greenhouse gas emission are to be reduced by 40-42% until 2030 (climate protection plan).

Thus, the discussion has radically changed within only some years: whereas in former years most experts warned about the so-called “dark calm” where not enough power would be produced to guarantee power supply, now the question is rather what to do with all the produced power from renewables to avoid too high redispatch costs and use every single produced kWh.

Here, it also has to be born in mind that security of supply is important, both economically and psychologically. Germany is a highly industrialised country

which is dependent on steady power supply and people are used to zero black outs in Germany.

The last years, the *Energiewende* has been supported very much by a majority of stakeholders and achieved very high approval rates, but lately the hype has flattened. Economists, official institutions and research institutes report about a diminishing engagement. Public opinion still supports the energy transition. Nevertheless, the system of feed-in tariffs to accelerate investment in renewable energy technologies has proven to result in ever higher electricity prices which the end-consumer is no longer ready to pay. At the same time, the “nimby” (not in my backyard)-effect has come up. Citizens object above all to the siting of new electricity pylons for the transmission grid in their neighbourhood.

To deal with these challenges and overcome the slack Germany has from 2015 until 2017 introduced new laws, found in chapter 4.

5.2 Power 2030

As mentioned above are integrated energy and system integration of renewable energy the most prioritised focus areas within the energy transition right now. Above that the federal government defines four more goals in a vision called “Power 2030” (*Strom 2030*):

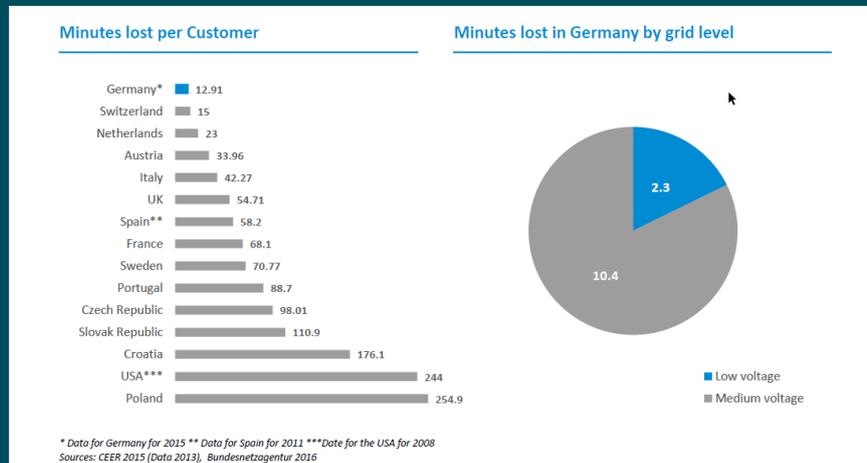
1. A more flexible power system

It is an explicit goal to reduce flexibility constraints, promote aggregators, enhance access to the operating reserve and work actively with grid fees. Most important here is not to favour a certain technology, but keep an open competition on the market.

2. Expand the grid

The German electricity grid is one of the most reliable in Europe.

Grid security, the German electricity grid is one of the most reliable in Europe



Source: Germany Trade and Invest, www.gtai.com

Figure 8 Grid security, the German electricity grid is one of the most reliable in Europe

Expansion of transmission, distribution and heat grid is of utmost importance for the success of the energy transition. At the same time measurements that reduce additionally needed grid capacity are more than welcome. However, four big transmission paths are in planning from north to south Germany – as underground cables. They are supposed to be in place as early as 2025.

1. Integrate and flexibilise European markets further

More European competition on the power markets reduces prices. Therefore, it is important to complete the integration of the European electricity wholesale. Only flexible European electricity markets can react on the intermittent feed-in of renewable energy. This presupposes, however, that both production and consumption can be accounted on a 15 minute base.

2. Reliability of supply put in a European context

Purely national analyses as regards the inner electricity market are no longer state of the art. That means, that even reliability of supply has to be assessed in a European context. Could i.e. generating capacities in other European countries be used for the national reliability of supply?

Thus, the vision for a power system 2030 is as follows:

“Power from renewable energy, above all wind and solar, is the central source of energy in the whole system. Power from wind and solar is increasingly used efficiently even in the sectors heat, mobility and industry (integrated energy). At the same time the European power markets are growing together more closely. With an increasing significance of fluctuating wind and solar power the power system has to remain stable and at the same time become more flexible. Well expanded and modern grids as well as flexible power plants and consumer bring production and consumption cost-efficient together. Digital solutions help to use decentral consumers like electric cars or heat pumps with a benefit for the system.”

6 Smart grid developments

Smart grids are in Germany above all considered as an instrument to reduce grid development need. They are supposed to enable an efficient communication between power producers and consumers, grid operators and storage installations as well as act as coordination centre on the basis of information and communication technology (ICT). This requires flexible operating strategies, innovative components and materials. A strong focus lies in Germany on smart metering (see below), which is partly criticised by researchers because smart meters are in their eyes not the most relevant elements for a smart grid.

There is no official road map or goal as regards smart grids in Germany by the state. However, smart grids are considered as integral part for the achievement of Germany's climate goals 2050. This is also reflected in the existing road maps of single actors. Thus, the industry association BDEW has in accordance with the European industry organisation Eurelectric issued a road map in 2013 that defines three phases for a smart grid in Germany: preparation phase – setting the framework conditions (2012-2014), implementation phase – adaption of infrastructure and processes (2014-2018) and market phase – creating transparency and new products (2018-2022). Additionally, there is a road map in the federal state Baden-Württemberg that defines own climate goals for the state with the help of smart grids.

6.1 Prioritised areas

Digitisation is the big buzz word within energy and the smart grids debate just now. Every mentioned topic is being discussed under the digital viewpoint, whether it is ICT, data protection, standardisation, system security or new business models. Here, even blockchain technologies or smart home applications are discussed. To cope with these challenges the Federal Ministry of Economics and Energy has started the project “Showcase intelligent energy – digital agenda for the energy transition” (*Schaufenster intelligente Energie – Digitale Agenda für die Energiewende, SINTEG*). One of the explicit focus areas of this project is the development of smart energy grids – besides system integration, flexibility, security of supply, system security, energy efficiency and market structures.

The *SINTEG* project is the best endowed energy project in Germany. Project promotion is the most classic way of promoting technical development. Sponsors of projects are both the state and the federal states. As regards power grids BMWi and the research department BMBF have sponsored 119 new projects with ca 53.23 million€ in 2016 in total. 620 projects worth 70.93€ are going on since previous years. The federal government's goal

with all these projects is to use the existing grid structure optimally and reduce the need for grid expansion, as already mentioned above.

SINTEG is planned for a period of five years (2016-2020) and endowed with 600 mills. €. It consists of five subprojects all over Germany. All the projects follow a holistic approach; however, the focus lies in the northern projects on integration of wind power into the grid and in the southern projects on integration of solar power into the grid. In every project several dozen actors are involved. In Bavaria, Baden-Württemberg and Hessen, for example, ca 40 different locations are engaged in the project C/sells. The following map gives an overview over the individual projects:

SINTEG – New Smart Energy Program, EUR 600* Million for 5 showcase regions from 2016 to 2020

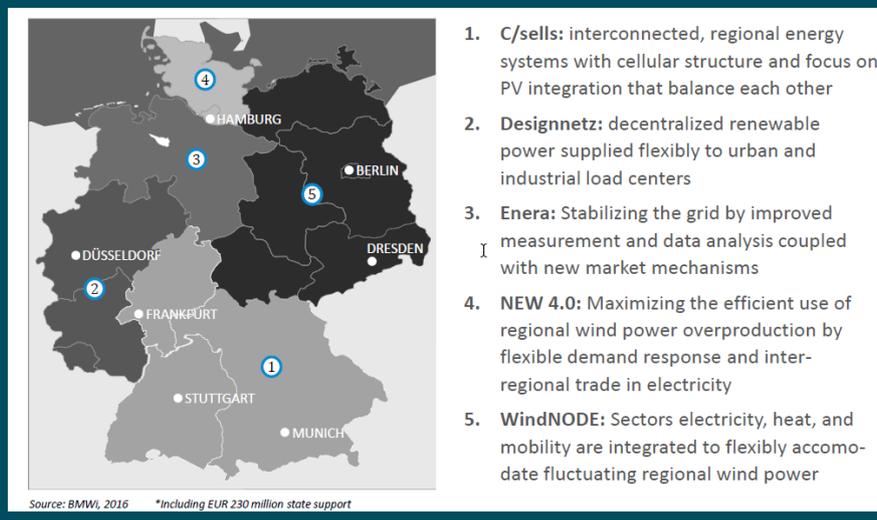


Figure 9 SINTEG – New Smart Energy Program

6.1.1 Smart metering

As already mentioned above smart meters are very much in the political focus right now. The digitisation act 2016 defined to start the roll out in Germany in 2017.

The mandatory roll out of full smart metering systems is about to start in 2017 with large users (over 10 000 kW/h) and producers with a capacity of more than 7 kW until 2020. From 2020 until 2032 consumers from 6 000 kW/h are to be included. Others are to follow. Already now, though, a smart metering system can always be fitted on a voluntary basis. The average consumption in Germany is 3500 kWh/a. Thus, most consumers and above all nearly none private household is affected by the roll out yet. However, by 2032 more than 50 million meters are supposed to be electronic, and many

of them smart. Right now, 90.5% of all meters are electromechanical.⁵ Included in the new law is a pricing model with price caps for the different user groups.

A very German specialty in the digitisation act is the function of the secure communication gateway. Due to data security regulations there has to be a gateway between the provider and the consumer which allows communication with the smart meter. The gateway has to be located inside the house/building. This system makes the installation of smart meters in Germany very expensive and unattractive for most households. The function of the gateway itself is not debated: 27% of Germans are afraid of a lack of data protection when installing a smart meter.⁶

However, at the moment this discussion is still theoretical. The digitisation act requires that the mandatory roll out starts when there are enough smart meter gateways are on the market that fulfil the high technical requirements and that are certified by the Federal Office for Information Security (*Bundesamt für Sicherheit in der Informationstechnik, BSI*). This is not the case yet. Additionally, both *VKU* and *BDEW* recently stated that they do not consider the smart meter rollout plan to be realistic. According to them the rollout for large users can start 2021 earliest.⁷

6.2 e-Mobility

Electro mobility is a highly prioritised area in Germany at the moment. The federal government has in a national development plan electro mobility announced that there are supposed to be one million electric cars until 2020 and six millions until 2030. It is, however, highly doubtful if Germany can reach the 2020 goal if there will not be more funding instruments and financial incentives.

In the same manner as with smart grids state support takes place in so called model regions electro mobility and in four showcases. On top, there are three model projects in rural areas in Germany. Focus of these activities lies on field tests and demonstration projects. One element of electro mobility which receives extra support is charging infrastructure. Until 2020 the federal governments grasps at 15 000 charging poles at least. From 2017 till 2020 it provides 300 million Euro for this roll out.

At the moment the German discussion on electro mobility focuses very much on standardisation and certification, interfaces and communication. As

⁵ GTaI

⁶ <https://www.welt.de/wirtschaft/article170853964/Naechster-schwerer-Rueckschlag-fuer-die-Energiewende.html>

⁷ <https://www.welt.de/wirtschaft/article170853964/Naechster-schwerer-Rueckschlag-fuer-die-Energiewende.html>

regards smart grids charging, billing, load management and power return into the grid are of highest interest. However, at the moment there are not enough applications like electro mobility in place and this dampens the development of smart grids.

Together with issuing the national development plan the Federal Government – the Federal Ministry of Transport and digital infrastructure, BMVi, is in charge – founded the national platform electro mobility (*Nationale Plattform Elektromobilität, NPE*) which serves as advisory council to the government. The platform aims at making Germany a leading market within electro mobility until 2020. The office for the NPE is the common agency electro mobility (*Gemeinsame Geschäftsstelle Elektromobilität, GGEMO*), which coordinates and pools the government activities. The Federal Ministry of Education initiated together with Fraunhofer-society a forum electro mobility (*Forum Elektromobilität*) which is supposed to be both platform and innovation network for industry, research and politics.

6.3 Initiatives and cluster

There are confusingly many initiatives and clusters in Germany. Apart from the clusters round the research institutes (see above) there are initiatives and clusters both on federal and on federal state level. Among the most important ones is the *Agora Energiewende*, a think tank which focuses according to self-description on “scientifically based and politically feasible approaches for ensuring the success of the energy transition”. It is financed by two foundations and is an important player in political Berlin.

The state itself finances several initiatives, where smart grids are incorporated. There is no initiative focusing on smart grids only. Two of the most important initiatives are the digital summit (*Digitalgipfel*) and the smart networks initiative (*Initiative Intelligente Vernetzung*). The digital summit is a conference that serves as central platform for the digital transformation in economy and society. One of the expert groups focuses on smart grids. Members of this group are industry representatives, federal state representatives and organisations.

The smart networks initiative is supposed to exploit the opportunities from digital networks within the five big sectors education, energy, health, transport and administration. The consultancy firm Roland Berger is contracted to work within four areas of activity, among others are they supposed to collect best practice examples, create model regions, improve framework conditions and enhance participation and acceptance.

Another cooperation focusing on digital innovation is the digital hub initiative. On behalf of the Ministry of Economics this initiative is supposed to create a national network of twelve digital hubs and at the same time initiate international contacts. The hub in Leipzig and Dresden, two neighbour cities

in the federal state of Saxony, is focusing on smart systems and smart infrastructures encompassing even smart grids.

Besides state level initiatives there are regional cooperations, for example the Smartgrids platform Baden-Württemberg (Smartgrids BW), a network of the industry, research and municipalities. Smartgrids BW has international contacts on their agenda. Another cluster is the energy region Nuremberg (*ENERGIEregion Nürnberg*), focusing more broadly on sustainable energy. In the biggest Germany federal state there is also an energy cluster (Energierregion NRW).

These three clusters are as regards geography especially interesting for smart grids activities. In Bayern and Baden-Württemberg there is the highly interesting project C/Sells located and there is a lot of industry in these states that could be partner or client to Swedish companies. Branch clusters here are amongst others automotive, engineering, electrical engineering, industrial automation and digital technologies. Northrhine-Westphalia (NRW) is Germany's biggest federal state and the No. 1 location for Swedish companies. Next to the above mentioned branches in NRW there is a lot of energy industry (E.On, RWE) and chemical industry. Cooperation within these federal states is therewith mostly interesting for Swedish companies. As regards political contacts and the start-up scene, Berlin is the place to be.

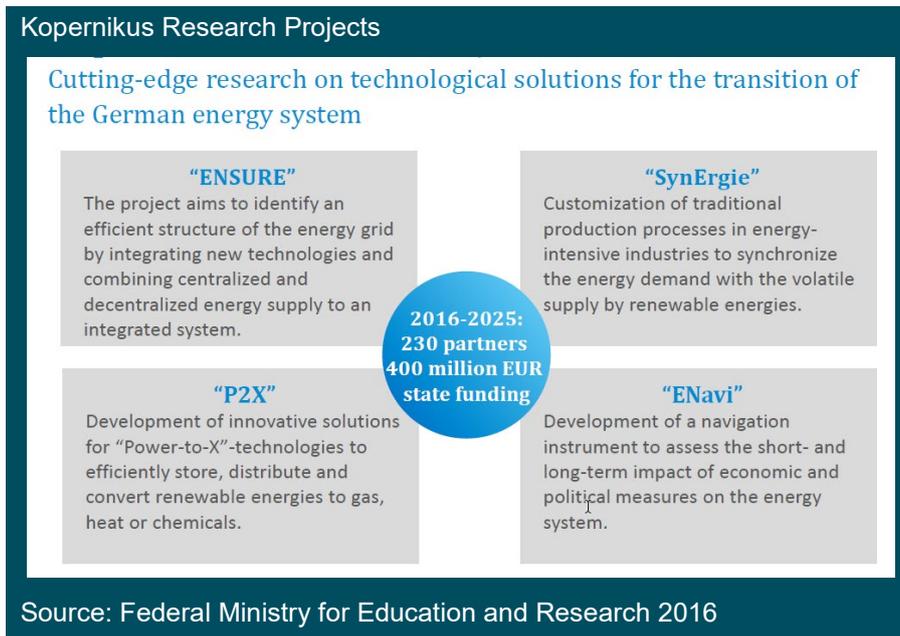
Besides these public private partnership projects there are completely federal state owned centres, like for example the innovation centrum Lower Saxony which is supposed to promote the economy of Lower Saxony. The innovation centre focuses on energy due to the fact that Lower Saxony has a lot of wind power.

6.4 Research Programs and projects

According to the 6th energy research program of the federal government research focus shall lie on projects that cope with the effects and the potentials of a digitalised grid infrastructure, such as new control strategies, grid management systems for smart grids, standardisation of interfaces for data exchange, data storage and security, forecasting methods and bidirectional energy management. One instrument within the energy research program focusing on transparency and participation are the research networks energy. There are seven networks in total; one of them is focusing on the grid (*Forschungsnetzwerk Energie – Stromnetze*). Members of the network are research institutions, universities, companies and state actors.

Another program are nine research campi, a PPP-project initiated 2013 and ongoing until 2020. Here, the Federal Ministry for education is sponsor of the programme, which is the major German lighthouse project at the moment as it has such a long reach. The focus lies on application oriented basic

research. As regards smart grids, two campi are of interest. One of them is focusing on “Mobility2Grid”, the other on “Flexible Electric Grids”. Mobility2Grid involves 36 partners and is located in Berlin and the Technical University Berlin is in charge. Focus of the project is the integration of electric vehicles into decentralised energy systems. Within the project there is a special focus on acceptance and participation and smart grid infrastructures. As a side project, the campus even offers a BA study programme “Master in Energy”, which is above all looked after by foreign students. A non-applied focus have the Kopernikus Research Projects.



6.5 Export programs for smart grids

11% of all German companies export, whereby 97% of them are SME. There are several instruments to promote foreign trade and investment. Various institutions work together in this area, such as the German chambers of commerce abroad, foreign missions and Germany Trade and Invest (GTAI). Germany’s bilateral chambers are represented in 90 countries and are supporting the activities of German firms on foreign markets. Thus, they take responsibility for a major aspect of the promotion of German foreign trade and investment. GTAI is responsible for promoting Germany’s foreign trade and investment and for marketing the country to potential investors.

The federal government is supporting German exporters by providing insurance for their claims to payments abroad (“Hermes insurance”). Additionally, there is a foreign trade-fair programme in form of information

stands and joint company exhibitions. This is mainly directed towards SME. Each year, the ministry participates in around 300 trade fairs abroad. Another programme targeted at SMEs is the Economic Affairs Ministry's export promotion service which helps small and medium-sized enterprises to develop new markets abroad. Here, there is a market development programme and an export initiative. Within this programme there is a special focus on energy. Here, SME can participate in study trips, take part in seminars and profit from business partner brokerage organised by i.e. the chambers of commerce. Here, smart grids can be a focus area.

Otherwise, there are no special export programmes exclusively for smart grids.⁸

⁸ <https://www.bmwi.de/Redaktion/EN/Dossier/promotion-of-foreign-trade-and-investment.html>

7 Challenges

Challenges as regards smart grids are manifold. The biggest issues are data protection, security and storage. Germany has one of the most strict data protection laws in the whole world and this issue is a very sensitive area, not least for the end consumer. Another challenge is standardisation and here above all compatibility of ICT and appropriate processes for interfaces. A third issue is even after coming into force of the digitisation act legal uncertainty relating to load management and dynamic pricing. It is here that regulation is needed.

On the other hand is the existing complex regulation in Germany a stop block for the further development of smart grids. Here smart metering can serve as an example (see below) where regulative barriers impede a broad market launch. Another barrier is the lack of applications. Experts agree upon the fact that technology itself is not a problem in Germany, it is just not in demand yet: There are not many electric vehicles; smart home applications are not common etc. This goes hand in hand with the fact that business cases are still lacking. According to the BDEW smart grid roadmap Germany is about to enter the market phase, but neither distribution grid operators nor municipalities or consumers see a business case in smart grids and can thus not be activated to engage in smart grids.

7.1 Obstacles for a market entry of Swedish companies

There are no official or formal obstacles for a market entry of Swedish companies. As Sweden is just like Germany a member of the European Union it is free trade between the countries. Both countries are on the same continent and in the same time zone, thus, geography is neither a barrier.

Nevertheless, there are barriers that Swedish companies have to bear in mind when trying to enter the German market. First, the German market is very big and very mature and it is a challenge to understand the market structure and identify the most relevant actors. This is of importance especially against the background of Germany's federal structure, where different conditions i.e. for investments apply in every federal state.

Another barrier is the language: in conservative industries, such as e.g. the steel industry, German is required for business meetings and not every entrepreneur speaks German.

A third barrier is the companies' complex organisational structure, which is not in every case made public and which hampers making contact with the right persons. Mostly, it takes a long time to find the right access.

Lastly, business culture can also arise as a problem. Swedes and Germans often believe that they know each other, but as regards making business

there are differences that can result in misunderstandings, problems and at the end failed negotiations – here closeness is misleading.

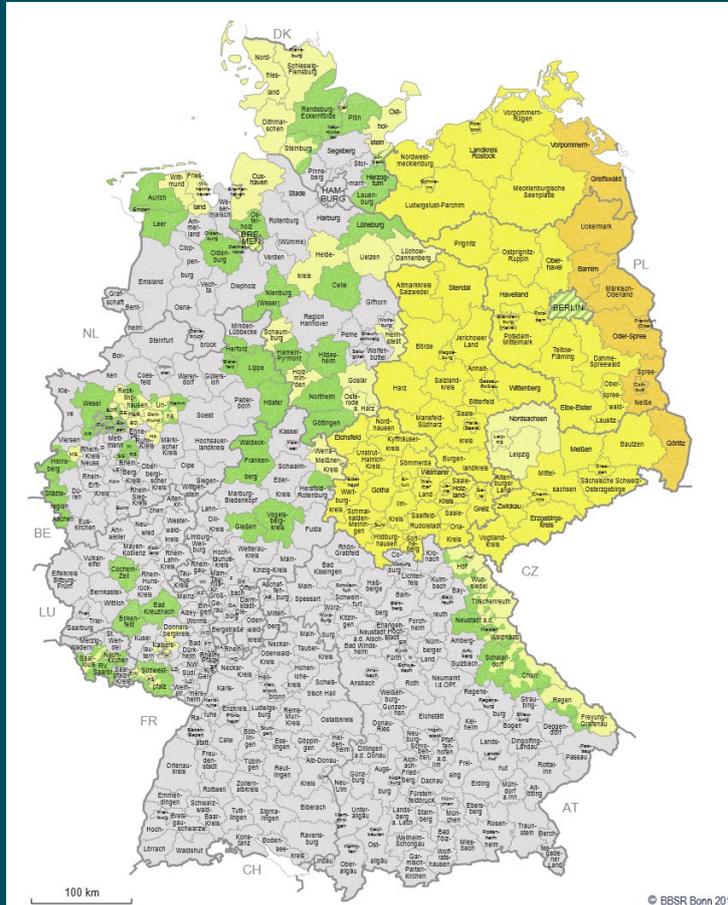
8 Opportunities for collaboration and key stakeholders

8.1 Excourse: Financing for foreign companies

Foreign companies investing in Germany will be helped with guiding information, location support and financial aid. For the first two points accounts the GTAI and the respective local/federal state investment promotion agency, for example Invest in Bavaria. Financial help can be subdivided into two categories: beneficial credits and investment grants.

As regards beneficial credits, it is most the KfW Banking Group that stands for credits. They have a special focus on energy and issue for example funds for renewable energy (see attached table). Besides, there are also the federal state banks that have special programmes. As regards investment grants there is one programme which is of extra relevance: the „joint task on enhancing regional infrastructure (GRW).“ According to the following map and table an investing company can ask for a grant up to 40% of investment costs - if it can prove that it will create new job opportunities. This is, however, valid not only for foreign companies.

GRW-Fördergebiete 2014-2020



Region	Small enterprises	Medium-sized enterprises	Large enterprises
Predefined C-Region*	max. 35%	max. 25%	max. 15%
Border area to Poland	max. 40%	max. 30%	max. 20%
Non predefined C-Region	max. 30%	max. 20%	max. 10%
D-Region	max. 20%	max. 10%	max. EUR 200,000 ¹

* Valid until Dec. 31th, 2017, Support 2018-2020 as per support intensity in „Non-predefined C-Regions“

¹ "De-minimis-rule"

Source: Germany Trade and Invest, www.gtai.com

Another incentive is the innovation program for the German “Mittelstand” (SME) (*Zentrales Innovationsprogramm Mittelstand, ZIM*) which incorporates cross-border tenders.

8.2 Organisations

Industrial organisations are of utmost importance in Germany. The most important association within energy is the German association of energy and water industries (*Bundesverband der Energie- und Wasserwirtschaft, BDEW*). It represents 1800 companies. The BDEW heads a working group intelligent grids and meters.

Besides this general energy association there are several more focused associations. Among these, there are the association for renewable energy (*Bundesverband Erneuerbare Energie, BEE*), association for wind energy (*Bundesverband Windenergie, BWE*) and the association for solar power (*Bundesverband Solarwirtschaft, BSW*). As regards electro mobility there is the association for electro mobility (*Bundesverband eMobilität, BEM*). An association of TSOs and DSOs does no longer exist. The former association of grid operators (*Verband der Netzbetreiber, VDN*) has been dissolved and integrated into the BDEW and the association for Electrical, Electronic & Information Technologies (*Verband der Elektrotechnik, Elektronik und Informationstechnik, VDE*) which is one of the largest technical and scientific associations in Europe. Another important association is the association of municipal companies (*Verband kommunaler Unternehmen, VKU*) which represents all municipal utilities. The central organisation for manufacturers is the *ZVEI*, the German Electrical and Electronic Manufacturers' Association (*Zentralverband Elektrotechnik- und Elektronikindustrie e.V., ZVEI*).

Next to these more or less representative industrial organisations, there are dozens of other associations and foundations that are gathering actors to promote certain aspects of energy. There is for example a foundation that promotes 100% renewables in Germany (*100% erneuerbar*). Foundations have a long tradition in Germany arising from the patronage idea of industrials and companies. Almost every major company in Germany has an own foundation. Additionally, there are state owned foundations and even the federal states have own foundations. In the federal state Baden-Württemberg, there is i.e. a foundation for energy and climate protection (*Stiftung Energie & Klimaschutz Baden-Württemberg*). Even municipalities or individuals create foundations. One of the biggest foundations in Germany is the Robert-Bosch-foundation (*Robert-Bosch-Stiftung*). Foundations are important partners in research and development and in projects.

8.3 Swedish projects and companies in Germany

German-Swedish Trade Relations date back to the Hansa times. Today, Germany is Sweden's biggest trading partner and there are a lot of connections. As regards FDI stocks, Sweden ranks 11th place in Germany. The highest volume of FDI stocks lies in the federal state of Hessen, home of the banking capital Frankfurt. Second comes Berlin. Most Swedish firms are located in Northrhine-Westfalia, the most populated German federal state. Bayern and Baden-Württemberg, that are very strong economically, follow. The northern federal state Hamburg has, nevertheless, the highest total share of employees. Together, software & IT-services, textiles and industry machinery, equipment & tools account for most of the projects (2011-2016).⁹

Berlin's and Hamburg's presence in this statistics is to a large share due to Vattenfall's activities in these cities. Here, Vattenfall produces heat and has district heating sales and provides customers with power. In Berlin, there is additionally power distribution. In Hamburg, Vattenfall's energy trading and asset optimisation organisation are as well concentrated as the German wind power activities. Additionally, Vattenfall has operating responsibility for decommissioning the nuclear power plants Brunsbüttel and Krümmel, steered from Hamburg. In earlier statistics even the federal state of Brandenburg appeared in the statistics, but after Vattenfall's production facilities have been sold there, Brandenburg is no longer that important as regards Swedish FDI.

Vattenfall is in the energy sector the largest Swedish player in Germany. Additionally, there are other companies like Studsvik and new players like the company Noda which opened an office in Germany only some years ago. Others like Celsicom and Solelia are on their way. Above that Swedish engineering companies working within energy like Sweco and ÅF are well established in Germany.

A current German-Swedish project within energy is the planned Hansa Power Bridge, a new undersea power cable between Sweden (Hörby) and Germany (Güstrow, Mecklenburg-Vorpommern). Here, the German TSO 50Hertz Transmission and the Swedish TSO Svenska Kraftnät are project leaders.

8.4 Swedish-German Cooperation within projects

Many of the Swedish-German cooperations take place within EU-projects such as Horizon 2020, Eureka or Eurostars. Under the roof of the ERA-Net Smart Energy Systems, headed of the European Strategic Energy Technology Plan (SET-Plan), the ERA-Net Smart Grids Plus initiative is the most important. Projects with both German and Swedish actors are here for

⁹ GTAI

example Reflex, Largo!, Nemogrid and Fishmep. Another initiative under the same roof is ERA-Net Integrated Regional Energy Systems (RegSys). A relevant platform for Swedish-German projects within the SET-Plan are the European Technology & Innovation Platforms (ETIPs), here especially the ETIP Smart Networks for Energy Transition (SNET). Another programme which is possibly very relevant with the new government in place is as mentioned above the European Innovation Partnership on Smart Cities and Communities (EIP-SCC). As regards IEA programmes Germany is not a member of IEA-DSM, but for example in IEA-EBC (Energy in Buildings and Communities). Project host in Germany is the *Forschungszentrum Jülich* (see above).

A new possibility is the German-Swedish Tech Forum, a German-Swedish innovation platform initiated and hosted by the German-Swedish Chamber of Commerce and the Royal Swedish Academy of Engineering Sciences (IVA) and launched by Chancellor Angela Merkel and Prime Minister Stefan Löfven in January 2017.

An intergovernmental cooperation is the German-Swedish innovation partnership launched at the same time. A first concrete outcome of the partnership is a R&D-tender for German and Swedish SME which is open for applications until April 18th.

In general, the Swedish image in Germany is very positive and often associated with a strong social focus, emancipation and modern family living on the one hand and innovations on the other hand. As remarkable is furthermore the positive Swedish attitude towards technique regarded. A great amount of attraction is also paid to Sweden's way towards a cashless society. This is connected with an expectation of a Swedish digital leadership competence.

Swedish organisations present in Germany are the Swedish Embassy in Berlin, Business Sweden in Berlin, the Swedish Chamber of Commerce in Düsseldorf and Visit Sweden in Hamburg. Together with the Foreign Department and the German-Swedish Chamber of Commerce they form Team Sweden Germany.

8.5 Potential partners

German companies are used to be contacted for new B2B contacts without prior announcement. However, there are a lot of requests incoming and thus it is of advantage if a neutral partner like a chamber of commerce initiates the contact. The chamber of commerce creates confidence in the contact seeking companies because it is an institution from inside the German network which has pre-checked the potential partner.

However, to enter the market more strategically and beyond the individual B2B contact the best way is to find a partner, i.e. a network, initiative or cluster, to create a rather long term partnership with. By this means, the partner can mobilise its own network and help spreading the message. As mentioned above there are a lot of initiatives and many of them are interesting partners, like for example the expert group smart grids within the digital summit, which is a high-flyer body, or the smart networks initiative. However, there are three networks in Germany that already showed interest in cooperation with the Forum Swedish Smartgrid:

1. **Mobility2Grid**, Research project Mobility2Grid is interested in contact with Swedish stakeholders, above all as regards research cooperation. Here, digitalisation and participation plus hybridisation and demand side management are of special interest. Contact to Mobility2Grid is established. On April 12th, 2018, there is a conference in Berlin taking place which possibly opens up for a speaker placement. This could be taken as opportunity to arrange a study trip to Germany.
2. **Smartgrids Baden-Württemberg**, Network Smartgrids Baden-Württemberg is a very important player in this federal state which hosts very much industry. It is striving actively after international contacts and is professionally organised. One of the most interesting members is the DSO of the state which is very pro-active as regards smart grids infrastructure. The network is even tightly connected to the C/Sells-project. Contact with Smartgrids BW is established. Here, both research cooperation, seminars but even B2B-matching is possible.
3. **Energy regions Nürnberg and NRW**, Both regions host as mentioned above industries that are suitable as partners or clients for Swedish smart grid companies. The networks combine players both from the industry and research.

Even the digital hub initiative is a potential partner for more long term cooperation. Here engagement of Swedish incubators and science parks is possible as well.

Another chance is to find a partner for a common project within the European framework or for a binational (research)-project financed by the Federal Ministry of Economics and Energy. This could for example be one of the Fraunhofer-institutes.

Other partners for pilot projects in Germany could be Sweco and ÅF.

8.6 Business opportunities

Business opportunities for Swedish smart grid companies in Germany can be regarded as good in the above defined areas. Especially as the key competences of the Swedish smart grid companies lie within customer system integration, renewable generation integration and e-mobility which corresponds very well with the German needs. Nevertheless, it has to be born in mind that Germany is a very developed market which is characterised by strong competition and which requires unique products with a clear USP and a good communication to get the message across.

Potential assignments for the different players within Swedish Smartgrid could look like this:

1. **Minister/secretary of state/steering committee**, Focus on transfer of competence by speaker placements directed towards key stakeholders of the energy industry in Germany (dena, BDEW etc.)
2. **Forum Swedish Smartgrid**, Focus on best practice examples also by speaker placements, in workshops and study trips directed towards regional networks (Smartgrids BW etc.) and leading companies within distribution
3. **Research**, Focus on applied science as regards participation and visualisation by workshops and study trips directed towards German research networks (Mobility2Grid etc.), having the new start of common projects always in mind
4. **Companies**, B2B business partner brokerages can in parallel be arranged all the time, but can and must also be part of the other activities, for examples during workshops, study trips etc.

9 Conclusions

9.1 Prioritised Areas

It is above all classical engineering that Germany is still good at. Machinery and plant engineering, automation technology, power electronics as well as measurement and control technology are areas where Germany does not need input from abroad. Here, even the broad variety of players and the level of maturity of technology is a German site advantage.

In contrast, there are areas in which German stakeholders regard input and cooperation with foreign companies as valuable because Germany has not come as far as in other areas. However, please bear in mind that even if Germans claim that areas are lacking behind the status quo is still on a very high level. Areas that are most likely more open for cooperation with foreign actors are as follows.

1. **Net stability**, As mentioned above the German grid is one of the most stable in the whole world – and all the relevant stakeholders are very keen to secure a stable grid even in the future. The main issue that is to be addressed is grid flexibility due to an increasing share of intermittent energy. Here, small scale flexibility is needed the most. Trans-regional flexibility with balancing power is not a problem at the moment. Here, pumped-storage plants are one of the options at hand. As one can see, this whole question is closely connected to storage technology development.

Possible cooperation areas are:

- load management
 - demand site management
 - transformers
 - flexible steering strategies
2. **ICT/digitalisation**, The roll out of fibre optic cables lies in a far future in Germany and a 3G telecommunication network is far away from being overall standard in Germany. These are two examples, where Sweden is regarded as forerunner in terms of digitalisation. This opens for a dialogue. This area is strongly related to the above mentioned areas and should be seen as underlying strength of Swedish players.

Given that the grand coalition comes into place smart cities could become a prioritised focus area within ICT.

3. **Electro mobility**, In terms of electro mobility there are several aspects that are open for input or cooperation:
 - Communication in connection to charging infrastructure
 - Pricing and billing
 - Energy management
 - Vehicle to grid

Not of interest are batteries itself. Their development is not regarded as lacking behind in Germany.

4. **(Power to Heat)**, Systemintegration and integrated energy are as mentioned above the two dominant challenges in Germany and one of the concrete action points which also play a role within the SINTEG-projects is power-to-heat. In northern Germany it is wind power that has to be integrated, in southern Germany it is solar power. An application which therefore is of high interest in Germany right now are heat pumps. Sweden has long-time experience with heat pumps and thus this could be a cooperation area. This area, however, is not central in the smart grids discussion – though it is worth mentioning.
5. **(Smart metering)**, As described above, Germany has only started with the smart meter roll out – which in fact has not really come into operation. With regard to the longer Swedish experience with smart metering this could be an area where Swedish input is welcome. However, it has to be born in mind that the Swedish experience cannot easily be transferred to Germany, given the special legal and technical requirements in Germany as regards data protection etc. Additionally, it might be too early for cooperations.

Thus, there are several categories of the International Energy Agency's definition of smart grids affected and some of them are closely intertwined.

9.2 Input options

Next to the action fields certain input options are more relevant than others. In the following three concrete actions are presented. These are contributing to the aim of showcasing Sweden and are at the same time supposed to support B2B-activities.

1. **Transfer of competence**, Sweden is being seen as enabler to increase German competence in the identified areas. It would be welcomed if Swedish stakeholders could tell the story of the smart meter roll out and digitalisation strategy, for example.

Thus, Germany could profit from the Swedish experiences and identify dos and don'ts adapted to German framework conditions.

2. **Participation, Apps and Visualisation**, Especially German consumers are quite reluctant towards new technology and are not easily convinced to use "smart" things. This inhibits the development of applications that promote smart grids, such as smart meters or smart home applications. Swedish consumers are much more open for this and Swedish stakeholders have good experience with encouraging consumers to participate in new technique, mostly with apps. Here, Swedish players can give some insights and tell about incentive strategies.
3. **Business cases/best practice**, The biggest stop block for the further development of smart grids is the lack of business cases in many areas. It is unclear how to make money with smart grids and therefore there is no incentive to implement the existing technique. It thus would be welcomed if Swedish stakeholders could show best practice examples and present business cases in the identified areas.