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How decentralization drives a change of the institutional framework on the distribution grid level in the electricity sector – the case of local congestion markets[1,2]

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Abstract

The increasing share of renewables in the electricity system results in congestion on all network levels. To address this congestion, the EU Commission proposed that distribution network operators become responsible for local congestion management. Within this paper we analyze the institutional implications of the introduction of local congestion markets and identify three discrimination concerns related to the DSO's role on these markets. We will argue that the standard governance models (legal unbundling, ownership unbundling, IDSO) are not adequate here. Instead, we discuss two novel approaches: The introduction of Independent Distribution Operators (IDO) or alternatively, a Common Flexibility Platform (CFP). Since the CFP does not require stronger unbundling of DSOs, we recommend to investigate this solution further.

Keywords: local congestion market, congestion management, regulation, unbundling, discrimination

JEL classification: D47, L52, L 94, L97, L98,

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1 Introduction

The business model of distribution network operators (DNOs) is changed by decentralization, but the institutional environment of DNOs has not been adapted to these changes so far. One specific change triggered by decentralization is the development of new local markets for congestion management. These markets define a new interface that allows the DNOs to interact more frequently with market parties. In this paper we pick up the question why and how the institutional environment of DNOs should be modified to cope with the development of local congestion markets.

The energy sector in general is facing a paradigm shift from a hierarchically organized electricity system, in which electricity produced by conventional power plants (gas, coal, nuclear, hydro) was fed-in to the transmission grids and distributed downwards, towards a decentralized and less hierarchical energy system. Today, in some countries like Germany, the generation capacity connected to the distribution grids (>100 GW in Germany 2018 (Fraunhofer ISE, 2018)) exceeds the capacity of conventional power plants connected to the transmission grids (<90 GW in Germany 2018 (Fraunhofer ISE, 2018)). We expect similar developments in countries like Denmark and Sweden, which produced more than 35 % of their electricity from renewables in 2017 (Eurostat, 2019). This puts pressure on the DNO to change their core task from unidirectional transportation of electricity, to an active coordination of generation and demand as well as feed-in the transmission grids.[3]

This increasing need for coordination transforms the DNOs role: While DNOs were primary asset owners, DNOs now need to become more active distribution system operators (DSO)[4] that make use of different coordination mechanisms (i.e. market interfaces) to fulfill their task to efficiently operate the distribution grids.

[3] Coordination here refers to the process of system optimization across different players, e.g. an owner of a renewable power plant and the network operator. While this coordination process was part of the management processes within large integrated utilities before liberalization and unbundling, this coordination now needs to be based on external processes, e.g. different market processes. See Brunekreeft (2015) for further details related to coordination in unbundled electricity systems with increasing shares of decentralized generation.

[4] Note that this definition differs from the DSO term as it is used in the US, where DSO refers to the operating task while DNO refers to the asset management tasks of network operators (Burger et al., 2018)

Agrell, Bogetoft and Mikkers (2013) stress that decentralization results in a market structure where the interfaces between regulated and non-regulated tasks become much more complex and, hence, much more difficult to regulate. Furthermore, decentralization transfers commercial value from the transmission to the distribution grid level, e.g. via distributed generators, demand response mechanisms, local price signals etc. This increasing commercial value on the distribution grid level results in new discrimination concerns and hence drives a discussion about further unbundling requirements on the distribution grid level (e.g. the introduction of Independent Distribution System Operators (IDSO) in the US (Burger et al., 2018) or stronger unbundling in the EU (Ruester et al, 2013)). So far, this discussion has focused on the discrimination concerns related to distributed generation (see for example (Brunekreeft & Ehlers, 2006; Niesten, 2010; van den Oosterkamp et al. , 2014; Cossent et al, 2009; de Joode et al., 2009; Ropenhus et al., 2011). Pérez-Arriaga et al. (2017) take this debate one step further by analyzing the need for institutional changes on the distribution grid given that the DSO become responsible for market provision. Against this background, we extend the debate in this paper by picking up the specific case of local congestion markets and how this new interface between the DSO and market parties drives new discrimination concerns.

Thereby, we build on the current debate on markets for local congestion management on the EU level: In the proposal for a new directive on common rules for the internal market in electricity (article 32 I) the EU Parliament and Council require DSOs to establish market mechanism to unlock flexibility by network users on the distribution grid level to address congestion on different network levels (EU COU, 2019).

The introduction of local congestion markets is discussed in the literature (see Nabe et al., 2017; Gerard, Rivero & Six, 2016; Zhang et al., 2014) to facilitate the coordination between flexibility providers (e.g. electric vehicles or renewable generators) and (distribution) network operators. Local congestion markets can be defined as markets through which distributed network users can provide flexibility to the (distribution) network operators to avoid network congestion. Flexibility here refers to the network users (producers and consumers) willingness to deviate from a previously planned feed-in or withdrawal of electricity from the network (Hoeckner et al., 2019).[5]

[5] Markets for congestion management[5] have already been introduced in the UK, Sweden and the Netherlands (Hirth & Schlecht, 2018), though these are national and not local markets. Local congestion management markets are currently under development in Germany and the Netherlands (see for example the enera-flex market

We show why and how the institutional design on the distribution grid level needs to change to facilitate local congestion markets in Europe. Specifically, we discuss different governance models based on different unbundling regimes for the DSO.

The paper is structured as follows: In chapter 2 we introduce the current debate on how DNOs are transforming into DSOs to cope with decentralization. In chapter 3 we introduce the specific case of local congestion markets and analyze, based on the current discussions in the EU, why they are becoming relevant. Then we discuss the potential role of DSOs in the context of local congestion markets and the discrimination concerns arising from this involvement of DSOs in market activities in chapter 4. Here, we introduce three discrimination concerns that evolve with local congestion markets:

- discriminatory flexibility selection or deployment decisions
- strategic network investment withholding
- discriminatory information sharing on future flexibility requirements

Subsequently, we discuss different institutional models based on different unbundling regimes (legal & ownership unbundling, IDSO & Independent Distribution operator (IDO)) that could be applied to address the discrimination issues. Furthermore, we introduce two governance approaches (network operator platform and common flexibility platform (CFP)) that could be applied given the current legal unbundling scheme in Europe. Chapter 5 concludes that the introduction of a common flexibility platform under the given legal unbundling scheme may achieve a sufficient level of non-discrimination without bearing the costs of introducing new and stronger unbundling rules.

2 Decentralization drives the need to rethink the institutional framework on the distribution grid level

In Brunekreeft, Buchmann et al. (2017), we illustrate that three trends have changed the distribution of gross main production, i.e. influenced the incumbents' business model: liberalization, vertical unbundling and decentralization. While liberalization and unbundling started to reduce the value-added by incumbents already in the end of the 1990s,

demonstrated by EPEX Spot in Germany (Hoeckner et al., 2019)). These local congestion markets are one approach to fulfill the above-mentioned EU requirement to unlock flexibility of network users on the distribution grid level (EUCOM, 2017; EU COU, 2019).

decentralization accelerated this effect, especially since 2007, when the diffusion of decentralized renewables increased its pace.

Similar observations concerning the interdependences between decentralization and the incumbent's business model were made with respect to DNOs. For example, Pereira et al. (2018) point out that decentralization and the beginning digitalization start to change the DNOs' business model from asset management towards system operation. In the past, DNOs were asset owners and operators of the physical electricity infrastructure. Basically, the DNOs business model was a "fit and forget" approach, which aimed at the technological estimation of future demand and supply in a certain part of the network area and building network lines accordingly (Bell & Gill, 2018). Applying this strategy in times of an increasing decentralization would result in high costs to integrate the expected high shares of distributed renewable generators in the near future (Bell & Gill, 2018; Woods & Gohn, 2011). This is one key driver for the changing role of DNOs towards DSOs.

Furthermore, with smart metering entering the stage, DNOs are becoming owners and operators of a digital infrastructure as well. For example, DNOs in the Netherlands have established a private telecommunications network for the purpose of distributing smart meter data (Robichon & Hermans, 2014). In some countries, DNOs cooperate to develop and operate data hubs for smart metering data (Brandstätt at al., 2017). Thereby, DNOs start to expand their established business model beyond owning electricity network infrastructure, which transforms them into DSOs (Küfeoğlu, Pollitt & Anaya, 2018).

DSOs focus on a more active involvement with market parties to increase the efficiency of network operation. To facilitate the integration of increasing shares of distributed generators into the distribution networks, the operators have to intensify the coordination with market parties, e.g. to address network congestion via load/generation shifting. This increasing interaction between regulated and market parties on the distribution grid level drives the discussion about the institutional requirements to facilitate the transition towards DSOs (Küfeoğlu, Pollitt & Anaya, 2018; van den Oosterkamp et al., 2014).

Pérez-Arriaga et al. (2017) argue in this context that the increasing decentralization of generation and flexibility of small-scale network users drive a need for a change of the institutional design of the energy supply chain on the distribution grid level. Pérez-Arriaga et

al. (2017) focus their discussion on the distribution of responsibilities for market provision, network ownership and system operation. Basically, this discussion is a transfer of the debate that has been going on for more than two decades for transmission networks.[6]

At the transmission grid level, different measures were introduced to prevent that the monopolistic power of transmission system operators does not result in market failures (Joskow & Schmalensee, 1983; Joskow, 1996; Brunekreeft et al., 2016). So far, the discussion on liberalization and vertical unbundling, i.e. the separation of network ownership from market activities such as generation and retail, has focused on transmission networks. The DNO's tasks have been considered much less relevant, as DNOs primary focused was on network expansion rather than operation (Bell & Gill, 2018). Furthermore, the commercial interests related to distributed generation are increasing. Now, with DNOs evolving towards DSOs, their role in an increasingly decentralized energy system and the potential for market failures on the distributed level are moving into the focus of the institutional debate.

In this paper, we focus on the role of DSOs in local congestion markets and the resulting institutional requirements to avoid market failures. Therefore, we evaluate different institutional setups (based on different unbundling regimes) for local congestion markets.

3 Local congestion markets – motivation, definition & the DSO's role

In today's electricity system the transmission system operator (TSO) has the responsibility to secure system stability. The system operators make use of different markets (or regulated models) to collect ancillary services for the purpose of system balancing (e.g. balancing markets) and congestion management (e.g. redispatch). Traditionally, the large power generators (e.g. conventional power plants) participate in these markets. Since these large power generators are connected to the transmission grid, the TSO had access to the relevant network data to optimize its operation via these markets.

[6] While there are several lessons for the distribution grid that can be drawn from the experiences from the institutional discussion related to the transmission grid, it is not possible to just transfer the institutional design from the transmission grid to the distribution grid. The main difference between these two systems is that the distribution grids are far more complex than transmission grids. For example, while the transmission grids in Germany have a cumulated length of around 100.000 km, the distribution grids ad up to more than 1.5 million km (dena, 2018). Similar differences exist with respect to other grid assets like transformer stations and the number of connected users to the grids. Due to this larger number of connected network user, network operation (e.g. load or generation projections) are more complex than on the transmission grid level.

However, with decentralization, an increasing share of generation capacities are now connected to the distribution grids. This results in three challenges: First, distributed network users, like loads or generators, are not participating in the current markets for ancillary services or congestion management. Therefore, these capacities are not available to the TSO for market-based congestion management. Second, even if the TSO could make use of distributed resources via existing markets, the TSO does not have all relevant information at hand to optimize the system, since the network data of the distribution grid is only available to the DSO. Therefore, if the TSO interacts with resources connected to the DSOs network, this might result in inefficiencies in the operation of the distribution networks. Third, DSOs do not have access to any congestion management market. But as discussed above, the cost-efficient integration of renewables requires that the DSO coordinates more frequently with the network users and market parties, which requires that DSOs have access to flexibility of network users.

To address these three challenges, the introduction of local congestion markets[7] is being discussed (Ramos et al., 2016; Villar et al., 2018; Esmat et al., 2018). The primary purpose of local congestion markets is to make the capacity of decentralized loads and generators connected to the distribution grids available to the TSOs and DSOs in the congestion management process.

Even though the EU Clean Energy Package (EU COM, 2016) stresses the relevance of DSOs in the process of local congestion management, it is not clear from today's perspective how this new role of the DSO should be facilitated. There are different models for local congestion management discussed, which range from quota models to market-based approaches (see (Nabe et al., 2017; Gerard, Rivero & Six, 2016)), often referred to as flexibility or local flexibility markets (Ramos et al., 2016).

On the European level (see for example (EU COM, 2018)) the focus is on market-based approaches for local congestion management. This could either result in a new market for local congestion management or an expansion of existing (national) congestion management markets and different coordination mechanisms between the network levels to secure efficiency of these

[7] Also referred to local flexibility markets if not only congestion, but ancillary services and portfolio optimization shall be addressed by these markets (Ramos et al., 2016).

markets (Gerard, Rivero & Six, 2016). The details of the different market models are beyond the scope of this paper. Instead, we focus on the question to which extent the DSOs are involved in local congestion markets and what institutional questions arise in this context.

In the following analysis, we will focus on three roles evolving with local congestion markets that could be assigned to DSOs.

1. The DSO will be one *buyer* (among different network operators) or potentially the single buyer at a local congestion market. This role arises from the fact that only the DSO has the knowledge on flows and constraints of the distribution grid.[8] While this role is independent of how the local congestion market is organized, the following two tasks evolve only in case a market platform for local congestion management is established.

2. Given a scenario with a market platform for congestion management, the second role of the DSOs could be the *platform owner*. The platform owner is responsible for defining the requirements for participants on the platform. For example, the platform owner carries out the certification of flexibility providers as a prerequisite for access to the platform. This involves collecting information about which flexibility can be provided at which specific location, as well as the exchange of data etc. Furthermore, the owner is responsible for the verification of physical flexibility supply contracted via its platform. Other tasks could include the formalization of the coordination process between network operators. The flexibility platform owner thereby has the power to set the rules of market participation and defines who can participate in the local congestion management market.

3. The DSO could become the *market operator*. The local congestion market operator facilitates the market processes, defines the products and timeframes for the market activities. In particular, the operator organizes the monitoring of trade – in practice, it can therefore reverse trading transactions etc..

[8] The only case in which the DSO would not become a buyer on the local congestion market evolves if the TSO takes care of the congestion management on the local level as well, as discussed as the preferred solution to the TSO-DSO-coordination challenge with local congestion markets by Gerard, Rivero & Six (2016).

In the following, we will discuss the discrimination concerns arising from the DSO's potential involvement in the governance (i.e. the three roles defined above) of local congestion markets.

We focus our analysis on three discrimination concerns, that become increasingly important in the context of local congestion markets. We first introduce these discrimination concerns for the case of an integrated utility which owns a DSO. Afterwards, we discuss different governance models and evaluate how they might address the discrimination concerns in the next chapter.

First, a local congestion market operator may discriminate against individual flexibility providers through its flexibility selection or deployment decisions. On the transmission grid level, the concern that TSOs might discriminate third parties in balancing markets (e.g. by high market entry barriers) was one of the key drivers to implement unbundling regimes that go beyond legal unbundling (Lowe et al., 2007). While only TSOs were able to exploit this discrimination potential on national balancing markets, this situation changes with local congestion markets. In these local congestion markets the DSOs gain a comparable position to the TSO on the national balancing market. Therefore, the same concerns are valid as well: In case the DSO is part of an integrated utility, it will have an incentive as a network operator to favor the affiliated marketer above independent flexibility providers, since this results in a higher revenue for the same company. This discrimination concern has been raised by Ruester et al (2013) for the procurement of services from RES in more general terms before.

In this context, it should be noted that the potential for discrimination does not only relate to the active process of selecting offers. It also already exists in the definition of products and contracts, for example with regard to possible prequalification for the flexibility market.

The second discrimination concern evolves from the fact that network operators can decide on the need and potential for flexibility through their network investments. This adds a new dimension to the debate on "strategic network investment withholding" by network operators. So far, the concept of "strategic network investment withholding" has been mainly discussed regarding TSOs. Balmert & Brunekreeft (2010) defined strategic network investment withholding as the notion that vertically integrated utilities would have inadequate incentives to invest in line capacity (mainly cross-border transmission lines).

Basically, the argument states that if an integrated company gains from limited network capacity, e.g. by reduced competition in its market area, then the integrated network company will have potentially inefficient incentives to delay network expansion to protect its affiliated market share and thereby the group's overall revenue. In other words, the network owner could strategically influence the level of competition for an affiliated market party.[9] Importantly, Brunekreeft & Balmert (2010) stressed that strategic network investment withholding only applies to the case that a network operator has the power to maintain capacity-based scarcity and thereby secure revenues for its affiliates. With local congestion markets, a similar problem applies to the distribution grid level: the integrated DSO has an incentive to delay network investments, if an affiliate company installs/operates a battery storage at a specific point in the network to participate in a local congestion market. Once the network operator invests into network expansion at this site, the business case of the affiliated battery storage suffers, since the income from the local congestion market breaks off. Especially in meshed networks, where the network operator might have a locational choice for investments, it would have an incentive to invest at locations where it does not harm the affiliate's business case.

Third, there is a possibility that integrated network operators may discriminately share information on future network bottlenecks and network investments with the associated competitive flexibility providers. Especially if liquidity on a local congestion market is low[10], prior knowledge on where network congestion is going to occur in the near future, offers the potential to build flexibility capacities at this site. This results in what we call a strategic first mover advantage. The question is whether market entry of an independent investor will still be profitable given that most revenues are already taken by the affiliate company of the network operator, i.e. the preemptive investment might secure a (temporary) monopoly profit for the affiliated company that persists till other flexibility providers enter the market[11]. This example shows that the potential damage of illegal information sharing between the integrated DSO and affiliated companies increases with local congestion markets.

[9] see Glachant et al. (2011) for details on strategic network investment withholding in different markets

[10] Which is one of the key challenges of this concept, see Hirth & Schlecht (2018)

[11] Preemptive investements might however delay the market entry of competitors significantly, if these second movers anticipate further competition which makes it less attractive to enter the market at all (Fudenberg & Tirole 1985).

4 The institutional side of local congestion markets

The analysis above shows that there exist discrimination concerns if an integrated DSO fulfills one or all of the above roles. In the European context, the key question then is whether legal unbundling of DSOs solves these discrimination concerns. Since legally unbundled DSOs are still integrated with the market parties that offer their flexibility on the local congestion market, the first discrimination concern related to the DSOs incentive to discriminate as a congestion market operator is not addressed sufficiently.

From the debate on the transmission grid level (see Brunekreeft & Balmert (2010) for details) we know that the incentive for strategic network investment withholding cannot be sufficiently addressed with legal unbundling either. With local congestion markets, the same arguments that were raised with respect TSOs in the context of strategic network investment withholding now apply to the DSO-level. Therefore, if we consider legal unbundling on the TSO level as insufficient to address the strategic network investment withholding problem, the same is true on the DSO-level. It might even be the case that for DSOs, the strategic network investment withholding incentive is stronger than in the case of TSOs, since there is still a high correlation between network ownership and market share of the affiliated retailers in this network area (for Germany see BNetzA (2018)).

The discriminatory threat of information sharing has been at the center of the unbundling debate in the last two decades (e.g. Mulder et al., 2007), for both, the transmission and distribution grid operators. As Davies & Waddams-Price (2007) noted, establishing "Chinese Walls" between network operators on the one hand and market parties on the other hand, is a very complex task: it is difficult to seal these walls in practice. The EU Commission shares this view (EUCOM, 2007), at least regarding the similar issue of the TSOs' separation from competitive activities. On the EU level, the analysis by Lowe et al. (2007) pointed out that legal unbundling of TSOs does not secure information leakage between the network operator and associated market parties. It should be noted though, that the more recent inquiry the EU Commission concluded that stronger legal unbundling (like in the Independent Transmission Operator Model) provides a sufficient level of unbundling to reduce the risk of information sharing from the Commissions point of view (CEC, 2014, p. 6).

So far, the perception was that the potential inefficiencies related to information sharing between TSOs and their affiliates was much larger than from similar behavior on the DSO-

level. With local congestion markets, this might change, since DSOs then have a direct influence on market activities, which they do not have so far. Furthermore, affiliated companies of the DSO might own renewable generators or other flexibilities in the DSOs network area, which might increase the DSOs incentive to share information with these affiliates to increase the holdings earnings.

This is one of the main reasons why many regulators in Europe are skeptical about an intensified involvement of DSOs with market parties via local congestion markets (see for example the Council of European Energy Regulators (CEER, 2014)). In a recent discussion paper, the German energy regulator stressed that non-discriminatory market-based local congestion management require ownership unbundled DSOs to achieve reliable non-discriminatory market processes (BNetzA, 2018, p. 38).

As described above, the identified discrimination risks related to local congestion markets cannot be addressed with legally unbundled DSOs. This leads to a discussion about alternative institutional designs to cope with these challenges arising from decentralization. In the following we introduce the different alternative institutional designs that might provide solutions to address the three discrimination concerns related to local congestion markets.

We will discuss six different institutional designs and how they cope with the identified discrimination concerns. First, we discuss three governance models that are based on stronger forms of unbundling (i.e. stronger than legal unbundling). These are the independent distribution system operator (IDSO), the independent distribution operator (IDO) and ownership unbundling.

Then, we introduce three governance models that are compatible with legal unbundling and hence do not require further unbundling*:* Independent market operator & platform owner, platform operated by a group of network operators and the common flexibility platform (CFP).

Independent distribution system operator (IDSO)

There is an ongoing debate (especially in the US) to introduce independent distribution system operators (IDSOs) to cope with the challenges arising from decentralization (Burger et al.,

2018). The IDSO is an adaption of the ISO concept to the distribution grid level: it is an independent and regulated entity that plans and operates the distribution grids, but does not own the networks. In addition, the IDSO could operate a local congestion market to balance the distribution grid. Independent here means that the IDSO is not owned or affiliated with market parties from retail, generation or other market parties like aggregators (Friedrichsen, 2015). Though the concept of IDSOs is discussed more frequently with increasing decentralization, Burger et al. (2018) point out that the separation of asset ownership and operation would probably result in a lower system efficiency compared to an integrated solution. These inefficiencies are due to several key challenges that are associated with the ISO model in general, and which are relevant to the IDSO concept as well. Pollitt (2012) summarizes these key challenges for the ISO model, and we point out two merits of the IDSO model that would be notably relevant for local congestion markets:

- Complex information exchange and potential duplication of tasks: the operator and asset owner need to have a highly complex system of information exchange to secure the correct projection of network congestion. Potentially, both entities will need tools to project congestion (e.g. IDSO for operational issues, asset owner for investment planning).

- Costly dispute resolution procedures: if operation and asset ownership are separated, the risk allocation process can reach very complex levels. In the case of congestion management, the question about liabilities becomes very important, since the costs for the different measures (e.g. local congestion management vs. curtailment) might differ significantly and disputes between asset owner and operator might evolve about the efficient allocation of costs.

Besides the associated potential inefficiencies related to the IDSO, this institutional setup is not an ideal solution to address the discrimination concerns in the context of local congestion markets. Whereas the IDSO model addressed one source of discrimination, it does not adequately address the other two sources. It holds true that an IDSO does not have an incentive to favor any particular flexibility provider, which should secure that the risk of discrimination in the operational decisions can be mitigated with this governance design. However, strategic network investment withholding and the strategic first mover advantage can only be addressed if the IDSO decides on network investment as well. This requires a deep-IDSO (see (Balmert

& Brunekreeft, 2010)) for details on the deep-ISO which can be applied to the IDSO accordingly), which has the authority to decide on network investments and thereby order the network asset owner to invest. In case of a "normal" IDSO (not deep-IDSO) the asset owner, which will be integrated with flexibility providers, will have an incentive to delay investment decisions, which cannot be addressed with the IDSO model. The same is true for the incentive to share economically relevant information with the flexibility provider.

Ownership unbundling

Especially in Europe, the discussion about the necessity to introduce ownership unbundling[12] of distribution network operators is intensifying with the acceleration of the decentralization process. For example, Ruester et al. (2013) pick up this debate on the EU level, and regulatory bodies like the Commission of European Energy Regulators (CEER) discuss the need for more unbundling as well, especially in the context of local congestion markets (CEER, 2018). Ownership unbundling provides a valid approach to address the different discrimination concerns in the context of local congestion markets. However, it needs be considered that ownership unbundling might come at high costs. For example, Brunekreeft (2015) pointed at the increasing costs of coordination between separated market entities. With decentralization, these costs are likely to increase (Brunekreeft & Ehlers 2006). Therefore, there are doubts whether ownership unbundling would be an efficient solution overall (see (Buchmann, 2016; de Nooij & Baarsma, 2009; Hoeffler & Kranz, 2011; Brunekreeft, 2014)).

Independent distribution operator (IDO)

An independent distribution operator (IDO) could be considered as a second option with stronger unbundling of DSOs – corresponding to the ITO at the TSO level. An IDO is a stronger form of legal unbundling than it is currently applied in the EU on the distribution grid level. Although the network operator is still owned by an integrated company, it is an independent division with its own corporate identity, resources and management. The use of services from the integrated company is prohibited. The aim of these additional firewalls between the network operator and the other parts of the utility is to ensure independence from management and network investment decisions. According to the European Commission, an ITO at the transmission system level is a well-functioning alternative to ownership unbundling (CEC, 2014).

[12] Full ownership unbundling prohibits joint ownership of network and generation or retail assets within one firm.

Transferring the ITO model to the distribution level could address several challenges associated with local congestion markets. For the given case of a local congestion market, we would expect that all three discrimination risks that we discuss in this paper can be reduced by the IDO model, compared to a case with the current form of legal unbundling. Since the IDO is a stronger form of legal unbundling and hence, makes the DSO more independent than the 'just' legally unbundled DSO, especially concerning its investment strategy, the incentive to favor affiliated companies (even if they offer their product at a higher price than the competitors) should be lower than in the case of legal unbundling. This lower discrimination incentive can be derived from the IDOs stronger independence in terms of investment strategies and the resulting revenues. That is at least what can be observed on the transmission grid level, where the ITO model seems to address this discrimination concern sufficiently (CEC, 2014). The same is true for "strategic network investment withholding", since the IDO is not influenced by the mother company's strategic planning, at least not to the extent a legally unbundled DSO is. Similarly, due to the managerial independence of the IDO, we would expect that the IDO's incentive to share confidential information with an affiliate company can be mitigated as well. So, compared to legally unbundled DSOs, the discrimination concerns should be reduced. Nevertheless, the incentives still exist and are not abolished as in the case of ownership unbundling. This is in line with the general perception of the ITO model on the transmission grid level: the incentives to discriminate might not be reduced to zero, but to a (potentially) sufficient extent.

The analysis above shows that though there are several institutional options to address the discrimination concerns that evolve in the context of local congestion markets, they all have weaknesses as well. Therefore, we cannot recommend them.

While the previous governance models require an adaptation of the unbundling regime in Europe, the following three governance models are based on legal unbundling.

Independent platform operator

In the current debate it is primarily discussed to assign the responsibility for market operation and platform ownership to an independent market operator (Zhang et al. 2014; Ramos et al. 2016). This solution would be similar to the market operator model for wholesale markets in Europe, e.g. the EPEX platform. The primary advantage of this approach is that it diminishes

the risk of discrimination in the flexibility selection process significantly: If an independent third party operates and supervises the matchmaking process on the local flexibility market, the DSO cannot influence the actual procurement of a specific flexibility resource. This approach requires that the definition of products that are traded on the congestion market and the contracts that define the processes and rules of interaction on the congestion market are defined in a non-discriminatory way as well. This could be achieved by assigning the regulator the task to define these products and contracts, or at least supervise the definition. [13]

An independent operator of the local congestion market does, however, not address the other two sources of discrimination potential: investment decisions and information advantage, since the network investment decisions and information advantages concerning future flexibility demand still lie with the DSO's whose incentives are not change by the independent platform operator.

Platform operated by a group of network operators

While the first platform model assigns the responsibility for platform ownership and market operation to an independent third party, this model proposes to assign the same tasks to a body which is established by the legally unbundled network operators (similar to data exchange platforms operated by different DSOs e.g. in Belgium (Buchmann, 2016)). Under the assumption that all these network operators are legally unbundled, the risk of discrimination is reduced compared to the base case with just one legally unbundled DSO, though not to a significant extent. In general, mutual checks and balances between the network operators involved should reduce the discrimination concerns. There are two separate arguments here. First, it is assumed that the network data is partly available via the network operators' platform to other network operators who have sufficient expertise to be able to exercise mutual control; i.e. network operator X must justify itself to experts of other network operators Y (shame-and-blame argument). Second, the other network operators (Y) are potential competitors (of X) on the local congestion market through their own group shareholdings and will therefore have

[13] We assume that anonymous processes are applied which secure that the network operator does not know which specific flexibility providers they are contracting, but only that this flexibility is connected to the congested network part. The smaller the market gets and the lower the liquidity on the market, the higher is the chance that network operators might learn in the long term which flexibility they choose even in an anonymous process. But if liquidity is that low, discrimination is just one of many concerns, e.g. market power might be the bigger institutional challenge then.

incentives to identify the possible discrimination. While this mutual control mechanism can reduce the risk of discrimination with respect to flexibility selection and information sharing to a certain extent, it does not secure that these discrimination concern are addressed sufficiently. Additionally, the risk of strategic investment withholding, cannot be addressed with this approach.

Common flexibility platform (CFP)

Another solution based on legal unbundling is the introduction of a common flexibility platform (CFP). The concept of the CFP is based on the insights of collaborative governance. Collaborative governance can be defined as a stakeholder-based decision-making process with public and private participants (Ansell & Gash, 2008). In this sense, the CFP is a cooperative, not-for-profit organization constituted by the relevant stakeholders of local congestion markets that takes over solely responsibility for the governance of the local congestion market. It is merely a rule-making body: It sets the framework and delegates operation to market parties. Network and system operation can remain in the hands of the incumbents. Based on the stakeholder-process the CFP will have to ensure non-discriminatory access to information through certain processes and rules.

PJM, Pennsylvania-New Jersey-Maryland (PJM) interconnection, which is a regional transmission organization in the US provides an example for an application of collaborative governance in the energy sector. PJM operates the largest competitive wholesale market worldwide (located in the US) and successfully applies a stakeholder approach to govern this market (Buchmann, 2016).

Whether such a collaborative stakeholder approach secures neutrality and non-discrimination depends on several factors (Buchmann, 2017b). Ansell and Gash (2008) evaluated 137 studies where stakeholder-based decision-making has been analyzed. Based on these insights, they conclude that two criteria are most relevant for the success of a stakeholder process that should secure neutrality and non-discrimination. First, the approach must be inclusive, i.e. all relevant stakeholders need to participate. Second, rules for participation need to be transparent and decision-making (e.g. consensus vs. majority voting) needs to be defined properly.

To meet the first criterion defined by Ansell and Gash (2008) for the specific case of the CFP, we would propose that at least the following three groups will be represented in the CFP:

- Flexibility providers (potentially separation between households, commercial and industrial network users to acknowledge the different preferences of these flexibility providers)
- Aggregators (who potentially will be the representatives of the flexibility providers on the local congestion market, at least for the network users with lower capacity or flexibility potential)
- Network operators (this includes all network levels since the local congestion market could be used to address congestion on all network levels)

To meet the second criterion, the decision-making process in the CFP needs to balance between stability and non-discrimination (e.g. via unanimous voting) on the one side, and flexibility (i.e. innovation) plus agility (e.g. time for decision making) on the other side (e.g. via majority voting). Identifying the right balance between these two sides is a challenging task and it is outside the scope of this paper to elaborate on this (for further details on the voting process and potential implications on innovation see (Buchmann, 2016) and (Buchmann, 2017a)).

If we suppose that these two criteria are met by the CFP, we would expect that all three discrimination concerns associated with local congestion markets can be addressed properly. First, the CFP defines the market rules and could either become responsible for the platform operation or the CFP could delegate the task of market operation to an independent third party. In both cases, discrimination by the DSO in the daily operation of the platform can be avoided, since the operator (CFP or third party) and not the DSO would be responsible for the matchmaking on the market. This holds true for the actual matchmaking as well as for the market-entry rules which are defined by all stakeholders, which should secure that no discriminatory market-entry barriers evolve. In this sense, the CFP could substitute the regulators role in defining market rules for the local congestion market. Thereby, the CFP provides a solution to overcome the information asymmetry, which exists between the regulator and the involved market parties (Buchmann, 2016).

Second, the CFP extends the checks and balances. In essence, the CFP constitutes a governing body that can be approached in case of disputes between different market participants, e.g. a DSO and a non-affiliated flexibility provider. As discussed above, the incentive for strategic network investment withholding might drive DSOs to behave in a discriminatory way. In such

a case, the CFP could ask for an evaluation process, e.g. by an external and neutral entity (research institute, consultants, etc.). The key advantage here is that there are many institutions at the table that have the resources and knowledge to reveal such behavior. Company A owns both, retail and network business, and competes with company B, who as well owns a retail and network business, in the network area of company B. Now if there is reasonable doubt about the behavior of Bs' network investment strategy, than this could be revealed by the competitors, since they have the network expertise inhouse.[14] Therefore, the risk that discrimination via strategic network investment could be identified by the CFP might provide an approach that might reduce the risk of strategic network investment withholding. Whether the incentive to discriminate via strategic network investment withholding can be addressed sufficiently in this case depends on the likelihood that this behavior can be identified by the other parties and the resulting penalties, if such a behavior is sanctioned. Furthermore, if the CFP only consist of parties that could gain from strategic investment withholding, e.g. via higher prices, then the CFP cannot address the discrimination concern. This stresses the importance that all affected parties are part of the CFP. Otherwise, it is less likely that the CFP will have an effect on the discrimination concerns discussed in this paper.

Third, the CFP could provide a control mechanism to evaluate cases in which market parties claim that the network operator made information available to affiliates in a discriminatory manner. While this does not secure that no information is exchanged, the risk of detection increases if all potentially damaged market parties are part of the same governing body. Furthermore, the CFP can establish rules for sharing the relevant information for a local congestion market with all participants, e.g. by defining mandatory information that needs to be revealed by the DSO in a timely and transparent manner (e.g. via mandatory network development plans as they are now required by the EU Parliament and Council (EU COU, 2019).

The analysis above reveals that only three of the evaluated governance approaches can address the discrimination concerns with respect to local congestion markets: The IDO, ownership unbundling and the CFP model. Though a governance design based on a common flexibility platform provides an alternative solution to further unbundling of network operators, it comes at high transaction costs related to defining processes, decision making etc. The question then

[14] This requires that the involved network operators reveal their specific network date in case of such disputes.

is, whether these transaction costs are lower than those costs associated with the other governance approaches that can address the identified discrimination concerns discussed above. Since the cost-benefit analyses of ownership unbundling on the distribution grid level in the Netherlands and New Zealand are inconclusive (see (Buchmann, 2017b) for details), the risk that the introduction of ownership unbundling might result in higher costs than its benefits should not be underestimated. Therefore, it comes down to a comparison between the cost and benefits of the IDO and the CFP model. While such a cost-benefit analysis is out of the scope of this paper, the fact that the IDO model requires a change in European regulation, while the CFP could be implemented without such a regulatory change, already provides a first indicator that the introduction of the CFP might overall result in lower costs.

The analysis above is summarized in figure 1, which provides an overview about the different governance models and whether they address the discrimination concerns identified.

			stronger unbundling			with legal unbundling		
X = discrimination concern addressed (x) = discrimination concern partially addressed		legal unbundling	Independent Distribution System Operator (IDSO)	Independent Distribution Operator (IDO)	ownership unbundling	Independent Platform Operator	Network Operator Platform	Common Flexibility Platform (CFP)
discrimination concerns addressed	flexibility selection		X	(X)	X	X	(X)	(X)
	strategic-investment withholding			(X)	X		(X)	(X)
	information sharing			(X)	X			(X)
Does not require a change in current EU unbundling regime		X				X	X	X

Figure 1: Overview of the analyzed governance models and whether they address the discrimination concerns associated with local congestion markets or require an adaptation of current EU unbundling rules

Source: own illustration

5 Conclusion

The decentralization in the energy sector, headed by the accelerating diffusion of distributed generation, drives a discussion about the need to adapt the institutional environment in the energy sector to cope with this trend. In this paper, we have focused on the distribution network operators' potential roles in the context of local congestion markets and how different institutional designs could address the discrimination concerns associated with this new roles.

The case of local congestion markets illustrates the increasing complexity of contractual relations between network operators and market parties. This increasing involvement of DSOs with different market participants requires an evaluation whether the upcoming tasks of DSOs, e.g. within local congestion markets, require an adaptation of the institutional framework on the distribution grid level to secure an efficient facilitation of the decentralization process. Different regulators expressed their concerns about the effective prevention of discriminatory behavior of legal unbundled DSOs, if these network operators gain more responsibilities to cooperate with network users which blurs the borderline between regulated and market activities. Within this analysis we have shown that discrimination concerns increase with new institutional settings like local congestion markets.

We identify three different sources of discriminatory behavior by DSOs that evolve with local congestion markets in the context of 1) flexibility selection, 2) strategic network investment withholding and 3) information sharing. Importantly, two of these concerns evolve independently of the DSO's active involvement in either ownership or operation of the congestion market. Rather, these discrimination concerns are related to the DSO's important role as the single buyer (or one of the few buyers (TSOs and DSOs)) on the local congestion market. Therefore, we conclude that even if DSOs are not involved in the ownership or operation of the local congestion markets, the informational advantage on the DSOs' side still constitutes a significant discrimination risk, which is not sufficiently addressed by legal unbundling. Additional discrimination concerns arise for the case that legally unbundled DSOs are the owner and operator of local congestion markets.

While ownership unbundling could address all three discrimination concerns related to local congestion markets, it is not clear from today's perspective whether these benefits outweigh the potential costs associated with the introduction of ownership unbundling. Therefore, we discuss other institutional setups for local congestion markets as well. For example, we show why the

independent distribution system operator (IDSO), which constitutes an adaptation of the independent system operator (ISO) model from the transmission level, addresses only one discrimination concern and brings its own challenges. Therefore, from our perspective, the IDSO is not an adequate solution to address the challenges that arise in the context of local congestion markets and beyond.

The introduction of independent distribution operators (IDO) seems to be more promising. The IDO model basically constitutes a stronger form of legal unbundling, which proves to be rather successful in addressing discrimination concerns on the transmission grid level (where the ITO model is applied in the EU). With an IDO, the discussed discrimination concerns can be reduced to a significant extent, even though this solution is not as effective as ownership unbundling. However, since the experiences on the transmission grid level currently postulate a sufficient reduction of discrimination incentives for ITOs, the IDO model might provide a solution if the cost of ownership unbundling are considered infeasible. This discussion is beyond the scope of this paper. Still, if an institutional change for DSOs is discussed, we would propose to further investigate the IDO solution as an alternative to ownership unbundling.

In our analysis, we evaluate three institutional models which are compatible with legally unbundled DSOs and therefore do not necessarily require further unbundling measures. In case that an independent third party (e.g. a market operator) is responsible for the matchmaking on the local congestion market, the additional discrimination risks are limited, but might still put efficient market operation at risk. Alternatively, the flexibility market could be operated by a group of network operators. This institutional model might reduce the risk of discriminatory flexibility selection and potentially reduce the risk of strategic investment withholding, but will probably not reduce the incentive to share information with affiliated parties in a discriminatory way.

Furthermore, we discuss the introduction of a common flexibility platform (CFP), which governs the local congestion market. Not only network operators from different network levels, but also other market parties (retailers, aggregators etc.) would become part of this platform. Thereby, the discussed discrimination concerns can be addressed without the costs of further unbundling measures on the distribution grid level. Whether this approach can sufficiently address the discrimination concerns discussed depends on many factors. Most prominently, all those parties that are affected by the flexibility market and could be discriminated would need

to be part of the CFP. Otherwise, it might be that all parties involved in the CFP gain from the discriminatory behavior on the flexibility market. Then, there would not be an incentive to identify and change the discriminatory behavior. Under the assumption that all relevant parties are part of the CFP and that the CFP has the tools and power to identify and address discriminatory behavior, the CFP can provide an institutional setup to address the discrimination concerns related to flexibility markets. If these assumptions are met and given the current unbundling regime on the EU-level, the CFP provides the most promising solution to the discrimination concerns associated with local congestion markets among the approaches investigated in this paper.

Since local congestion markets are a new concept in Europe, the discrimination concerns discussed in this paper are theoretical for now. Therefore, an important issue for further research is the evaluation whether these concerns actually evolve if local congestion markets are applied in Europe, which should be investigated once these markets evolve. Furthermore, the new EU directive on the internal electricity market requires distribution grid operators to publish network development plans every two years which shall give information on the medium- and long-term flexibility requirement as well (EU COU 2019). We did not discuss in this paper whether the information provided in these network plans could address some of the discrimination concerns, but we suppose that there will be a relation between these network development plans and the incentives for strategic network investment withholding and information sharing. This needs further investigation once these network development plans are published.

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