Statement of the German Power Engineering Society within VDE (ETG) regarding

The Position Paper on Smart Grids

An ERGEG Public Consultation Paper

1. Power Engineering Society within VDE (ETG)

The German Power Engineering Society (ETG) organized within the VDE promotes innovations in the field of electric power technologies. ETG offers engineers, scientists and companies a knowledge platform for the exchange of information regarding technical trends. In an interdisciplinary and international network of experts professional studies, analyses and technical papers are provided. Also specialist congresses, workshops and presentations are organized.

2. General

The position paper gives an excellent overview about the challenges and new needs of Smart Grids. It summarizes the findings of different international bodies and first experiences in some countries. It becomes clear that the Smart Grids are the mandatory pre- requisite for

- Sustainability – in the sense of
  - Decrease of the environmental impact of power production and emissions
  - Security of supply ensuring the availability of adequate primary energy sources in the future
  - Lower dependency from imported primary energy resources
- Quality of supply including its 3 pillars
  - Reliability of supply (in the paper named operational security)
  - Voltage quality and
  - Service quality (including new "Smart Grid related" services)
- Competitiveness what implies
  - Market integration of the consumers by variable tariffs and the monitoring of demand and costs
  - Free market access of all kind of generators including the markets for energy, balancing power and emission certificates
  - Full market integration of renewable energy sources and dispersed generation

The ETG/VDE recommends the use of the terms and the systematic above.
The ETG/VDE has performed several studies to underline the need of new regulatory rules for overcoming the barriers for Smart Grids [1-7]. Today the main barriers for implementation of Smart Grid solutions are not technical but the current regulations in some countries.
In the first line, Smart Grids will create benefits for the society. However, we will need a win- win – situation for all stakeholders – the traditional and the new service providers.
Answering the question for public consultations we will consider possible solutions how the different stakeholders can be better integrated in the implementation process of Smart Grids.

3. Answering questions

1. We agree that the electricity networks are facing new challenges. The required innovations are differently for the transmission and distribution level. They can be summarized in the following way
   Transmission:

- New technologies to strengthen the network capability including new transmission technologies e.g. HVDC (High voltage DC transmission) and FACTS (flexible AC transmission systems),
- Advanced technologies for wide area monitoring, control and protection, especially applied for better management of congestions.

Distribution:

- Wide spread installation of smart meters,
- Introduction of dynamic tariffs for the end consumers,
- Penetration of a communication infrastructure in the distribution level (it means the use of the existing infrastructure for smart grid solutions) covering the last meters to the socket of the consumers,
- Installation of more storage capacity in the distribution level (partly by use of electro-mobiles and heat pumps),
- Aggregation of dispersed generation, demand control capabilities and storage into virtual power plants to increase their market opportunities and to participate on the power scheduling and balancing processes,
- Implementation of automation facilities in the distribution network for shorting interruptions and to build "self healing" capabilities,
- Introduction of new building and energy management solutions in household, business and industry.

2. We agree with the ENERGEG understanding of Smart Grids. It corresponds with the European definitions in several official documents.

3. Not only the higher energy efficiency but the dispersed generation as well will impact on the charges for network. The today applied approach to charge for peak load and energy flow in the vertical direction (top down) only cannot lead to an interest of the network operators to implement smart grid solutions. The future basic for network charges shall be fundamentally changed in different ways for transmission and distribution.
   Transmission: The transmission system operators (TSO) provide not only the grid for transmission of power but they are also responsible to provide ancillary services and to compensate all fluctuations from intermittent power plants (balancing zone of renewable sources). For that they get compensation in proportion to the peak load in and the vertical energy flow to the sub- transmission system (110 kV).However, if the vertical flow is low than the TSO has to increase its related charges. Otherwise, if the vertical flow is negative do they pay network charges to the 110 kV network? This contradiction has to be solved in the near future. Figure 1 demonstrates an example.

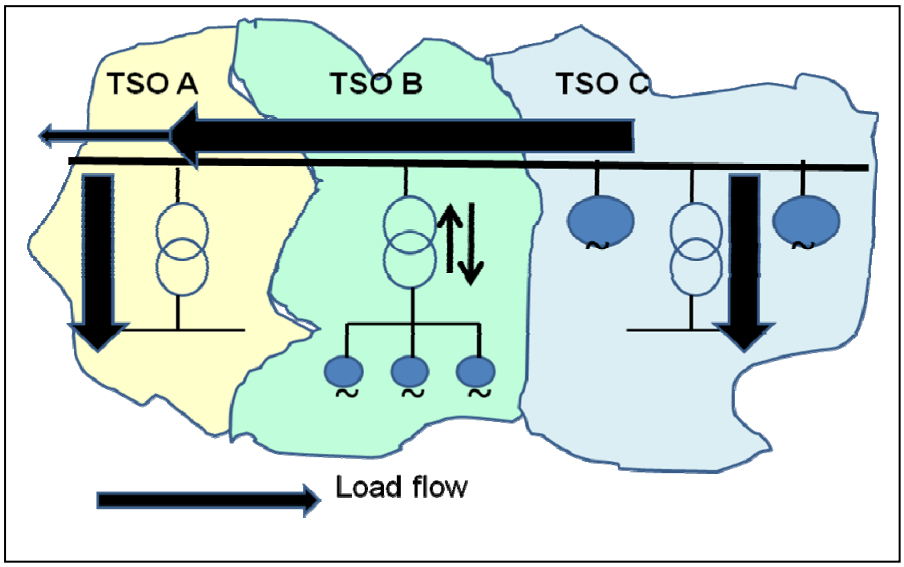

Figure 1.Various situations of transmission systems

TSO A has only weak generation inside his control zone. The energy is mainly imported from other TSOs. TSO C has large power generation capacity feeding into the transmission network. Both have significant vertical power flows.
TSO B has low and bi- directional vertical flows caused by the large amount of dispersed generation in the 110 kV and MV levels. However, its grid is heavily loaded because of the transfer between C and A.
For TSOs in the future the vertical (V) compensation cannot incentivize any network enhancement in the sense of smart grids. A "H" component (horizontal power exchange) and a" G" component (generation) should be included in the charging model. Consequently, charges shall be paid from A (H) and C (G) to B for the network use. Today, the clients of the under-laying networks of B do not load the grid significantly but they have to pay for the transmission system B alone.
Another issue is the current obligation of the TSOs to compensate the fluctuations of renewable sources. This obligation shall be assigned to the power producer who caused the deviations from the schedules. Only in this way, renewable sources can be integrated into the markets. Furthermore, this approach increases the pressure for aggregation into virtual power plants. They can take over the role of balance responsible parties in their area.
Distribution: The basics of the network charges have to be changed in the distribution level as well. In the normal case, here we meet a permanent decreasing power flow because of the dispersed generation (DG) near to the consumers. However, the networks have to be designed for the case that the DG is not available to feed in.
The best way to calculate network charges is to apply the CAPEX (abbreviations) and the OPEX as a basic. (OPEX could be benchmarked on the base of the age and the quantity of equipment). Additionally, bonus or malus can be charged in accordance with the provided power quality parameters.
Finally, a bonus can be paid for the application degree of smart grid solutions.

4. We agree with the mentioned drivers in the document. As a sixth driver we would like to add:
   - Availability of advanced metering, information and communication (ICT) technologies

   From our point of view, it should be clarified that market integration includes the market participation of storage, renewable and distributed energy sources (preferably aggregated in a virtual power plant - VPP).

5. The user centric approach is the pre- requisite of the deployment of smart grids. Each user of the grid shall be involved if the smart grid approach will become successfully. Consequently, each user has to feel its benefits in Euro and Cent. The statement: "The smart grid solutions have the potential to deliver new services in a more cost-efficient way as the traditional solutions would do." is accepted. However, in the first line the implementation of smart grid solutions costs a huge amount of investment. All this investment cannot be assigned to the network operators alone. New service providers will occur and take over the investment related to their business models.
   The deployment of smart grids will happen if each stakeholder can see its benefit.

6. First of all, clear regulatory rules shall be established promoting the deployment of Smart Grids. Such rules can be: If meters have to be changed – smart meters must be installed. For each new meter installation smart meters will be used. The trader has to offer variable tariffs in accordance with the energy market price and the network charges motivating the consumer to shift demand. The responsibility for meters will be handed over to meter service providers as an independent entity based on new regulatory rules (existing practice in UK or Netherlands). A communication provider offers the communications services based on tenders for concrete regions. The VPP as aggregator needs such rules like unlimited access to the markets for energy, balancing power and emission certificates. The establishment of VPPs will happen only on advantageous market conditions and if the responsibility of each power producer including renewable generation is clarified regarding the power balancing process. The shift of this responsibility to the TSO is the main barrier for aggregations. Aggregation will be useful from an economical point of view only if all power producers will become obliged to schedule its day-ahead output and to compensate the costs of deviations from the schedule in real time. The second barrier is the practice of fix feed- in

tariffs for renewable energy independent from and of much higher than the market prices for energy. The subsidy scheme shall support a real market participation of renewable generation as it is described in reference [26] of the position paper!!!
Only after the establishment of adequate regulatory rules all service providers achieve a secure grounding for evaluation of their business models and for starting the required investment.

7. The chapter 3.3. presents a good overview about some future needs and services . However, there is expected more.
   Consumers should expect such services like:
   - Real- time information about the current tariffs and a tariff forecast of about 6 hours,
   - Monitoring of the current demand and the related costs,
   - Home automation means optimizing the costs through shifting of some kind of load not affecting the life quality into the low tariff time.

   In accordance with the large scale introduction of electro-mobiles further services are expected like market participation of the storage capability considering the constraints of the car owners and monitoring the charges and discharges by showing the related costs and compensations.
   In our mind, the network operators (they are users of the network as well) will receive services:
   - shifting the peak load,
   - ancillary services by aggregators (scheduling, balancing, voltage quality, recovery of supply)

   All stakeholders will receive the adequate information which concerns only their business.
   That concerns for example the
   - network operators (switching states, load situation, voltage quality, short circuit indication)
   - the traders – hourly metered values from the consumers
   - the VPP aggregators – quarterly hour metered values of the VPP participants
   - consumers (see above)

   The selection, compression and marshalling of information for the several stakeholders will be a task of an information provider.
   The communication provider has to ensure a bidirectional information exchange for sending e.g. price signals, switch commands or target power values and profiles.

8. The main future challenges and possible solutions are presented well. Some remarks:
   - The main challenge for dispersed generators, prosumers, storage units is their aggregation into VPPs. Only on this base they can better participate on the markets and provide ancillary services.
   - Active demand management sounds like switching of load. That is not in the interest of the most of the consumers. Only some industrial consumers can participate in the demand management to provide reserve power in the framework of VPPs. The dynamic tariffs will cause a demand side response which is not active (switchable centrally).
   - Planning of network capacity is a traditional task of the network operators and does not belong to the generators.
   - The network operators have to provide ancillary services. They cannot impact any minimizing of these services.
   - A splitting of the challenges between transmission and distribution systems would be useful.

9. The smart grid solutions require in the first line additional investment. They cannot be compared with traditional solutions because they execute new functions which are not available in traditional grids. Some examples:
   - A smart meter costs more than a traditional electromechanical meter (Ferraris)
   - ICT infrastructure is not used in the distribution level today.
   - The VPP- Aggregation of generators, prosumers etc. does not happen because of missing incentives.
   - The described solutions for more secure network operation (3.5.2.) are not in use today. They have to be developed, implemented and approved for each network separately– what causes additional expenses.

In our mind, the benefit/ cost discussion cannot happen on the base how many expenses can be saved because of cheaper smart grid solutions.
The main **objectives of smart grid solutions are in concern with the society needs: Ensuring sustainability, quality of supply and competitiveness in the environment of the growing impact of the "smart grid drivers".**
Only in the second line smart grid solutions will achieve benefits for each stakeholder. However, it is not possible to define these benefits in Euro and Cent in the moment. We need the experience of such projects like E- Energy in Germany or the European projects of the 7th framework programme. Based on the experience in practice the new business models will be developed and the benefit analysis will deliver concrete value for each stakeholder including new service providers.

10. We agree with the conclusions about the regulatory challenges. The regulatory framework will not only play an important role – it is the main enabler for establishing new smart grid solutions and services in the electricity network. It is the time now that the barriers for smart grid solutions will be recognized and that countermeasures will be integrated into the regulatory framework as soon as possible. ETG / VDE is ready to support the finding process based on the experience of its members and presented partially in several studies. However, the main challenge for the regulators is the embedding of the regulatory framework into a European context. **In order to achieve rapid deployment and full efficiency it is necessary to coordinate the development of the legal and regulatory framework, the introduction and implementation of the technical and market processes throughout the whole European Union.**

11. In the first line the focus of regulators should be directed on enabling mechanisms. This can be
    - the support of the introduction of technical solutions like smart meters
    - the use of outputs as benchmarks and for incentives like the reliability parameters SAIFI, SAIDI or parameters expressing the market integration of consumers based on load profile changes like the development of the ratio between peak and weak load (or hours of peak load use) etc.
    - the establishment of clear market rules for new service providers like communication provider, metering service provider, VPP aggregator etc.

    For the progress of smart grids it is important that the regulators introduce the whole scope of rules in cooperation with the legislative of the European countries. Some rules require changes of existing acts in the countries (e.g. the market participation of renewable generation).

12. First of all it should be clear, who is the driver of the effects of smartness in table 1. Our proposal: 1- traders, power producers, VPPs, 2 – TSO, DSO, 3 – DSO, TSO, 4 – DSO, traders, power producers 5 – TSO, DSO, 6 – TSO, 7 – TSO
    We recommend the inclusion of an additional column.
    Secondly, the performance indicators should not present a snap- shoot but a development trend (210, current year, targets 2020, 2030). The following indicators are proposed additionally:

N	**Smartness criterion**	**Performance indicator (2010, current year, 2020, 2030)**	**Stakeholder**
8	Smart Meter coverage	Ratio Smart/ Traditional meters in the supply area Measurable demand response (peak load/weak load ratio) separately for industry, business and households	Metering service provider (today DNO)

9	VPP market participation	Ratio of aggregated and single power production of RES and DG Best practice VPP: profit growth VPP in comparison with the not aggregated components Balancing power required to compensate deviations of the VPP schedule at the TSO level	VPP aggregator
10	Storage technology	Ratio storage capability /installed intermittent power generation Share of used storage capacity from electro- cars	VPP aggregator
11	ICT penetration	Ratio between consumers/ producers with communication access and overall number of consumers/ producers in the supply area	Communication provider
12	Wide area monitoring, control and protection for congestion management	Introduction of advanced principles in the grid and in the control centers • PMUs (Phasor measurement units) • Steady state security assessment • Dynamic security assessment • Preventive actions in case of stability limits • Thermal observation of lines • Automatic reconfiguration after faults	TSO, (DSO)
13	Load flow control and shift	Ratio of maximum loading and minimum loading of lines in one tie (snapshoot for maximum load flow situation)	TSO
14	Frequency stability	Ratio of control power provisions from RES and DG aggregated in VPPs and from traditional power stations for primary control power, secondary control power and minute reserve	TSO

Priority of significance: 1 - 9 – 10 – 14 - 2 – 8 – 11 – 5 – 4 – 3 – 6 - 7 – 12 – 13
In a future regulation the progress in achieving the performance targets 2020 and 2030 should be measured.

13. The output measures for network operators are the same as the related performance indicators in table 1. A sample of measurable indicators could be selected to monitor targets and the trend of changes. The following overview presents such a possible and measurable sample:
    - Reliability of supply: SAIDI, SAIFI, ENS (DSO)
    - Network capacity: Maximum loading of equipment (lines, transformers) , % (TSO, DSO)
    - Availability of the network capacity, % or h/a (TSO, DSO)
    - Coverage of Smart Meters, % (DSO, Meter Service Provider)

    On the European level there are effects which are mainly not affected by the network operators. They often depend on the legal frame in the countries:
    - Decrease of carbon emission (related to 2010),
    - Share of renewable resources in the energy balance,
    - Interconnection capability to neighbor countries related to the peak load of the country.

14. We are convinced that the network companies need incentives for establishing smart grid solutions. In the first line, this could be done by an adaptation of the calculation base for network

charges (see topic 3). A second method is to establish directives for targets, e.g. in which time the full coverage of smart meters shall be reached.

15. In the first line, standards are requested for the communication and information infrastructure. The problem is not the lack of standards but the availability of too many standards.
Various standards are in use for:

- Data base management, (Every vendor of data base systems delivers proprietary data formats. The data files are not exchangeable between various enterprise data systems).

- Communication for power system control, protection and supervision
  - Level 1 – TSO control center (CC) – 400 /220 kV substations, power plants, Sub-transmission CCs
  - Level 2 – inside substations, power plants
  - Level 3 – 110 kV substations – Sub- transmission CC
  - Level 4 - MV terminals (medium voltage), consumes,/ small producers, storage units to DSO CC, traders and VPP

  There is a trend to use commonly the latest standard IEC 61850 on all levels in the future.

- Communication of meters (a large number of standards and proprietary protocols, no common trend visible)

- Communication of building technologies like "smart home"," industrial energy management" (a large number of standards and proprietary protocols, trend goes to KNX)

In [1] the ETG/VDE worked out recommendations which are now mainly applied in the German European and E- Energy projects:

- Data base management using the common information model CIM accordingly IEC 61968 (Distribution) and IEC 61970 (Transmission),
- Uniform communication protocol using the data models and services (application layer) of IEC 61850 but various physical and link layers for flexibility and economy for all communication tasks in the power system (Level 1 – 4),
- Protocol converter at the level of the meter data concentrators,
- Gateways to building automation.

This recommendation is demonstrated in Figure 2.

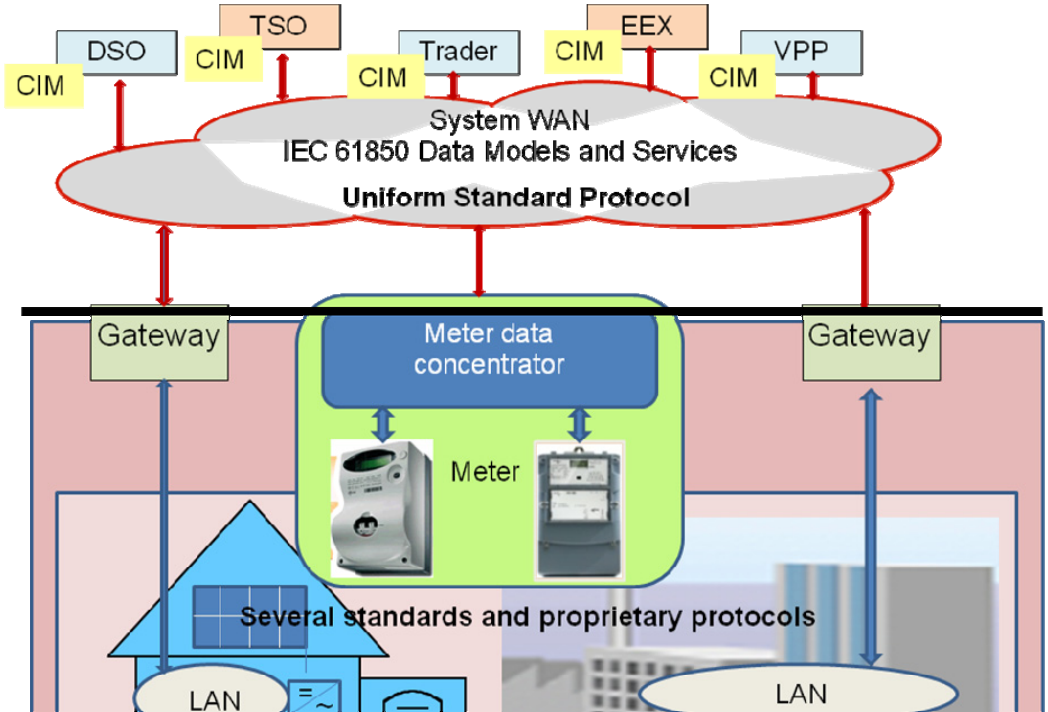

Figure 2. ICT landscape for smart grids and the ETG/ VDE recommendations
(EEX – European Energy Exchange market)

This approach applies the European project "WEB to Energy" in the supply area of HSE AG in Darmstadt. Furthermore, this project will impact on the IEC standardization work and bring the findings to the related standards. It is now clear that 3 of the E- Energy projects will apply the same approach: Cuxhaven, Harz Region and Ruhr area.
In this sense a barrier concerning standards is not seen.

Further standardization demand is seen in the whole complex of services for electro- cars beginning from the sockets for charging / discharging up to the communication of metered values and revenues. A consortium of car manufacturers and energy suppliers was build to work on these standards.

16. In our understanding, the main barriers are currently:
    1. In the majority of European countries the growing share of renewable energy is not integrated in the energy market because of the applied supporting schemes:
        - The right of unlimited feed –in, fully independent of the demand,
        - Fixed feed- in tariffs significantly higher as the market prices,
        - The responsibility for schedule deviations is assigned to the TSO

    The first condition should be kept to keep the priority for renewable resources in the future. However, this condition should be accompanied by supporting schemes for storage technologies. The other two conditions must be skipped. They are the main barrier for an aggregation and market participation of renewable resources and DG (dispersed generation). (A proposal for changes is given in reference 26 of the position paper and in [1]).
    Figure 3 demonstrates the current supporting schemes in Europe

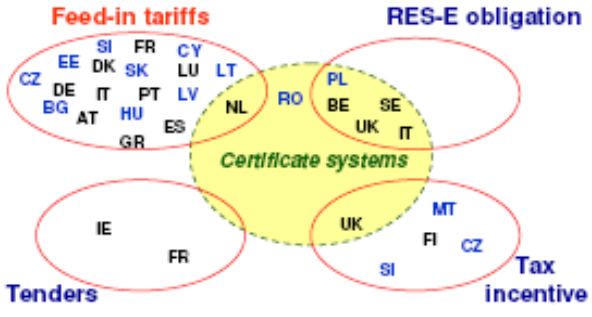

Figure 3. Supporting schemes for renewable energy in Europe (source Eurelec)

2. There is no core interest to install smart meters. In the first line it costs money. The regulations should support adequate business models for meter service providers.

3. There are protests of the population in some countries against the erection of new transmission lines.

4. A supporting scheme for storage is still missing. The currently available storage technologies are not in a technical and a cost position which allows their economical application for power system purposes. The further development and a future broad application of storage technologies require a similar support like it is recommended for the renewable energy sources. (See [1]).

17. Intelligent regulatory rules are able to avoid any cross subsidizing between the stakeholders of the smart grids.
Today the renewable sources are cross- subsidized in the following ways:
    - By the consumers through higher tariffs covering the fixed feed – in tariffs
    - By the network operators (TSO, DSO) through network access without charges
    - By the TSOs through compensation of all deviations from the forecasts

A stepwise market integration of RES will avoid this kind of cross subsidizing.

18. We see the first priority for regulators to achieve a European con-sense that **Smart Grids are the mandatory pre- requisites to reach the 20- 20 – 20 targets of the European Community.**
The second priority is seen in the necessity to integrate renewable energy sources stepwise into the market mechanisms. Intelligent legal and regulatory frameworks are required that this process will run flexible, supports the aggregation of small dispersed units and keeps the quantity of before agreed subsidies.
Thirdly, the legal and regulatory framework for new kinds of service providers is expected. Especially the installation of smart meters and the provision of the "last meter" communication infrastructure are pre- requisites that the customers and the dispersed generation are able to participate on the markets.
The fourth priority (after successful realization of 1-3 priorities) is to set minimum performance parameters or a bonus/ malus system in concern to these parameters (see topic 13).
In our mind, R&D activities are well supported by the European commission and by the governments of some countries. The role of the regulators should be to initiate smart grids activities and projects in such countries where the smart grid initiative is still not started (new members from East and South Europe for example).
Furthermore, the regulators can participate on information days of the ongoing projects with the goal to support the dissemination of the new solutions.
The European project "WEB to Energy" www.w2e.com plans a workshop in 2011:
"This workshop serves the linking with parallel European or German projects (German projects under the brand "E- Energy"). The target is, to exchange experience or good solutions and to build a broad base for a global supporting of the standardization efforts of W2E. Vendors and network operators which are not involved in similar projects are invited as well. It is foreseen that the workshop will be organized under the umbrella of an international organization with high reputation."
ERGEG could build the umbrella for this workshop.

4. Conclusions

The main objectives of smart grid solutions are in the context with the society needs:
Ensuring sustainability, quality of supply and competitiveness in the environment of the growing impact of the "smart grid drivers" – large scale renewable energy sources, distributed generation including small scale renewable sources, end – user participation on the electricity market, market integration and accessibility, new services and the wide spread penetration of enabling technologies like smart meters and ICT.
The European regulators play the key role in promoting the smart grid solutions. The progress on smart grids does not depend on technical solutions. They are available. Europe waits for intelligent legal and regulatory frameworks that make smart grids reality!
VDE/ETG has published some studies in this area and is ready to support the regulators with expert know- how.

5. References

Studies of VDE/ETG:

[1] Smart Distribution: Technical, regulatory and commercial framework for the “smart” integration of a significant proportion of distributed generators in the energy balance

[2] Die deutschen Energie- und Klimaziele in Gefahr – lassen sich die Vorgaben im Stromsektor erreichen?

[3] Energy storage in power supply systems with a high share of renewable energy sources

[4] The efficiency and saving potential of electrical energy in Germany

[5] Decentralized Energy Supply: Technical, regulatory and commercial framework for the “smart” integration of a significant proportion of distributed generators in the energy balance

[6] Versorgungsqualität im deutschen Stromversorgungssystem

[7] Elektrische Energieversorgung 2020 - Perspektiven und Handlungsbedarf