Renewables Grid Initiative

6th RGI Future Scenario Exchange Workshop 22 Oct 2018, Berlin

Brief of studies and protocol

This document follows the Chatham House Rules under which the Workshop took place and provides:

- Attendee list and agenda.
- A brief of the studies presented.
  - “Future Energy Scenarios” (FES) – Andrew Dobbie *(National Grid)*
  - "Decentralization, regionalization and power lines: metastudy about assumptions, insights and narratives" – Eva Schmid *(Germanwatch)*
- The main insights and comments.
- Conclusions and next steps.

1. Attendees

Name	Organisation
1. Bilal Hahati	Elia
2. Sebastian Bohlen	Amprion
3. Giacomo Donnini	Terna
4. Eva Schmid	Germanwatch
5. Maximilian Schulze-Vorberg	50Hertz
6. Andrew Dobbie	National Grid
7. Craig Morris	RGI
8. Andrew Carryer	RGI
9. Antonella Battaglini	RGI

You can find all information about RGI’s future scenario exchange workshops, previous presentations and workshop summaries here.

2. First session: National Grid: technical findings

2.1 Background and purpose of the study

National Grid is the licensed operator the British electricity grid and of the gas grid. As such, it is required to produce annual planning reports based on stakeholder engagement.

Although northern Ireland is in the United Kingdom, the grid there is managed along with the one in the Republic of Ireland by Eirgrid. The Scottish grid is managed by National Grid but does not belong to National Grid. National Grid currently owns and manages the grid in England and Wales but only manages the grid in Scotland. This situation is changing, however. NG's system operator function is to be separated from grid ownership when an "ISO" is created next year.

For the Future Energy Scenarios (FES), NG's role in both gas and electricity means that it takes a perspective that encompasses all sectors of the energy system. The FES consists of numerous published products. In addition to the full report, there is a high-level "FES in 5" version designed to be readable in 5 minutes. The data are made available in a workbook, and the modelling assumptions are presented in a dedicated document.

The FES also feeds into a set of other documents:

- Seasonal outlooks (security of supply / system adequacy analyses)
- Ten-year statements (network development)
- System Operability Framework

The FES is updated on an annual basis. Most of these updates concern near-term assumptions, but those for mid-century are also adjusted as needed. Ofgem, the national regulatory authority (NRA), reviews the recommendations in the FES. Over time, since its first edition in 2011, the FES has developed from a forecasting approach towards an approach that consciously highlights important uncertainties.

2.2 The four scenarios

The FES consists of four scenarios. The number is an appropriate balance between the number of scenarios that can be handled, also in downstream processes (such as system adequacy analyses), and the range of future uncertainties that should be covered in the selection of scenarios. The FES is developed under several requirements, including security of supply and decarbonization.

In order to ensure system adequacy, scenarios must deliver no more than 3 hours of loss of load expectation. Interconnects are also taken into consideration; for Belgium, for instance, Elia's networks plans are used.

Also, decarbonization is a modelling constraint. Up to now, the focus has been on a percentage by 2050, such as 80% lower emissions. However, this number may not be in line with the "well below" 2 degrees requirement in the Paris Agreement. National Grid is working with stakeholders to figure out how to adapt the FES accordingly. In the latest edition of the FES, two of the scenarios meet climate targets; two do not.

- the Steady Progression scenario is closest to a business as usual development

- the Consumer Evolution scenario foresees greater decentralization of renewables but fails to meet a 2° target in 2050.
- the Two Degrees scenario meets a 2° climate target in 2050.
- the Community Renewables scenario also meets the 2° target in 2050, but with greater decentralization.

"Decentralized" is defined as renewable generation capacities not connected to the transmission grid but to the distribution grid. It is assumed that the power sector will undergo such a transformation in the coming decade. The decarbonization of the transport sector is foreseen in the 2030s and that of the heat sector in the 2040s. For transport, electric-vehicle charging is a central question. Although the overall level of power consumption is not expected to rise considerably, peak demand could increase from the current level of around 60 GW to 80 GW by 2050.

For the heat sector, change is expected to come more slowly because the replacement rate is so low. Heat pumps are assumed along with district heating, but hydrogen could also be used as a gas for heating. Indeed, hydrogen boilers were found to have far greater potential than district heat.

2.3 Insights and comments

The audience appreciated the extensive stakeholder process and its capability to shape the scenarios. The national regulatory authority Ofgem does not set forth the framework, but National Grid cooperates closely with Ofgem.

Participants were surprised at how little peak demand in the FES is expected to grow: by just around 10% depending on the scenario.

Questions were posed about whether National Grid postpones much of the needed change until after 2030, in the hope that some miracles will happen later while we continue with business as usual today. National Grid says it tries to pull things forwards, but for the next decade there are plans in the pipeline.

It was noted that National Grid, as the gas operator, might unconsciously favour gas networks. National Grid does not take the potential impact of climate change into account in its modelling of heat demand; there may be lower heat demand as temperatures rise, but in return air-conditioning demand could grow.

Brexit was briefly mentioned. Participants said they had perceived NG as an outspoken Remain supporter up to the referendum but that the firm had been quiet since. National Grids's position is now that it simply stresses what it sees as the benefits of GB consumers having access to the EU market. Otherwise, it is currently unclear what the rules for interconnections will be under Brexit.

3. National Grid: stakeholder engagement process

National Grid is required by its license to conduct stakeholder engagement in the future scenario process. National Grid sees the process as a way of learning from stakeholders not only what the rights answers are, but what the right questions are.

The stakeholder process undergoes various phases but is basically continuous; it starts when the FES are launched. In addition to workshops, webinars, and bilateral meetings, from the 2019 edition onwards there is a "call for evidence": here, stakeholders can submit evidence for their critiques, thereby facilitating uptake by modellers.

The stakeholder community is essentially everyone: investors, trade bodies, community developers, government officials, NGOs, politicians, etc. The invitation is open, but National Grid may restrict access at events due to given space constraints. In prioritizing stakeholders, an effort is made to ensure the diversity of the group.

Capacity is being increased all the time to ensure outreach. However, there are limits to what can be productively managed; the number of organizations involved in the stakeholder process grew from 233 to 430 from 2015-2018 – nearly a doubling in four years. Continued growth along that trajectory is not a goal. Already, the number of questions to be answered is more than can be handled within a given timeframe, so stakeholders are asked to prioritize their questions.

National Grid engages with stakeholders on everything from models and assumptions to data sets. Some information remains confidential, however, because it might reveal too much about a particular company's business.

4. "Decentralization, regionalization and power lines: metastudy about assumptions, insights and narratives"

4.1 Background and purpose of the study

In March 2018, RGI published the German edition of the study "Decentralization, regionalization and power lines: metastudy about assumptions, insights and narratives". The English translation was published on the day of this workshop and is available online here. RGI commissioned the study with Dr. Felix Christian Matthes of the Öko-Institut in the context of the project "Shaping the grid debate", one of the *Implementing the European Grid Declaration projects*.

The metastudy covers 10 different model-based scenario studies for Germany published between 2013 and 2018. A total of 28 scenarios from these studies is included in the analysis. However, it was a challenge to identify metrics for comparisons of the studies, especially in the context of network expansion. Also the authors of the metastudy had to contact many authors of the model-based scenario studies individually in order to obtain data in a comparable format (e.g., when the data was reported in graphs only).

In terms of method, the metastudy follows three steps. First, it reviews and analyses the different dimensions and aspects of decentralization of electricity generation based on literature reviews: technical, spatial, integration and coordination. The technical dimension differentiates between small generation units on lower voltage levels of the grid and large generation units on high voltage levels. The spatial dimension differentiates between generation close to demand centres and far away from demand centres. The integration dimension looks at flexibility options close to demand centres and far from them. Finally, the coordination dimension is about market rules and stretches across a continuum from “own consumption” to cellular / locationally differentiated market zones and a large-scale centralized electricity market. Across these four dimensions, the economic, ecological and innovation effects of the different solutions matter, as do the societal implications for comprehending decentralization as a concept. The major take-away here is that there is no standard definition of decentralization; the various actors see many different aspects are pivotal. Hence, if someone pledges for a decentralized energy transition, one should always ask: what do you mean precisely?

The second step of the metastudy aims to understand numerically basis how the potential of wind and solar generation compares with electricity demand. This analysis provides a theoretical understanding of the possibilities of different regions to generate the electricity they consume locally. For this analysis, flexibility options are ignored; the analysis looks only at quantity balances with a high spatial resolution. The results show first a substantial concentration of demand in the industrial regions in the west and south and in the metropolitan regions of Germany. Second, good solar power potential is particularly found in southern Germany and on rooftops in metropolitan regions. Third, good wind power potential is located in north and northeast Germany and offshore. Finally, challenges concerning the public acceptance of onshore wind power plants will have a restrictive effect on the usable potentials, especially in densely populated regions with high electricity demand.

The third step of the metastudy pursues a comparative analysis of the 28 scenarios mentioned above. The main finding is that scenarios that reduce grid expansion by 20% to 50% have the following characteristics:

- They assume or determine a strong expansion of onshore wind energy in southern Germany. The scope of the additional wind power capacity expansion resulting for 2030 and 2035 is three to four times, and in extreme cases six times, higher than the values assumed in the German network development plans.
- They assume or determine a strong expansion of onshore wind energy in western Germany. The additional wind power capacity expansion amounts to a factor of 2 to 3, and in two extreme cases to a factor of 7, higher than that assumed in the German network development plans.
- They largely assume or determine a strong expansion of solar energy in southern Germany. The capacities of PV systems in the “South” zone exceed that of the German network development plans for 2030 and 2035 by a factor of 2 to 3.
- For 2030, the relationships between the remaining coal-fired power plant capacities and the necessary grid expansion depend to a great extent on how (additional) renewable power generation is regionalized. For 2035, the amount of coal-fired power generation no longer shapes the dimensions of electricity grid expansion.

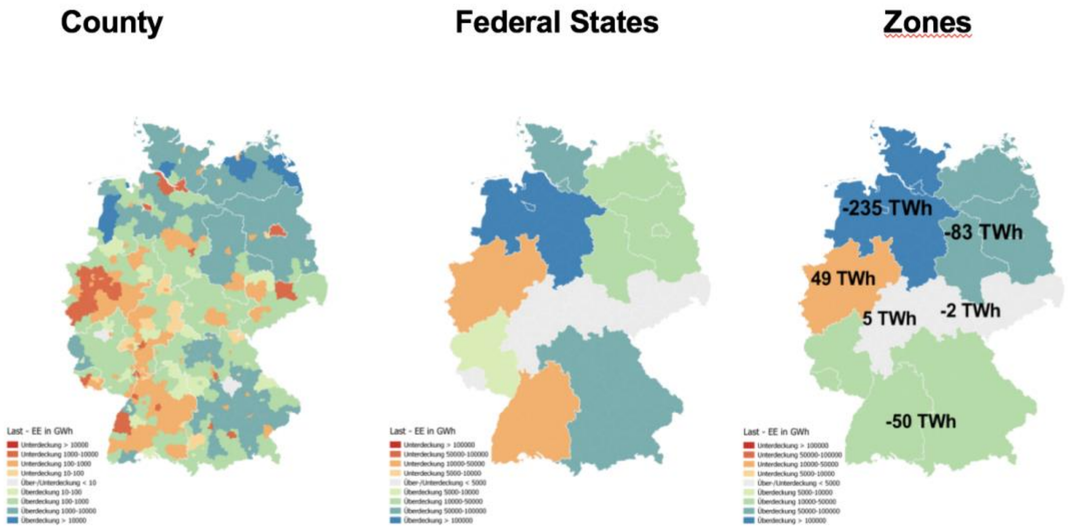
The metastudy draws four major recommendations for action. First, a structured discourse is needed to clarify whether decentralized (“cellular”) control approaches – aside from optimization of self-consumption – could be implemented or considered as a variant for grid expansion planning. Second, the assumptions for expansion limits of renewable power generation need to be validated for onshore wind, offshore wind, and PV capacity potentials. The actually usable potential and acceptance should receive special attention. Third, there is an urgent need to develop a uniform assessment criterion for calculating all the costs and land requirements (for electricity generation plants, flexibility options and infrastructures) in order to enable comparability of future analyses. Fourth, to improve the comparability of future studies, it would be helpful to develop a pragmatic metric to compare grid expansion needs and take into account the different modelling approaches.

4.2 Insights and comments

It was discussed that, in addition to the spatial distribution of power generation, the location of demand also matters. Less grid expansion may be necessary if demand is flexible and can be shifted to supply centres. In general, it is challenging to satisfy regions with very high electricity demand, especially industrial areas, with local wind and solar generation. Hence grid expansion is necessary to transport electricity from areas with sufficient wind and solar potential to industrial centres.

The following set of maps illustrating the results of the second part of the metastudy were discussed. Here, renewable generation is deducted from demand to produce the residual demand within a given “cell” or zone. On the left, Germany is divided into 402 districts or “counties”; in the middle, we see the 16 German states as grid zones; and on the right, Germany is divided into five grid zones.

The red areas indicate a shortfall of renewable energy within a given area; dark blue, areas where there is excess supply relative to demand. If individual “grid cells” are as small as counties (left), numerous areas have a shortfall (red). If the 16 German states are the grid cells, then the extreme cases are rarer. And if Germany consists only of five cells/zones, the situation improves further. In other words, the greater the cell size, the better the situation.



It was noted that the colour scheme makes the maps hard to understand. The one in the middle seems to overlap a bit with the one on the right; black lines could have been used to demarcate state boundaries within areas of one colour. For instance, the entire northeast section has one colour and thus seems to be the same area in the centre and right map; yet, the excess amount of renewable energy increases on the right. The reason is that the areas are not the same: the NE zone on the right map consists of three states that just happen to have the same colour on the centre map, where they are still three separate grid zones.

It was also noted that the definition of “cell” (a term coined by German engineering organisation VDE) may not overlap with what campaigners for community energy imagine to be a cell, particular sizewise. In the VDE study, a cell is the size of a state.