
IASS WORKING PAPER

Institute for Advanced Sustainability Studies (IASS)

Potsdam, May 2017

The Organisation of an Electricity Sector based on Renewables – A Delphi Study

Appendix

Patrick Matschoss and Armin Haas



The Organisation of an Electricity Sector based on Renewables – A Delphi Study

Appendix

Patrick Matschoss & Armin Haas

Content of This Document

This document contains the responses of the participants of our Delphi study entitled *The Organisation of an Electricity Sector based on Renewables*. The study is a follow-up to our workshop “The Organisation of Electricity – A Multi-perspective Inquiry” that was held at the IASS on 8 and 9 January 2015. In total, 26 experts participated in the Delphi exercise. The report on our Delphi can be retrieved under the following Digital Object Identifier (DOI): [10.2312/iass.2017.012](https://doi.org/10.2312/iass.2017.012)

We posed the following five questions:

- Question 1: What should be the division, if any, between primarily market-based and primarily regulatory-based parts of the system?
- Question 2: Who should have responsibility for planning each part of the system? Who should have the responsibility for planning the system as a whole?
- Question 3: How should the interaction between the responsible actors/institutions be governed so as to ensure an efficient and effective overall coordination among the components of the system?
- Questions 4 and 5: After having answered the questions above, please tell us how you think your suggested scheme would perform in a scenario in which both households and industry each produce (Q4) 25% and (Q5) 50% of their own electricity consumption?

The answers are organised in two respective appendices. In appendix 1, they are sorted by questions; in appendix 2, they are sorted by respondents.

All answers are tagged with individual identifiers for easy reference. The format used is A.R, where A is the answer to the respective question, and R is the respondent. For example, 3.15 is the answer to question 3 given by respondent 15. Where an answer or general remark was given without tagging it to a specific question, we use the XX.R format.

Appendix 1: Responses to Rounds 1 and 2 – Sorted by Questions

All answers are tagged with individual identifiers for easy reference. The format used is A.R, where A is the answer to the respective question, and R is the respondent. For example, 3.15 is the answer to question 3 given by respondent 15. Where an answer or general remark was given without tagging it to a specific question, we use the XX.R format.

Ident. (A.R)	Answers sorted by Questions n.a. = no answer; <i>own remarks</i>	
	Round 1	Round 2
Q1: What should be the division, if any, between primarily market-based and primarily regulatory-based parts of the system?		
01.01	Grid as natural monopoly should be regulated, the rest of the value chain market-based.	
01.02	Infrastructure, i.e. the grids as well as technical system operation (ensuring stable and reliable operation of the entire system) should be regulated, energy business and provision of services using either generation or demand resources should be market-based.	
01.03	generation(all kinds), supply and trade- market-based; TSO-system, DSO- system, storage, transformation between electricity, gas and heat, controlling of load, real-time communication and data transfer, prevention and all aspects of security of supply (SoS)- regulatory-based	

01.04	<p>The electricity system is composed of the following elements: <u>hardware</u>: generation plants/units and transmission and distribution networks including metering devices; <u>generation plants/units system contributions</u>: electricity, capacity, system services for security of supply; <u>system arrangements</u>: wholesale markets / power exchanges – OTC arrangements, retail markets / non-discriminatory access to the grids; balancing markets; TSO responsibilities for system services; <u>network regulation</u>) <u>market-based parts of the system</u>: As long as we have generation plants/units with different marginal costs larger than zero we need wholesale markets/power exchanges in order to determine which of them should be used. Beside this the regulator might decide that market arrangements can provide certain well-defined products and services efficiently and effectively. This holds true today for the balancing markets, and it might hold true in the future eventually for reserve and/or capacity markets as well as for renewables, CHP plants and storages (“auctions”). I doubt whether the price signal of the wholesale market will ever provide a stable investment signal for renewables, CHP plants, storages or backup capacities. In principle markets are blind with respect to long-term necessities, so the framework for well-defined market arrangements is essential. <u>b) regulatory-based parts of the system</u>: Networks as natural monopolies will always be regulated. The same holds true for ensuring security of supply because this must be seen as a public good (“meritorisches Gut”). Balancing accounts (“Bilanzkreise”) of the suppliers/retailers will have to be regulated as well. Beside this market design for special markets and auctions is always a regulatory task.</p>	
01.05	<p>I do not know enough about the German electricity system to give the kind of detailed answers that I think your questions require. I don't think they can be answered concisely. In general, I advocate that the new German regulatory system follow the older US cost-of-service based regulatory system with something equivalent to a US Public Utility Commission being the appropriate authority to plan the system, set electricity rates for consumers, etc. I don't think markets for electricity are needed, perhaps with an exception being a long-term electricity supply contract market. Obviously, given all the municipal electric systems in Germany, the new “PUC” type agency will need to</p>	

	coordinate very closely with each municipal utility. But I don't know what kinds of new laws consistent with overall German law would be required to make that happen.	
01.06	Only ownership should be market-based the rest should be regulated.	
01.07	As energy supply has features of a public good, it is necessary to have a division between market-based and regulatory-based elements in the design of the energy sector. From a banking perspective, the division between market- and regulatory-based elements is primarily important as it bears implications for the assessment of risks and thus – the costs and conditions of finance. In general, regulatory-based instruments bear political risks, while market-based instruments bear competitive risks. An assessment of regulatory risks needs to take into consideration the prevailing contextual arrangements. Take for example the regulation of RE-advancement. In Germany, the political risks of the FIT scheme – the EEG – have been relatively low. The EEG provided RE-producers with guaranteed prices and banks with highly predictable cash-flows, making highly standardised non-recourse project finance solutions possible that were an important backbone of the growth-story of German RE. The political risks of the Spanish FIT, however, turned out to be much higher. The retrograde price adjustments in Spain destroyed a lot of trust in the regulatory framework and in the predictability of RE-development. An assessment of the preferability of regulation in general – or even FIT-regimes in particular – is therefore difficult. What matters is predictability; the higher the predictability of the regulatory framework, the lower the risks and the better the conditions for finance. Market risks on the other hand are in general borne with unpredictability and therefore often require different forms of finance. As cash-flows are not as predictable as under FIT-schemes, non-recourse structures often require different forms of mitigants – such as price hedges, guarantees or variable obligations. Another option to mitigate market risks is more collateral, which may give classical on-balance finance an advantage. A switch towards on-balance products would also imply a change in the loan periods: non-recourse project finance contracts typically provide maturities up to 17 years while corporate loans usually have durations	

	<p>between 5 to 7 years. In the end, such changes may have lasting effects on both, the composition of market players and the growth dynamics of the sector as a whole. From a banking perspective, there is no preference for a general division between market- and regulatory elements. This choice remains political. What matters for the bank is the particular design of the measures and their implications for the risk assessment. Regulatory elements being predictable and safe bear low risks and hence allow for beneficial conditions of finance; market elements tend to increase complexity and thus may lead to alterations in the availability and conditions of debt. As such implications may change the composition and dynamics of the electricity sector – political agents should take these assessments into account when planning new measures of the future electricity market design.</p>	
01.08	<p>The question is not clear enough for me or I have too little knowledge about it. If the solutions were totally market-based, there wouldn't be any regulations at all. However, there will always be regulatory component, because the electricity system works inside the country, it's connected with other countries' system, it's taxed etc.</p>	<p>Having seen the other answers this question is now clearer to me. Thank you for sending the summarised replies. Anyway, I agree with the European paradigm of electricity market liberalisation, however I think that power generation should stay regulated to some extent, because there are big differences in power production between different European states. Without a proper coordination and regulation only market-based instruments will not solve all problems. Transmission and distribution should remain regulated; however, once again it requires strong collaboration between different actors in Europe.</p>

01.09	<p>The transmission (I would include distribution grid as well in this category) part, which is deemed to be natural monopoly, could be regulatory-based. That is, the regulatory body and the operation of transmission bodies (companies or other agencies) should be bundling to make sure that the tariff was set in a reasonable way and the access of the third parties.</p> <p>Other parts of the system, including the generation and retail, which could be market-based and with multi-sellers and multi-buyers. The dispatching center would be one part of the competition in generation system.</p>	<p>(1.19 & XX.24) Inspired from some peer comments, I would like to add a temporal limit on the consensus (market-based for generation/retails, and natural monopoly for the transmission), limited to short- to medium- term. In fact, as the original idea, the natural monopoly means that one single supplier can provide the lowest price due to the rising return to scale (paralleled lines impossible and infeasible economically). But this might be invalid and outdated with the technology progress (e.g. in the communication sector), or competition in some other forms, or beyond the “power line” sector. In a future world with enough large prosumers and suppliers, if (!) this is true, I would tend to believe that the competition between the grid and the consumers on the reliability of electricity supply (with means of storage, interruptible supply with the grid ancillary service) would exist. This is reflected in the worrying of future role of grid as “Death spiral”, where a condition of the grid service in which costs rapidly increase as a result of changes in the covered electricity volume. So the grid part of the system will be exposed into the competition, and it will not need to be regulated in some degree. Grid might not disappear, but also can’t do strategic market behaviour as now.</p> <p>Of course, this change is very radical and only possible in a long-term horizon. This paper analysed this balance development between solar PV system and grid from overall cost perspective (www.sciencedirect.com/science/article/pii/S0301421515001111). It could be a foundation for some further more detailed and data-oriented discussion.</p>
01.10	<p><u>Primarily market-based</u>: Dispatch decision of electricity market (conventionals, renewables, flexibility options). Capacity payments based on market-based auctions, while capacity needs estimated by a central authority (regulated). Liberalised end-consumer tariffs. <u>Primarily regulation-based</u>: Network operation & planning, Renewables promotion scheme organisation</p>	<p>... <u>Primarily regulation-based</u>: Network operation & planning, renewables promotion scheme organisation (if promotion scheme is necessary. However promotion scheme itself can be market-based, only scheme design needs regulation), regulated inclusion of externalities of electricity generation (nuclear hazard&waste, air pollution, health issues).</p>
01.11	<p><u>In general</u>: market-based. <u>Exemptions</u>: Natural monopoly (grid), market failure/distortion (eg domination), market introduction (RES-support), disproportion between private and public benefit (RES-support)</p>	
01.12	<p>A combination of energy-only market and focused (!) capacity market, combined with increasing energy tax or ETS. Actors who produce own electricity should nevertheless contribute to necessary system</p>	

	services.	
01.13	Policy sets targets and rules, regulation monitors them, and the market fulfils them.	The first question was about the division between market-based and regulatory-based parts of the system. As we know there is no general optimal setup of institutions. On the one hand institutions have to regard proper incentives so that decision-making is channeled into the direction wanted, on the other hand cultural traditions to a large extent are important as to what kind of setup of institutions will lead to success. The present setup of institutions regarding the promotion of renewable energy has led to a number of follow-up problems that need to be considered when we discuss the future institutional setup. At present the addition of renewable energy plants is not synchronised with necessary infrastructure. This is like producing cars in a country where there are no roads. In addition the stability of the electricity system is in danger because fluctuations in the renewable segment need to be compensated by other plants guaranteeing stability. The price disparity between renewable plants and other plants makes stabilising plants more and more uneconomic and thus the system stability is in danger. But in the future the twofold market structure (legally fixed prices for renewables and open market for all others) has to be changed towards a unified market system. Regulation is necessary to make sure that infrastructure develops in line with the increase in renewable production and in order to make sure that renewables grow according to targets. As mentioned there is no optimum setup of institutions. What is much more important is a learning process so that the rules of the game are adjusted whenever this seems necessary.
01.14	In my opinion the division should be determined on the one hand by the type of (technology) supply market and system service under consideration/investigation and on the other hand on the costs and lifetime characteristics of the infrastructure entity. For example: Technologies with high investment but barely marginal cost on the one hand and longtime economical and technological lifetimes (wind, PV, grid and sometimes storage and base-load technologies) suffer from high financing risks in a liberalised and therefore more or less unpredictable future development of (wholesale) market prices and regulation frameworks. In these cases risks can be decreased by being hedged by some kind of accountable and big insurance institution the	In Principle I stick to my answer of the 1 st round, that the definition of the division between market and regulated based parts should be determined by the type and cost structure of the technologies in the market. Real capital-intensive technologies like RES as well as Nuclear will never be able to handle the high financing risks on the completely free and liberalised market without hedging the investment risk through high risk premiums (compare historic or current investment decisions in RES and nuclear, where no investments would have been undertaken without the takeover of risks by the state or end consumer (see EEG mechanism or contract for differences and the state guarantee of payment of a loan for the new build Hinkley Point C Nuclear Power Plant in UK). In the end high risk premiums makes the system

	<p>best (e.g. the state) or by a widespread diversification of the risk through many risk takers (e.g. the millions of end consumers). By doing so, cost of capital (and therefor the “system costs”) can be kept low. This would probably lead to the lowest macro-economic costs.</p>	<p>unnecessarily expensive from a macro-economic perspective. Therefore I would agree with the answer of other respondents that generation sector can (in principle) be organised market-based but only to a certain extent. And that the market-based area also require a certain amount of regulation, especially if there is the political will to transform the system to a renewable-based one with high share of volatile RES (VRE) with high capital cost. So yes, development/deployment of RE would require a more regulated environment (1.10, 1.11, 1.16, 1.17) on the generation sector. I think that the need for the grid sector as natural monopoly to be completely regulated is unquestioned. The retail sector though can be organised by a liberalised market. Although local RES direct marketing and prosumer concepts do not require a “market” at all. I also agree with other respondents that IF the generation sector is completely market-based we will probably need some kind of capacity payments in the future (with high share of RES), but not yet! And that’s for the same reason as mentioned above: Probably no one will invest in capital-intensive technologies in a market environment with no possibility of long-term price development predictions as well as very volatile short-term price developments because of high shares of VRE in the systems. A capacity market could lower the involved risks. So in the end I stick to my general opinion, that it is all about handling the risk to attract new capital for investment. But I am not able to determine in the end whether the market-based or the political-based induced risks will play a more important role. Although for now I tended to believe that market risks are more complex and expensive to handle.</p>
--	---	--

01.15	<p><u>In short:</u> the overall direction will most probably be regulatory-based, but the execution should be market-based wherever possible.</p> <p><u>Examples: Generation:</u> the general direction in generation mix will be determined by society and thus by politics/regulation, since a pure market-based choice without any restrictions would possibly neglect societal goals such as climate protection or preference for renewables. Also an adequate mechanism to ensure that the technologies of choice are being built needs to be in place. However, the execution can be market-based, via e.g. tender processes/auctions for new-built and the present merit-order system for optimal operation of the generation park. Decentral generation (i.e. beyond the meter on a customers premise): regulation (e.g. via tariffs, i.e. mix of kW/kWh-based) should be set up in a way, so that the right investments from a societal viewpoint are being enticed. Currently not the case! <u>Grid:</u> networks are and should remain a natural monopoly, since it is not desirable to have parallel network structures, neither from an economic nor from an acceptance viewpoint (although in gas we have parallel systems...). However, performance incentive regulation and possibly other mechanisms ensure efficiency.</p>	<p>Some thoughts on question 1: from a commercial point of view, PV (even in combination with home battery) are already reaching competitiveness today on the basis of grid parity (i.e. w/o FIT). However, from an economic point, this is due to the market distortion immanent in the system, which is based on the present situation that with PV on your roof you can save a lot of money due to the high (EEG, tax etc. loaded) cost per kWh, while the savings in the overall system are only a very small fraction of this, since the system is dominated by fixed cost, while the tariffs are still largely variable cost. This is a state, which cannot be continued ad ultimo, because then less and less consumers with decentral generation (and still relying on the system as backup or feed-in) would not pay for the system any more, leaving the burden to those w/o the opportunity to generate decentrally.</p>
01.16	<p>Generation and distribution of electricity should be primarily market-based (except for the generation of renewable technologies which is excluded from the market due to the government goal of achieving a share of 80 percent to 2050). Transportation of electricity should be primarily regulatory-based due to its character as a natural monopoly.</p>	
01.17	<p>The RES-E development should be determined by the government including the support mechanism (Main reason: Political balance of public acceptance of infrastructures and cost is required.). Grid needs to be planned by the regulator (Main reason: political balance of public acceptance of infrastructures and cost) Leave the rest to the market since it is more efficient than a regulator. (Acceptance issues between the remaining generation, storage and flexibility options may not be as important in these cases)</p>	
01.18	<p>The electricity system has many subsystems that must be addressed in different ways. So the answer cannot be such simple. Also you can</p>	<p>ADDED: I wondered, what was meant with „the system“. By breaking the system into subsystem, what many respondents did, it is easier/possibly to</p>

	<p>move to a market-based system from a regulatory-based subsystem without changing the system very much (i.e. going from feed-in tariffs to auctioning/“Ausschreibungsmodell”), while others may not change the label of the subsystem (market vs. regulatory) but will change the subsystem drastically.</p>	<p>answer. But then I still have problems – any market-based solution (even so-called free markets) needs a regulatory setting. There are several limitations that have to be addressed (lack of storage, need to serve full demand,...), so that you definitely need a strong regulatory setting. Anyway, you may have subcomponents that can be labeled „primarily market-based“ – but in a larger context, the subsystem won't.</p>
01.19	<p>The first issue to address is, if this governance scheme is supposed to a) facilitate the transition to such a system or b) sustain a new steady state once the transition has been made. <u>Let's start with b.</u> If we assume that we have a steady state at high shares of (Variable) Renewable Energy, such a system will need to have sufficient flexible resources to be cost-effective. In the presence of storage and DSM, a lot of the problems articulated today about marginal cost pricing will actually be less pertinent – electricity markets will become much more like normal commodity markets where demand responds to price and demand and supply need not be balanced each second. Also, once we are 'locked into' such a system, the regulatory uncertainty, which is a large factor in paralyzing market-based investments today, will go away. What remains in terms of market-based vs regulatory-based is the question of natural monopolies or public/common goods (the most relevant component here is grid infrastructure). <u>Turning to option a).</u> If the question is about a design that gets us to such a system, I am convinced that a purely market-based system is bound to fail, because there is uncertainty about the level of ambition (what will be the price per tonne or the cap by when etc) and path (CCS yes/no, nuke yes/no) of decarbonisation. Also, CO₂ pricing is extremely challenging to implement. As such, technology specific instruments appear the best choice and these do rely on a great deal of regulatory intervention. It appears that a hybrid price/quantity approach is becoming the mainstream choice (either via banded certificate schemes of FITs/premiums that have caps in terms of total funds committed or capacity allocated (tenders)).</p>	

01.20	<p>First, I do not believe that any part of a large-scale electricity system (whether renewables are part of that system or not) can be primarily market-based and free of regulation in the same way that markets for other products or commodities are. We now have lots of experience showing that lightly regulated markets for both generation and transmission are either too easily manipulated; provide poor signals for investment; or both. I may be convinced to change this view if large amounts of distributed storage are deployed, along with market price signals, so that individuals could have some ability to shift consumption between local and grid-provided sources.</p> <p>That being said, with appropriate regulation it may be the case that generation decisions could be made in a more decentralised manner. Having large amounts of zero-marginal cost generation does not really change this, but new regulatory frameworks would be required that reflect imperfections in forecasting output from variable energy producers like wind and solar. It may be possible for multiple transmission companies to exist within the same planning footprint (as happens right now in the US), but particularly with respect to high levels of renewable integration some level of coordination on the transmission side seems necessary.</p>	<p>... That being said, with appropriate regulation it may be the case that generation decisions could be made in a more decentralised manner. There is a basic risk-reward calculus here, however, that would require some coordination between generating companies and consumer interests (as well as an independent grid operator if one exists). Because of the presence of various externalities related to power generation and because risk preferences between generating companies and other interests (customers or grid operators) may not be identical, I could easily see how decentralised power generation decisions could lead to various undesirable outcomes. Having large amounts...</p>
01.21	<p>The key question is on the meaning of market-based and regulatory-based. My definition refers to prices: If prices are set by the regulator I would describe this as a regulatory-based approach, if prices are set by competitive processes which identifies the equilibrium between demand and supply (irrespectively of who defines the demand) I describe this as a market-based approach. In the long term I would two parts of the system: <u>(1) the market-base part:</u> fossil power generation/generators, renewable power generation/generators, demand response (including power-to-heat, power-to-X), storage; <u>(2) the regulatory-based part:</u> network infrastructure see however in the market-based part different segments: <u>(1a) a segment driven by consumer demand:</u> the energy-only-market, based on short-term contracts, <u>(1b) a segments driven by demand created by the regulator:</u> the system service markets, based on short-term contracts, <u>(1c) two or three segment driven by demand created by the regulator:</u> (1ci) markets for firm and flexible capacity (including storage) and demand</p>	

	<p>response/flexibility and (1cii) renewable capacity, based on longer-term contracts. Last but not least, one should not forget two additional market segments which will play a significant role for the system and the system transformation: (1d) the market segment for clean dispatch aka the EU ETS, (1e) the market segment for energy efficiency (which will be indispensable in a world dominated by zero-marginal cost options). The main functions are: <u>Ensuring</u> the coordination of the system: 1a, 1b, 1d; <u>Ensuring</u> investments at appropriate risks: 1ci, 1cii, 1e; <u>Ensuring</u> the appropriate infrastructural basis which also provides some flexibility for the range of transition pathways: 2</p>	
01.22	<p>It is economic orthodoxy that the natural monopoly of the grid infrastructure is primarily regulatory-based while there is – in the interest of efficiency and innovation – no reason to deviate from market-based approaches where there is no such market failure (generation, retail, services).</p>	
01.23	<p>Cannot be answered in general. It's not about whether we use market-based components or other forms of regulation (market instruments are a form of regulation as much as regulations impede markets) – it is about how well these instruments are designed and how well they play together in the policy mix. Think effectiveness, efficiency, fairness, etc. as guiding principles.</p>	
01.24	<p>Multiple division points are possible. In the US alone, entirely regulated, and almost entirely market-based, grids are functioning physically. The key question is the understood purpose of the grid. If it is a physical purpose, then logically one regulates any monopoly link in the functioning of the grid, and allows the rest to function on a purely market basis. But a principal purpose of the grid's original design was capital formation – utilities historically were the capital formation engines of the community energy grid, with two functions: 1) aggregate chaotic disaggregated short-term demand into stable, creditworthy, long-term demand that could support long-term finance, and 2) thereby reduce the cost of capital and with it the cost of energy, making long-term infrastructure affordable and keeping energy rates fair and affordable. It's worth examining whether purely market-based systems</p>	

	have replicated the historical ability of rate compact utilities to accomplish these functions.	
01.25		Monopoly and competition: Heutige Entscheidung (die ich schlüssig finde) Netz-Monopol, der Rest im Markt. Nur bei Zählern könnte man streiten....
01.26		I agree with 01.12. As the system becomes more decentralised we need to ensure that all producers of energy contribute to the grid (even though investment in the distribution grid could become less necessary when smart, ICT-driven solutions are put in place). The whole system is and should stay highly regulated. Even though EU should check whether regulation is still fit for the Energiewende and the current investment needs (is unbundling blocking private investment?). Mechanisms like the ETS should be strengthened. To ensure there is enough backup capacity (and investment in backup capacity) in a mostly renewable system, we need focused capacity mechanisms that are in line with the climate goals. (I agree with 1.12)
Q2: Who should have responsibility for planning each part of the system? Who should have the responsibility for planning the system as a whole?		
02.01	Those who take the financial risk in case of failure to make profits.	Those should have the responsibilities who take the financial risk in case of failure / losses instead of profits. If the government would stop to intervene into the market (beyond providing information and continuing the emission cap and trade system, the system as a whole will work because most actors are able to quickly adapt to new situations.
02.02	As the infrastructure is not a business case in itself but enabling other businesses this part of the system requires external supervision and also planning. Governments or other suitable public authorities, such as regulators, should be in charge for this. In the market-based part of the system I would not talk about one party having the responsibility of planning – this is the task of the individual market players for their enterprises. But a public authority should monitor whether the competitive market provides sufficient capacity and uses the infrastructure efficiently and take counteractions by adapting the market	In the light of the responses from the first round of this study I would like to emphasise that monitoring the competitive market explicitly includes surveillance of generation adequacy and the interference between positioning power plants and grid requirements (a task which is addressed in vertically integrated systems by integrated planning of generation and grid).

	rules in case this does not apply.	
02.03	<p>In general- Federal Ministry for Economic Affairs and Energy (BMWi) under control of a new committee of the Bundestag (realisation of Energiewende), For coordination with Europe and in Germany: A new federal authority for coordination of energy aspects, esp. electricity, gas, heat, storage and energy-based communication (including the current departments of BNetzA) and realisation of Energiewende. The responsibility for the system as whole, esp. for the frequency, the general SoS, all voltages higher 220 kV, the coordination and cooperation with the European partners is given direct by the new federal authority (in cooperation with the national TSO's). The responsibility for the local SoS, all other voltages, DSM, local communication between all players, real-time communication, transparency of all data is given by the energy authority of the federal states (in close cooperation with the national new authority for energy and Energiewende).</p>	
02.04	<p><u>Networks:</u> Bundesnetzagentur plus TSOs and DSOs; <u>Security of supply:</u> Bundesnetzagentur plus TSOs and DSOs; <u>renewables targets:</u> Government / Ministry for Economic Affairs; <u>CHP/cogeneration targets:</u> Government / Ministry for Economic Affairs; <u>Other backup capacities:</u> wholesale market plus eventually a decentralised capacity market and/or a reserve market plus "Bilanzkreisgleich" of the suppliers/retailers.</p> <p>The monitoring of the system as a whole including security of supply should be with the government / Federal Ministry for Economic Affairs and Energy and the Bundesnetzagentur on a yearly basis. "Monitoring" is not "planning", but the authorities should have the instruments to intervene if security of supply is at risk or if certain political targets will obviously be missed.</p>	

02.05	<i>See Answer 01.05 above</i>	
02.06	An independent system operator should do the planning.	
02.07	<p>The political planning of the diverse parts of the electricity sector should focus on the setting-up of an adequate regulatory framework under which market dynamics can prosper. To set up such a framework, the legislator should involve private stakeholders. Such private stakeholders should include manufacturers, producers, grid operators, distributors, consumers and financiers. Such a broad range of addressees is important as the dynamics of each part of the system are intertwined with all the other parts.</p> <p>As the electricity grid is a natural monopoly, an eligible regulatory body (i.e. BNetzA) should have a central role in the planning of the system. It is important to note, however, that legally, this part of the system needs to be unbundled from the other parts since the liberalisation of the European energy sectors. A close collaboration with ministries, utilities and regional bodies is nevertheless advisable to maintain requisite information about the system as a whole. A concentration of responsibilities, such as the implementation of the German Ministerium für Wirtschaft und Energie, may help to acquire additional legislative impact.</p>	
02.08	State should have responsibility for planning the system as a whole, however state should do it in close cooperation with DSO's, TSO's and representatives of civic society. It tackles the issue of governance, financial support for developing technologies, environmental protection and energy security.	
02.09	<p>The owners of the corresponding property have the responsibility to plan its future, and they would do that by themselves. Typically, the TSO have the responsibility to invest on the grid system, and maintain a working balance capacity market.</p> <p>The government is responsible for planning the system as a whole, but to what degree this plan involves is an open question. It can include (but not limited) in rules, market framework (e.g. capacity market), and spatially-relevant usage plan, and large-scale, cross-border projects,</p>	No change. To what extend the planning needed and with which criteria (value standard) to plan seems very controversial.

	nationalisation of some assets etc.	
02.10	<p><u>Capacity needs</u>: a central authority that estimates the needed capacity to ensure security of supply in respective year for which capacity auction is held. <u>Renewables promotion</u>: a central authority needs to organise auctions (if auction-based promotion scheme) or needs to set the levels of the feed-in tariffs (if FIT scheme). <u>Network operation & planning</u>: a central authority needs to regulate the network companies (natural monopolies) and check network expansion plans. <u>Dispatch, end-consumer tariffs</u>: planned and organised by market participants. <u>Overall system planning</u>: The federal ministry responsible for energy should be responsible for planning the system as a whole, e.g. setting the market design rules, etc.</p>	<p>... <u>Overall system planning</u>: The federal ministry responsible for energy should be responsible for planning the system as a whole, e.g. setting the market design rules, etc, based on climate targets being the result of an international political process.</p>
02.11	Each individual part should be subject to private governance; only the exemptions should be managed by regulatory authorities; the system as a whole has to be managed by private parties and regulatory authorities on a well-balanced level-playing field which has to be granted as a framework by the state.	
02.12	State (and related actors) should introduce climate targets, standard for grid stability, renewable energy targets, energy efficiency target and tools, focused capacity market. Market should decide the rest - but in a way that individuals, co-operatives have a fair access to market place.	
02.13	Producers of renewable and non-renewable plan their investment and production. Competition by auctioning investment slots. Production on the basis of merit order. TSOs plan network investment. DSOs plan network investment. A central agency is needed to coordinate investment plans by producers and TSOs, could be the regulator. DSOs need to develop IT tools and incentives to coordinate autoproduction (virtual generation)	The second question was about responsibility within the system and for the system as a whole. In order to synchronise infrastructure development and the development of renewable production it may be a good idea to auction slots for additional renewable production where ever infrastructure is available or can be made available. This could be the task of the TSO's. Either under supervision of the regulator or directly done by the regulator. A certain amount of independence from direct government intervention seems necessary so that direct interference by interested groups can be at least partly avoided.

02.14	<p>This question depends on (a) the kind of system one wants do have, (b) at within which time frame the system should undergo a transition path and (c) the (spatial) boundary definition of the system under discussion. If we follow a normative goal like being formulated in the German energy concept of 2011, the transition of the system and be accelerated if 'innovation niches' for specific technologies, business models and (new) consumer behavior are being created by specific "economic development zones" (e.g. the EEG, direct marketing of RES-E via the former 'green electricity privilege'). Therefore the answer is: - As long as we have no "level-playing-field" (e.g. in the generation sector by not internalised external costs), the regulator needs to intervene with specific instruments to at least converge to fair market conditions for every market participant.- The grid is generally accepted of been a natural monopoly and must therefore be regulated at all times.- The supply side can be organised by market forces as long as there are no unequal market entry and market participation conditions (e.g. if there are fair market conditions in place, e.g. by enforced EU directives).</p>	<p>For the second questions I also stick to my previous answers of the 1st round. Although I deeply think that the security of supply should be a public good, or public service respectively. But I am not sure if capacity <i>needs</i> should be determined [only] by regulatory-based processes (1.10). What do I mean by that?1) In my opinion the state needs to ensure every end consumer to have the level of security of supply (SoS) he wants and that the general assumption/obligation about the level should be the need for almost 100% of SoS around the clock.2) But I believe that we can lower the total system (backup) costs, if we leave the decision of really requiring a 100% SoS-level to the end consumer itself. So in the end every end consumer can refrain from the 100% level and offer a lower level on needed SoS to its utility company in exchange to a lower tariff, DSM measures of storage usage. Therefore some mixture of regulated and market-based approach would be helpful to reach SoS a the lowest costs (e.g. similar to the decentralised capacity market concept). Furthermore, I would go along with respondent (2.19), who mentions the need to keep grid and generation planning together. Especially with higher shares of VRE the need for more regulated approaches or a hybrid approach of price and quantity instruments (1.19) is necessary in my opinion. But this does not mean that the deployment of RES should follow the speed of grid extension, but rather to better harmonise the process in total. I also go along with the tree respondents (2.7, 2.8, 2.11) to explicitly including stakeholder participation as well as an explicit need for target setting, either "governmental" for RE, CHP, (2.4, 2.5, 2.9, 2.10, 2.12, 2.16, 2.17, 2.21), but NOT for DSM!</p>
02.15	<p>In short: Planning/execution for each plant/component of the system should be in the hand of market players. However, adequate supervisory mechanisms need to be in place in order to ensure esp. security of supply and the adequate design of the overarching infrastructure lay-out (esp. high-voltage grid).</p> <ul style="list-style-type: none"> - Supervisory mechanisms: responsibility can be given to either the TSOs/DSOs or also to other market players (e.g. retailers) to ensure sufficient capability to fulfil their supply contracts. - Overarching: governmental bodies (on regional, national and EU-level) need to plan iteratively and set guidelines that over time a well functioning system develops. 	

02.16	<p>Market-based parts of the system cannot (or should not) be planned explicitly due to their complexity. This is the reason why the responsibility for “planning” is delegated to the individual market participants. Electricity generation from renewable technologies should be planned by the government (or parliament) – at least with regard to quantities, kind of technology and subsidies). This is due to the societal relevance of renewable technologies and the societal goal of achieving a share of 80 percent to 2050. The transportation system should be planned by the regulatory authority. As higher the percentage the share of renewables becomes, as more flexibility is required also on the level of European electricity exchange. The energy system as a whole should be coordinated by the government.</p>	
02.17	<p>The government (EU/Country) needs to set the targets for GHG-emissions, RES-E development and the required support mechanism. These targets need to be set by the government since they are part of the political balance of public acceptance of infrastructures and cost. The regulator should determine the required grid infrastructure. The rest such as dispatch and investments into generation units should be left to the market.</p>	
02.18	<p>Governments should at national and European level have the responsibility for planning the whole system (transmission lines, long-term targets for energy sources, ...), while there must be room for different decentralised solutions where various actors will play a role.</p>	

02.19	<p>In general, I would answer this depending on the type of problem involved. If the problem is about resolving uncertainty about a path-dependency-inducing choice (decarbonise with nuke or decarbonise with wind and PV) and where relevant data and information can be accessed and aggregated, planning decisions should rest with an independent planning entity (eg EPE in Brazil). I am not sure, if making system operators also planners would have any detrimental effects. In any case, the planner should be unbundled from owning any particular asset because of conflicts of interest. Planning may take place at different levels of aggregation, i.e. a European grid and large-scale (offshore etc) planning agency, national agencies and possibly sub-national etc. Planning should cover both grid infrastructure and location of RE generation (preferential development zones for larger VRE projects to resolve some of the chicken-egg problems around grid development). Auctions could award who gets to build projects. I would keep grid and generation planning together, the fact that they are separated today is a major issue. The answer suggests a scale-based disaggregation of planning tasks (multi-national, national, sub-national). I think grid and generation planning should rest in one hand, because there are strong interactions between both. Note that there is an important class of problems, where centralised planning will not lead to good outcomes. In particular where information is distributed over vast number of agents and cannot be aggregated easily (think of demand-side response potential in different industrial processes)</p>	
-------	--	--

02.20	<p>Here I am unsure if ‘part of the system’ refers to geography (geographic or electrical portions of a larger grid) or to function (e.g. generation vs transmission vs distribution, or energy markets vs capacity markets). With respect to variable renewables, I think it is clear that the incentives of individual developers are not the same as the incentives of the system as a whole (i.e., the system operator and its customers). Good wind and solar sites from a revenue perspective are not the same as good wind and solar sites with respect to grid integration – things like transmission cost, predictability of output or variability of output. That being said, I think it is also clear that the gains to coordination in the siting of wind and solar plants diminish rapidly after a relatively small number of plants are interconnected. (In other words, maximal geographic smoothing occurs with a relatively small number of plants.) So on the generation side there is room for more decentralised decision-making than on the transmission or distribution side. Planning of the system as a whole is an interesting question. In light of variable renewables investment and the need for transmission to interconnect, it does seem like some coordination is needed between the generation and transmission functions. This could arise through a variety of channels – regulations to encourage transmission investment or a structure of long-term purchase contracts for wind or solar energy that would provide a signal to wires businesses (much the same type of arrangement is necessary in natural gas).</p>	<p>... (i.e., the system operator and its customers, as mentioned in the answer to the previous question). Good wind Planning of the system as a whole is an interesting question. Perhaps the best thing that government could (and should) provide is certainty surrounding regulatory requirements, market design and so forth. In light of variable renewables...</p>
02.21	<p><i>See answer 01.21 above:</i> 1a) no planning by the regulator, regulator should only set a robust framework for contract fulfilment; 1b-1e) and 2) the regulator</p>	

02.22	<p>Planning of the regulated infrastructure (e.g. expansion of transmission capacity) needs to be done by a regulatory administrative body (such as the Bundesnetzagentur). However, this does not necessarily mean micro-planning but setting the right incentives (e.g. expansion of distribution capacity, smart-grid-investments). The market-based sector does not need planning in a strict sense, resources are allocated based on price signals. However, every market needs a legal framework that needs to be developed and executed by the administration (esp. EU-Kommission, Bundeswirtschaftsministerium, Bundesnetzagentur) and decided on by the legislative bodies (esp. EU-parliament, Bundestag). Especially RES-deployment is an area where governments can drive developments (technology, location, quantity). The „overall system planning“ is basically the challenge to coordinate decisions on regulated infrastructure investments and market dynamics. It needs to be done and decided on by the abovementioned bodies.</p>	
02.23	<p>Policies/regulation/market framework: Our elected representatives. Need to have stakeholder dialogues in place and principles like transparency, accountability etc. Individual decisions within the framework: private sector. Key question is who manages the grid in the future if it is not the giant utilities of the past in quasi-monopolistic structures.</p>	
02.24	<p>I don't believe these questions have one answer. It depends on the nature of the system being planned. As a general principle: the people whose success depends on deploying the solution, should plan it. In a competitive market, that will be multiple players, each planning their own portion. In monopoly (and presumably regulated) portions of the grid, it will be just the one player, subject to regulatory oversight.</p>	
02.25		<p>Planning of monopoly infrastructure is as a public good by gov. authorities with public consultation. Competition by competitors investment decisions.</p>
02.26		<p>EU should set binding targets for each part of the system (generation/grid integration/infrastructure...). Member states should put in place effective market-based mechanisms to ensure targets are reached - in close</p>

		coordination with the national regulatory bodies and civil society.
<p>Q3: How should the interaction between the responsible actors/institutions be governed so as to ensure an efficient and effective overall coordination among the components of the system?</p>		
03.01	What should be an effective overall coordination among the components? The electricity system is too complex that neither the regulator nor the market can accomplish this task. The market is not effective but at least it is able to coordinate, in contrast to political institutions. It is obvious that they create a growing mis-coordination.	What should ... political institutions. It is obvious that the intensified interventions cause mis-coordination thus requiring even more interventions.
03.02	Assuming that this question refers to coordination of resources in operation (and not in extension planning) this should be ensured by market places (power exchanges, bilateral markets) for energy and other services required (e.g. balancing, control power). Market rules must allow and support services to integrate distributed resources on both the generation and demand sides.	Coordination in structural planning in an ideal world would to be implicitly ensured by the legal and regulatory market framework. In reality at least I am not aware of such a perfect framework – in the best case unbundled markets are still searching for it (it is important to understand that liberalisation is still work in progress!), but more likely there is no perfect system. That means that a supervisory authority needs to monitor the market permanently and initiate adaptations of the framework as soon as wrong developments are observed. (What refers back to the response to the second question.)
03.03	<u>one way:</u> to develop the current law “NABEG”not only as law for the transmission grid, but also as law for the system as whole, this can help to include the process of participation and the right balancing of all complex aspects. <u>In every case:</u> organisation of emergency process with help of a developed EnSiG (law from 1975 for SoS) Organisation of education and operational training of all (!!) new players like Energiegenossenschaften, Stadtwerke, local grids, multilateral players and so(implementation of a “driver license for energy system”)	
03.04	<u>Coordination of existing generation plants/units:</u> Priority access for intermittent renewables with respect to any other system option, priority access for cogeneration with respect to conventional plants; in case of	

	<p>“too much” intermittent renewables in the electricity system the suppliers should be responsible for handling it (heating market, electric vehicles etc.). In case of “too much” cogeneration in the electricity system the price signal of the spot market will give guidance, as well as for the coordination of the existing conventional power plants. In case of network restrictions the TSOs have to coordinate the re-dispatch. If beside the political targets for renewables and cogeneration another target for storages is adopted framework conditions for storages have to be fixed in order to ensure their proper position in the merit order of the spot market – like it has to be done for cogeneration. <u>Coordination of new-to-build generation plants/units:</u> We need political targets for renewables, cogeneration and eventually storages. Other backup capacities could be acquired through auctions where ecological criteria could play a role beside prices. The amount of backup/reserve capacities has to be fixed by the Bundesnetzagentur.</p>	
03.05	<i>See Answer 01.05 above</i>	
03.06	Same as above (<i>see answer 02.06 above</i>)	
03.07	<p>The more market elements are installed, the higher the need for an adaptive planning process, as market developments cannot be predicted in detail – and neither can their effects on other parts of the system. As the object of governance is the evolving electricity sector, the governance system needs to incorporate negative feedback mechanisms that provide agents with information about the sectors development in order to qualify them to take responsible action. In general: static goals trigger problems with uncertain market dynamics; static means (i.e. the static FIT within the EEG) trigger unintended consequences in other parts of the system (i.e. rising EEG-costs for consumers). Design guidelines for a smart regulatory scheme should involve negative feedback mechanisms and rule-based decision-making.</p>	
03.08	<p>It should be governed in a multi-level way. The information should flow from the lowest levels of territorial units to the central level just for gathering and analysing them. However, the system should be divided</p>	

	into smaller units so governance would take place at local level so it would enable better coordination.	
03.09	<p>Effective coordination: government has the authority to allocate power resource in clear-defined emergency situation. Maybe it is too general answer, I am not very clear yet.</p> <p>Efficient coordination: TSO and dispatching center are the key roles to link generation and consumers together. They should be in strict regulation and monitoring. As well, maybe too general and not very clear yet for me.</p>	(1.13) (Some additional words on the understanding) I interpret the “overall coordination” targeting to keep the system balanced, reliable, and safety. Roles of TSO and ISO are both important, but the way they keep balance of the system at each second should/could be market-oriented (e.g. auction, purchase of balance source etc.).
03.10	The central authorities governing the capacity need estimates and the renewables promotion scheme definition should closely interact or even be in the same entity, as capacity need estimates are dependent both on expected demand and renewables capacity. One could also think of having all organised by the responsible federal ministry of energy.	
03.11	See above (<i>see answer 02.11 above</i>)	
03.12	n. a.	
03.13	Medium-term investment needs analysed by central agency. Basis for regular auctions.	The third question was about the interaction between the actors and institutions. A big problem in this context is the time lag between adjustment of rules and arising problems. The first study about the problems of coordination between renewables and infrastructure was published in 2005 10 years ago and it took too long before adjustments were made. Efficient coordination means flexibility. On the other hand regulations laid down in a law that has to be accepted in a parliamentary way are extremely inflexible. If the task of the government is to set targets rather than to intervene into the coordination of the process by a higher degree of flexibility could be possible.

03.14	<p>The answer once again depends on the system – or more precise the system level – under consideration and the stage of system transformation or time step respectively. In my opinion new “grass-roots” developments and social innovations at the lowest system level shouldn’t be governed at all by a central institution. If there is a need to support certain very decentralised low level developments, this should be governed by local authorities (e.g. quarter management actors like being in place by local agenda 21 initiatives or the municipality). The expansion of RES-E generation technologies at an early transformation stage should be governed by the federal and national authorities in close cooperation. The grid and the overall framework conditions (“Leitplanken”) must be governed by a central intuition (e.g. the state) but should be derived by a deliberative and democratic process. Last but not least, in my opinion there is already one actor in the system that should be given a more coordinating and responsible function in the future: the energy supply companies (dt. EVU). Because they are the only actors in the system who have direct consumer contact on the generation as well as the consumption side of the electricity system. Therefore they are predestined for the complex coordination of variable supply and (stochastic and in the near future still inelastic) demand by taking control over all the available flexibilisation options being out there.</p>	<p>I will stick mainly to my previous answers of round one. For the need for capacity markets either for firm or flexible capacity, see my answer above (Question 1 and 2). But I also want to stretch once more my idea/concept of integrating the VRE via the suppliers (or “Bilanzkreisverantwortliche”) directly, which is described in my discussion paper. In this concept the supplier/retailer should be responsible for balancing the system in the long run by directly integrating the volatile feed-in of RES into their portfolios. The way of marketing the VRE on the spot market like today, is not goal constructive, because in the end “in the open market” no one will take the responsibility of handling the intermittency. Therefore in the near future VRE will always be curtailed by market forces first, as it will always be the “cheapest” option compared to invest in flexibility options. But with a (forced) central “dispatch” of VRE into the portfolios of the suppliers (“physikalische Wälzung”) or by (voluntary) bilateral contracts between RES generators and suppliers (including an additional “integration bonus”), the suppliers will need to look in the system/market for the cheapest options of balancing and coordinating the more intermittent supply with the yet inflexible demand. This way an additional capacity market would be unnecessary and the price for a secured supply will be set market endogenously. The short-term balancing of the grid will be done like today by the TSOs. The overall long-term goals need to be set by the government through a deliberative and democratic process.</p>
03.15	<p>The governance should work via the mechanisms laid out above (i.e. overarching long-term goals/plans by governance, regulatory mechanisms to ensure the boundary conditions and market mechanisms for efficient execution)</p>	
03.16	<p>Coordination by the government with inclusion of relevant political bodies, market actors, NGOs and other institutions has proved to be an efficient means of governance.</p>	
03.17	<p>The government needs to set the targets for the long-term development. The rest of the system has to evolve accordingly.</p>	
03.18	<p>Supranational solutions and institutions should be more important than</p>	

	now.	
03.19	This is a tough question and I do not think there is an easy answer. A clear political consensus, that is translated into long-term objectives would appear very useful. This would give each planning level criteria on which to base individual decisions. Apart from that, a system of representation could ensure that higher level bodies duly factor in the regional concerns. Maybe this could look a bit like parliaments in a federal state, but I am just thinking out loud.	
03.20	I am not sure that 'efficient' in its strictest sense could ever realistically be achieved...but it is a worthy goal so I will go with 'effective' (the word that is often used in the US context is 'workable'). There are some elements of the US system that I think are instructive here. In the Mid-Atlantic US, for example (the PJM market) the level of market-based and decentralised decision-making by generation firms in particular is so high, and incentives are so dispersed, that either a strong democratic-type coordination architecture or a strong centralised architecture is needed explicitly for this coordination. The PJM market has a process that is supposed to promote the former, but in reality PJM adopts the position of the latter, either because institutionally it believes it has the best ideas and policy proposals, or because important issues get caught up in its democratic stakeholder process. In the Midwestern US (the MISO market), a broad regional market is layered on top of a stronger state regulatory system. There are thus a relatively small number of powerful actors at the top (state regulators and the MISO itself), which seems to make coordination much easier without the MISO needing to act as a strong central authority.	... MISO needing to act as a strong central authority. Part of the answer to this question lies in the type of system that is judged to be desirable. A large-scale highly-interconnected system would likely need more centralised coordination (if not outright decision-making power or control) because there is an inherent tension between the increased costs of self-organisation with a large number of system actors and the overall performance goals of the system as a whole. A system that does not have the level of geographic interconnection as current grids in North America and Europe may not need the same level of centralised coordination if the number of participatory actors is small. The nature of that trade-off – between interconnectedness and organisational complexity – is not very well understood.
03.21	The basic idea of a mainly market-based system, based on different segments with different (short-term and long-term) contractual arrangements is to address two functions of a market <ul style="list-style-type: none"> • coordination of operations (and to some extent investments) • closing the pay-back gap for investments by other revenues In this system prices would overtake a large part of coordination. The issue of regulatory demand-setting should be ensured by a governance structure which is characterised by three main points	

	<ul style="list-style-type: none"> • independent institutions • relatively high frequency of reviews and potential adjustments • transparent processes and methodologies, strong role of public consultation 	
03.22	See above / don't know / too broad a question.	
03.23	Policymakers make smart decisions, the market/private sector responds. If policies do not work, they need to be adjusted until they are smart and working in the public interest.	
03.24	By contract, insofar as possible. Multiple models work in the US alone.	
03.25		Public planning need to be app. 5 years ahead for efficient decisions within markets
03.26		The goals set by the EU have to be translated into national goals. Governments should involve relevant groups of stakeholders in the process to ensure a consensus that is as broad as possible.
<p><i>Q4: After having answered the questions above, please tell us how you think your suggested scheme would perform in a scenario in which both households and industry each produce 25% of their own electricity consumption and...</i></p>		
04.01	The suggested scheme has nothing to do with own (decentralised) generation. Such result is possible as well as the contrary. The incumbents risk to lose and will therefore develop strategies to compensate for their losses (if not exit the market). Today these strategies are based on state aid (direct and indirect).	The suggested scheme has nothing to do with own (decentralised) generation. Such result is possible as well as the contrary. Consumption of autogenerated electricity obviously corresponds to the risk that incumbents lose market share. They will therefore develop innovative strategies to prevent autogeneration or to compensate for the associated losses (if not exit the market). Today these strategies are based on claiming state aid (direct and indirect, for example the new tax on autogeneration introduced 2014). It is rather absurd that the government has introduced this tax with the argument of social justice.

04.02	Assuming that covering their own consumption means locally balanced generation this would reduce the required grid capacity. However, at a self-supply rate of 25% I would not expect fundamental changes to what has been said before.	
04.03	Sorry, but it is not the question. Important is the acceptance of the understanding: 1. of the system as whole, 2.the future of an energy market, 3.the principle of a high level of SoS, 4.the cooperation and coordination with Europe in accordance with the European law, article 194 regarding energy and of course, 5. in accordance with climate protection	
04.04	For the industry this would mean much more cogeneration and a little PV (assumed that wind parks in the near of industrial parks are more an exception), for households it would mean much more PV and batteries in the cellar. If these shares of cogeneration and PV are already included in the above mentioned political targets, nothing in my argumentation would change. If not, the targets should be reconsidered if they still make sense in the system as a whole.	
04.05	<i>See Answer 01.05 above</i>	
04.06	Planning for energy infrastructure will need to be done with long-term energy and climate targets. Incentives need to be introduced in the market for flexibility. Increasing shares of RES would be the main mandate of the ISO	
04.07	As the profitability of own electricity consumption depends largely on the regulatory framework, the stability of this framework is the more important the higher the percentage of own electricity consumption.	
04.08	The production of power would be more sustainable and efficient. The more independence would be shifted to single stakeholders. The system would promote smaller producers than large utilities.	

04.09	<p>The further development of Germany current status could be this case. The grid operators would have bigger challenge to face more and more complicated situation. The technology (e.g. smart grid) and management (e.g. more backup) countermeasures to adapt to reduced, centralised electricity supply/demand modes are needed. To a large degree, conventional fossil fuel generators with high operating cost would be out of the market, and take only the backup and reserve role. The flexibility of electricity usage for prosumer is enhanced.</p>	
04.10	<p>If 25% of the electricity is self-consumed, one of the main questions arising is, how the network infrastructure financing is organised. If self-consumed energy is exempted from network tariffs, the base of paying electricity consumers shrinks, rendering network tariffs higher and incentivising self-consumption even more -> a vicious circle with respect to the financing of the network infrastructure. Therefore, a general base tariff for network infrastructure or some kind of other financing scheme has to be thought of. The other parts of the system should not be significantly affected by self-consumption, as this translates simply into a lower demand seen by electricity producers (in certain hours of the year).</p>	
04.11	<p>A proper segmentation of the regulated and the market-based regimes would also function in this kind of framework. Whenever a disproportion between public and private optimisation occurs, regulation would intervene. Eg when there is 25% or more private production and the grid is used for stability, capacity prices for infrastructure have to be implemented as an instrument to maintain public benefits.</p>	
04.12	n. a.	

04.13	<p>Depends on degree of independence from network. Could be zero if full backup power is needed, could be 100% if autoproduction leads to no need for backup from network. Leads to completely different scenarios.</p>	<p>Regarding the questions relating to higher share of 25 or 50% renewable production by consumers many different scenarios are possible I must honestly say that my fantasy is not sufficient to imagine all these different scenarios without going into any more details about a lot of the framework parameters. Autoproduction is no problem as long no system backup is desired. Consumers that produces for his own needs can do so and of course have to take the risk of insufficient production at certain times. If however autoproducers are connected in order to partly supply other consumers and partly need the network to back up their own needs a lot of additional infrastructure is necessary to solve all the information and control problems in such a system. Network operators have to adjust their role and a lot of innovation is needed. Nobody knows the answer about the best arrangement and so my answer would be that the best arrangement is one where we find out the answer step-by-step and also allow different approaches at least for a certain time. Again this is a learning process. A kind of experimental stage is necessary.</p>
04.14	<p>The system would perform perfect, no matter how much electricity is being consumed by households and industry. I call this “flexible regulation schemes”. For further information I can only refer to my discussion paper: http://www.dlr.de/tt/de/Portaldata/41/Resources/dokumente/institut/system/discussion_papers/STB_Diskussionspapier_01-2014_Entwurf_eines_ganzheitlichen_Strommarktdesigns_fuer_hohe_Anteile_erneuerbarer_Energien.pdf</p>	
04.15	<p>(i.e. in sum 50% generated on consumers premises!) For Germany I do not see 50% generation on consumers premises as a beneficial way for society, neither from a cost perspective, nor from a security of supply perspective, nor from an ecological perspective, nor from a feasibility perspective (since decentral needs to be essentially PV, as long as CHP is based on fossil fuel). Note: if the end-customer tariffs are more reflective of cost structure (i.e. ratio fix/ variable) from an economic viewpoint, decentral generation cost of about 5 ct/kWh would be needed to be attractive.</p>	<p>Regarding question 4: I have briefly reflected to change my response to question 4, but have finally decided to stick with my initial statement. I appear to be the only participant, who deems 25% of “on premise” generation as unrealistic/not adequate, but would like to stick with this assessment for the following reasons: we are talking about the energy system of the future (ie. Ca. 2050), in which RES are dominating, i.e. having a share (in power as well as heating etc.) of significantly more than 50% (e.g. 60, 70,80%). Therefore fossil-based CHP cannot play a major role any more for various reasons (CO₂, little flexibility without large storages, too expensive etc.). The only major generation source “on premise” will then be PV. For households I can imagine a share of 25% (although this might be difficult for inner city</p>

		apartment buildings...), but for industry I do not see this share. One could think of H ₂ -driven Fuel cells for generation, but for this we would need a gas grid besides a power grid on the one hand and this would be by far less efficient than direct use of electricity from (more central) RES.
04.16	The grid which has been planned by the regulatory authority might not be designed for this kind of usage. Therefore planning of the grid has to bear in mind the development of self-generation and must be updated regularly.	
04.17	The suggested scheme would still be working as the government can set the rules for the res-e development in the private sector. An efficient market for dispatch and the investment into generation units is still required. The actual location of the generation units is not the crucial aspect. If generation and demand are still matched on a market it does not matter if the consumption and generation take place on the same site.	
04.18	See answer on question 1 (<i>see answer 01.18 above</i>)	
04.19	See answer below. (<i>see answer 05.19 below</i>)	
04.20	There is some irony here in that the higher level of customer-owned production, the more coordination required for the larger grid as a whole, because the grid's requirements for reliable service may change and because the mechanism for paying fixed costs to keep the grid operating will need to be adjusted. That being said, at 25% customer-owned generation I think additional coordination would be required in terms of resources available to the grid to ensure reliable service. I am not sure that the financing mechanism for the grid would need to be	... grid operating will need to be adjusted. The way that customer-owned generation, which would include basically everything from PV to energy storage to electric vehicles to small fossil generators, offers services to the broader electric grid or market (unless all customer-generators are simply supplying for self-consumption, which seems unlikely as new technologies and IT/communication systems emerge) would entail a fairly radical adjustment to both market and regulatory constructs. In addition, at 25% customer-owned generation...

	adjusted at this level although it may be highly context dependent (for example, if customer-owned generation growth increases at the same time as a massive transmission build-out for renewables integration, this may create basic solvency issues).	
04.21	The issue is not what share of self-generation exists. The key issue is the role of indirect transfers (avoided network access fees, structure of surcharges for system costs etc.). Each system would collapse if 20% of total consumption (this would be the equivalent of the shares mentioned above) would not contribute to significant parts of the system costs. The power market arrangement indicated above would however work also in this situation: the energy-only market would shrink, for the other markets the share of self-generation would be reflected in the demand-setting process. Nevertheless, if 20% of the system opt-out from system coordination and optimisation, the total system costs would significantly increase because of the significantly increasing cost of flexibility (which would arise from the lacking portfolio effects among the system resources which are solely subject to micro-optimisation).	
04.22	See below. (<i>see answer 05.22 below</i>)	
04.23	It would work well at this and all other shares.	
04.24	Just fine.	
04.25		Same as above. But, I believe self-generation on this percentage level within today's technologies would be very un-economically. It could happen by bad incentives i.e. surcharges. Because of the inefficiency of this scenario, the wrong incentives needs to be avoided.
04.26		Hard to say. I think the industry is already producing 20 percent of their electricity consumption, households only around 1 percent.

Q5:...50% of their own electricity consumption?		
05.01	The incumbents would have to carry even higher losses.	
05.02	Based on the same assumption as before, i.e. local balance of load and generation, a self-supply rate of 50% (and more) could further reduce the required grid capacity. In case this applies a competitive approach for the remaining 50% and less may become less attractive as a competitive market requires a grid infrastructure with a reasonable over-capacity.	It is important to address that the answer looks very different in case “own consumption” is meaning only production of 50% of their annual load, but without assuming physical local balance (which is a quite likely scenario considering PV being an important source). In this case the liberalised scenario still may make sense, but it will require much more sophisticated services (i.e. offerings) than we are seeing today to integrate highly distributed resources on both the generation and the demand sides into the market.
05.03	n. a.	
05.04	How should this happen except for PV with batteries in the household sector? Or do you think micro-cogeneration on the basis of power-to-gas (hydrogen, methane) will prevail? I really do not consider this scenario as a realistic one. But it could be good starting point for a common project financed by the Ministry for Economic Affairs.	
05.05	<i>See Answer 01.05 above</i>	
05.06	Same as above. You will need a flat rate for grid infrastructure. The grid should be a social good like hospitals and schools, everyone pays for it however, the more you use it the more you pay	
05.07	see above (<i>see answer 04.07 above</i>)	
05.08	The production of power would be even more sustainable and efficient.	

05.09	The predictability of system decline further. The demand response would be important, otherwise, the system TSO must take a greater role to invest on more resource to ensure the reliability and balance of the power system.	(1.19) Grid would NOT monopoly at all with market evolution and self-solution. It becomes a public good to need the supporting role of regulators to keep it alive and exerts benefit to the system (otherwise, the self-solution for the reliability and credit capacity would be higher cost and risky).
05.10	If self-consumption rises to 50%, any quantity-based network tariff with exemption of self-consumption is no longer possible. Or a flat rate for network services or some other financing scheme have to be implemented. The other parts of the system should not be significantly affected by self-consumption, as this translates simply into a lower demand seen by electricity producers (in certain hours of the year).	
05.11	See above (<i>see answer 04.11 above</i>)	
05.12	This shouldn't be a problem as long as those actors take responsibility for system stability / services and assuming, that we speak about average own electricity consumption.	
05.13	See above (<i>see answer 04.13 above</i>)	<i>See answer 04.13 above</i>
05.14	See above (<i>see answer 04.14 above</i>)	I developed my holistic market design concept among others especially for the above mentioned case of ours, as I think that a main driver for RES and capacity investment in the future will be determined by the prosumer concept and the wish of many people/companies of being "energy independent/autarkic" or at least less dependent on the big utilities, world market developments and politics.
05.15	See previous answer.... (<i>see answer 04.15 above</i>)	
05.16	See above (<i>see answer 04.16 above</i>)	
05.17	The suggested scheme would still be working as the government can set the rules for the res-e development in the private sector. An efficient market for dispatch and the investment into generation units is still required. The actual location of the generation units is not the crucial aspect. If generation and demand are still matched on a market	

	it does not matter if the consumption and generation take place on the same site.	
05.18	See answer on question 1 (<i>see answer 01.18 above</i>)	
05.19	<p>I think what is behind this question is, if centralised decision-making – which is suggested by many experts, stakeholders in the current debate – will ultimately collapse once self-generation becomes dominant. I agree that there is a point here. A centrally planned allocation of millions of distributed generators is theoretically awkward and practically impossible.</p> <p>I would still see an important role for providing the infrastructure both for the physical and the economic exchange of the different agents. Even if storage becomes much cheaper, an electricity grid will remain in densely populated areas and where there are seasonal patterns in generation that can be mitigated by different technology mixes in different locations (think wind and sun complementarity in Germany). For large-scale build-out of distributed resources to take place in an orderly fashion, planning standards for such infrastructure need to be robust in the face of such high uptake of distributed resources. Mobilising demand-side response to integrate centralised (V)RE plants raises quite similar issues, by the way.</p>	
05.20	At 50% customer-owned production I think the model of the large-scale grid basically falls apart, and a different model may be needed entirely for both the physical system and the business/regulatory arrangements that govern it.	At 50% customer-owned production I think that existing financial models in support of the large-scale grid basically fall apart, and a different model may be needed entirely for both the physical system and the business/regulatory arrangements that govern it.
05.21	See answer above, no significant difference, the challenge would only be bigger (one third of the system would have opted-out from contributions to the system costs and system optimisation).	
05.22	What kind of scenario is this? Is that likely to come about? Under which conditions? What makes it so special? In general: The coordination-challenges described above need to be met in any case, independent of who owns RES-capacity and whether or not there will be a lot of self-consumption or not (this is only one of many different open	

	features of the future system).	
05.23	It would work well at this and all other shares.	
05.24	Also fine.	
05.25		Even more worse, and more inefficient scenario.
05.26		There would be problems with the grid/backup capacities. How would the infrastructure be financed if 50 percent don't use it anymore? (Agree with 4.16)
Miscellaneous: final remarks / other answers / not linked to question		
XX.15		One more question regarding the key topic, we are addressing in our Delphi Round: in my understanding the key questions, we discussed in our workshop were: 1) if the RES-based energy system of the future needs central planning (or in other words: who decides which technologies will be built or sets the incentives) and 2) how can the financing be done (FIT, ROCs, EOM). In our Delphi Round answers to these central questions seem to be lacking.
XX.17		"I do believe that a market-based dispatch the electricity system is still the most efficient solution in a scenario with high shares of own production. However, this requires dramatic adjustments in the regulatory framework for the financing of grids and support for renewables. These adjustments will also reduce the likelihood of such a scenario as the economics of own production will suffer from these changes towards a higher share of fixed payments."

XX.21	<p>1. The organisation of the electricity system should not only been seen as a result of economic optimisation. Distributional aspects play a major role as well as the legal framework (of the EU), at least for the foreseeable future and the fundamental political core beliefs and decisions (ordnungspolitische Grundüberzeugungen und -entscheidungen) on how the electricity market should be organised.</p> <p>2. The emergency of market design changes results less from self-generation etc. but from the share of renewables in the system, which is important for the levels of revenues which can be generated from the energy-only market as well as the number of installations which need to be coordinated (traditionally 300 installations, at 30% renewables: 1.5 million installations, at 60% renewables ~5 million installations, at 90% renewables >10 million installations)</p>	
XX.24	<p>Building energy consumption in Europe is about half that of the US, and the European grid still works. Efficiency is just another form of load service, so this question is already answered in the field. Rates per unit delivered may go up, but this is a function of the capital cost of the grid. A more interesting question is whether the capital formation purpose of the grid can be brought to bear to solve the problem of behind-the-meter resource deployment, especially efficiency. We think it can. For about 40 years, international energy policy has viewed behind-the-meter resources as inevitably leading to what's now called the "death spiral" – grid and utility economics destroyed by the undermining of the rate base. This view of behind-the-meter resources as economically destructive is rooted firmly in the belief that the grid can only pay for behind-the-meter resources by delivering savings – fewer units. But the development of the feed-in tariff (associated with rooftop solar energy and the German experience), and with the "qualifying facility" (associated typically with combined cycle industrial operations in the US) and much more recently with the advent of the metered energy efficiency transaction system (see www.meetscoalition.org), demonstrate that behind-the-meter resources need not reduce the transaction potential in units on the grid. In each of these cases, the resource is treated like a conventional powerplant; the grid is effectively issuing a power purchase agreement. In each, the powerplant output is not understood as supply to the host building, but</p>	

	<p>instead as supply to the grid - which then supplies the host building at normal rates. Each of these systems enables the transaction and capital formation infrastructure of the grid to access, and scale, behind-the-meter resources. Each encourages the long-term maintenance and persistence of the resource it contracts. And conceptually, each shows the way for the same utility transaction and investment system that lit up the planet in the 20th century, to green it in the 21st.</p>	
--	---	--

Appendix 2: The Responses of Round 1 – Sorted by Respondents

All answers are tagged with individual identifiers for easy reference. The format used is A.R, where A is the answer to the respective question, and R is the respondent. For example, 3.15 is the answer to question 3 given by respondent 15. Where an answer or general remark was given without tagging it to a specific question, we use the XX.R format.

Ident. (A.R)	Answers sorted by respondents n.a. = no answer; <i>own remarks</i>	
	Round 1	Round 2
01.01	Grid as natural monopoly should be regulated, the rest of the value chain market-based.	
02.01	Those who take the financial risk in case of failure to make profits.	Those should have the responsibilities who take the financial risk in case of failure / losses instead of profits. If the government would stop to intervene into the market (beyond providing information and continuing the emission cap and trade system, the system as a whole will work because most actors are able to quickly adapt to new situations.
03.01	What should be an effective overall coordination among the components? The electricity system is too complex that neither the regulator nor the market can accomplish this task. The market is not effective but at least it is able to coordinate, in contrast to political institutions. It is obvious that they create a growing mis-coordination.	What should ... political institutions. It is obvious that the intensified interventions cause mis-coordination thus requiring even more interventions.

04.01	<p>The suggested scheme has nothing to do with own (decentralised) generation. Such result is possible as well as the contrary. The incumbents risk to lose and will therefore develop strategies to compensate for their losses (if not exit the market). Today these strategies are based on state aid (direct and indirect).</p>	<p>The suggested scheme has nothing to do with own (decentralised) generation. Such result is possible as well as the contrary. Consumption of autogenerated electricity obviously corresponds to the risk that incumbents lose market share. They will therefore develop innovative strategies to prevent autogeneration or to compensate for the associated losses (if not exit the market). Today these strategies are based on claiming state aid (direct and indirect, for example the new tax on autogeneration introduced 2014). It is rather absurd that the government has introduced this tax with the argument of social justice.</p>
05.01	<p>The incumbents would have to carry even higher losses.</p>	
01.02	<p>Infrastructure, i.e. the grids as well as technical system operation (ensuring stable and reliable operation of the entire system) should be regulated, energy business and provision of services using either generation or demand resources should be market-based.</p>	
02.02	<p>As the infrastructure is not a business case in itself but enabling other businesses this part of the system requires external supervision and also planning. Governments or other suitable public authorities, such as regulators, should be in charge for this. In the market-based part of the system I would not talk about one party having the responsibility of planning – this is the task of the individual market players for their enterprises. But a public authority should monitor whether the competitive market provides sufficient capacity and uses the infrastructure efficiently and take counteractions by adapting the market rules in case this does not apply.</p>	<p>In the light of the responses from the first round of this study I would like to emphasise that monitoring the competitive market explicitly includes surveillance of generation adequacy and the interference between positioning power plants and grid requirements (a task which is addressed in vertically integrated systems by integrated planning of generation and grid).</p>

03.02	Assuming that this question refers to coordination of resources in operation (and not in extension planning) this should be ensured by market places (power exchanges, bilateral markets) for energy and other services required (e.g. balancing, control power). Market rules must allow and support services to integrate distributed resources on both the generation and demand sides.	Coordination in structural planning in an ideal world would to be implicitly ensured by the legal and regulatory market framework. In reality at least I am not aware of such a perfect framework – in the best case unbundled markets are still searching for it (it is important to understand that liberalisation is still work in progress!), but more likely there is no perfect system. That means that a supervisory authority needs to monitor the market permanently and initiate adaptations of the framework as soon as wrong developments are observed. (What refers back to the response to the second question.)
04.02	Assuming that covering their own consumption means locally balanced generation this would reduce the required grid capacity. However, at a self-supply rate of 25% I would not expect fundamental changes to what has been said before.	
05.02	Based on the same assumption as before, i.e. local balance of load and generation, a self-supply rate of 50% (and more) could further reduce the required grid capacity. In case this applies a competitive approach for the remaining 50% and less may become less attractive as a competitive market requires a grid infrastructure with a reasonable over-capacity.	It is important to address that the answer looks very different in case “own consumption” is meaning only production of 50% of their annual load, but without assuming physical local balance (which is a quite likely scenario considering PV being an important source). In this case the liberalised scenario still may make sense, but it will require much more sophisticated services (i.e. offerings) than we are seeing today to integrate highly distributed resources on both the generation and demand sides into the market.
01.03	generation(all kinds), supply and trade- market-based; TSO-system, DSO- system, storage, transformation between electricity, gas and heat, controlling of load, real-time communication and data transfer, prevention and all aspects of security of supply - regulatory-based	

02.03	<p>In general- Federal Ministry for Economic Affairs and Energy (BMWi) under control of a new committee of the Bundestag (realisation of Energiewende), For coordination with Europe and in Germany: A new federal authority for coordination of energy aspects, esp. electricity, gas, heat, storage and energy-based communication (including the current departments of BNetzA) and realisation of Energiewende. The responsibility for the system as whole, esp. for the frequency, the general SoS, all voltages higher 220 kV, the coordination and cooperation with the European partners is given direct by the new federal authority (in cooperation with the national TSO's). The responsibility for the local SoS, all other voltages, DSM, local communication between all players, real-time communication, transparency of all data is given by the energy authority of the federal states (in close cooperation with the national new authority for energy and Energiewende).</p>	
03.03	<p><u>one way</u>: to develop the current law "NABEG" not only as law for the transmission grid, but also as law for the system as whole, this can help to include the process of participation and the right balancing of all complex aspects. <u>In every case</u>: organisation of emergency process with help of a developed EnSiG (law from 1975 for SoS) Organisation of education and operational training of all (!!) new players like Energiegenossenschaften, Stadtwerke, local grids, multilateral players and so(implementation of a "driver license for energy system")</p>	
04.03	<p>Sorry, but it is not the question. Important is the acceptance of the understanding: 1. of the system as whole, 2.the future of an energy market, 3.the principle of a high level of SoS, 4.the cooperation and coordination with Europe in accordance with the European law, article 194 regarding energy and of course, 5. in accordance with climate protection</p>	
05.03	n. a.	

01.04	<p>The electricity system is composed of the following elements: <u>hardware</u>: generation plants/units and transmission and distribution networks including metering devices; <u>generation plants/units system contributions</u>: electricity, capacity, system services for security of supply; <u>system arrangements</u>: wholesale markets / power exchanges – OTC arrangements, retail markets / non-discriminatory access to the grids; balancing markets; TSO responsibilities for system services; network regulation</p> <p><u>a) market-based parts of the system</u>: As long as we have generation plants/units with different marginal costs larger than zero we need wholesale markets/power exchanges in order to determine which of them should be used. Beside this the regulator might decide that market arrangements can provide certain well-defined products and services efficiently and effectively. This holds true today for the balancing markets, and it might hold true in the future eventually for reserve and/or capacity markets as well as for renewables, CHP plants and storages (“auctions”). I doubt whether the price signal of the wholesale market will ever provide a stable investment signal for renewables, CHP plants, storages or backup capacities. In principle markets are blind with respect to long-term necessities, so the framework for well-defined market arrangements is essential. <u>b) regulatory-based parts of the system</u>: Networks as natural monopolies will always be regulated. The same holds true for ensuring security of supply because this must be seen as a public good (“meritorisches Gut”). Balancing accounts (“Bilanzkreise”) of the suppliers/retailers will have to be regulated as well. Beside this market design for special markets and auctions is always a regulatory task.</p>	
02.04	<p><u>Networks</u>: Bundesnetzagentur plus TSOs and DSOs; <u>Security of supply</u>: Bundesnetzagentur plus TSOs and DSOs; <u>renewables targets</u>: Government / Ministry for Economic Affairs; <u>CHP/cogeneration targets</u>: Government / Ministry for Economic Affairs; <u>Other backup capacities</u>: wholesale market plus eventually a decentralised capacity market and/or a reserve market plus “Bilanzkreisausgleich” of the suppliers/retailers.</p> <p>The monitoring of the system as a whole including security of supply should be with the government / Federal Ministry for Economic Affairs</p>	

	and Energy and the Bundesnetzagentur on a yearly basis. “Monitoring” is not “planning”, but the authorities should have the instruments to intervene if security of supply is at risk or if certain political targets will obviously be missed.	
03.04	<p><u>Coordination of existing generation plants/units:</u> Priority access for intermittent renewables with respect to any other system option, priority access for cogeneration with respect to conventional plants; in case of “too much” intermittent renewables in the electricity system the suppliers should be responsible for handling it (heating market, electric vehicles etc.). In case of “too much” cogeneration in the electricity system the price signal of the spot market will give guidance, as well as for the coordination of the existing conventional power plants. In case of network restrictions the TSOs have to coordinate the re-dispatch. If beside the political targets for renewables and cogeneration another target for storages is adopted framework conditions for storages have to be fixed in order to ensure their proper position in the merit order of the spot market – like it has to be done for cogeneration. <u>Coordination of new-to-build generation plants/units:</u> We need political targets for renewables, cogeneration and eventually storages. Other backup capacities could be acquired through auctions where ecological criteria could play a role beside prices. The amount of backup/reserve capacities has to be fixed by the Bundesnetzagentur.</p>	
04.04	<p>For the industry this would mean much more cogeneration and a little PV (assumed that wind parks in the near of industrial parks are more an exception), for households it would mean much more PV and batteries in the cellar.</p> <p>If these shares of cogeneration and PV are already included in the above mentioned political targets, nothing in my argumentation would change. If not, the targets should be reconsidered if they still make sense in the system as a whole.</p>	
05.04	How should this happen except for PV with batteries in the household sector? Or do you think micro-cogeneration on the basis of power-to-gas (hydrogen, methane) will prevail? I really do not consider this scenario as a realistic one. But it could be good starting point for a	

	common project financed by the Ministry for Economic Affairs.	
01.05	I do not know enough about the German electricity system to give the kind of detailed answers that I think your questions require. I don't think they can be answered concisely. In general, I advocate that the new German regulatory system follow the older US cost-of-service based regulatory system with something equivalent to a US Public Utility Commission being the appropriate authority to plan the system, set electricity rates for consumers, etc. I don't think markets for electricity are needed, perhaps with an exception being a long-term electricity supply contract market. Obviously, given all the municipal electric systems in Germany, the new "PUC" type agency will need to coordinate very closely with each municipal utility. But I don't know what kinds of new laws consistent with overall German law would be required to make that happen.	
02.05	<i>See Answer 01.05 above</i>	
03.05	<i>See Answer 01.05 above</i>	
04.05	<i>See Answer 01.05 above</i>	
05.05	<i>See Answer 01.05 above</i>	
01.06	Only ownership should be market-based the rest should be regulated.	
02.06	An independent system operator should do the planning.	
03.06	Same as above (<i>see answer 02.06 above</i>)	

04.06	<p>Planning for energy infrastructure will need to be done with long-term energy and climate targets. Incentives need to be introduced in the market for flexibility. Increasing shares of RES would be the main mandate of the ISO</p>	
05.06	<p>Same as above. You will need a flat rate for grid infrastructure. The grid should be a social good like hospitals and schools, everyone pays for it however, the more you use it the more you pay</p>	
01.07	<p>As energy supply has features of a public good, it is necessary to have a division between market-based and regulatory-based elements in the design of the energy sector. From a banking perspective, the division between market- and regulatory-based elements is primarily important as it bears implications for the assessment of risks and thus – the costs and conditions of finance. In general, regulatory-based instruments bear political risks, while market-based instruments bear competitive risks.</p> <p>An assessment of regulatory risks needs to take into consideration the prevailing contextual arrangements. Take for example the regulation of RE-advancement. In Germany, the political risks of the FIT scheme – the EEG – have been relatively low. The EEG provided RE-producers with guaranteed prices and banks with highly predictable cash-flows, making highly standardised non-recourse project finance solutions possible that were an important backbone of the growth-story of German RE. The political risks of the Spanish FIT, however, turned out to be much higher. The retrograde price adjustments in Spain destroyed a lot of trust in the regulatory framework and in the predictability of RE-development. An assessment of the preferability of regulation in general – or even FIT-regimes in particular – is therefore difficult. What matters is predictability; the higher the predictability of the regulatory framework, the lower the risks and the better the conditions for finance.</p> <p>Market risks on the other hand are in general borne with unpredictability and therefore often require different forms of finance. As cash-flows are not as predictable as under FIT-schemes, non-</p>	

	<p>recourse structures often require different forms of mitigants – such as price hedges, guarantees or variable obligations. Another option to mitigate market risks is more collateral, which may give classical on-balance finance an advantage. A switch towards on-balance products would also implies a change in the loan periods: non-recourse project finance contracts typically provide maturities up to 17 years while corporate loans usually have durations between 5 to 7 years. In the end, such changes may have lasting effects on both, the composition of market players and the growth dynamics of the sector as a whole. From a banking perspective, there is no preference for a general division between market- and regulatory elements. This choice remains political. What matters for the bank is the particular design of the measures and their implications for the risk assessment. Regulatory elements being predictable and safe bear low risks and hence allow for beneficial conditions of finance; market elements tend to increase complexity and thus may lead to alterations in the availability and conditions of debt. As such implications may change the composition and dynamics of the electricity sector – political agents should take these assessments into account when planning new measures of the future electricity market design.</p>	
02.07	<p>The political planning of the diverse parts of the electricity sector should focus on the setting-up of an adequate regulatory framework under which market dynamics can prosper. To set up such a framework, the legislator should involve private stakeholders. Such private stakeholders should include manufacturers, producers, grid operators, distributors, consumers and financiers. Such a broad range of addressees is important as the dynamics of each part of the system are intertwined with all the other parts.</p> <p>As the electricity grid is a natural monopoly, an eligible regulatory body (i.e. BNetzA) should have a central role in the planning of the system. It is important to note, however, that legally, this part of the system needs to be unbundled from the other parts since the liberalisation of the European energy sectors. A close collaboration with ministries, utilities and regional bodies is nevertheless advisable to maintain requisite information about the system as a whole. A concentration of responsibilities, such as the implementation of the German Ministerium</p>	

	für Wirtschaft und Energie, may help to acquire additional legislative impact.	
03.07	The more market elements are installed, the higher the need for an adaptive planning process, as market developments cannot be predicted in detail – and neither can their effects on other parts of the system. As the object of governance is the evolving electricity sector, the governance system needs to incorporate negative feedback mechanisms that provide agents with information about the sectors development in order to qualify them to take responsible action. In general: static goals trigger problems with uncertain market dynamics; static means (i.e. the static FIT within the EEG) trigger unintended consequences in other parts of the system (i.e. rising EEG-costs for consumers). Design guidelines for a smart regulatory scheme should involve negative feedback mechanisms and rule-based decision-making.	
04.07	As the profitability of own electricity consumption depends largely on the regulatory framework, the stability of this framework is the more important the higher the percentage of own electricity consumption.	
05.07	see above (<i>see answer 04.07 above</i>)	
01.08	The question is not clear enough for me or I have too little knowledge about it. If the solutions were totally market-based, there wouldn't be any regulations at all. However, there will always be regulatory component, because the electricity system works inside the country, it's connected with other countries' system, it's taxed etc.	Having seen the other answers this question is now clearer to me. Thank you for sending the summarised replies. Anyway, I agree with the European paradigm of electricity market liberalisation, however I think that power generation should stay regulated to some extent, because there are big differences in power production between different European states. Without a proper coordination and regulation only market-based instruments will not solve all problems. Transmission and distribution should remain regulated; however, once again it requires strong collaboration between different actors in Europe.

02.08	State should have responsibility for planning the system as a whole, however state should do it in close cooperation with DSO's, TSO's and representatives of civic society. It tackles the issue of governance, financial support for developing technologies, environmental protection and energy security.	
03.08	It should be governed in a multi-level way. The information should flow from the lowest levels of territorial units to the central level just for gathering and analysing them. However, the system should be divided into smaller units so governance would take place at local level so it would enable better coordination.	
04.08	The production of power would be more sustainable and efficient. The more independence would be shifted to single stakeholders. The system would promote smaller producers than large utilities.	
05.08	The production of power would be even more sustainable and efficient.	

01.09	<p>The transmission (I would include distribution grid as well in this category) part, which is deemed to be natural monopoly, could be regulatory-based. That is, the regulatory body and the operation of transmission bodies (companies or other agencies) should be bundling to make sure that the tariff was set in a reasonable way and the access of the third parties.</p> <p>Other parts of the system, including the generation and retail, which could be market-based and with multi-sellers and multi-buyers. The dispatching center would be one part of the competition in generation system.</p>	<p>(1.19 & XX.24) Inspired from some peer comments, I would like to add a temporal limit on the consensus (market-based for generation/retails, and natural monopoly for the transmission), limited to short- to medium- term. In fact, as the original idea, the natural monopoly means that one single supplier can provide the lowest price due to the rising return to scale (paralleled lines impossible and infeasible economically). But this might be invalid and outdated with the technology progress (e.g. in the communication sector), or competition in some other forms, or beyond the “power line” sector. In a future world with enough large prosumers and suppliers, if (!) this is true, I would tend to believe that the competition between the grid and the consumers on the reliability of electricity supply (with means of storage, interruptible supply with the grid ancillary service) would exist. This is reflected in the worrying of future role of grid as “Death spiral”, where a condition of the grid service in which costs rapidly increase as a result of changes in the covered electricity volume. So the grid part of the system will be exposed into the competition, and it will not need to be regulated in some degree. Grid might not disappear, but also can’t do strategic market behavior as now.</p> <p>Of course, this change is very radical and only possible in a long-term horizon. This paper analysed this balance development between solar PV system and grid from overall cost perspective (www.sciencedirect.com/science/article/pii/S0301421515001111). It could be a foundation for some further more detailed and data-oriented discussion.</p>
02.09	<p>The owners of the corresponding property have the responsibility to plan its future, and they would do that by themselves.</p> <p>Typically, the TSO have the responsibility to invest on the grid system, and maintain a working balance capacity market.</p> <p>The government is responsible for planning the system as a whole, but to what degree this plan involves is an open question. It can include (but not limited) in rules, market framework (e.g. capacity market), and spatially-relevant usage plan, and large-scale, cross-border projects, nationalisation of some assets etc.</p>	<p>No change. To what extend the planning needed and with which criteria (value standard) to plan seems very controversial.</p>
03.09	<p>Effective coordination: government has the authority to allocate power resource in clear-defined emergency situation. Maybe it is too general answer, I am not very clear yet.</p> <p>Efficient coordination: TSO and dispatching center are the key roles to</p>	<p>(1.13) (Some additional words on the understanding) I interpret the “overall coordination” targeting to keep the system balanced, reliable, and safety. Roles of TSO and ISO are both important, but the way they keep balance of the system at each second should/could be market-oriented (e.g. auction,</p>

	link generation and consumers together. They should be in strict regulation and monitoring. As well, maybe too general and not very clear yet for me.	purchase of balance source etc.).
04.09	The further development of Germany current status could be this case. The grid operators would have bigger challenge to face more and more complicated situation. The technology (e.g. smart grid) and management (e.g. more backup) countermeasures to adapt to reduced, centralised electricity supply/demand modes are needed. To a large degree, conventional fossil fuel generators with high operating cost would be out of the market, and take only the backup and reserve role. The flexibility of electricity usage for prosumer is enhanced.	
05.09	The predictability of system decline further. The demand response would be important, otherwise, the system TSO must take a greater role to invest on more resource to ensure the reliability and balance of the power system.	(1.19) Grid would NOT monopoly at all with market evolution and self-solution. It becomes a public good to need the supporting role of regulators to keep it alive and exerts benefit to the system (otherwise, the self-solution for the reliability and credit capacity would be higher cost and risky).
01.10	<u>Primarily market-based</u> : Dispatch decision of electricity market (conventionals, renewables, flexibility options). Capacity payments based on market-based auctions, while capacity needs estimated by a central authority (regulated). Liberalised end-consumer tariffs. <u>Primarily regulation-based</u> : Network operation & planning, Renewables promotion scheme organisation	... <u>Primarily regulation-based</u> : Network operation & planning, renewables promotion scheme organisation (if promotion scheme is necessary. However promotion scheme itself can be market-based, only scheme design needs regulation), regulated inclusion of externalities of electricity generation (nuclear hazard&waste, air pollution, health issues).
02.10	<u>Capacity needs</u> : a central authority that estimates the needed capacity to ensure security of supply in respective year for which capacity auction is held. <u>Renewables promotion</u> : a central authority needs to organise auctions (if auction-based promotion scheme) or needs to set the levels of the feed-in tariffs (if FIT scheme). <u>Network operation & planning</u> : a central authority needs to regulate the network companies (natural monopolies) and check network expansion plans. <u>Dispatch, end-consumer tariffs</u> : planned and organised by market participants. <u>Overall system planning</u> : The federal ministry responsible for energy should be responsible for planning the system as a whole, e.g. setting	... <u>Overall system planning</u> : The federal ministry responsible for energy should be responsible for planning the system as a whole, e.g. setting the market design rules, etc, based on climate targets being the result of an international political process.

	the market design rules, etc	
03.10	The central authorities governing the capacity need estimates and the renewables promotion scheme definition should closely interact or even be in the same entity, as capacity need estimates are dependent both on expected demand and renewables capacity. One could also think of having all organised by the responsible federal ministry of energy.	
04.10	If 25% of the electricity is self-consumed, one of the main questions arising is, how the network infrastructure financing is organised. If self-consumed energy is exempted from network tariffs, the base of paying electricity consumers shrinks, rendering network tariffs higher and incentivising self-consumption even more -> a vicious circle with respect to the financing of the network infrastructure. Therefore, a general base tariff for network infrastructure or some kind of other financing scheme has to be thought of. The other parts of the system should not be significantly affected by self-consumption, as this translates simply into a lower demand seen by electricity producers (in certain hours of the year).	
05.10	If self-consumption rises to 50%, any quantity-based network tariff with exemption of self-consumption is no longer possible. Or a flat rate for network services or some other financing scheme have to be implemented. The other parts of the system should not be significantly affected by self-consumption, as this translates simply into a lower demand seen by electricity producers (in certain hours of the year).	
01.11	<u>In general:</u> market-based. <u>Exemptions:</u> Natural monopoly (grid), market failure/distortion (eg domination), market introduction (RES-support), disproportion between private and public benefit (RES-support)	
02.11	Each individual part should be subject to private governance; only the exemptions should be managed by regulatory authorities; the system as a whole has to be managed by private parties and regulatory	

	authorities on a well-balanced level-playing field which has to be granted as a framework by the state.	
03.11	See above (<i>see answer 02.11 above</i>)	
04.11	A proper segmentation of the regulated and the market-based regimes would also function in this kind of framework. Whenever a disproportion between public and private optimisation occurs, regulation would intervene. Eg when there is 25% or more private production and the grid is used for stability, capacity prices for infrastructure have to be implemented as an instrument to maintain public benefits.	
05.11	See above (<i>see answer 04.11 above</i>)	
01.12	A combination of energy-only market and focused (!) capacity market, combined with increasing energy tax or ETS. Actors who produce own electricity should nevertheless contribute to necessary system services.	
02.12	State (and related actors) should introduce climate targets, standard for grid stability, renewable energy targets, energy efficiency target and tools, focused capacity market. Market should decide the rest - but in a way that individuals, co-operatives have a fair access to market place.	
03.12	n. a.	
04.12	n. a.	
05.12	This shouldn't be a problem as long as those actors take responsibility for system stability / services and assuming, that we speak about average own electricity consumption.	

01.13	Policy sets targets and rules, regulation monitors them, and the market fulfils them.	<p>The first question was about the division between market-based and regulatory-based parts of the system.</p> <p>As we know there is no general optimal setup of institutions. On the one hand institutions have to regard proper incentives so that decision-making is channeled into the direction wanted, on the other hand cultural traditions to a large extent are important as to what kind of setup of institutions will lead to success. The present setup of institutions regarding the promotion of renewable energy has led to a number of follow-up problems that need to be considered when we discuss the future institutional setup. At present the addition of renewable energy plants is not synchronised with necessary infrastructure. This is like producing cars in a country where there are no roads. In addition the stability of the electricity system is in danger because fluctuations in the renewable segment need to be compensated by other plants guaranteeing stability. The price disparity between renewable plants and other plants makes stabilising plants more and more uneconomic and thus the system stability is in danger. But in the future the twofold market structure (legally fixed prices for renewables and open market for all others) has to be changed towards a unified market system. Regulation is necessary to make sure that infrastructure develops in line with the increase in renewable production and in order to make sure that renewables grow according to targets.</p> <p>As mentioned there is no optimum setup of institutions. What is much more important is a learning process so that the rules of the game are adjusted whenever this seems necessary.</p>
02.13	Producers of renewable and non-renewable plan their investment and production. Competition by auctioning investment slots. Production on the basis of merit order. TSOs plan network investment. DSOs plan network investment. A central agency is needed to coordinate investment plans by producers and TSOs, could be the regulator. DSOs need to develop IT tools and incentives to coordinate autoproduction (virtual generation)	<p>The second question was about responsibility within the system and for the system as a whole. In order to synchronise infrastructure development and the development of renewable production it may be a good idea to auction slots for additional renewable production where ever infrastructure is available or can be made available. This could be the task of the TSO's. Either under supervision of the regulator or directly done by the regulator. A certain amount of independence from direct government intervention seems necessary so that direct interference by interested groups can be at least partly avoided.</p>

03.13	Medium-term investment needs analysed by central agency. Basis for regular auctions.	The third question was about the interaction between the actors and institutions. A big problem in this context is the time lag between adjustment of rules and arising problems. The first study about the problems of coordination between renewables and infrastructure was published in 2005 10 years ago and it took too long before adjustments were made. Efficient coordination means flexibility. On the other hand regulations laid down in a law that has to be accepted in a parliamentary way are extremely inflexible. If the task of the government is to set targets rather than to intervene into the coordination of the process by a higher degree of flexibility could be possible.
04.13	Depends on degree of independence from network. Could be zero if full backup power is needed, could be 100% if autoproduction leads to no need for backup from network. Leads to completely different scenarios.	Regarding the questions relating to higher share of 25 or 50% renewable production by consumers many different scenarios are possible I must honestly say that my fantasy is not sufficient to imagine all these different scenarios without going into any more details about a lot of the framework parameters. Autoproduction is no problem as long no system backup is desired. Consumers that produces for his own needs can do so and of course have to take the risk of insufficient production at certain times. If however autoproducers are connected in order to partly supply other consumers and partly need the network to back up their own needs a lot of additional infrastructure is necessary to solve all the information and control problems in such a system. Network operators have to adjust their role and a lot of innovation is needed. Nobody knows the answer about the best arrangement and so my answer would be that the best arrangement is one where we find out the answer step-by-step and also allow different approaches at least for a certain time. Again this is a learning process. A kind of experimental stage is necessary.
05.13	See above (<i>see answer 04.13 above</i>)	<i>See answer 04.13 above</i>
01.14	In my opinion the division should be determined on the one hand by the type of (technology) supply market and system service under consideration/investigation and on the other hand on the costs and lifetime characteristics of the infrastructure entity. For example: Technologies with high investment but barley marginal cost on the one hand and longtime economical and technological lifetimes (wind, PV,	In Principle I stick to my answer of the 1 st round, that the definition of the deviation between market and regulated based parts should be determined by the type and cost structure of the technologies in the market. Real capital-intensive technologies like RES as well as nuclear will never be able to handle the high financing risks on the completely free and liberalised market without hedging the investment risked though high risk premiums (compare historic or

<p>grid and sometimes storage and base-load technologies) suffer from high financing risks in a liberalised and therefore more or less unpredictable future development of (wholesale) market prices and regulation frameworks. In these cases risks can be decreased by being hedged by some kind of accountable and big insurance institution the best (e.g. the state) or by a widespread diversification of the risk through many risk takers (e.g. the millions of end consumers). By doing so, cost of capital (and therefore the “system costs”) can be kept low. This would probably lead to the lowest macro-economic costs.</p>	<p>current investment decisions in RES and nuclear, where no investments would have been undertaken without the takeover of risks by the state or end consumer (see EEG mechanism or contract for differences and the state guarantee of payment of a loan for the new build Hinkley Point C Nuclear Power Plant in UK). In the end high risk premiums make the system unnecessarily expensive from a macro-economic perspective. Therefore I would agree with the answer of other respondents that generation sector can (in principle) be organised market-based but only to a certain extent. And that the market-based area also requires a certain amount of regulation, especially if there is the political will to transform the system to a renewable-based one with high share of volatile RES (VRE) with high capital cost. So yes, development/deployment of RE would require a more regulated environment (1.10, 1.11, 1.16, 1.17) on the generation sector. I think that the need for the grid sector as natural monopoly to be completely regulated is unquestioned. The retail sector though can be organised by a liberalised market. Although local RES direct marketing and prosumer concepts do not require a “market” at all. I also agree with other respondents that IF the generation sector is completely market-based we will probably need some kind of capacity payments in the future (with high share of RES), but not yet! And that’s for the same reason as mentioned above: Probably no one will invest in capital-intensive technologies in a market environment with no possibility of long-term price development predictions as well as very volatile short-term price developments because of high shares of VRE in the systems. A capacity market could lower the involved risks. So in the end I stick to my general opinion, that it is all about handling the risk to attract new capital for investment. But I am not able to determine in the end whether the market-based or the political-based induced risks will play a more important role. Although for now I tend to believe that market risks are more complex and expansive to handle.</p>
---	---

02.14	<p>This question depends on (a) the kind of system one wants do have, (b) at within which time frame the system should undergo a transition path and (c) the (spatial) boundary definition of the system under discussion. If we follow a normative goal like being formulated in the German energy concept of 2011, the transition of the system and be accelerated if ‘innovation niches’ for specific technologies, business models and (new) consumer behavior are being created by specific “economic development zones” (e.g. the EEG, direct marketing of RES-E via the former ‘green electricity privilege’). Therefore the answer is:</p> <ul style="list-style-type: none"> - As long as we have no “level-playing-field” (e.g. in the generation sector by not internalised external costs), the regulator needs to intervene with specific instruments to at least converge to fair market conditions for every market participant. - The grid is generally accepted of been a natural monopoly and must therefore be regulated at all times. - The supply side can be organised by market forces as long as there are no unequal market entry and market participation conditions (e.g. if there are fair market conditions in place, e.g. by enforced EU directives). 	<p>For the second questions I also stick to my previous answers of the 1st round. Although I deeply think that the security of supply should be a public good, or public service respectively. But I am not sure if capacity <i>needs</i> should be determined [only] by regulatory-based processes (1.10). What do I mean by that?</p> <p>1) In my opinion the state needs to ensure every end consumer to have the level of security of supply (SoS) he wants and that the general assumption/obligation about the level should be the need for almost 100% of SoS around the clock.</p> <p>2) But I believe that we can lower the total system (backup) costs, if we leave the decision of really requiring a 100% SoS-level to the end consumer itself. So in the end every end consumer can refrain from the 100% level and offer a lower level on needed SoS to its utility company in exchange to a lower tariff, DSM measures of storage usage.</p> <p>Therefore some mixture of regulated and market-based approach would be helpful to reach SoS a the lowest costs (e.g. similar to the decentralised capacity market concept).</p> <p>Furthermore, I would go along with respondent (2.19), who mentions the need to keep grid and generation planning together. Especially with higher shares of VRE the need for more regulated approaches or a hybrid approach of price and quantity instruments (1.19) is necessary in my opinion. But this does not mean that the deployment of RES should follow the speed of grid extension, but rather to better harmonise the process in total.</p> <p>I also go along with the tree respondents (2.7, 2.8, 2.11) to explicitly including stakeholder participation as well as an explicit need for target setting, either “governmental” for RE, CHP, (2.4, 2.5, 2.9, 2.10, 2.12, 2.16, 2.17, 2.21), but NOT for DSM!</p>
-------	--	--

03.14	<p>The answer once again depends on the system – or more precise the system level – under consideration and the stage of system transformation or time step respectively. In my opinion new “grass-roots” developments and social innovations at the lowest system level shouldn’t be governed at all by a central institution. If there is a need to support certain very decentralised low level developments, this should be governed by local authorities (e.g. quarter management actors like being in place by local agenda 21 initiatives or the municipality). The expansion of RES-E generation technologies at an early transformation stage should be governed by the federal and national authorities in close cooperation. The grid and the overall framework conditions (“Leitplanken”) must be governed by a central intuition (e.g. the state) but should be derived by a deliberative and democratic process. Last but not least, in my opinion there is already one actor in the system that should be given a more coordinating and responsible function in the future: the energy supply companies (dt. EVU). Because they are the only actors in the system who have direct consumer contact on the generation as well as the consumption side of the electricity system. Therefore they are predestined for the complex coordination of variable supply and (stochastic and in the near future still inelastic) demand by taking control over all the available flexibilisation options being out there.</p>	<p>I will stick mainly to my previous answers of round one. For the need for capacity markets either for firm or flexible capacity, see my answer above (Question 1 and 2). But I also want to stretch once more my idea/concept of integrating the VRE via the suppliers (or “Bilanzkreisverantwortliche”) directly, which is described in my discussion paper. In this concept the supplier/retailer should be responsible for balancing the system in the long run by directly integrating the volatile feed-in of RES into their portfolios. The way of marketing the VRE on the spot market like today, is not goal constructive, because in the end “in the open market” no one will take the responsibility of handling the intermittency. Therefore in the near future VRE will always be curtailed by market forces first, as it will always be the “cheapest” option compared to invest in flexibility options. But with a (forced) central “dispatch” of VRE into the portfolios of the suppliers (“physikalische Wälzung”) or by (voluntary) bilateral contracts between RES generators and suppliers (including an additional “integration bonus”), the suppliers will need to look in the system/market for the cheapest options of balancing and coordinating the more intermittent supply with the yet inflexible demand. This way an additional capacity market would be unnecessary and the price for a secured supply will be set market endogenously. The short-term balancing of the grid will be done like today by the TSOs. The overall long-term goals need to be set by the government through a deliberative and democratic process.</p>
04.14	<p>The system would perform perfect, no matter how much electricity is being consumed by households and industry. I call this “flexible regulation schemes”. For further information I can only refer to my discussion paper: http://www.dlr.de/tt/de/Portaldaten/41/Resources/dokumente/institut/system/discussion_papers/STB_Diskussionspapier_01-2014_Entwurf_eines_ganzheitlichen_Strommarktdesigns_fuer_hohe_Anteile_erneuerbarer_Energien.pdf</p>	

05.14	See above (<i>see answer 04.14 above</i>)	I developed my holistic market design concept among others especially for the above mentioned case of ours, as I think that a main driver for RES and capacity investment in the future will be determined by the prosumer concept and the wish of many people/companies of being “energy independent/autarkic” or at least less dependent on the big utilities, world market developments and politics.
01.15	<p><u>In short:</u> the overall direction will most probably be regulatory-based, but the execution should be market-based wherever possible.</p> <p><u>Examples: Generation:</u> the general direction in generation mix will be determined by society and thus by politics/regulation, since a pure market-based choice without any restrictions would possibly neglect societal goals such as climate protection or preference for renewables. Also an adequate mechanism to ensure that the technologies of choice are being built needs to be in place. However, the execution can be market-based, via e.g. tender processes/auctions for new-built and the present merit-order system for optimal operation of the generation park. Decentral generation (i.e. beyond the meter on a customer’s premise): regulation (e.g. via tariffs, i.e. mix of kW/kWh-based) should be set up in a way, so that the right investments from a societal viewpoint are being enticed. Currently not the case! <u>Grid:</u> networks are and should remain a natural monopoly, since it is not desirable to have parallel network structures, neither from an economic nor from an acceptance viewpoint (although in gas we have parallel systems...).</p> <p>However, performance incentive regulation and possibly other mechanisms ensure efficiency.</p>	Some thoughts on question 1: from a commercial point of view, PV (even in combination with home battery) are already reaching competitiveness today on the basis of grid parity (i.e. w/o FIT). However, from an economic point, this is due to the market distortion immanent in the system, which is based on the present situation that with PV on your roof you can save a lot of money due to the high (EEG, tax etc. loaded) cost per kWh, while the savings in the overall system are only a very small fraction of this, since the system is dominated by fixed cost, while the tariffs are still largely variable cost. This is a state, which cannot be continued ad ultimo, because then less and less consumers with decentral generation (and still relying on the system as backup or feed-in) would not pay for the system any more, leaving the burden to those w/o the opportunity to generate decentrally.

02.15	<p>In short: Planning/execution for each plant/component of the system should be in the hand of market players. However, adequate supervisory mechanisms need to be in place in order to ensure esp. security of supply and the adequate design of the overarching infrastructure lay-out (esp. high-voltage grid).</p> <ul style="list-style-type: none"> - Supervisory mechanisms: responsibility can be given to either the TSOs/DSOs or also to other market players (e.g. retailers) to ensure sufficient capability to fulfil their supply contracts. - Overarching: governmental bodies (on regional, national and EU-level) need to plan iteratively and set guidelines that over time a well functioning system develops. 	
03.15	<p>The governance should work via the mechanisms laid out above (i.e. overarching long-term goals/plans by governance, regulatory mechanisms to ensure the boundary conditions and market mechanisms for efficient execution)</p>	
04.15	<p>(i.e. in sum 50% generated on consumers premises!) For Germany I do not see 50% generation on consumers premises as a beneficial way for society, neither from a cost perspective, nor from a security of supply perspective, nor from an ecological perspective, nor from a feasibility perspective (since decentral needs to be essentially PV, as long as CHP is based on fossil fuel). Note: if the end-customer tariffs are more reflective of cost structure (i.e. ratio fix/ variable) from an economic viewpoint, decentral generation cost of about 5 ct/kWh would be needed to be attractive.</p>	<p>Regarding question 4: I have briefly reflected to change my response to question 4, but have finally decided to stick with my initial statement. I appear to be the only participant, who deems 25% of “on premise” generation as unrealistic/not adequate, but would like to stick with this assessment for the following reasons: we are talking about the energy system of the future (i.e. Ca. 2050), in which RES are dominating, i.e. having a share (in power as well as heating etc.) of significantly more than 50% (e.g. 60, 70,80%). Therefore fossil-based CHP cannot play a major role any more for various reasons (CO₂, little flexibility without large storages, too expensive etc.). The only major generation source “on premise” will then be PV. For households I can imagine a share of 25% (although this might be difficult for inner city apartment buildings...), but for industry I do not see this share. One could think of H₂-driven Fuel cells for generation, but for this we would need a gas grid besides a power grid on the one hand and this would be by far less efficient than direct use of electricity from (more central) RES.</p>
05.15	<p>See previous answer.... (see answer 04.15 above)</p>	

01.16	Generation and distribution of electricity should be primarily market-based (except for the generation of renewable technologies which is excluded from the market due to the government goal of achieving a share of 80 percent to 2050). Transportation of electricity should be primarily regulatory-based due to its character as a natural monopoly.	
02.16	<p>Market-based parts of the system cannot (or should not) be planned explicitly due to their complexity. This is the reason why the responsibility for “planning” is delegated to the individual market participants. Electricity generation from renewable technologies should be planned by the government (or parliament) – at least with regard to quantities, kind of technology and subsidies). This is due to the societal relevance of renewable technologies and the societal goal of achieving a share of 80 percent to 2050.</p> <p>The transportation system should be planned by the regulatory authority. As higher the percentage the share of renewables becomes, as more flexibility is required also on the level of European electricity exchange. The energy system as a whole should be coordinated by the government.</p>	
03.16	Coordination by the government with inclusion of relevant political bodies, market actors, NGOs and other institutions has proved to be an efficient means of governance.	
04.16	The grid which has been planned by the regulatory authority might not be designed for this kind of usage. Therefore planning of the grid has to bear in mind the development of self-generation and must be updated regularly.	
05.16	See above (<i>see answer 04.16 above</i>)	

01.17	The RES-E development should be determined by the government including the support mechanism (Main reason: Political balance of public acceptance of infrastructures and cost is required.). Grid needs to be planned by the regulator (Main reason: political balance of public acceptance of infrastructures and cost) Leave the rest to the market since it is more efficient than a regulator. (Acceptance issues between the remaining generation, storage and flexibility options may not be as important in these cases)	
02.17	The government (EU/Country) needs to set the targets for GHG-emissions, RES-E development and the required support mechanism. These targets need to be set by the government since they are part of the political balance of public acceptance of infrastructures and cost. The regulator should determine the required grid infrastructure. The rest such as dispatch and investments into generation units should be left to the market.	
03.17	The government needs to set the targets for the long-term development. The rest of the system has to evolve accordingly.	
04.17	The suggested scheme would still be working as the government can set the rules for the res-e development in the private sector. An efficient market for dispatch and the investment into generation units is still required. The actual location of the generation units is not the crucial aspect. If generation and demand are still matched on a market it does not matter if the consumption and generation take place on the same site.	
05.17	The suggested scheme would still be working as the government can set the rules for the res-e development in the private sector. An efficient market for dispatch and the investment into generation units is still required. The actual location of the generation units is not the crucial aspect. If generation and demand are still matched on a market it does not matter if the consumption and generation take place on the same site.	

01.18	The electricity system has many subsystems that must be addressed in different ways. So the answer cannot be such simple. Also you can move to a market-based system from a regulatory-based subsystem without changing the system very much (i.e. going from feed-in tariffs to auctioning/“Ausschreibungsmodell”), while others may not change the label of the subsystem (market vs. regulatory) but will change the subsystem drastically.	ADDED: I wondered, what was meant with „the system“. By breaking the system into subsystem, what many respondents did, it is easier/possibly to answer. But then I still have problems – any market-based solution (even so-called free markets) needs a regulatory setting. There are several limitations that have to be addressed (lack of storage, need to serve full demand,...), so that you definitely need a strong regulatory setting. Anyway, you may have subcomponents that can be labelled „primarily market-based“ – but in a larger context, the subsystem won´t.
02.18	Governments should at national and European level have the responsibility for planning the whole system (transmission lines, long-term targets for energy sources, ...), while there must be room for different decentralised solutions where various actors will play a role.	
03.18	Supranational solutions and institutions should be more important than now.	
04.18	See answer on question 1 (<i>see answer 01.18 above</i>)	
05.18	See answer on question 1 (<i>see answer 01.18 above</i>)	

01.19	<p>The first issue to address is, if this governance scheme is supposed to a) facilitate the transition to such a system or b) sustain a new steady state once the transition has been made.</p> <p><u>Let's start with b.</u> If we assume that we have a steady state at high shares of (Variable) Renewable Energy, such a system will need to have sufficient flexible resources to be cost-effective. In the presence of storage and DSM, a lot of the problems articulated today about marginal cost pricing will actually be less pertinent – electricity markets will become much more like normal commodity markets where demand responds to price and demand and supply need not be balanced each second. Also, once we are 'locked into' such a system, the regulatory uncertainty, which is a large factor in paralyzing market-based investments today, will go away. What remains in terms of market-based vs regulatory-based is the question of natural monopolies or public/common goods (the most relevant component here is grid infrastructure). <u>Turning to option a).</u> If the question is about a design that gets us to such a system, I am convinced that a purely market-based system is bound to fail, because there is uncertainty about the level of ambition (what will be the price per tonne or the cap by when etc.) and path (CCS yes/no, nuke yes/no) of decarbonisation. Also, CO₂ pricing is extremely challenging to implement. As such, technology specific instruments appear the best choice and these do rely on a great deal of regulatory intervention. It appears that a hybrid price/quantity approach is becoming the mainstream choice (either via banded certificate schemes of FITs/premiums that have caps in terms of total funds committed or capacity allocated (tenders)).</p>	
-------	--	--

02.19	<p>In general, I would answer this depending on the type of problem involved. If the problem is about resolving uncertainty about a path-dependency-inducing choice (decarbonise with nuke or decarbonise with wind and PV) and where relevant data and information can be accessed and aggregated, planning decisions should rest with an independent planning entity (eg EPE in Brazil). I am not sure, if making system operators also planners would have any detrimental effects. In any case, the planner should be unbundled from owning any particular asset because of conflicts of interest.</p> <p>Planning may take place at different levels of aggregation, i.e. a European grid and large-scale (offshore etc.) planning agency, national agencies and possibly sub-national etc. Planning should cover both grid infrastructure and location of RE generation (preferential development zones for larger VRE projects to resolve some of the chicken-egg problems around grid development). Auctions could award who gets to build projects. I would keep grid and generation planning together, the fact that they are separated today is a major issue.</p> <p>The answer suggests a scale-based disaggregation of planning tasks (multi-national, national, sub-national). I think grid and generation planning should rest in one hand, because there are strong interactions between both.</p> <p>Note that there is an important class of problems, where centralised planning will not lead to good outcomes. In particular where information is distributed over vast number of agents and cannot be aggregated easily (think of demand-side response potential in different industrial processes).</p>	
03.19	<p>This is a tough question and I do not think there is an easy answer. A clear political consensus, that is translated into long-term objectives would appear very useful. This would give each planning level criteria on which to base individual decisions. Apart from that, a system of representation could ensure that higher level bodies duly factor in the regional concerns. Maybe this could look a bit like parliaments in a federal state, but I am just thinking out loud.</p>	
04.19	<p>See answer below. <i>(see answer 05.19 below)</i></p>	

05.19	<p>I think what is behind this question is, if centralised decision-making – which is suggested by many experts, stakeholders in the current debate – will ultimately collapse once self-generation becomes dominant. I agree that there is a point here. A centrally planned allocation of millions of distributed generators is theoretically awkward and practically impossible.</p> <p>I would still see an important role for providing the infrastructure both for the physical and the economic exchange of the different agents. Even if storage becomes much cheaper, an electricity grid will remain in densely populated areas and where there are seasonal patterns in generation that can be mitigated by different technology mixes in different locations (think wind and sun complementarity in Germany). For large-scale build-out of distributed resources to take place in an orderly fashion, planning standards for such infrastructure need to be robust in the face of such high uptake of distributed resources. Mobilising demand-side response to integrate centralised (V)RE plants raises quite similar issues, by the way.</p>	
01.20	<p>First, I do not believe that any part of a large-scale electricity system (whether renewables are part of that system or not) can be primarily market-based and free of regulation in the same way that markets for other products or commodities are. We now have lots of experience showing that lightly regulated markets for both generation and transmission are either too easily manipulated; provide poor signals for investment; or both. I may be convinced to change this view if large amounts of distributed storage are deployed, along with market price signals, so that individuals could have some ability to shift consumption between local and grid-provided sources.</p> <p>That being said, with appropriate regulation it may be the case that generation decisions could be made in a more decentralised manner. Having large amounts of zero-marginal cost generation does not really change this, but new regulatory frameworks would be required that reflect imperfections in forecasting output from variable energy producers like wind and solar. It may be possible for multiple transmission companies to exist within the same planning footprint (as</p>	<p>... That being said, with appropriate regulation it may be the case that generation decisions could be made in a more decentralised manner. There is a basic risk-reward calculus here, however, that would require some coordination between generating companies and consumer interests (as well as an independent grid operator if one exists). Because of the presence of various externalities related to power generation and because risk preferences between generating companies and other interests (customers or grid operators) may not be identical, I could easily see how decentralised power generation decisions could lead to various undesirable outcomes. Having large amounts...</p>

	happens right now in the US), but particularly with respect to high levels of renewable integration some level of coordination on the transmission side seems necessary.	
02.20	<p>Here I am unsure if ‘part of the system’ refers to geography (geographic or electrical portions of a larger grid) or to function (e.g. generation vs transmission vs distribution, or energy markets vs capacity markets). With respect to variable renewables, I think it is clear that the incentives of individual developers are not the same as the incentives of the system as a whole (i.e., the system operator and its customers). Good wind and solar sites from a revenue perspective are not the same as good wind and solar sites with respect to grid integration – things like transmission cost, predictability of output or variability of output.</p> <p>That being said, I think it is also clear that the gains to coordination in the siting of wind and solar plants diminish rapidly after a relatively small number of plants are interconnected. (In other words, maximal geographic smoothing occurs with a relatively small number of plants.) So on the generation side there is room for more decentralised decision-making than on the transmission or distribution side.</p> <p>Planning of the system as a whole is an interesting question. In light of variable renewables investment and the need for transmission to interconnect, it does seem like some coordination is needed between the generation and transmission functions. This could arise through a variety of channels – regulations to encourage transmission investment or a structure of long-term purchase contracts for wind or solar energy that would provide a signal to wires businesses (much the same type of arrangement is necessary in natural gas).</p>	<p>... (i.e., the system operator and its customers, as mentioned in the answer to the previous question). Good wind ...</p> <p>... Planning of the system as a whole is an interesting question. Perhaps the best thing that government could (and should) provide is certainty surrounding regulatory requirements, market design and so forth. In light of variable renewables...</p>
03.20	<p>I am not sure that ‘efficient’ in its strictest sense could ever realistically be achieved...but it is a worthy goal so I will go with ‘effective’ (the word that is often used in the US context is ‘workable’).</p> <p>There are some elements of the US system that I think are instructive here. In the Mid-Atlantic US, for example (the PJM market) the level of market-based and decentralised decision-making by generation firms in particular is so high, and incentives are so dispersed, that either a strong democratic-type coordination architecture or a strong</p>	<p>... MISO needing to act as a strong central authority.</p> <p>Part of the answer to this question lies in the type of system that is judged to be desirable. A large-scale highly-interconnected system would likely need more centralised coordination (if not outright decision-making power or control) because there is an inherent tension between the increased costs of self-organisation with a large number of system actors and the overall performance goals of the system as a whole. A system that does not have the level of geographic interconnection as current grids in North America and</p>

	<p>centralised architecture is needed explicitly for this coordination. The PJM market has a process that is supposed to promote the former, but in reality PJM adopts the position of the latter, either because institutionally it believes it has the best ideas and policy proposals, or because important issues get caught up in its democratic stakeholder process.</p> <p>In the Midwestern US (the MISO market), a broad regional market is layered on top of a stronger state regulatory system. There are thus a relatively small number of powerful actors at the top (state regulators and the MISO itself), which seems to make coordination much easier without the MISO needing to act as a strong central authority.</p>	<p>Europe may not need the same level of centralised coordination if the number of participatory actors is small. The nature of that trade-off – between interconnectedness and organisational complexity – is not very well understood.</p>
04.20	<p>There is some irony here in that the higher level of customer-owned production, the more coordination required for the larger grid as a whole, because the grid's requirements for reliable service may change and because the mechanism for paying fixed costs to keep the grid operating will need to be adjusted.</p> <p>That being said, at 25% customer-owned generation I think additional coordination would be required in terms of resources available to the grid to ensure reliable service. I am not sure that the financing mechanism for the grid would need to be adjusted at this level although it may be highly context dependent (for example, if customer-owned generation growth increases at the same time as a massive transmission build-out for renewables integration, this may create basic solvency issues).</p>	<p>... grid operating will need to be adjusted. The way that customer-owned generation, which would include basically everything from PV to energy storage to electric vehicles to small fossil generators, offers services to the broader electric grid or market (unless all customer-generators are simply supplying for self-consumption, which seems unlikely as new technologies and IT/communication systems emerge) would entail a fairly radical adjustment to both market and regulatory constructs.</p> <p>In addition, at 25% customer-owned generation...</p>
05.20	<p>At 50% customer-owned production I think the model of the large-scale grid basically falls apart, and a different model may be needed entirely for both the physical system and the business/regulatory arrangements that govern it.</p>	<p>At 50% customer-owned production I think that existing financial models in support of the large-scale grid basically fall apart, and a different model may be needed entirely for both the physical system and the business/regulatory arrangements that govern it.</p>

01.21	<p>The key question is on the meaning of market-based and regulatory-based. My definition refers to prices: If prices are set by the regulator I would describe this as a regulatory-based approach, if prices are set by competitive processes which identifies the equilibrium between demand and supply (irrespective of who defines the demand) I describe this as a market-based approach. In the long term I would two parts of the system: <u>(1) the market-base part:</u> fossil power generation/generators, renewable power generation/generators, demand response (including power-to-heat, power-to-X), storage; <u>(2) the regulatory-based part:</u> network infrastructure</p> <p>I see however in the market-based part different segments: <u>(1a) a segment driven by consumer demand:</u> the energy-only-market, based on short-term contracts, <u>(1b) a segments driven by demand created by the regulator:</u> the system service markets, based on short-term contracts, <u>(1c) two or three segment driven by demand created by the regulator:</u> (1ci) markets for firm and flexible capacity (including storage) and demand response/flexibility and (1cii) renewable capacity, based on longer-term contracts</p> <p>Last but not least, one should not forget two additional market segments which will play a significant role for the system and the system transformation: <u>(1d) the market segment for clean dispatch</u> aka the EU ETS, <u>(1e) the market segment for energy efficiency</u> (which will be indispensable in a world dominated by zero-marginal cost options)</p> <p>The main functions are: <u>Ensuring</u> the coordination of the system: 1a, 1b, 1d; <u>Ensuring</u> investments at appropriate risks: 1ci, 1cii, 1e; <u>Ensuring</u> the appropriate infrastructural basis which also provides some flexibility for the range of transition pathways: 2</p>	
02.21	<p><i>See answer 01.21 above:</i> 1a) no planning by the regulator, regulator should only set a robust framework for contract fulfilment; 1b-1e) and 2) the regulator</p>	

03.21	<p>The basic idea of a mainly market-based system, based on different segments with different (short-term and long-term) contractual arrangements is to address two functions of a market</p> <ul style="list-style-type: none"> • coordination of operations (and to some extent investments) • closing the pay-back gap for investments by other revenues <p>In this system prices would overtake a large part of coordination. The issue of regulatory demand-setting should be ensured by a governance structure which is characterised by three main points</p> <ul style="list-style-type: none"> • independent institutions • relatively high frequency of reviews and potential adjustments • transparent processes and methodologies, strong role of public consultation 	
04.21	<p>The issue is not what share of self-generation exists. The key issue is the role of indirect transfers (avoided network access fees, structure of surcharges for system costs etc.). Each system would collapse if 20% of total consumption (this would be the equivalent of the shares mentioned above) would not contribute to significant parts of the system costs.</p> <p>The power market arrangement indicated above would however work also in this situation: the energy-only market would shrink, for the other markets the share of self-generation would be reflected in the demand-setting process. Nevertheless, if 20% of the system opt-out from system coordination and optimisation, the total system costs would significantly increase because of the significantly increasing cost of flexibility (which would arise from the lacking portfolio effects among the system resources which are solely subject to micro-optimisation).</p>	
05.21	<p>See answer above, no significant difference, the challenge would only be bigger (one third of the system would have opted-out from contributions to the system costs and system optimisation).</p>	

01.22	It is economic orthodoxy that the natural monopoly of the grid infrastructure is primarily regulatory-based while there is – in the interest of efficiency and innovation – no reason to deviate from market-based approaches where there is no such market failure (generation, retail, services).	
02.22	<p>Planning of the regulated infrastructure (e.g. expansion of transmission capacity) needs to be done by a regulatory administrative body (such as the Bundesnetzagentur). However, this does not necessarily mean micro-planning but setting the right incentives (e.g. expansion of distribution capacity, smart-grid-investments).</p> <p>The market-based sector does not need planning in a strict sense, resources are allocated based on price signals. However, every market needs a legal framework that needs to be developed and executed by the administration (esp. EU-Kommission, Bundeswirtschaftsministerium, Bundesnetzagentur) and decided on by the legislative bodies (esp. EU-parliament, Bundestag). Especially RES-deployment is an area where governments can drive developments (technology, location, quantity).</p> <p>The „overall system planning“ is basically the challenge to coordinate decisions on regulated infrastructure investments and market dynamics. It needs to be done and decided on by the abovementioned bodies.</p>	
03.22	See above / don't know / too broad a question.	
04.22	See below. <i>(see answer 05.22 below)</i>	
05.22	<p>What kind of scenario is this? Is that likely to come about? Under which conditions? What makes it so special?</p> <p>In general: The coordination-challenges described above need to be met in any case, independent of who owns RES-capacity and whether or not there will be a lot of self-consumption or not (this is only one of many different open features of the future system).</p>	

01.23	Cannot be answered in general. It's not about whether we use market-based components or other forms of regulation (market instruments are a form of regulation as much as regulations impede markets) – it is about how well these instruments are designed and how well they play together in the policy mix. Think effectiveness, efficiency, fairness, etc. as guiding principles.	
02.23	Policies/regulation/market framework: Our elected representatives. Need to have stakeholder dialogues in place and principles like transparency, accountability etc. Individual decisions within the framework: private sector. Key question is who manages the grid in the future if it is not the giant utilities of the past in quasi-monopolistic structures.	
03.23	Policymakers make smart decisions, the market/private sector responds. If policies do not work, they need to be adjusted until they are smart and working in the public interest.	
04.23	It would work well at this and all other shares.	
05.23	It would work well at this and all other shares.	
01.24	Multiple division points are possible. In the US alone, entirely regulated, and almost entirely market-based, grids are functioning physically. The key question is the understood purpose of the grid. If it is a physical purpose, then logically one regulates any monopoly link in the functioning of the grid, and allows the rest to function on a purely market basis. But a principal purpose of the grid's original design was capital formation – utilities historically were the capital formation engines of the community energy grid, with two functions: 1) aggregate chaotic disaggregated short-term demand into stable, creditworthy, long-term demand that could support long-term finance, and 2) thereby reduce the cost of capital and with it the cost of energy, making long-term infrastructure affordable and keeping energy rates	

	<p>fair and affordable. It's worth examining whether purely market-based systems have replicated the historical ability of rate compact utilities to accomplish these functions.</p>	
02.24	<p>I don't believe these questions have one answer. It depends on the nature of the system being planned. As a general principle: the people whose success depends on deploying the solution, should plan it. In a competitive market, that will be multiple players, each planning their own portion. In monopoly (and presumably regulated) portions of the grid, it will be just the one player, subject to regulatory oversight.</p>	
03.24	<p>By contract, insofar as possible. Multiple models work in the US alone.</p>	
04.24	<p>Just fine.</p>	
05.24	<p>Also fine.</p>	
01.25		<p>Monopoly and competition: Heutige Entscheidung (die ich schlüssig finde) Netz-Monopol, der Rest im Markt. Nur bei Zählern könnte man streiten....</p>
02.25		<p>Planning of monopoly infrastructure is as a public good by gov. authorities with public consultation. Competition by competitors' investment decisions.</p>
03.25		<p>Public planning need to be app. 5 years ahead for efficient decisions within markets</p>
04.25		<p>Same as above. But, I believe self-generation on this percentage level within today's technologies would be very un-economically. It could happen by bad incentives i.e. surcharges. Because of the inefficiency of this scenario, the wrong incentives needs to be avoided.</p>
05.25		<p>Even more worse, and more inefficient scenario.</p>

01.26		I agree with 01.12. As the system becomes more decentralised we need to ensure that all producers of energy contribute to the grid (even though investment in the distribution grid could become less necessary when smart, ICT-driven solutions are put in place). The whole system is and should stay highly regulated. Even though EU should check whether regulation is still fit for the Energiewende and the current investment needs (is unbundling blocking private investment?). Mechanisms like the ETS should be strengthened. To ensure there is enough backup capacity (and investment in backup capacity) in a mostly renewable system, we need focused capacity mechanisms that are in line with the climate goals. (I agree with 1.12)
02.26		EU should set binding targets for each part of the system (generation/grid integration/infrastructure...). Member states should put in place effective market-based mechanisms to ensure targets are reached - in close coordination with the national regulatory bodies and civil society.
03.26		The goals set by the EU have to be translated into national goals. Governments should involve relevant groups of stakeholders in the process to ensure a consensus that is as broad as possible.
04.26		Hard to say. I think the industry is already producing 20 percent of their electricity consumption, households only around 1 percent.
05.26		There would be problems with the grid/backup capacities. How would the infrastructure be financed if 50 percent don't use it anymore? (Agree with 4.16)

Miscellaneous: final remarks / other answers / not linked to any question		
XX.15		One more question regarding the key topic, we are addressing in our Delphi Round: in my understanding the key questions, we discussed in our workshop were: 1) if the RES-based energy system of the future needs central planning (or in other words: who decides which technologies will be built or sets the incentives) and 2) how can the financing be done (FIT, ROCs, EOM). In our Delphi Round answers to these central questions seem to be lacking.
XX.17		“I do believe that a market-based dispatch the electricity system is still the most efficient solution in a scenario with high shares of own production. However, this requires dramatic adjustments in the regulatory framework for the financing of grids and support for renewables. These adjustments will also reduce the likelihood of such a scenario as the economics of own production will suffer from these changes towards a higher share of fixed payments.”
XX.21	<p>1. The organisation of the electricity system should not only been seen as a result of economic optimisation. Distributional aspects play a major role as well as the legal framework (of the EU), at least for the foreseeable future and the fundamental political core beliefs and decisions (ordnungspolitische Grundüberzeugungen und -entscheidungen) on how the electricity market should be organised.</p> <p>2. The emergency of market design changes results less from self-generation etc. but from the share of renewables in the system, which is important for the levels of revenues which can be generated from the energy-only market as well as the number of installations which need to be coordinated (traditionally 300 installations, at 30% renewables: 1.5 million installations, at 60% renewables ~5 million installations, at 90% renewables >10 million installations)</p>	

XX.24

Building energy consumption in Europe is about half that of the US, and the European grid still works. Efficiency is just another form of load service, so this question is already answered in the field. Rates per unit delivered may go up, but this is a function of the capital cost of the grid. A more interesting question is whether the capital formation purpose of the grid can be brought to bear to solve the problem of behind-the-meter resource deployment, especially efficiency. We think it can. For about 40 years, international energy policy has viewed behind-the-meter resources as inevitably leading to what's now called the "death spiral" – grid and utility economics destroyed by the undermining of the rate base. This view of behind-the-meter resources as economically destructive is rooted firmly in the belief that the grid can only pay for behind-the-meter resources by delivering savings – fewer units. But the development of the feed-in tariff (associated with rooftop solar energy and the German experience), and with the "qualifying facility" (associated typically with combined cycle industrial operations in the US) and much more recently with the advent of the metered energy efficiency transaction system (see www.meetscoalition.org), demonstrate that behind-the-meter resources need not reduce the transaction potential in units on the grid. In each of these cases, the resource is treated like a conventional powerplant; the grid is effectively issuing a power purchase agreement. In each, the powerplant output is not understood as supply to the host building, but instead as supply to the grid - which then supplies the host building at normal rates. Each of these systems enables the transaction and capital formation infrastructure of the grid to access, and scale, behind-the-meter resources. Each encourages the long-term maintenance and persistence of the resource it contracts. And conceptually, each shows the way for the same utility transaction and investment system that lit up the planet in the 20th century, to green it in the 21st.



IASS Working Paper May 2017

Institute for Advanced Sustainability Studies e.V. (IASS)
Berliner Strasse 130
14467 Potsdam
Tel: +49 (0) 331-28822-340
Fax: +49 (0) 331-28822-310
E-Mail: media@iass-potsdam.de
www.iass-potsdam.de

ViSdP: Prof. Dr Mark G. Lawrence, Managing Scientific Director

DOI: 10.2312/iass.2017.013

To contact the authors:

Dr Patrick Matschoss: matschoss@izes.de
Dr Armin Haas: armin.haas@iass-potsdam.de

