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Editor's Note

by Jacob Huber

Welcome to the March edition of the EDI Quarterly!

This issue focuses on issues of public acceptance and public engagement. In addition, the theme of Polish gas is continued with a contribution from Gaz System and a piece giving the perspective of the Polish chemical industry on the Polish gas hub.

The themes of the next Quarterly include energy services and an update on developments in the Asian gas market. Should any of our readers be interested in writing on either of these topics please contact us at the address below. We hope that you enjoy all of the informative contributions in this issue.

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The next phase in social acceptance of renewable innovation

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With atmospheric CO₂-eq increasing rapidly, there is an urgent need to switch to low carbon energy sources. Policies on the utilization of renewables, such as solar, wind, geothermal, biomass and marine sources have been drafted in most countries. Although such policies have existed for more than three decades now, the acceptance of renewables by society has hardly been recognized as an important issue. Currently, the slow development of renewable energy sourcing in most countries is often blamed on this oversight[1], and within policy and among developers there still is little understanding of social acceptance issues[2]. Moreover, the next crucial phase in the deployment of renewable energy systems for electricity (RES-E) concerns the integration of several different RES-E sources in the power supply system and with electricity demand. This requires the introduction of 'intelligent grids' (frame) that facilitate 'distributed generation' (DG), i.e. geographically dispersed power generation using renewable sources. However, such intelligent grids imply a fully different way of organizing the power supply, and all elements of the reorganization may suffer from lack of acceptance in society, just as the 'simple' deployment of renewables within the existing power supply has shown to be problematic.

Distributed Generation

The social dimensions of intelligent grids are, just as originally in deployment of renewables seem hitherto largely neglected, as research again focuses merely on technology[3]. Why would social actors accept all changes in energy supply the way the power sector is defining them and take part in this development? And under what conditions?

Essential for smart grid development is that it furthers so called 'Distributed Generation' (DG)[3], and smart grids should serve efficiency and reliability. Systems with a large amount of DG preferably tapping variable renewable energy sources, attuning the production patterns of multiple generation systems, and matching their production to the variable loads of end-users is needed to prevent a huge increase of required power transmission infrastructure. The most enlightening and comprehensive definition is that a 'smart grid' is a *'network of integrated microgrids that monitors and heals itself'*[6] Figure 1 shows that central to this definition is the recognition that the development of smart grids completely changes the underlying organizational principles. A single public power grid will cease to exist, to be replaced by many different interconnected 'microgrids'. In these grids energy flows from different sources, regulated and fine-tuned to local demand within the same microgrid.

With the on-going splintering of central power grids, there is already a move towards DG. An important new development is the possibility for reloading plug-in electric vehicles with DG, at home or at the work-place. Opening the option to apply storage capacity for fine-tuning demand and supply in microgrids may become crucial for advancing the deployment of RES-E[8]. The integration of numerous microgrids marks a revolutionary turn that requires many fundamental changes in the social construction of power supply. However, currently technology development follows strong but highly questionable assumptions of

Intelligent Grids and Distributed Generation

Smart grids are 'hot'. Some projects applying demand managing devices claim to be 'smart', and some companies sell devices labelled 'smart' as a marketing strategy. Despite the popularity of this label, the 'smart grid' still lacks a precise definition and to date, there is no functioning smart grid in existence[4,5]. Smart grid is still a buzzword, but there is substantial and accelerated technology driven progress towards developing it. Companies sell devices, and, in pilot-projects meters are implemented that collect data for analysis of consumer demand, and increasingly these are applied by smart end-users to make their own renewable co-production more effective. Technically a smart grid is defined as two networks: one for electricity connecting multiple power generation and consumer units and a parallel information network for data generated by smart metering devices that monitor, analyze and regulate energy production and consumption. Why social actors would accept all this and take part in this development –and under what conditions– remains a largely neglected topic.

Distributed Generation (DG): Traditional power plants are large centralized units. Today's trend is towards smaller, numerous geographically dispersed power generation units situated close to energy consumers, so called Distributed Generation[3]. Together with improvements in smart grids that serve efficiency and reliability, a system with a large amount of DG and preferably tapping renewable energy sources is considered an environmentally friendly alternative to the traditional power supply system[4]. Attuning the production patterns of multiple generation systems, and matching their production to the variable loads of end-users increasingly requires a 'smart grid'[6,7].

expected social acceptance of the basic principles and crucial elements of these smart grids.

The possible paths for development will be the following ones or somewhere in between:

- (a) Policies will be increasingly designed to enhance the autonomy of (local) groups of end-users to further their options to become co-producers who apply renewable sources and smart meters and regulating devices to adapt their energy use to the variability of their production units; or
- (b) The options for decentralised generation capacity and smart metering will be used for regulating individual consumption behaviour by increasing the surveillance of domestic consumers by network managers with the aim of regulating demand in line with central policy prescribed levels.

Line (b) is the current dominant line of thinking, as it matches with the existing institutional framework in the power sector as well as in policy. Path (a) is likely to open up much more social acceptance and will therefore create more potential to implement renewables.

SMART GRID

A vision for the future — a network of integrated microgrids that can monitor and heal itself.

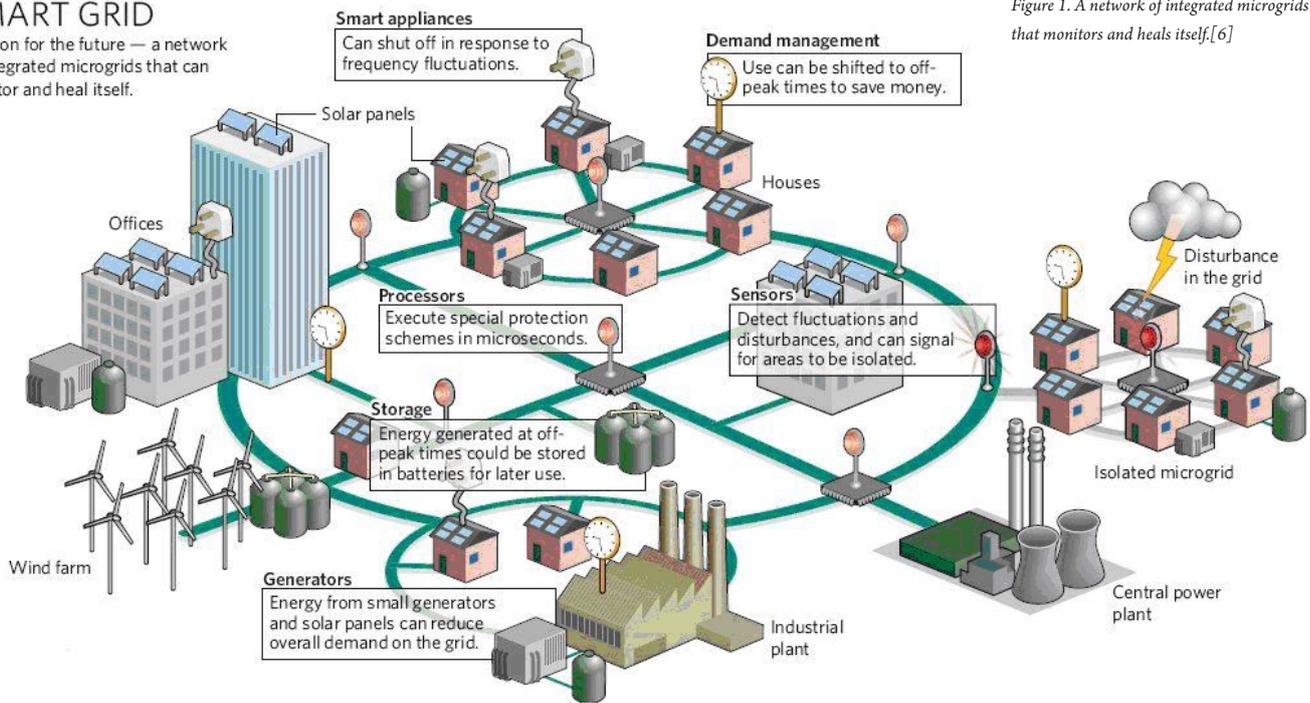


Figure 1. A network of integrated microgrids that monitors and heals itself.[6]

Social acceptance: common sense misunderstandings

The construction of smart grids and implementing RES-E is not simply a matter of individual choice. Whether this option can be used depends on several choices, to be made by many actors, including actors outside the power sector. It is an extension of the question of ‘social acceptance’ of renewable energy innovation. Many persistent misconceptions exist on the importance and complexity of social acceptance (Table 1). In the concept of social acceptance, three dimensions are distinguished[1]. Figure 2 shows these dimensions with the main issues associated with them, and these dimensions can be viewed as layered[9]. Deployment is ultimately an aggregation of all positive decisions at the community level to invest, install and site renewable infrastructure. Such positive decisions require the willingness to accept the consequences of implementing renewables among market actors, and their willingness is in turn heavily depending upon socio-political acceptance of institutional changes that are needed to create the necessary conditions for market acceptance and community acceptance. The figure illustrates that social acceptance is relevant in all layers and sectors of society. Public acceptance is only a small component, and in fact not the most important one.

In Table 1 some selected issues in the current state-of-the-art knowledge on social acceptance of renewables are summarized. For example, contrary to common sense views in policy and among developers, acceptance of wind power is something entirely different from acceptance of a wind power project. Actually, there are no theoretical foundations to expect a clear relationship [10], and empirically the relation between both is found to be weak indeed [11].

Another example: the common assumption that social acceptance equals public acceptance. Many developers and authorities alike still think social acceptance equals public acceptance, and unfortunately, this theoretically fully unfounded common sense assumption is reproduced all the time. However, current knowledge about acceptance is that public acceptance –aggregated individual preferences– is a poor proxy for social acceptance[10]. The idea that the main “barriers” to renewable innovation are found on the community level in local resistance is in fact



Figure 2. Three dimensions of social acceptance of renewable energy innovation with their main associated issues [1,9]

a myth reproduced over and over again. However, most problems with social acceptance of innovation in renewables are in fact found in the socio-political acceptance dimension, as illustrated by the following conclusion by Lund, from a study on 12 decision-making processes in Denmark, the first country that was successful in renewable energy implementation:

“Alternatives representing radical technological change have to come from outside organisations representing the existing technologies,

Acceptance Renewable Energy	≠	Acceptance renewable energy Projects
Social Acceptance	≠	Public Acceptance
Acceptance technology	≠	Acceptance socio-technical system
Basic acceptance	=	Acceptance of institutional changes
Barriers to deployment	NOT	Primarily community acceptance

Table 1. State-of-the-art fundamentals of social acceptance of renewable innovation

whereas the existing organizations even make efforts to eliminate alternatives from decision-making processes.”[12]. The real issue of acceptance concerns the lack of acceptance to break down current institutional lock-ins that impede acceptance in most countries [13,14,15]. Country comparisons show that institutional factors have proven to be the main determinants of RES-E deployment. The institutional changes needed for full deployment are resisted, mainly among actors that are linked to the existing energy supply system, including government agencies and policy makers. This lock-in issue will probably become even more important for smart-grid developments. Distributed generation in microgrids with a fair amount of control for the new co-producers, run counter to today’s highly centralized power grids[7].

Acceptance of renewable DG in microgrids

The geographical space required for the infrastructure needed to achieve a shift towards a low-carbon energy system with little environmental impact is highly underestimated[16]. In fact, in policy realms there is little awareness of key aspects of renewable power generation. For example, centralized, large-scale generation (e.g. offshore wind, desert solar etc.) can only provide a part – and in a relatively unreliable and inefficient fashion – of the renewable energy needed for satisfying current energy demand. All space, particularly at close distance to the energy user, must be utilized intelligently, and to encourage acceptance, the RES-E system should match with the character of the community[7].

Beyond the technological characterization, all potential participants in microgrids (Fig.1) are social actors. Their characteristics, their behaviour and their preferences are unknown. Their willingness to support innovation by participating in the new power supply system is questionable, as smart grids imply a drastic departure from the current, predominant centralized power supply systems. Innovation is not merely the introduction of new technology, but rather of socio-technical systems (STS)[17]. Microgrids with DG are socio-technical systems, characterized by the active management of both information and energy flows, and by the community in which members cooperate to construct the microgrid and manage it. Such co-producing communities should replace the existing social characteristics of the energy supply system. This requires new ‘patterns of social practices and thinking’, which is exactly the definition of institutions[18]. Existing institutional frameworks are serving the advantages of incumbents (“path dependency”), so they create lock-ins for innovations[13,14]. In energy, these patterns are manifested in the organization of the energy sector as well as related sectors; in particular in regulation, standardization, and existing infrastructure.

Effective integration of renewable DG is unlikely to be made without changes to the transmission and distribution network structure, and planning and operating procedures. For example, Fig.1 only shows a peripheral ‘central’ power plant. Regarding innovation, the close connection between the sector’s incumbents and policymakers induces strong inertia and retards the innovation processes[19]. This is why socio-political acceptance is necessary to establish the institutional conditions that are conducive for implementing innovations should be high on the agenda to escape from the policy scenario (a) described above. The community and market acceptance (Fig.2) concern the decisions about installation of renewable energy generating units, and about willingness to take part in investing in such installations. The introduction of DG integrated in microgrids completely changes the picture of market acceptance relations between incumbents, new firms, consumers, and authorities as investment decisions shift from the market to communities, so market and community acceptance will coincide more at this level. The literature on the implementation and acceptance of RES-E shows that high transaction costs (money, time, efforts) are

principally determined by institutional conditions and policies at national levels. Meta-analysis also reveals that policies generally fail to address issues of local RES-E implementation[20].

Acceptance issues in the next phase of renewables

As renewable energy generation integrated with demand comes close (geographically) to end-users, territorial acceptability is prominent in acceptance. This is mainly a question of space and of the siting of infrastructure facilities, and particularly who is in control over the infrastructure and over decision-making about siting them. Decisions on siting energy infrastructure are strongly determined by the connections between the energy system and the community in which it is sited. In fact the organization of co-production by renewables in microgrids, integrated with adaptation of demand, is becoming a question of proper and sustainable management of a natural resource. The overall question in regard to renewable DG should become: how would such a common good be managed properly, primarily to create it, then to maintain it and to optimize its application? In those systems we are dealing with:

- a. *Natural resources* – renewable energy flows;
- b. *Scarcity*, in particular the space needed to locate the power generating units and the time patterns of the availability of the resources;
- c. *Co-production of a common good*: electricity for anyone participating in the micro-grid, and abandonment of environmental impact of conventional power generation;
- d. *Self-organization*, which makes up a community applying and investing in DG, the micro-grid and energy consuming equipment that can easily be applied for adapting demand – cooling, heat storage in home or underground, electric vehicles;
- e. *Huge diversity* in optimal design of systems, both with regards the natural conditions – landscape, climate, resources – as well as the socially defined identity factors of the community of end-users and co-producers.

The position and role of all actors in the electricity production-consumption chain will change. All can become co-producers, but co-production of public goods must be supported by institutions. “Citizens are an important co-producer. If they are treated as unimportant or irrelevant, they reduce their efforts substantially”[21]. This observation corresponds with the recognition that for RES-E deployment, the socio-political and market acceptance of institutional changes are the bottleneck for the application of the Common Pool Resource of renewable energy[7].

Research agenda

Though we must recognize that, due to the institutional lock-ins in the power supply system, the current policy scenario tends to match line (b) described above, the challenge is to bend it towards (b). However, most knowledge needed to do that is lacking, so currently an urgent research agenda is unfolding. CPR studies show that simple governance strategies, applied in the name of efficiency, that rely on imposed markets on only one-level, or on centralized command and control, tend to fail[22], and such conclusion are fully in line with those in research on the problems in the governance of RES-E implementation. The acceptability is usually low in cases of exogenously initiated projects that are disconnected from the communities’ socio-economic and environmental context. This applies to both renewable energy projects initiated and defined by community outsiders (e.g. energy companies) as well as demand side management projects applying devices that energy companies themselves call ‘smart meters’[23]. Such projects are much more likely to face resistance. As DG is located close to end users, the deployment of renewables depends upon securing a good match between energy schemes and host communities, in particular collaborative manners of decision-making and by effective involvement and participation in the management and property of the RES-E systems[24].

Founded on those two domains of knowledge, some general questions with regards social acceptance of renewables in the next phase can be formulated. Among others, for example:

- What are the institutional conditions that determine, impede or foster the creation of renewable DG in smart microgrids?
- How does decision-making – and institutional frameworks such as spatial planning systems that tend to overrule or impede necessary collaborative planning – about infrastructure associated DG affect the creation of new socio-technical systems?
- Under what (geographical and institutional) conditions are actors willing (and do policies allow them):
 - To invest and install renewables' generating units?
 - To cooperate in microgrids and mutually exchange the co-produced renewable energy, regulated by smart metering devices?
 - To adapt their energy behaviour, shaping demand patterns that match the supply of renewables?
 - To achieve reasonable access for all under conditions that avoid free-rider behaviour?

Associated with the previous questions: what about the property and control of the assets in the energy system? This includes smart metering devices and the data generated by them: are they controlled by remote companies serving large scale centralized and inflexible production, or are they controlled by the co-producing end-users serving the feasibility of their RES-E distributed generation units and the management of their microgrid?

Furthermore, are the actors with a strong position in the current institutional framework willing:

- To accept these new configurations and infrastructure of power supply?
- To accept the institutional arrangements that are required to create and maintain DG in microgrids that shaped for co-production with renewable DG?

There are many more prominent questions [10], but the main issue of social acceptance of renewables innovation should be emphasized once more. As in the first phase, questions seem to focus on community acceptance, but the fundamental question beyond that is how we can escape from the institutional lock-ins connected to the existing power supply system and policy structures that are preventing most of the innovations needed for optimal deployment of renewable energy.

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