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ISGAN
INTERNATIONAL SMART GRID ACTION NETWORK

ISGAN Side Event at CEM9 jointly organized with the Swedish Smart Grid Forum

Opportunities to Accelerate Smart Grid Deployment through Innovative Market Design

Policy Brief and Workshop Summary

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About ISGAN

ISGAN (International Smart Grid Action Network) is an initiative of the Clean Energy Ministerial (CEM) and an IEA Technology Collaboration Programme (TCP) with the vision to accelerate progress on key aspects of smart grid policy, technology, and related standards through voluntary participation by governments in specific projects and programs. The present ISGAN membership includes countries responsible for more than 80% of the global GHG emissions and promoters of more than 90% of clean energy technologies investments.

As the only global government-to-government initiative for sharing information, best practices, and competence on smart grid ISGAN helps to identify solutions to accelerate smart grid deployment, enable replication of proven ideas, and support greater national ambition in developing and deploying smart grids. ISGAN focuses its activities on those aspects of smart grids where governments have regulatory authority and expertise.

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About Swedish Smart Grid Forum

The Swedish Smart Grid Forum is an initiative of the Swedish Government. The objective is to strengthen the capability and capacity for smart grid solutions for the future, in Sweden and globally.

The mission of the Swedish Smart Grid Forum is to develop dialogue and enable actions towards a smarter grid. It provides a platform for stakeholders that want to contribute and be part of the development of the future grid. The Forum is led by the Minister for Policy Coordination and Energy, Mr. Ibrahim Baylan, together with a steering group consisting of a wide range of stakeholders, both authorities, academia and industry. The Forum also works closely with the Swedish Energy Agency.

Read more: **www.swedishsmartgrid.se/in-english/**

Disclaimer

Preface

The purpose of this report is to present an overview of the results from the workshop and high-level panel discussion, “Intelligent market design – boosting global smart grid deployment,” organized by International Smart Grid Action Network (ISGAN) and the Swedish Smart Grid Forum in conjunction with the 9th Clean Energy Ministerial (CEM), 24 May 2018 and as a part of the Nordic Clean Energy Week in Malmö and Copenhagen.

The report gives a summary of the discussions and conclusions from the workshop and includes the background policy brief prepared by representatives from the organizers based on relevant position papers and studies from, for example, ISGAN, IEA, and IRENA as well as individual feedback from ISGAN national experts and the Swedish Smart Grid Forum representatives. The final version presented here also includes input received during the workshop on May 23.

Nomenclature or List of Acronyms

AMI	Advanced Metering Infrastructure
CAPEX	Capital Expenditures
CBA	Cost Benefit Analysis
CO_2	Carbon Dioxide
DER	Distributed Energy Resources
DR	Demand Response
DSO	Distribution System Operator
ESS	Energy Storage Systems
EV	Electric Vehicle
ICT	Information and Communication Technology
IOT	Internet of Things
OPEX	Operational Expenditures
PV	Photovoltaics
RES	Renewable Energy Sources
TSO	Transmission System Operator
V2G	Vehicle to Grid

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1. Introduction

The objective of the workshop organized in conjunction with the 9th Clean Energy Ministerial has been to promote knowledge exchange through an interactive dialogue, highlighting opportunities and needs to accelerate smart grid deployment through market design involving opportunities on both the local/decentralized and the global/interconnected level.

As a starting point for the discussion a draft policy brief was prepared providing a first framing of opportunities and needs to accelerate smart grid deployment through market design. To stimulate the discussion the document was distributed to participants in advance with the objective to function as a guidance document for the interactive dialogue during the workshop and following high-level panel discussion. Comments received during these dialogues has resulted in some minor changes of the draft policy brief distributed before the meeting. For the sake of transparency these changes are highlighted in gray in the final version presented in chapter 2.

The discussions during the workshop was centered around the following key themes:

- How to design an energy market for a greater variety of stakeholders and roles?
- How to achieve energy system integration and interaction?
- What are the key elements in market design to accelerate smart grid deployment?

The outcome and recommendations for each of these themes was summarized and presented as input to the high-level panel discussion in Copenhagen the next day – in connection to the Clean Energy Ministerial meetings – aiming to stimulate an in-depth policy discussion within the framework of CEM9 defining priority actions to push the market design agenda forward. These summary conclusions are presented in chapter 3.

Moreover, participants individual reflections, recommendations and priorities was also collected during the workshop and are summarized in chapter 4 for each of the three key themes.

The workshop and high-level panel programmes are find in the Appendix to this report. Presentations from the workshop are available for download on the ISGAN website **www.iea-isgan.org**

2. Policy brief: Opportunities to Accelerate Smart Grid Deployment through Innovative Market Design

A discussion document prepared for the workshop and high-level panel discussion, "Intelligent market design – boosting global smart grid deployment," organized by International Smart Grid Action Network (ISGAN) and the Swedish Smart Grid Forum in conjunction with the 9th Clean Energy Ministerial (CEM), 24 May 2018.

Smart grid technologies and practices are key building block for advancing power system integration and transformation, in support of more competitive and innovative lower-carbon economies. This document frames the main principles for an efficient electricity market design capable of managing opportunities and challenges of accelerating smart grid deployment, addressing both the local/decentralized and the regional/interconnected level. One objective is to clarify the pivotal role of market design for smart grid deployment. Another is to identify market design principles that can be applied in a wide range of circumstances to support the key function that smart grid plays to accelerate power system integration and transformation supporting the transition towards competitive and innovative low carbon economy.

Smart grid captures a range of advanced information, sensing, communications, controls and energy technologies, resulting in an electric power system that can intelligently integrate the actions of all connected users – from power generators to electricity consumers to those who do both. Smart grid solutions are also found across the entire electrical system, from the high voltage transmission grid, through the distribution grid (local grid), and finally at consumer level.

2.1. Electricity system challenges and global trends

The transformation of our energy systems to meet energy and climate policy objectives is one of the most challenging missions of our time. To facilitate the move towards lower-carbon economies while sustaining economic growth and maintaining system reliability, electricity markets will need to go through transformational changes. For example, the challenge of integrating variable renewable energy sources (RES) calls for a consistent yet flexible electricity and energy market framework that acknowledges that the current just-in-time mode of electricity production will increasingly be complemented, if not replaced in some locales, by a "harvesting" mode of electricity generation. Older market rules and structures need to be modernized and better matched with clean energy policies and opportunities provided by innovative technology solutions, while ensuring a secure electricity supply. Furthermore, in many countries, there is growing need to modernize an increasingly ageing electrical infrastructure and at the same time there is flat or declining demand. In others, there is rapidly growing demand for electricity, connecting more and more people to power systems with growing expectations for a prominent level and high reliability of energy services. Together, these trends highlight the potentially pivotal role of smart grid solutions as a vehicle to manage infrastructure investments more cost efficiently.

Accelerating the deployment of new smart grid technologies will enable a broader, faster, and more cost-effective utilization of a range of clean energy technologies and increase energy efficiency on all levels in the energy system, substantially transforming how electricity systems are planned, operated and controlled. Electricity market design must be able to

adapt to this changing environment to a considerable extent determined by five major global trends[1]:

- *Decarbonization* – the move from systems based primarily on high-carbon, fossil fuel-based power sources to much more energy-efficient systems powered mostly – and someday, exclusively, by a broad range of lower-carbon sources. With faster changes in system conditions, largely caused by weather patterns, market solutions need to be ”faster”, enabling response closer to real time;
- *Decentralization* – the transition from centralized power plants and control to an increasingly complex mix of centralized and decentralized power generation (e.g. rooftop solar photovoltaics, energy storage) and distributed controls including also flexible loads, storage and self-production. With novel market solutions “local markets” may occur providing opportunities amongst prosumers to trade at the local level;
- *Integration* – the trend toward more integrated electricity markets and greater interconnection of previously independent grids and/or power markets along with the broader perspective of, more integrated energy systems including sector coupling with transport, heating and cooling. With larger markets including cross-border trade the available transmission capacity needs to be clearly defined to maximize the use of existing infrastructure:
- *Digitalization* –the trend toward more of ubiquitous information and communication technologies (ICT) and data applications (modern sensors, automatic control and encrypted communication, and solid-state technologies etc.). With these novel technologies opportunities to facilitate a fair market access and increased transparency of operation procedures will increase.
- *Inclusion / accessibility for all* – increasing demand for sustainable, affordable and accessible energy for everyone including increased electrification (e.g., of industrial processes and transport) and challenges related to global urbanization. To fulfil these demands the capability of demand-side-resources and synergies with other energy carriers and infrastructure will become increasingly important.

2.2. Smart grid deployment and the importance of efficient market design

Good governance is needed to assure that market rules adapt to meet future challenges. Therefore, there is a need for novel solutions in market design. Energy policy and power sector regulation must work in co-ordination and be adapted to the new reality, while considering the specific characteristics of each power market, such as its institutional arrangements, grid development, electrification characteristics and renewables penetration. For instance, priorities in emerging economies may be determined by rapid growth in demand, while developed countries face challenges related to aging infrastructure and flat or declining demand.

Power system integration and transformation presents increasingly complex policy challenges, which will require a combination of new initiatives, regulations, standards, strategies, and business models to make use of emerging opportunities provided by smart grid solutions. These are to be found across the entire electrical system, from the high voltage transmission grid, through the local grid, and finally to households. However, to meet national challenges, different approaches and priorities may be needed, and there is no generic or one-size fits all solution. At the same time, there are generally applicable findings

[1] These trends are highlighted as a base for ISGAN´s (International Smart Grid Action Network) Strategic Work Plan for its second term, March 2017 through February 2021.

from experiences that can be adapted more broadly to make local implementation faster and more efficient. In other words, an emerging body of best practices is increasingly available.

2.2.1. The key role of policy maker and regulators

Although many different approaches are possible to meet the challenges that power grids are facing, policymakers and regulators have a key role to play in developing both coherent and innovative market design supporting the transition towards clean sustainable solutions and, at the same time, provide reliable electricity at least cost to consumers.

- Decentralisation and the growing penetration of RES are bound to transform the power sector. While some challenges remain, favourable policies and regulations can bridge the gap and avoid technology lock-ins that prevent the achievement of a suitable low-carbon path. These policies include those that reduce barriers, promote investment, create a fair and level playing field and ensure the long-term financial viability of the power system[2].
- Competitive markets are important tools, but they must be supplemented by appropriate policy incentives to ensure an effective transition to lower-carbon power at least cost[3];
- For investors and owners of grid infrastructures, a clear regulatory framework will, in all scenarios, make long-term investment decisions less risky and help incentivize investment in smart grid solutions to deal with appropriate grid operation challenges.

2.3. Leveraging a variety of stakeholders and roles

2.3.1. An increased need for flexibility service providers

As electricity generation from variable RES grows, and end-use consumption patterns become increasingly complex, the electricity system needs to become more responsive. New storage technologies and demand response options in industry and smart buildings can provide solutions. In most cases, this will require enhancements to certain market rules, including lowering barriers for new market entrants, acknowledging that the specific properties of power systems as well as the characteristics of electricity demand differs from country to country and system to system.

- To support operation of transmission and local grids, new market solutions safeguarding the use of available assets for flexible response need to be developed, for example through strategies for demand response and integration of embedded generation, energy storage systems (ESS) and power-to-x[4] solutions This development will in several cases also challenges the prevailing role of local network operators;
- New utility practices and services will be needed to increase the potential for use of flexibility assets throughout the system, especially through the coordinated use of flexibility for system balancing and congestion management.

[2] Adapting Market Design to High Shares of Variable Renewable Energy, IRENA 2017
[3] Re-powering Markets, Market design and regulation during the transition to low-carbon power systems, IEA 2016
[4] Power-to-x refers to different possibilities such as power-to-gas or power-to-heat to manage changes in capacity needs.

- Improving short-term power markets or, depending on market structure, shifting operational decisions closer to real-time, can enhance the use of flexibility resources and improve system operation[5].

2.3.2. Impact of new market actors and consumer empowerment

Rapid developments in information and communication technology are facilitating the introduction of new market solutions, creating new business opportunities for decentralized renewable energy resources and flexibility services. The dynamic will contribute to crucial changes in the way todays electricity consumers participate in different markets, not only as end-users, but also as producers (prosumers) or "flexibility service providers" (e.g. from demand response or local storage facilities)[6].

- The implementation of Advanced Metering Infrastructure (AMI) is an important prerequisite in many circumstances to increase consumer and prosumers empowerment and active market participation, including aggregation of flexible resources[7].
- Improved data handling and accuracy including privacy, management of big data and data protection issues are also pivotal for customers' and end-users' trust.
- The development and uptake of innovative and attractive services based on, for example, smart appliances, internet of things (IOT), energy management applications, and similar, can be bolstered for both existing and new market participants by a common set of communications standards adopted throughout the market chain, from individual appliances/equipment up to market interfaces.
- The development of peer-to-peer (transactive) market mechanisms between energy producers and end-users at small scale, supported by distributed ledger technologies like Blockchain and smart contracts, might challenge prevailing market rules and regulation.

2.3.3. A growing market for local energy systems and microgrids

Microgrids are either established off-grid networks or grid-connected with the ability to disconnect from the traditional grid to operate autonomously. Grid-connected microgrids can strengthen grid resilience and help mitigate grid disturbances as well as function as a grid resource for faster system response and recovery. Growing electricity demand, especially in developing countries, and the ambitions to provide energy access for all, taking both energy security and affordability into account, are increasing the potential for local energy systems and off-grid microgrids. Local energy schemes are diverse in their aims and configuration; while some business models can be replicated elsewhere, the potential system benefits of local solutions will be determined by the prevailing physical system characteristics, consumer behaviour, market design, and other localized circumstances.

- It is possible for the centralized grid and microgrids to support each other in a way that is beneficial for all stakeholders. However, there are still several technical and policy-related issues to be resolved with respect to grid and microgrid integration.

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[5] See, for example, "Clean Restructuring: Design Elements for Low-Carbon Wholesale Markets and Beyond," 21st Century Power Partnership, 2016 or The Power of Transformation – Wind, Sun and Economics of Flexible Power Systems, IEA 2014

[6] ISGAN Smart Grid Casebook Spotlight on Customer engagement and empowerment, 2017, provides an international approach and lessons learned in Customer Engagement and Empowerment, to be downloaded from www.iea-isgan.org

[7] ISGAN AMI Casebook, Spotlight on Advanced Metering Infrastructure provides an international approach and lessons learned in relation to the potential costs and benefits of advanced metering infrastructure (AMI), and the associated business cases for investments. to be downloaded from www.iea-isgan.org

- Clear regulation and adherence to relevant technical requirements will increase the potential for a microgrid to become a long-term solution including, for example, local energy networks that have potential for future interconnection and interaction with the central grid. Good planning, appropriate requirements and clear regulations for microgrids limit the risk of stranded assets and enable better business cases for the involved stakeholders[8].
- In industrialized countries the growth of local energy systems may challenge prevailing regulatory arrangements for networks and the wider system including regulatory safeguards that system costs and benefits are fairly and equitably shared. Concerns have been expressed that more cost-effective microgrid and off-grid solutions will allow formation of distinct local energy systems with the ability to completely disconnect from the larger power grid, which might result in increased tariffs for the remaining customers, thus increasing their incentive to invest in the same solutions, leading to even more disconnections (and so on).

2.4. Energy system integration and interaction

2.4.1. Increased system complexity calls for closer interaction, coordinated planning and advanced analytical tools

Irrespective of the differences in size and complexity of electricity markets, a common vision for market transformation and related aspects of market integration will benefit from integrated energy resource planning and grid integration studies. Market integration both between various levels, such as emerging local energy markets and wholesale markets, and market coupling between system and countries/regions are important aspects to be considered. This calls for novel solutions facilitating coordinated network planning and information exchange as well as new analytical tools.

- Although market solutions and grid structure vary substantially throughout the world, ensuring that smart grid systems can function effectively within different grid environments requires modelling complex electricity systems, including transmission level, substations, primary and secondary distribution (i.e. local grids), and increasingly storage as well as power-to-x. This holistic approach provides a unified view of the system together with planning capabilities
- With increasingly complex electricity systems, an ever-closer cooperation between system operators will be required to avoid increased system vulnerability. The technical and non-technical solutions required for a closer interaction between transmission system operators and distribution system operators (distribution network operators) are very similar in most cases, making exchange of experiences and best practice a key area for cooperation[9].

[8] ISGAN discussion paper, The role and interaction of microgrids and centralized grids in developing modern power systems, Jonas Tjäder, Susanne Ackeby, ISGAN Annex 6, 2016, to be downloaded from www.iea-isgan.org

[9] Key challenges in relation to TSO-DSO interaction are presented in ISGAN discussion paper TSO-DSO interaction: An Overview of current interaction between transmission and distribution system operators and an assessment of their cooperation in Smart Grids, Annex 6 2014, to be downloaded from www.iea-isgan.org

- Despite the increase in distributed energy resources and self-production, transmission remains a cost-efficient means to ensure the integration of high shares of wind and solar power. In addition, the transmission grid remains essential to secure electricity supply.

2.4.2. A broader energy system perspective amplified by cyber-physical systems

The long-term and sustainable planning of the future electricity system will require a broad and holistic approach. Seeking synergies between the electricity network and other energy-carriers and infrastructures, (including gas grids and storage, heating and cooling systems, and e-mobility) can provide new sources of value. Rapid developments in information and communication technology and the increasing importance of Cyber-Physical Systems will amplify the benefits that can be gained from this broader systems perspective.

- New models for market design and network operation through smart grid solutions that enable more efficient use of resources and improved network resilience needs to be developed and there appropriate harmonized. Important considerations are opportunities provided through, for example, real-time monitoring and control, integration of ICT, microgrid concepts, and cost-effective energy storage solutions.
- Opportunities of cyber-physical systems, for example merging physical and digital elements of the electricity system, include proactive maintenance at lower cost, lessening outage in time and number as well as facilitating aggregation and use of storage for flexibility purposes.
- Across this landscape of change, it is crucial for policymakers to understand the possible synergies within the energy sector and between the energy sector and industry in a circular, interconnected economy. This is a global challenge that requires strong international cooperation and systems views in which know-how and best practice from around the world can be shared.

3. Summary recommendations from the workshop

3.1. Key components in innovative market design

Irrespective of differences in market characteristics and approaches (e.g. vertically integrated or unbundled markets), a transparent and clear regulatory framework will reduce regulatory uncertainty and facilitate the ability of market actors to adapt to a changing environment. Key component to address in regulation are:

- The demand for energy market transformation could be leveraged by a more innovative regulatory approach, for instance by promoting regulatory sandboxes and sharing experiences
- Exposing customers to price signals reflecting the actual costs of electricity distribution, including costs related to local congestion, will incentivize end-users to adjust their consumption according to local network conditions.
- DSO's and TSO's organizing local flexibility markets to address local grid congestion may complement network tariffs or other incentive programs that are not sufficiently differentiated in time and space.
- In unbundled markets the DSO should act as a neutral market facilitator, e.g. provide accurate and timely metering and communication of end-user data to relevant market actors respecting customers privacy.
- The network regulation needs to ensure that the DSOs' have incentives to be cost efficient (e.g. efficient utilization of existing network, reducing network losses, efficiently balancing capital investments and operational costs, including adopting innovative technology). Performance based regulation may be a way forward.

3.2. Leveraging a variety of stakeholders and roles

End-users may lack interest and knowledge about the electricity system. However, automatic control equipment is perfectly capable of minimizing the end-user's electricity bill based on price signals or other incentives. It is therefore paramount that transparent and efficient price signals from all levels of the electricity system are reaching the end-users. This goes both for centralized dispatch and exchange-based decentralized dispatch systems.

Customers are different in their priorities and interests and what kind of incentives they respond to (prices, environmental concern, security of supply etc.).

- Different levels of awareness and commitment among end-users does not need to be an obstacle to demand side flexibility, as long as sufficient numbers of end-users are opting-in.
- A broader spectrum of services may be considered as different customers might have different demands in terms of reliability, quality etc.
- We should see people as both customers and citizens with different motives for engagement and participation in the energy markets.

With increasing shares of variable renewables electricity production, market actors capable of delivering new types of ancillary services will be needed, e.g. inertia and reactive power.

3.3. Energy system integration and interaction

Good system integration requires a combination of bottom-up and top-down approaches, involving all relevant stakeholders.

There is a clear relationship between decentralized solutions and market integration as they often are interdependent affecting the market potential and economy of different choices calling for more comprehensive system integration analysis.

Within each balancing area, methods for capacity calculation need to be consistent and harmonized, resulting in timely and transparent information to all stakeholders.

Market integration need to take physical network constraint (e.g. congestion, deficits and surpluses) into account and reflect these constraints in the price formation.

4. Participants individual comments and recommendations

4.1. How to design an energy market for a greater variety of stakeholders and roles?

4.1.1. General market arrangements

Although different markets have different challenges, the need for a common vision is generally highlighted by participants. Policy makers should be responsible but contributions from other stakeholders would be beneficial, especially from academia and regulators who are trustworthy due to their independence.

Regulators need to adapt to technology change and new circumstances and allow for and regulate new roles on the market according to several participants. One issue mentioned is to define and possibly ringfence the role of DSOs. Another objective highlighted is market actors need to see that investments made to move toward a fossil free future will pay off. One participant reckons that “we need to rethink the one-size-fits-all model and that the current implementation of EU regulation (centralized) will turn out to be an obstacle for deployment of new technology and an enhanced market design”.

Third-party access to transmission & distribution networks is mentioned as a basic requirement giving the space for market competition. Moreover, there is a common agreement that cost reflective retail pricing are paramount. The pricing schemes should reflect the full system costs and the price signal needs to reach consumers! Dynamic pricing is recommended by some participants and others are stressing the need to phase out support schemes that do not allow the market price to reach consumers or to unleash flexibility in generation and demand by amplifying spot price variations. The influence of taxes on price signals is raised by several participants Dynamic taxation (taxes that reflect spot prices) instead of fixed fees on energy (fee/kWh) are recommended as a preferred solution.

One participant highlights the need to design market rules that acknowledge that we will probably have both an exchange-based market and peer-to-peer trading, which will also impact the networks. “The local communities need different kinds of solutions (pricing models) than customers that do not participate in peer-to-peer. Regardless of the differences in eco systems we need transparency and fairness as guiding principles”.

4.1.2. Active consumers and demand for flexibility services

How to create real benefits to consumers are key according to a large part of the participants. “Costumers have the ability to not just consume but also provide services to the network and these services should be rewarded” says one participant. Another participant is stressing that different customers have different needs and willingness to pay and recommends more diversification related to e.g. quality and reliability in power supply.

The importance of markets for flexibility services will increase according to most participants and aggregation is expected to play a key role possibly influencing current market situation substantially. However, one participant raises the risk of pushing systems that have no market potential and emphasis that it is critical to design systems so that every stakeholder is capable of and has incentive to participate.

The benefit of automated flexibility services which help consumers engage without too much work is also stressed together with the need to improve knowledge and research about drivers for behavioral change (price, time, environment, local engagement etc.).

4.1.3. The role of network operators and innovation

The possibility of conflict between the price signals sent by retail prices and the regional/local situation in the grid are highlighted. Proposed solutions to this conflict are efficient price signals on the local grid level that reflects bottlenecks or DSOs organizing additional local flexibility markets. “Whole sale prices are not taking local conditions into account and the DSOs that have the knowledge about the local conditions have barriers to provide customers with flexible and geographically differentiated agreements to use the resources and infrastructure more efficiently” explains one participant.

The potential for more diversified ancillary services markets are highlighted by several participants. According to some participants the criteria are often biased and should be changed to open markets to new actors. Other participants are reckoning the fact that in some electricity markets grid services provided by traditional powerplants are not being compensated, impacting the economic viability of those assets.

Several participants are highlighting the challenge to get grid owners to implement and apply new strategies and new smart grid technologies. Having a flexible regulatory and policy framework that can accommodate changes in technology, business models and market conditions are mentioned as one key factor. DSOs incentive to innovate provided by regulation is generally considered to be too low. One example of promising solutions reckoned by one participant is “more efficient use of the distribution grid through metering, monitoring and analyzing data” another is distributed technologies such as blockchain and their effects on future markets. One the other hand, examples of disincentives are double taxation on battery storage and rules in relation to ownership of storage.

Learning how actual implementation (after pilots and test-beds) might be promoted both by regulation and market design are paramount. A promising approach are regulatory sand-boxes (see theme 3). Long-term financed programs and "light-house projects" are also mentioned as important vehicles.

4.2. How to achieve energy system integration and interaction?

4.2.1. Over all benefits and scope

Several participants stress the need to identify the desirable performance/characteristics of the energy system (e.g. cost, reliability, emissions, dispatchability, resilience) to be able to define an optimal level of system integration also taking into account the physical properties and constraints of the actual energy system. One participant describes this process as “Identification of present and future limitations in the system which are impacting the capacities and security of the system, to provide correct incentives for integration at the right level and location within the power system”.

The importance of market integration to accelerate deployment and uptake of renewable electricity production are highlighted by some participants. Also pricing of CO_2 emissions and the reflection of the true social costs are mentioned as aspects that need to be included when defining the benefits of market integration. Moreover, communication with customers is highlighted. “At the end of the day, the society and customer should benefit” says one participant.

On a general level competition and correct price signals are regarded as important tools to steer system integration and new infrastructure investments. Besides this general perspective, some participants are stressing the necessity to base integration solutions on cost-benefit analysis to determine the most appropriate solutions. Moreover, besides identifying and quantifying the benefits of the energy system integration an appropriate allocation of benefits is also highlighted. “However, we need to ensure that solutions

proposed are not too complex, on the same time ensuring proposed changes are directly tied to achieving a benefit" stresses one of the participants.

The interfaces between local markets and overlaying markets should be carefully designed to avoid incentives for sub-optimization according to some participants. DSOs and TSOs should be incentivized to ensure an overall efficient system, both in how to develop the system and for operating it. We need to both integrate markets across grid levels to ensure overall efficiency and develop local markets and provide incentives for local circumstances.

4.2.2. Electricity market integration and market coupling

The opportunities for energy system integration and interaction are both related to further integration of national and regional electricity systems and sector coupling with other energy sources. A large part of the comments received in relation to electricity market integration are based on participants experiences from the European market. In this context the importance of capacity calculation methods, allocation of interconnection capacity in the most efficient way and defining of bidding zones in a way that better reflect bottlenecks are highlighted.

Another aspect stressed by several participants is that interconnectors between different jurisdictions can contribute greatly to the possibility to deploy RES in a more cost-efficient way, minimizing curtailment and making the best use of preferable locations for different RES. Also, the advantage of VRE-based flexibility services (balancing and ancillary services) based on standardized products tailored to opportunities provided by RES and available across borders is highlighted by some participants.

4.2.3. Network planning and regulation

The need for coordinated network planning is key according to several participants. This coordination needs to include network companies on different levels and between regions, but also producers and other actors such as municipalities are mentioned by some participants. Besides coordinated planning, improved information exchange between grid operators and producers is highlighted, which can contribute to identify the most suitable location of connection points.

Incentives for investments is a crucial part of regulation stressed by several participants. However, incentives should not be biased towards network expansion but focus on network efficiency including reduction in losses. The challenge related to how to incentivize investment where benefits are shared among multiple parties is also highlighted. The advantage of market-based regulation is also mentioned.

4.2.4. Sector integration

Several participants emphasize the need to also consider integration of energy systems (e.g. power to gas) and to identify the most appropriate energy system boundaries using the complementarities between different types of energy. One participant reckons that "increased electrification (EV, heat pumps) offer potential to overcome barriers to cross sectorial energy integration but can create new planning and operational challenges in power sector".

One participant highlights the potential in regarding EVs and transports as an integrated part of the energy system. But as the EV penetration rate increases, there are big challenges for the grid which will demand for game changing solution with energy storage and V2G.

4.3. What are the key elements in market design to accelerate deployment?

4.3.1. General market arrangements

Several participants stressed the need to base a future innovative market design on a long-term strategic vision. including sustainability goals e.g. in relation to RES and CO_2 emissions.

According to some participants, such a vision also needs to be anchored on the local level to make the implementation successful.

The importance of considering the differences between regions and countries in the overall market structure (i.e. vertically integrated vs. deregulated) is highlighted, on the same time pointing to the opportunities for deregulated markets to learn from technology leap-frogging in centralized markets. Irrespective of market structure significant key elements influencing future markets are expected to be related to increased uncertainty and variability in production and consumption patterns, increasing the need for flexibility services. Key elements in this context, mentioned by several participants, are organized flexibility markets facilitating demand response, storage and dynamic pricing for consumer. Some participant stresses the importance to consider the possible wider effects of system transitions, i.e. what happens when microgrids are connected to the grid?

Moreover, adequate incentives to different market actors are mentioned by most participants. One suggestion is to “find incentives which are correct for each specific region/country to involve customers and other plausible market participants to behave in a way which supports the system from a broad and local perspective”.

4.3.2. The role of network operators

Regulatory approaches stimulating DSO/TSO investments in new promising technologies are mentioned by several participants as one of the most important key elements. Barriers to these kinds of investments listed by participants are e.g. CAPEX-bias on grid investments, tariffs not being cost reflective and local pricing areas not reflecting actual congestion in the grid. One participant points to the long-term perspective in network investments and proposes “measures for risk mitigation important for DSOs to choose "non-traditional" options with (added) costs having an uncertainty value. So, instruments for risk management and mitigation targeting DSOs could facilitate deployment”.

The benefits of local markets for flexibility are stressed together with the view that tariffs ought to be more cost reflective also reflecting local conditions. Some participants recommend seizing the opportunities provided by the increasing ability of DSOs to provide ancillary services related to system stability and avoiding congestion on the higher voltage level.

4.3.3. Importance of customer engagement

Customers understanding of market arrangements and their possible benefits are key to success according to several participants. The generally limited economic incentives for end-users to be flexible are often highlighted calling for services on aggregated level e.g. utilizing the flexibility potential provided by large numbers of small appliances. Moreover, dynamic grid tariffs and taxes reflecting the value of capacity are proposed.

Some participants are recommending specific support schemes to accelerate deployment of demand response and flexibility services. One participant is recommending to “implement market-based incentives to end consumers to invest in flexible solutions (e.g. heat pumps) via e.g. white certificate schemes“. Another participant proposes discounts or tax-credits related to “bundled benefits” e.g. an investment into a charging station combined with storage or PV.

The importance of protecting customers with less ability to adapt or provide flexibility are also mentioned as a key aspect.

4.3.4. Innovative regulation

Besides the necessity to ensure price signals are right and reaches end-users, one of the most important key components mentioned is to remove any possible incentive distortions in

the regulation. Strengthening incentive-based regulations is one possible way forward highlighted by some participants.

One participant is reckoning the opportunities provided by V2G (vehicle to grid) solutions. Upgrading infrastructure must allow bi-directional changing and re-selling energy to the grid and stable grids and flexible regulations that enable these solutions are key.

The concept of regulatory sandboxes is widely highlighted and one participant phrase it as “we need to have a more evidence-based approach to what changes we need in market design to accelerate deployment. Regulatory sandboxes are one way for getting that evidence”. To identify best practices knowledge exchange in a variety of regulatory sandboxes from different countries might be a helpful tool.

5. Appendix

5.1. Workshop programme

An opportunity to contribute to ministerial policy discussions

The rapid development of technology and innovative services has the potential to enable the transition to a renewable future. What policy initiatives and regulatory changes are needed in the electricity market to accelerate the deployment of new solutions and create a smarter grid?

This workshop is your chance to influence the global agenda by contributing with your ideas and expertise. The key findings from the workshop will provide basis for a high-level panel dicussion, and be included in a policy brief distributed to participants of the Clean Energy Ministerial.

If you want to share your views and experiences on how challenges in the prevailing market rules need to be tackled in the future – this is the event for you. A draft version of the policy brief will be distributed to you before the workshop and serve as a starting point for the discussions.

We offer coffee and lunch. It is also possible to participate part of the day.

To help us think around the topics at hand we have gathered a range of great minds. See the full programme and keynote speaker details below.

Target groups

Electricity market professionals, government administration, industry representatives, political representatives, think tanks, investors and academic professionals.

Time and location

May 23, 2018, 9:30 am – 5:00 pm, Malmö Live, Dag Hammarskjölds Torg 4, Malmö

Organizers

Smart Grid Action Network (ISGAN) and Swedish Smart Grid Forum

Read more and register

www.swedishsmartgrid.se/intelligentmarketdesign

The event is part of the Nordic Clean Energy Week www.nordiccleanenergyweek.com/

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INTERNATIONAL SMART GRID ACTION NETWORK

NORDIC CLEAN ENERGY WEEK
COPENHAGEN MALMÖ
21-25 MAY 2018

Programme

Moderator: Marie Fossum Strannegård, partner Ernst and Young and member of the Swedish Smart Grid Forum steering committee.

09:30 am Coffee and mingle

10:00 Welcome and opening speech: *Karin Widegren, Chair, ISGAN and Maria Sandqvist, Executive Director, Swedish Smart Grid Forum*

10:15 am Key note speaker: *Ewald Hesse, CEO Grid Singularity*

Interactive Session 1: How to design an energy market for a greater variety of stakeholders and roles?

10:45 am Key note speaker: *Dr. Liu Yang, Senior Research Fellow, National University of Singapore*

11:00 am Dialogue in roundtable groups and short presentation by rapporteurs from each group

12:00 am Lunch

Interactive Session 2: How to achieve energy system integration and interaction?

1:15 am Key note speaker: *Jeffrey Logan, Chief Analyst, NREL (National Renewable Energy Laboratory), Operating Agent of the 21 Century Power Partnership (21CPP)*

1:30 am Dialogue in roundtable groups and short presentation by rapporteurs from each group

2:30 pm Coffee break

Interactive session 3: What are the key elements in market design to accelerate deployment?

2:45 pm Key note speaker: *Anne Vadasz Nilsson, vice president Council of European Energy Regulators (CEER) and Director General of the Swedish Energy Market Inspectorate*

3:00 pm Dialogue in roundtable groups and short presentation by rapporteurs from each group

4:00 pm Panel discussion reflecting on the results from the interactive sessions

4:50 pm Closing remark

Our speakers

Ewald Hesse (GER) leads the Grid Singularity venture, rooted in his extensive experience in the energy sector and acute interest in distributed business models. Grid Singularity is a green blockchain technology company, leading the development of an open, decentralised energy data exchange platform under the auspices of the energy web Foundation (EWF). This newly structured ecosystem provides a data transparency and integrity solution in a major shift away from a traditional, centralized model of the energy market. In addition to building the core technology, Grid Singularity is also developing applications, including a grid management agent with the objective to coordinate increasing numbers of small energy producers and flexible loads, in a trustless, open, decentralized network.

Dr. Liu Yang (SIN) joined The Energy Studies Institute at the National University of Singapore as a Senior Research Fellow in 2017. He was previously an Energy Specialist at the International Energy Agency (IEA), whereby his work was focused on the monitoring of energy efficiency trends and impacts in emerging economies, as well as providing technical assistance to governments and businesses. Earlier, he advised on governments and influenced policy decision makers in Paris, France and the West African region to accelerate their clean energy and climate finance programmes. He started his professional career as a diplomat in Beijing and in Morocco from 2001 to 2004.

Jeffery Logan (USA) is Chief Analyst at the Strategic Energy Analysis Center (SEAC), NREL (National Renewable Energy Laboratory). SEAC conducts a broad range of energy analysis in support of NREL programs and initiatives, DOE's Office of Energy Efficiency and Renewable Energy (EERE), technology transfer, and the greater energy analysis community. SEAC integrates and supports the energy analysis functions located in many of the Laboratory's research programs and technology centers. Jeff is also part of the leadership team of the Clean Energy Ministerial initiative 21 Century Power Partnership (21CPP) supporting national and regional initiatives in power sector transformation.

Anne Vadasz Nilsson (SWE) was appointed Director General of the Swedish Energy Markets Inspectorate in 2013. Since the end of 2017 she is also a member of the board of the Swedish Agency for Government Employers and Vice President of the Council of European Energy Regulators (CEER). During 2014–2017, she has been a member of the Board of the Swedish Telecom and Post Regulator. She graduated as a lawyer from the University of Uppsala, Sweden in 1993. Upon leaving university, she worked as legal advisor at the Swedish Energy Regulator until 2000 when she joined the Swedish Competition Authority. At the Competition Authority she held various positions, among others Deputy Director General.

Context

New challenges are emerging with the ongoing transformation of the electricity industry. The forces driving change include the expansion of renewables, distributed generation, digitalization and increased electrification e.g. within the transport sector. The shift away from fossil fuels to renewables raises both technical and non-technical issues calling for an increasingly responsive electricity systems. New storage technologies and demand response from smart homes may provide solutions, but this will require some market rule enhancements. Energy policy and power sector regulation must work in co-ordination and be adapted to the new reality, whilst considering the specific characteristics of each power market, such as its institutional arrangements, grid development, electrification rate and renewables penetration.

Accelerating the deployment of new smart grid technologies will enable a broader, faster, and more cost-effective utilization of a range of clean energy technologies, substantially transforming how electricity systems are planned, operated and controlled. Power system integration and transformation is an increasingly complex policy challenge, which will require a combination of new initiatives, regulations, standards, strategies and business models to make use of emerging opportunities provided by smart grid solutions. These are to be found across the entire electrical system, from the high voltage transmission grid, through the local grid and finally at consumer level. Good governance is needed to assure market rules adapt to meet the challenges generated by this transformation of the power system calling for novel and innovative solutions in market design.

To meet national challenges different approaches and priorities may be needed and there is no generic solution or one-size that fits all. At the same time, there are generally applicable findings from experiences that can be adapted by other countries to make local implementation faster and more efficient. Identifying best practice principles, which apply in a wider range of circumstances, will play a key role to accelerate power system integration and transformation to the benefit of consumers.

5.2. High-level panel programme

CEM9 side event, May 24 2018, 11:30–12:30

This high-level panel discussion brings together key stakeholders and policy experts to discuss the influence of market design on smart grid deployment in an international context involving opportunities on both the local/decentralized and the regional/interconnected level. Key questions to be addressed are; how to design energy markets for a greater variety of stakeholders and roles, how to achieve energy system integration and interaction and what are the key elements in market design that we must focus on to accelerate deployment of smart grid technologies and solutions?

As input to the discussion a draft policy paper providing a first framing of opportunities and needs to accelerate smart grid deployment through market design has been prepared by the organizers and discussed/amended during a workshop the day before. Based on the discussion during this side event the document will be further developed and communicated to CEM9 participants (entirely or partially) to stimulate a continued in-depth policy discussion and to define priority actions to push the market design agenda forward.

Panelists

Ibrahim Baylan, Minister for Policy Coordination and Energy, Ministry of the Environment and Energy, Sweden

David Turk, Acting Director, Sustainability, Technology and Outlooks, IEA (International Energy Agency)

Doug Arent, Deputy Associate Lab Director, NREL (National Renewable Energy Laboratory), Operating Agent of the 21CPP (21 Century Power Partnership)

Steven Hauser, CEO, Gridwise Alliance and Secretary-Treasurer, GSGF (Global Smart Grid Federation)

Fransisco Carranza Sierra, Director of Battery and Energy Services, Nissan Renault Alliance in Europe

Professor Yibo Wang, Institute of Electrical Engineering of Chinese Academy of Sciences, Co-lead of Mission Innovation Challenge 1 on Smart Grid *(TBC)*

Moderator: Marie Fossum Strannegård, partner Ernst and Young and member of the Swedish Smart Grid Forum steering committee.

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Time and location

May 24, 2018, 11:30 am – 12:30 pm, Room 2, Strandgade 27 B, Copenhagen

Organizers

Smart Grid Action Network (ISGAN) and Swedish Smart Grid Forum

Registration

The number of seats are limited and priority will be given to CEM/MI delegates. For non-CEM/MI delegates: please register your interest by sending an email to info@swedishsmartgrid.se stating your name, title and organisation/company.

Context

New challenges are emerging with the ongoing transformation of the electricity industry. The forces driving change include the expansion of renewables, distributed generation, digitalization and increased electrification e.g. within the transport sector. The shift away from fossil fuels to renewables raises both technical and non-technical issues calling for an increasingly responsive electricity systems. New storage technologies and demand response from smart homes may provide solutions, but this will require some market rule enhancements. Energy policy and power sector regulation must work in co-ordination and be adapted to the new reality, whilst considering the specific characteristics of each power market, such as its institutional arrangements, grid development, electrification rate and renewables penetration.

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To meet national challenges different approaches and priorities may be needed and there is no generic solution or one-size that fits all. At the same time, there are generally applicable findings from experiences that can be adapted by other countries to make local implementation faster and more efficient. Identifying best practice principles, which apply in a wider range of circumstances, will play a key role to accelerate power system integration and transformation to the benefit of consumers.