Steffen Wehkamp, Lucas Schmeling, Sven Leonhardt

2 Regulatory and Legal Challenges for District Energy Systems in Practice and Research

Summary: In line with the objectives of the European Commission, local and sustainable energy systems are to be implemented. The energy supply sector is subject to strong regulation because of its critical and sensitive nature. Innovative ideas are often tested first in simulations and later in reality (living labs). In practice, there is a lack of clarity in the regulations and in the communication on how these goals are to be implemented. The objective of this paper is to explore how regulatory aspects can pose an uncertainty for the planning in this area. For this purpose, the current legal framework for local energy systems is examined using the example of a customer system. A qualitative potential analysis is carried out in terms of feasibility. A potential model could be presented, in which the regulatory layer limits the technical potential. It has been shown that regulation that is not clearly defined can represent uncertainty in the form of economic risk. If this uncertainty is too great, it limits the economic and thus the sustainable potential.

2.1 Motivation

The development of the energy transition in Germany so far is taking place away from urban areas. Part of the energy transition is to increase the share of renewable energy technologies. The largest share of renewable energies, are photovoltaic systems (PV), wind turbines on- and offshore. Project developers of wind farms and open field installations of PV and home PV installation owners benefited from the subsidy conditions.

Acknowledgments: The authors thank all the other ENaQ project partners for support, inspiration and fruitful discussions.

Funding: This research was funded by the Federal Ministry for Economic Affairs and Climate Action (BMWK) and the Federal Ministry of Education and Research (BMBF) of Germany in the project ENaQ (project number 03SBE111).

Steffen Wehkamp, OFFIS e.V. – Institute for Computer Science, R&D Devision Energy, Escherweg 2, 26121 Oldenburg, e-mail: steffen.wehkamp@offis.de
Lucas Schmeling, Lintas Green Energy, Alter Stadthafen, 3b, 26122 Oldenburg, e-mail: l.schmeling@lintas-greenenergy.de
Sven Leonhardt, ubineum, Uhdestrasse 25, 08056 Zwickau, e-mail: sven.leonhardt@fh-zwickau.de

https://doi.org/10.1515/9783110777567-002

It was found that stakeholder acceptance is a major factor in the success of such projects. Acceptance can often be achieved through social, economic and physical participation. Thus, in the first step, the construction of wind turbines and PV could be achieved through financial support (Agora 2020).

To date, many PV installations, such as rooftop PV, in rural areas have been obtained through incentives. The next target for subsidies is the urban area, in that the previous support mechanisms were less effective. In cities, the energy demand density is very high and the potential for renewable energies is relatively low. Thus, the city is a critical area in need of energy supply on the way to climate neutrality.

The support of renewable energies, also in urban areas, initially took place via fixed feed-in tariffs, then direct marketing and now also to some extent via tenant electricity. It was also possible to lease roof areas to project developers, such as energy cooperatives. The system operator of a tenant electricity building was supported, while the low-cost provision to tenants in the same building was obligatory.

2.1.1 Local Energy Districts

To include the urban area more in the energy transition strategy, the idea of efficient local supply was developed, in which several stakeholders act together as an energy community. The European Commission introduced the term “Citizen Energy Community” (CEC) in the Clean Energy Package and “Renewable Energy Community” (RES, EU2019). The Clean Energy Package contains several Directives. These Directives represent a request from the European Union to integrate the contents into national law.[1] Within this CEC, for example, the trading of electricity surpluses between neighbors, as well as the distribution of heat via local heating grids should take place. Whereas the REC is not limited to a local area, but in the choice of technologies to renewables.[2]

Similar ideas were already developed and implemented in the Vauban neighborhood in 1993. In this quarter, a low-car traffic concept was followed, and a decentralized energy supply was built via a wood and gas combined heat and power plant (CHP) and PV. In German law, the legal form of the cooperative[3] was used for this purpose. In this case, the operation of the plants was managed by the cooperative, and there was no direct energy trade between residents (Vauban 2022).

---

1 Regarding CES, the Electricity Directive 14/06/2019 – Directive (EU) 2019/944 includes in Article 16 the requirements on how to form a regulatory framework for CES.

2 This is already requested by the European Commission in the Clean Energy Package. See Renewable Energy Communities and Citizen Energy Communities. (Renewable energy: 21/12/2018 – Directive (EU) 2018/2001, Governance of the energy union: 21/12/2018 – Regulation (EU) 2018/1999, Electricity directive: 14/06/2019 – Directive (EU) 2019/944). Available at: https://energy.ec.europa.eu/topics/energy-strategy/clean-energy-all-europeans-package_en#electricity-market-design.

3 German: *„Genossenschaft.“*

The core of the idea and such district approaches lies in energy efficiency. The aim is to reduce energy consumption as much as possible and to supply the remaining consumption as efficiently as possible. Local supply, e.g. by PV, can save transport and the associated losses. But it can also make sense to accept pipeline losses, e.g. in local heating grids, to supply heat with highly efficient CHP.

This article focuses mainly on the power sector. However, since the sectors are strongly interrelated in the field of energy system planning, energy is often referred to generically here. The form of energy or the energy carrier (electricity, heat, gas) is irrelevant when addressing some issues and is therefore not always discussed in detail.

2.1.2 Planning Phase of Districts

When planning such districts, the priority is to examine the potential of the project. This includes, above all, (1) the coordination of the partners involved (building society, local energy supplier, potential residents, local grid operator), (2) the development plan[4] and (3) the choice of an energy supply concept for the district.

In step (1), a common goal is worked out. Here, a vision is formulated at a relatively high level of abstraction. Step (2) deals with concrete conditions for the development of the district. This includes, for example, the parking space ratio for cars and the possibility or obligation to build energy systems on the roofs.[5] In step (3), the design of the energy supply must be determined. For this purpose, energy consumption is forecasted and a possible energy supply is determined. The choice of connection to the power grid is an important parameter of this decision. The owner of the property can decide whether to make a connection request to the (gas and electricity) grid operator, which voltage level to choose depending on the local energy system, or even whether a self-sufficient grid is planned.

Based on the jointly developed objectives, the various concepts of potential can first be defined (see Figure 2.1).

The following potential terms were defined based on VDI (2019) and Hadlak (2020):

- Theoretical potential:
  - Limits of physics.
- Technical potential:
  - Limits of current research and development.
- Practical potential:
  - Limits of regulation, administration and law.

4 German: *„Bebauungsplan."*

5 In development plans, specifications can already be made for various things, such as parking ratios and roof use. The context here is the energetic use. Number of charging columns, roof area that can be used for energy, etc.

- Sustainable achievable potential
  - Intersection of economic, environmental and social potential that can be sustained. Each has its limitations. The smallest intersection is the one that is sustainably achievable for all dimensions.
    - Economical potential
    - Ecological potential
    - Social potential

While investigating the practical potential, we encountered the regulatory framework of the supply grid for such a district. This will be discussed in the following chapter.

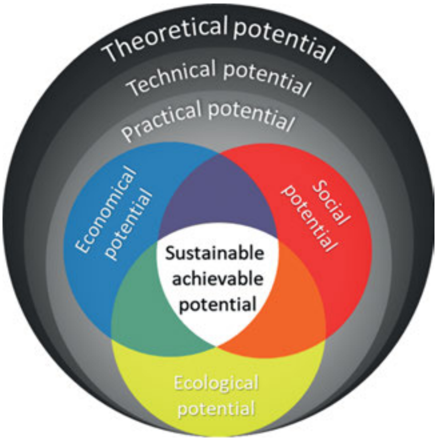

Figure 2.1: Potential terms in the context of energy flexibility.
(Source: Bauer 2016, Dufter 2017, Hadlak 2020, Ausfelder 2020, VDI-Richtlinie VDI 5207)

2.2 History and Overview of Power Supply Grids

The energy industry is a highly regulated area by design. This is due to the precarious nature of the energy system, as is made clear by § 1 of the German Energy Industry Act (EnWG). The following list is intended to briefly illustrate the expert knowledge required to operate in the regulated environment of the energy industry.

Thus, in addition to the EnWG, the regulatory areas are divided into other more specific legal texts such as EEG for renewable energies, KWKG for combined heat and power, StromNZV for access to electricity grids, EnEV for energy conservation, StromGVV for basic electricity supply, GasGVV for basic gas supply, StromNEV for electricity grid fees, GasNEV for gas grid fees, StromStG for electricity tax or EnVKG for energy consumption labeling.

For investments, it is necessary to have legal and regulatory security for the respective project. Various risks are mapped via a risk interest rate to secure the project. Utilizing an example, it shall be shown here that broad detailed knowledge is required to be able to assess the regulatory environment with certainty. Similar terms may be defined differently in different legal texts.

The term end consumer is defined in the legal texts EnWG (§ 3 No. 25), EEG (§ 3 No. 33) and KWKG (§ 2 No. 17). The latter two definitions are identical:

> *any natural or legal person who consumes electricity.*[6]

The definition of the EnWG deviates from this since it already concerns the purchase of energy for the own consumption. This means that final consumption only applies to purchased energy, but not to self-generated and consumed energy if one follows the EnWG.[7, 8] In addition to the multitude of regulations, which must be known to determine the legal certainty, there are also changes in the regulations, which are intended to serve the path to the desired energy system. But even such changes are initially associated with uncertainties. In the case of district power supply, the construction of so-called customer systems[9] has become established. The customer system represents a special non-regulated form of the power grid. This form of grid will be explained in the following. For this purpose, the various forms of power grids in the regulatory system will be discussed, and the associated practice will be explained.

2.2.1 Public Supply Grids

Public supply grids are basically available to supply any end user. It is legally defined in EnWG § 3 No. 17. Due to the public nature of these grids, there are various regulatory requirements for this form of grid. These include:

1. Incentive regulation,[10]
2. Regulation of grid operation (such as: general connection obligation),[11]

---

6 German original: *„jede natürliche oder juristische Person, die Strom verbraucht.“*

7 German original: *„Natürliche oder juristische Personen, die Energie für den eigenen Verbrauch kaufen; auch der Strombezug der Ladepunkte für Elektromobile und der Strombezug für Landstromanlagen steht dem Letztverbrauch im Sinne dieses Gesetzes und den auf Grund dieses Gesetzes erlassenen Verordnungen gleich,.“*

8 Further examples are the terms grid operator (§ 3 No. 36 EEG, § 2 No. 21 KWKG) or operator of: electricity distribution grids, gas distribution grids, energy supply grids (electricity supply grids or gas supply grids), long-distance transmission grids, transmission grids, transmission grids with control area responsibility, hydrogen grids (§ 3 No. 2–5, 7–8, 10–10b, 16 EnWG).

9 German: *„Kundenanlage“*, EnWG § 3 Nr. 24a. & 24b.

10 EnWG § 21a Regulatory requirements for incentives for efficient service provision; German original: EnWG § 21a *„Regulierungsvorgaben für Anreize für eine effiziente Leistungserbringung“*. Further: Ordinance on Incentive Regulation of Energy Supply Grids (Incentive Regulation Ordinance); German originial: *„Verordnung über die Anreizregulierung der Energieversorgungsnetze (Anreizregulierungsverordnung – ARegV).“*

11 EnWG Part 3 §§ 11–35 Regulation of grid operation; German original: EnWG *„Teil 3 §§ 11–35 Regulierung des Netzbetriebs.“*

3. Unbundling of grid and supply,[12]
4. Right to levy grid charges,[13]
5. Compliance with the standards for business processes for the supply of electricity to customers.[14]

Transmission grid. The transmission grid includes the transmission of electricity over long distances, federal states and also countries. The voltage level is ≥ 220 kilovolts and is called high and extra high voltage. Large power plants and industrial electricity consumers are connected to the transmission grid. It is legally defined in EnWG § 3 Nr. 2, 10, 10a.

Distribution grid. The distribution grid includes the transmission of electricity within regional zones, counties and cities. The voltage level is ≥ 400 volts and is called medium and low voltage. Medium power plants, industry, commerce and households are connected to the distribution grid. It is legally defined in EnWG § 3 Nr. 3.

2.2.2 Grids for Specific End Consumers

Local distribution grid. This distribution grid is separated from the grid level above by the concession area. It is legally defined in EnWG § 3 Nr. 29c.

Closed distribution grid. This special type is not connected to the public supply grid and is considered an island grid. It is often used for industrial and commercial areas. It is legally defined in EnWG § 110. This form of grid requires an approval request. The state regulatory authorities or Ruling Chamber 8 are responsible for the approval (Fietze 2019). Now it is necessary to meet the regulatory obligations 1 fully and 2 for the most part. However, large parts of 3. (unbundling) and 5. (business process standards) remain unregulated (DIHK 2017).

Object grid (Areal grid, Factory grid). This form of grid served as an exception to the regulated grid area. Thus, the above-mentioned regulatory provisions did not apply in this grid. Object grids are separate from the regulatory system and are self-managed. It was intended to decouple grids for linked operational supply from the

---

12 EnWG Part 2 §§ 6–10e – Unbundling; German originial: EnWG „*Teil 2 §§ 6–10e – Entflechtung*."

13 Former: EnWG § 92 Fee, Now: Ordinance on Charges for Access to Electricity Supply Grids (Electricity Grid Charges Ordinance); German original: „Verordnung über die Entgelte für den Zugang zu Elektrizitätsversorgungsnetzen (Stromnetzentgeltverordnung – StromNEV)."

14 Business Processes for the Supply of Electricity to Customers – in accordance with Ruling RC6-19-218 of 11.12.2019; German original: „Geschäftsprozesse zur Kundenbelieferung mit Elektrizität (GPKE) – gemäß Beschluss BK6-19-218 vom 11.12.2019."

public supply grid. It was legally defined in EnWG § 110 until 04.08.2011. The reason for the change was a decision on illegality under European law (Fietze 2019).[15]

Customer systems. This form of the grid has been in force since 04.08.2011. It represents the new form of the unregulated grid area and thus replaces the former object grid. It is legaly defined in EnWG § No. 24a. These customer systems are grids for small local residential areas.

Customer systems for company self-supply. It is legaly defined in EnWG § 3 Nr. 24b. These customer systems for company self-supply are grids for small local industrial and commercial areas.

2.2.3 Distinguishing between Power Line and Grids

Direct Line. A line between a single power generation facility and a single point of energy consumption. It is legally defined in EnWG § 3 Nr. 12.

2.3 Legal Uncertainty in Practice of District Energy Systems

Grids in districts, quarters, neighborhoods and between individual residential and/or commercial buildings were operated as customer systems (formerly object grids). These grids are outside the regulation of the EnWG. Regulation at this point refers to the points mentioned in 21.2.1. There are still requirements of a regulatory nature, such as the non-discriminatory choice of electricity suppliers within the customer system.

The term customer system was explained in the previous subchapter. At this point, the advantages and disadvantages of the customer system are intentionally not discussed. This is often accompanied by the question of whether they are justified or whether this is a tax-saving model. This is part of the support policy debate. This particular controversy of the customer system is not intended to be part of this article. Rather, this article presents the circumstance of how uncertainty about the regulatory implementation of local energy systems can have an effect for the decision making process.

In practice, this new regulation of customer systems led to increased legal uncertainty. This was mainly due to the lack of a possibility to have the status of one's system confirmed. Thus, unregulated grids were built and operated according to given non-regulation without confirmation whether this was legal. There was no verification or confirmation mechanism in place (BBH 2011). Thus, it is possible that the oper-

15 Infringement of Art. 20 of the Electricity Directive of 2003, identical to Art. 32 EltRL 2009.

ators of such plants will be sued due to the lack of regulation and, in the event of a corresponding ruling, their operation will be prohibited. The amendment of the EnWg in August 2011 for the first time specified facts for the delimitation of customer systems. However, these were only descriptive and not nominal (BBH 2012).

2.3.1 Rulings as Guidelines

From this circumstance, the practice developed that rulings against the status of a customer system were referred to, to be able to assess one's legal uniqueness. For this purpose, the nominal facts that contradicted the status of a customer system were taken from the reasons given in the court rulings.

This is to be illustrated by the example of residential customer systems according to EnWG § 3 Nr. 24a. The four criteria for a customer system are:
1. Territorial unit,
2. Connection to an Energy Supply Grid or to a generation facility,
3. Insignificance for competition and
4. Non-discriminatory and free use for everyone.

2.3.1.1 Territorial Unit

03.04.2017: In the Ruling Chamber 6, in the ruling RC6-15-166, the status of a customer system was withdrawn, because the territorial unit is not given, if the energetic units are separated by a four-lane road.

12.11.2019: The Federal Court (EnVR 66/18) confirms the status of a customer system due to its physical coherence.

12.11.2019: The Federal Court (EnVR 65/18) withdraws the status of a customer system due to its lack of physical coherence. The external perception is of decisive importance here.

2.3.1.2 Connection to an Energy Supply Grid or a Generation Facility

To date, there is no court ruling based on this criterion.

2.3.1.3 Insignificance for Competition

This characteristic can be further subdivided into:

1. Number of connected end consumers

27.07.2017: In the Ruling Chamber 6, in the ruling RC6-16-279, the status of a customer system was confirmed, because the insignificance for competition is given. The justification referred to the number of end users, which was 20 row houses.

03.04.2017: In the Ruling Chamber 6, in the ruling RC6-15-166, the status of a customer system was withdrawn, because the insignificance for competition is not given. The justification referred to the number of end users, which was 457 and 515 households.

08.03.2018: The Frankfurt Higher Regional Court (Case No. 11 W 40/16 (Kart)) questions the status of a customer system. In its reasoning, the number of 397 households was considered to be contrary to the status of a customer system.

12.11.2019: In the ruling EnVR 65/18 the Federal Court declines the status of customer systems if *„several hundred end consumers are connected“*. This judgment should be evaluated in the context of the other nominal quantified factors since it was made with an AND-conjunction. This ruling confirms the ruling of Ruling Chamber 6 with the case from RC6-15-166.

26.02.2020 The Düsseldorf Higher Regional Court (Case No. VI-3 Kart 729/19) confirmed the status of a customer system with 200 households.

25.01.2022: The Federal Court (EnVR 20/18) confirms the withdrawal of the customer system status from case 11 W 40/16 (Kart). A further trend-setting judgment is expected.

2. Geographical area

03.04.2017: In the Ruling Chamber 6, in the ruling RC6-15-166, the status of a customer system was withdrawn, because the insignificance for competition is not given. The justification referred to the geographical area of 44,631 m^2 (13 plots and 22 residential buildings) and 53,323 m^2 (17 plots and 25 residential buildings).

12.11.2019: In the ruling EnVR 65/18 the Federal Court declines the status of customer system if *„the plant supplies an area of well over 10,000 m^2 and several buildings are connected“*. The exceeding amount, in this case, was 44,631 m^2 and 53,000 m^2 as well as 22 and 30 buildings. This judgment should be evaluated in the context of the other nominal quantified factors since it was made with an AND conjunction. This ruling confirms the ruling of Ruling Chamber 6 with the case from RC6-15-166.

3. Quantity of transmitted energy

03.04.2017: In the Ruling Chamber 6, in the ruling RC6-15-166, the status of a customer systems was withdrawn, because the insignificance for competition is not given. The justification referred to the quantity of transmitted energy, which was 1,005 MWh/a and 1,133 MWh/a.

08.03.2018: The Frankfurt Higher Regional Court (Case No. 11 W 40/16 (Kart)) questions the status of a customer system. The amount of transmitted energy is between 1,000 and 1,200 MWh/a.

26.02.2020 The Düsseldorf Higher Regional Court (Case No. VI-3 Kart 729/19) confirmed the status of a customer system with a quantity of 450 MWh/a transmitted energy.

12.11.2019: In the ruling EnVR 65/18 the Federal Court declines the status of customer systems if *„the annual amount of energy transmitted is expected to significantly exceed 1,000 MWh"*. The exceeding amount, in this case, was 1.483 MWh/a and 1.672 MWh/a. This judgment should be evaluated in the context of the other nominal quantified factors since it was made with an AND-conjunction. This ruling confirms the ruling of Ruling Chamber 6 with the case from RC6-15-166.

25.01.2022: The Federal Court (EnVR 20/18) confirms the withdrawal of the customer system status from case 11 W 40/16 (Kart). The amount of transmitted energy is between 1,000 and 1,200 MWh/a. A further trend-setting judgment is expected.

4. Other characteristics
To date, there is no court ruling based on this criterion.

2.3.1.4 Non-discriminatory and Free Use for Everyone

18.10.2011: Federal court (EnVR 68/10) decides that consumption-based costs for the use of the customer systems lead to the withdrawal of the status of a customer system. An increased electricity price within the customer systems also indicates hidden consumption-based costs.

2.3.1.5 Interim Conclusion

The opposing parties in customer system projects were often the local distribution system operators, housing companies or smaller energy suppliers. Project developers or operators of such systems were able to use the rulings to identify boundaries for the individual facts of customer systems. However, there were large gray areas, such as the number of end users between 20 and 397 households (as of 08.03.2018).[16] In addition, some factual characteristics are less nominal, such as the territorial unit criterion. Other factors have not yet been used at all to make a judgment and remain open to date.

16 Current grey area is between 200 and 397 households as of 26.02.2020.

Based on these examples, it can be seen that the ruling practice in the courts is characterized by uncertainty.

2.3.2 Local Electricity Trading via District Aggregator

Any sale of electricity to end customers generates the status of an energy supply company. The high requirements for energy supply companies[17] make local trading by private individuals and non-specialized trade extremely difficult. Previous studies have presented the business model of the aggregator or, in this case, the neighborhood aggregator (Nemanja 2021). The regulatory framework with the constellation of an aggregator in a customer system is presented below. This list does not claim to be complete.

In principle, the structure of actors in an energy neighbourhood in a customer system is similar to that found in the German energy industry as a whole. The only difference is the size of the area supplied. Associated with this is a new market role that controls the energy flows in the neighborhood. This role is assumed by the neighborhood aggregator. Especially for this actor and its interaction with the other actors, new situations arise that have to be investigated from a legal and regulatory point of view.

The case of self-consumption with the sale of the surplus quantities in terms of the feed-in tariff corresponds to the currently established case and does not require further legal examination. Newly added at the district level is the possibility to deliver the electricity to the aggregator in its role as a local direct marketer (see § 3 Nr. 16 EEG / § 4 KWKG) or energy flow coordinator. There is an energy purchase agreement between these actors, which regulates the scope and remuneration of the electricity supply.

Due to the connection of the customer system to the medium-voltage network of the grid operator, registered power measurement meters (RPM) are used to record electricity consumption when a final consumer is supplied by external energy supply companies. These consumers are then subtracted from the reference quantity of the grid access meter, thus virtually removing these customers from the customer system.

17 German: *„Elektrizitätsversorgungsunternehmen“* following § 3 Nr. 20 EEG (Renewable Energy Sources Act).

2.3.2.1 Customer System Operators

The customer system in the neighborhood is operated either by the aggregator itself or by an external service provider on behalf of the aggregator. The costs incurred for this are passed on to the end consumer.

Due to the legal uncertainty of the status of a customer system, the withdrawal of the status must be taken into account. In this case, the distribution system operator is generally not obliged to return the existing grid to the public grid. Each subscriber may have to submit a new connection request to the grid operator. This may entail new connection costs for the subscriber. It is possible to agree with the distribution system operator to construct and operate the customer system in accordance with the standards of the higher-level grid. In the event of a reversal, the grid operator could therefore take over the customer system at its asset value and convert it into a classic public supply grid.

In the context of Chapter 2.3.1.4, important for refinancing is, according to § 3 No. 24a EnWG, that this is available to the end consumers free of charge. The legislator's main aim here is to prevent the choice of energy supplier from determining who participates in the financing and to what extent. In this logic, it is therefore important that refinancing is not carried out together with the neighborhood electricity product and certainly not dependent on consumption, but rather, for example, via the property owner or a flat rate for network use to be paid by all tenants. Since both tenants and property owners benefit from favorable electricity prices, this can be justified to a certain extent.

2.3.2.2 Metering Concept

The metering of electricity flows in the neighborhood is carried out by smart metering systems, which are installed and managed by a metering service provider. Since the Metering Point Operation Act (MsBG) does not apply within the customer system, the installation of the metering infrastructure and the choice of the scope of functions is the responsibility of the customer system operator.

The metrological equipment must comply with the provisions of the Measurement and Calibration Act and also with the requirements of § 21e (2–4) of the EnWG.

The operator of the customer system is responsible for the selection and installation of the metering systems within the customer system. The public grid operator is responsible for the metering concept at the grid connection point of the customer system, as well as the measurements at the customers supplied by third parties.

In accordance with § 20 Nr. 1d (1) EnWG, the operator of the Energy Supply Grid to which the customer system is connected, i.e. usually the distribution grid operator, is responsible for the sub-meters relevant for balancing. This operator assigns a corresponding market and metering location[18] and thus includes this end consumer in the usual processes of market communication, which is not necessary for internally supplied end consumers. The basic metering point operator (bMPO)[19] then installs the metering infrastructure that is now required. Of course, the end consumer is also free to choose a competitive metering point operator (cMPO)[20]. If the customer system is connected to the medium-voltage grid, it must necessarily be RPM. An externally direct-marketed plant is basically subject to the Metering Point Operation Act (MsbG). Consequently, the plant operator is responsible for the metering concepts in coordination with the responsible distribution grid operator. The hardware is then provided by the basic metering point operator, but the operator can also turn to a third-party metering point operator to install and deploy the metering infrastructure for him.

In the ruling RC6-06-009, it was stipulated in 2006 that the metering concept must enable the allocation of meters within the customer system for end customers. It must be possible to automate the handling of business processes (GPKE38).[21] According to § 20 (1d) EnWG, the operator of the higher-level network must provide a) the meter for the customer system and b) all sub-meters within the customer system that are relevant for accounting.

2.3.2.3 End Consumer

The end user in the district generally has two options for covering his electricity demand, apart from self-consumption of self-generated electricity:

1. purchase from the aggregator,
2. purchase from an external energy supply company.

The possibility of external supply must be guaranteed according to § 3 Nr. 24a EnWG. This case corresponds to the current normal case and does not represent a special case of the quarter-internal power supply.

In case an end consumer wants to switch his electricity supply between options 1. and 2., the same legal principles according to the EnWG apply. However, since the grid operator generally has no knowledge of the customers in the customer system, it is the responsibility of the customer system operator to order a market location for the customer wishing to switch to the grid operator. A normal change of grid supplier is then handled via this market location.

---

18 German: *„Markt- und Messlokation (MaLo/MeLo).“*

19 German: *„Grundzuständiger Messstellenbetreiber (gMSB).“*

20 German: *„Wettbewerblicher Messstellenbetreiber (wMSB).“*

21 Last change in RC6-11-150 from 28.10.2011.

2.3.2.4 Prosumer

Private individuals will rarely deal intensively with the legal situation of their power supply themselves. Here, there is a need for advice and handling of certain processes by a service provider. Therefore, no private individuals may be plant operators in a neighborhood.

2.3.2.5 Feed-in Tariff

The remuneration of energy generation plants within the customer plant depends on the operator and operator model. For electricity from PV plants, the aggregator receives the market premium from the distribution grid operator according to § 19 Nr. 1 1(1) EEG / feed-in tariff according to § 19 Nr. 1 (2) EEG, for electricity from CHP it receives the surcharge for grid-fed or § 7 Nr. 3 KWKG the surcharge for non-grid-fed CHP electricity according to § 7 Nr. 1 KWKG. These revenues refinance the compensation paid to the plant operator. The difference between the remuneration paid and the market premium/KWKG surcharge must be made up by marketing the electricity on internal or external markets.

2.3.2.6 Deconstruction of the Customer System

In the event of a successful lawsuit against the status of the customer system, the operator of the customer system is responsible for the costs of deconstruction. In addition, there are often various costs for the legal proceedings. No statement can be made here about further costs, e.g. on the basis of claims for damages.[22]

2.4 Legal Uncertainty in Research Projects

Within the research of living labs, a technical focus, practical experience and knowledge of current adjudication practice are required. However, in our experience, the integration of legal expertise into a project consortium is difficult to *implement* and *involves* high personnel costs. It can be done either via subcontracting or via integration of expertise as a funded partner. The latter has the advantage of being able to clarify legal issues promptly at any time without additional engagement.

22 German: *„Schadensersatz-Ansprüche.“*

The sister project "Zwickau energy transition demonstration" (ZED)[23] had such a partner, a large business and legal auditing company, in the consortium of an already evaluated project outline. Here, of course, the focus was on the topics of the basic regulatory framework and how it can be improved. Overall, the partner was thus planned as a cross-sectional task almost across all work packages with a not insignificant funding amount in the seven-digit range. During the project submission phase, the budget for such expertise was greatly reduced. This was justified by the ministry and the funding agency because answering such fundamental regulatory questions is not part of this research initiative. Rather, it was the task of accompanying research or higher-level research by institutions commissioned by the federal government to clarify these issues. Instead, the funding agency took on targeted issues by engaging a legal report (BMWK 2020).

This means that research projects like those of this research initiative and the consortia contributing here are not able to make basic research and general statements on these topics. In the course of these projects, we have made the experience that the inclusion of legal expertise is necessary for such investigations. However, in the area of innovative research, one encounters the limits of regulation, which can also be referred to as gray zones. Such existing uncertainties in the ruling practice cannot be compensated for by the most competent partner. Based on the experience gained in the projects, we recommend that the topic of legal certainty be given greater prominence in practical projects and, if necessary, that funding be provided for energy law issues within an appropriate framework.

The ministry has recognized this fact and is calling for clear regulatory insight interest for future living labs. Testing different regulatory approaches in living labs is referred to as regulatory learning. It is intended to give research projects an active role in shaping future legislation. This is partly made possible by exception clauses, as already tested in SINTEG projects (BMWK 2021).

2.5 Conclusion

Achieving the goals of the national energy transition and the international Paris Agreement will require an immense political commitment to the necessary measures. Researchers, climate associations and often governments themselves call for the implementation of innovative (decentralized) energy concepts. It could be shown that certain forms of sustainable decentralized (local) energy supply systems are not an option. This is due to the fact that unclear regulation prevents certain forms of sustainable decentralized (local) energy supply systems through regulatory uncertainty, which has the effect of an economic risk.

23 German: *„Zwickauer Energiewende demonstrieren (ZED).“*

The practice has recognized that the government's goals and current case law are not consistent with each other. The regulation currently restricts the implementation of above mentioned sustainable innovative supply concepts. Case law continues to accord the customer system the exceptional character (Richter 2020). Thus, there is a lack of understanding of how the government intends to implement its own goal of decentralized energy supply. There is a lack of a communicated concrete concept. This is accompanied by two demands: 1) creation of appropriate regulation to own objectives, 2) elimination of uncertainties within regulation. This is also reflected in the criticism of the implementation of the Clean Energy Package directives, which include the introduction of the legal forms "Citizen Energy Community" (CEC) and "Renewable Energy Community" (REC).

In research, too, the regulation makes it difficult to test innovative supply concepts. Regulation in living labs is intended to protect participants and is thus a reasonable claim. Regulation must ensure a safe and just form of care, and this applies to research as well. The regulatory framework is often created for the status quo and thus hinders the exploration of innovative concepts in living labs. The claim that research is open to results can thus only be understood within the restrictive frame of the regulatory framework.

In this paper, the example of local power supply systems was used to show the limitation of technical potential by regulation. Furthermore, it has been shown that regulation that is not clearly defined can represent uncertainty in the form of an economic risk. If this uncertainty is too great, it limits the economic and thus the sustainable potential. Thus, the statement of the present study is only qualitative. For a quantitative statement, the factor of the reduction of the potential through regulation would have to be determined. For this purpose, the climate reports of the IPCC can be consulted. These show that the technical potential is sufficient to avert the climate crisis. It also shows that regulatory adaptation can contribute very strongly to mitigating the climate crisis (IPCC 2022).

Bibliography

Agora (2020) *Akzeptanz und lokale Teilhabe in der Energiewende*. Handlungsempfehlungen für eine umfassende Akzeptanzpolitik. Impuls im Auftrag von Agora Energiewende. Available at: https://www.agora-energiewende.de/veroeffentlichungen/akzeptanz-und-lokale-teilhabe-in-der-energiewende/. (Accessed: 1 April 2022)

Ausfelder, F., Seitz, A., Von Roon, S. (2020) *Flexibilitätsooptionen in der Grundstoffindustrie: Methodik, Potenziale, Hemmnisse.* Bericht des AP V.6 „Flexibilitätsoptionen und Perspektiven in der Grundstoffindustrie" im Kopernikus-Projekt „SynErgie – Synchronisierte und energieadaptive Produktionstechnik zur flexiblen Ausrichtung von Industrieprozessen auf eine fluktuierende Energieversorgung", gefördert durch das Bundesministerium für Bildung und Forschung. Förderkennzeichen: 03SFK3P0 (VDEh-BFI), 03SFK3N0 (DEC), 03SFK3S0 (DIW), 03SFK3C1 (DLR), 03SFK3O0 (FFE), 03SFK3M1 (FGF), 03SFK3M0 (HVG), 03SFK3E1 (TUM), 03SFK3K0 (VDZ), 03SFK3L0 (WI).

Available at: https://dechema.de/dechema_media/Bilder/Publikationen/Buch_FLEXIBILITAETSOPTIONEN.pdf,. (Accessed: 1 April 2022)

Bauer, A. (2016) *Langfristige Bereitstellung von Energie aus der Landwirtschaft*. Institut für Landtechnik Universität für Bodenkultur, Wien. Available at: https://www.oeaw.ac.at/fileadmin/kommissionen/klimaundluft/5_BAUER.pdf,. (Accessed: 1 April 2022)

BBH (2011) *Die EnWG-Reform, Teil 8: Was bin ich – Kundenanlage versus Energienetz*. Available at: https://www.bbh-blog.de/alle-themen/energie/die-enwg-reform-teil-8-was-bin-ich-kundenanlage-versus-energienetz/. (Accessed: 13 April 2022)

BBH (2012) *Kundenanlage und geschlossenes Verteilnetz – Probleme aus der Praxis: Teil 1 einer Serie*. Available at: https://www.bbh-blog.de/alle-themen/energie/kundenanlage-und-geschlossenes-verteilernetz-probleme-aus-der-praxis-teil-1-einer-serie/. (Accessed: 13 April 2022)

BMWK (2020) *Rechtsgutachten bringt Forschung und Datenschutz in Einklang*. Available at: https://www.energiewendebauen.de/forschung-im-dialog/neuigkeiten-aus-der-forschung/detailansicht/rechtsgutachten-bringt-forschung-und-datenschutz-in-einklang. (Accessed: 24 June 2022)

BMWK (2021) *Reallabore – Testräume für Innovation und Regulierung*. Available at: https://www.bmwk.de/Redaktion/DE/Dossier/reallabore-testraeume-fuer-innovation-und-regulierung.html. (Accessed: 24 June 2022)

DIHK (2017) *Merkblatt Kundenanlage und geschlossenes Verteilernetz Abgrenzungen | Voraussetzungen | Empfehlungen.* DIHK – Deutscher Industrie- und Handelskammertag Berlin | Brüssel. Available at: https://www.dihk.de/resource/blob/2602/d87c75d2167bc9237e6d4750dc946814/dihk-merkblatt-kundenanlage-und-geschlossenes-verteilernetz-data.pdf. (Accessed: 13 April 2022)

Dufter, C., Guminski, A., Orthofer, C., et al. (2017) *Lastflexibilisierung in der Industrie – Metastudienanalyse zur Identifikation relevanter Aspekte bei der Potenzialermittlung*. In: IEWT 2017 – 10. Internationale Energiewirtschaftstagung, Energy Economics Group – Technische Universität Wien.

European Commission (2019) *Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU*. Available at: ELI http://data.europa.eu/eli/dir/2019/944/oj. (Accessed: 1 April 2022)

Fietze, D. and Kahl, H. (2019) *Das Energieversorgungsnetz: Eine kritische Bestandsaufnahme der aktuellen Rechtslage und Ansätze zur Vereinheitlichung energierechtlicher Netzbegriffe*. Im Auftrag des Bundesministeriums für Wirtschaft und Energie im Rahmen des Vorhabens Übergreifendes Energierecht (Strom). Available at: https://stiftung-umweltenergierecht.de/wp-content/uploads/2015/10/%C3%9CE_Energieversorgungsnetz.pdf. (Accessed: 6 April 2022)

Hadlak, M. (2020) *Entwicklung von Strategien und Lösungen zur Ausschöpfung zukünftiger Flexibilitätspotenziale vollelektrischer Haushalte, Gewerbe, Industrien und Elektromobilität – AP 1.2 Identifikation von Flexibilitätspotentialen – heute und zukünftig*. (Förderkennzeichen: 03EI4005A) Available at: https://www.tu-braunschweig.de/fileadmin/Redaktionsgruppen/Institute_Fakultaet_5/Elenia/Forschung/Forschungsprojekte/flexess/dokumente/flexess_AP_1_2_Potenzialanalyse.pdf,. (Accessed: 1 April 2022)

IPCC (2021) *Sechster IPCC-Sachstandsbericht (AR6) Beitrag von Arbeitsgruppe III: Minderung des Klimawandels Hauptaussagen aus der Zusammenfassung für die politische Entscheidungsfindung (SPM)*. Version vom 4. April 2022. Available at: https://www.de-ipcc.de/media/content/Hauptaussagen_AR6-WGIII.pdf,. (Accessed: 14. April 2022)

Nemanja, K. and Schmeling, L. (2021) *Designing a marketplace for energy exchange among neighbours*. Conference paper: YEEES Conference – Resilience through Sustainable Entrepreneurship, Digital Solutions and Education. March 2021.

Richter, C. and Herms, M. (2020) *BGH-Urteile zur Kundenanlage: Eine Straße macht noch kein öffentliches Netz*. Available at: https://www.prometheus-recht.de/bgh-urteile-zur-kundenanlage/. (Accessed: 14 April 2022)

Vauban (2022) *DAS QUARTIER VAUBAN*. Available at: https://quartiersarbeit-vauban.de/das-quartier-vauban/,. (Accessed: 1 April 2022)

VDI (2019) *VDI-Richtlinie VDI 5207*, 10.2019: Energieflexible Fabrik: Grundlagen.

Weyer, H. (2008) *Dezentrale Energieerzeugung in Arealnetzen.* Technische Universität Clausthal / 28.05.2008. Available at: https://www.iber.tu-clausthal.de/fileadmin/IBER/Dokumente_Dateien/Sachverhalt_-_Dezentrale_Energieerzeugung_in_Arealnetzen.pdf,. (Accessed: 6. April 2022)