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CEER Paper on Alternative Connection Agreements

Distribution Systems Working Group

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INFORMATION PAGE

Abstract

The issue of electricity network congestion is increasingly prevalent within many European electricity distribution networks. As an alternative, or as an intermediary measure before grid reinforcements, distribution system operators (DSOs) can procure flexibility via various methods to solve local network issues. This paper (C23-DS-83-06) focuses on one of these methods: alternative connection agreements. It shows how these agreements can take many forms and are already employed by DSOs within Europe to varying degrees.

The prevalence of, and the regulatory efforts towards, alternative connection agreements appear to depend on: 1) the perceived actual or foreseeable inability of the grid to accommodate new connections; 2) the unavailability of local flexibility markets; and 3) the existing legal and regulatory framework concerning alternative connection agreements and the current regulatory approach.

If national regulatory authorities (NRAs) were to consider the implementation of alternative connection agreements, to enable DSOs to access flexibility and solve network issues, the following recommendations are outlined: 1) assessment of the interaction with respect to other, especially market-based, flexibility procurement mechanisms; 2) consideration of typical use cases for alternative connection agreements and their justification; and 3) data requirements from DSOs' and NRAs' perspectives to ensure well-informed decisions and a fit-for-purpose regulatory design.

Target audience

European Commission, energy suppliers, DSOs, other network operators, traders, electricity/gas customers, electricity/gas industry, consumer representative groups, Member States, academics and other interested parties.

Keywords

Flexibility, connection agreements, alternative connection agreements, distribution networks, electricity, regulation, flexible connections, non-firm access, flexibility procurement, flexible grid connection arrangements, flexible grid connection schemes, flexible access and connection agreements.

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Related documents

CEER Documents

- CEER Paper on DSO Procedures of Procurement of Flexibility, 16 July 2020, Ref: C19-DS-55-05.
- CEER Paper on Electricity Distribution Tariffs Supporting the Energy Transition, 20 April 2020, Ref: C19-DS-55-04.
- CEER Conclusions Paper on Flexibility Use at Distribution Level, 17 July 2018, Ref: C18-DS-42-04.

External Documents

- "Framework Guideline on Demand Response", Agency for the Cooperation of Energy Regulators, 20 December 2022. Retrieved from: https://acer.europa.eu/sites/default/files/documents/Official_documents/Acts_of_the_Agency/Framework_Guidelines/Framework%20Guidelines/FG_DemandResponse.pdf.
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EXECUTIVE SUMMARY

Background

An increasing penetration of distributed energy resources (DER), and electrification of heat and energy demand in distribution networks, challenges distribution system operators (DSOs) to provide the required network capacity through active network management and expansion of the network through investment. This development has led DSOs and national regulatory authorities (NRAs) to explore all necessary and useful means to meet this challenge. Allowing DSOs to conclude alternative connection agreements - agreements that deviate in one or more attributes from the traditional firm connection agreements - is one of the possible options for enabling DSOs to optimally use all available network capacity. Although there is a strong interest in alternative connection agreements across countries, there has so far been only limited practical use cases.

Objective

This paper aims to assist regulatory decision-making regarding alternative connection agreements by:

- Describing the relevant legal framework at the EU level;
- Arguing that (alternative) connection agreements should be considered as only one of the possible mechanisms for DSOs to use flexibility that is available in distribution networks;
- Describing a (non-exhaustive) range of alternative connection agreements that may be considered; and
- Collecting information from several countries regarding the current status of alternative connection agreements.

Conclusions

There are large differences between countries in the uptake of alternative connection agreements that may be explained by the following key factors:

1. The degree to which countries experience network issues, which determines the urgency of action and hence the necessity of using all possible means to optimally use available network capacity.
2. The direction of regulatory decisions and the level of development of flexibility markets and market-based procurement of flexibility by the DSO. This describes whether the regulatory framework and market developments have been successful in developing local flexibility markets and allows DSOs to procure market-based flexibility.
3. The current legislation and regulatory framework, which determines the status of alternative connection agreements and whether they are able to be used (and under which circumstances and for what purposes) in practice.

NRAs that are considering the implementation of alternative connection agreements, need to carefully assess the interaction between alternative connection agreements and other market-based mechanisms for DSOs to access flexibility. The EU Directive (Art. 32) prescribes market-based procurement as the primary mechanism for DSOs to access flexibility, and the introduction of alternative connection agreements might negatively affect the market for flexibility by reducing liquidity and creating market distortions.

Alternative connection agreements should therefore be considered in the case of either underdeveloped (local) flexibility markets or as a temporary instrument to connect new users[1] that can only be connected on a firm basis once ongoing network reinforcements are realised. When local flexibility markets are underdeveloped, DSOs could be allowed to use alternative connection agreements as a mechanism to access flexibility, as market-based options are not sufficiently available. Alternatively, alternative connection agreements can be an effective temporary instrument to connect new users, or existing users that require larger connection capacity, until planned network reinforcements are realised. This would avoid some of the social welfare loss that results from system users not being connected timeously.

Successful implementation of alternative connection agreements requires smart grid operation by DSOs, a well-informed NRA and a fit-for-purpose regulatory design. For the DSO, more detailed information on flows and capacity is needed to remain in control of the network and enable optimal use of network capacity. The NRA should be able to make informed decisions on the optimal regulatory framework to deal with the network issues DSOs are faced with. Finally, NRAs need to carefully consider the regulatory design choices regarding alternative connection agreements, both at their introduction and over time.

[1] Or existing users that applied for an increase of their existing connection capacity.

1 INTRODUCTION

1.1 Challenges for the European power systems

Recent EU climate legislation and targets,[2,3,4] and the urgent need to decrease EU dependence on fossil fuels[5] gives plenty of incentives for the proliferation of renewable energy sources (RES). In its REPowerEU Plan, the European Commission proposed to increase the target for the share of renewable generation in the RES directive to 45% by 2030. This would increase the total renewable energy generation capacity to 1236 GW by 2030, in comparison to a capacity of 1067 GW by 2030 that was envisaged under the previous "Fit for 55" proposal in 2021.[6] According to Eurostat, in 2019, the net maximum electrical capacity for wind and solar photovoltaic (PV) was around 300 GW (out of a total of almost 500 GW).[7] When considering that wind and solar power are the most economic[8] and most quickly deployable RES technologies, it seems that their installed capacity must nearly triple by 2030 to reach the above-mentioned target. Figure 1 illustrates the expected tripling of solar PV and wind installed capacities based on targets outlined in the REPowerEU Plan, compared to previous 2021 proposals.

[2] Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law'). Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021R1119.

[3] Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast) ('Renewable Energy Directive') Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG&toc=OJ:L:2018:328:TOC and its planned revision, retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021PC0557.

[4] "Fit for 55", Council of the European Parliament, retrieved from: https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/.

[5] "REPowerEU: A plan to rapidly reduce dependence on Russian fossil fuels and fast forward the green transition", European Commission, 18 May 2022. Retrieved from:https://ec.europa.eu/commission/presscorner/detail/en/IP_22_3131

[6] Renewable energy targets, European Commission. Retrieved from: https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-targets_en#:~:text=This%20would%20bring%20the%20total,envisaged%20under%20the%202021%20proposal.

[7] See https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Electrical_capacity_for_wind_and_solar_photovoltaic_power_-_statistics.

[8] See, for example: "Levelized Cost of Electricity Renewable Energy Technologies", Fraunhofer Institute for Solar Energy Systems, June 2021. Retrieved from: https://www.ise.fraunhofer.de/en/publications/studies/cost-of-electricity.html; and "Renewable Power Generation Costs in 2021", International Renewable Energy Agency (IRENA), 2021. Retrieved from: https://irena.org/-/media/Files/IRENA/Agency/Publication/2022/Jul/IRENA_Power_Generation_Costs_2021_Summary.pdf?la=en&hash=C0C810E72185BB4132AC5EA07FA26C669D3AFBFC.

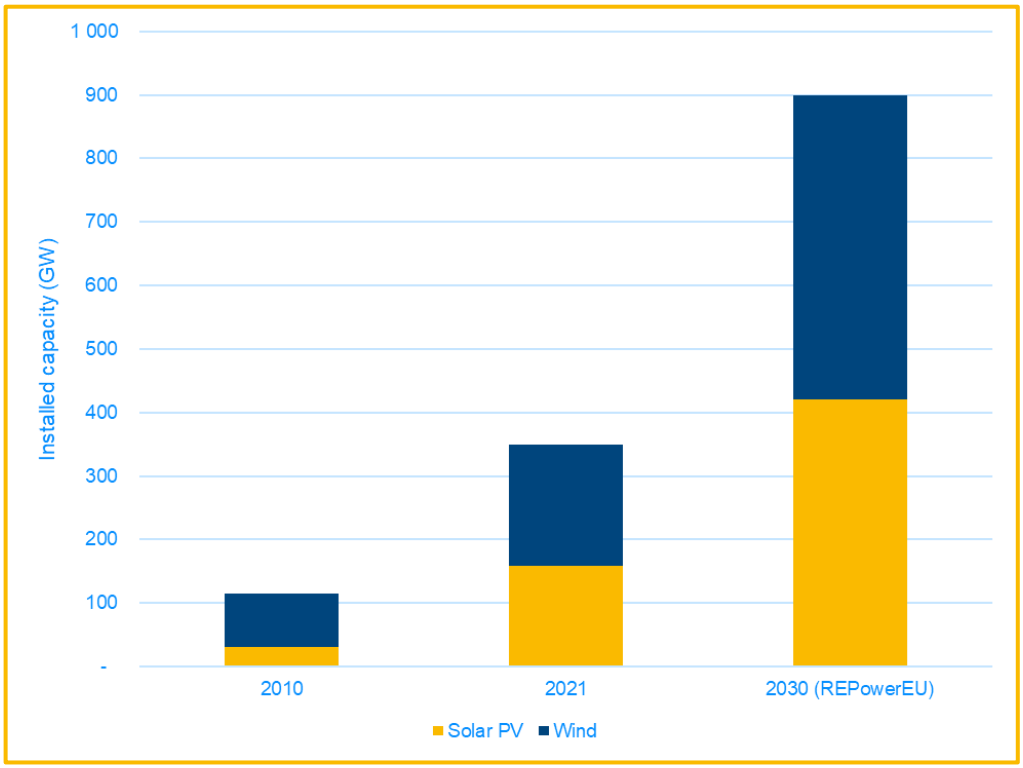


Figure 1 – Predicted 2030 installed capacities of solar PV and wind based on REPowerEU targets compared to 2021[9]

[9] Data taken from "The EU's Plan to Scale Up Renewables by 2030 - Implications for the Power System", The French Institute of International Relations (IFRI), April 2022, p.4. Retrieved from: http://ifri.org/sites/default/files/atoms/files/nies_eu_plan_renewables_2022.pdf. IFRI's analysis was based on IRENA, Ember Climate, Agora Energiewende and the REPowerEU plan.

However, it is worth noting that wind and solar PV, as intermittent renewables, put a special burden on the grid that they are connected to, in terms of increased flexibility needs and new stability challenges. A significant proportion of intermittent RES, especially PV[10], is connected to the distribution network, which was not originally designed to accommodate these kinds of flow patterns. Also, while the installation of these generation technologies is relatively quick, there is an increasing need for grid expansion and reinforcement to accommodate the rising share of decentralised generation. Unlike installation, grid infrastructure development is often lengthy and prone to delay. Thus, the gap between available network capacity and connection requests has recently widened significantly and is expected to grow further. This is exacerbated by the rapidly progressing electrification of the transport sector, energy-intensive industries and residential heating. As a result, in more and more instances, third-party access to the transmission or distribution network, in accordance with Article 6 of the Electricity Directive,[11] cannot be granted (be it for demand or generation, or a mixture thereof) because of a lack of network capacity.[12] Until recently, alternative connection agreements[13] - as opposed to the default firm connection agreements - were considered a possible solution to this problem only in a rare number of cases. Now that the problem is becoming more widespread,[14] regulators might want to facilitate alternative connection agreements as a tool for dealing with grid congestion. This might entail standardisation, to fulfil EU requirements for transparent and non-discriminatory treatment of grid users.[15]

1.2 Challenges for regulators

As each Member State's (MS) power system and electricity market are unique, the above issues have taken shape differently and with different timings, until recently. From a questionnaire conducted among NRAs in mid-2022, it can be concluded that the latest (political and climate-related) events have pushed the target curve of distributed generation installation so steep that most European DSOs, and thus regulators, face considerable levels of network issues already today, or will in the near future.

Given the high priority of decarbonisation, the phasing out of fossil fuels, and the need to end the EU's import dependence, especially from Russia, these issues will remain if they are not resolved. Non-firm connections might be applied either as an interim solution to defer grid reinforcement or under certain specific conditions as a permanent remedy.

[10] As outlined in "Distribution System Operator Observatory 2020", the Joint Research Centre, p.30: "Only in a few cases PVs are connected to the high voltage level (> 36kV). The majority of PVs are in fact connected to a voltage level below 36kV which often in Europe indicates the Medium and Low voltage (< 1kV) levels."
[11] 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.
[12] Network capacity is usually calculated at present grid standards based on the grid codes in effect. As will be mentioned later in Chapter 3, changing these rules might also serve as one of the solutions, see 'Rules-based' approach in Chapter 3.1.
[13] Alternative connection agreements are also known in literature as 'non-firm contracts' or 'flexible connection agreements.' Throughout this paper the term 'alternative connection agreements' will be used as it is more inclusive in terms of covering the various forms of connection agreements that are all on one or more aspects different from default firm connection agreements.
[14] See, for example: "Distributed Flexibility - Lessons learned in the Nordics", Nordic Electricity Market Group, June 2022. Retrieved from:https://www.nordicenergy.org/publications/distributed-flexibility-lessons-learned-in-the-nordics/; National Grid capacity map (UK). Retrieved from:https://www.nationalgrid.co.uk/our-network/network-capacity-map-application; and Netbeheer Nederland congestion map (the Netherlands). Retrieved from: https://capaciteitskaart.netbeheernederland.nl/.
[15] This could even result in a standardised non-firm contract template. See Ofgem's "Access and Forward-Looking Charges Significant Code Review: Decision and Direction" ('Ofgem Access SCR Decision'), p.5: "Ensure a standardised non-firm access option is available for larger network users".

1.2.1 Non-firm connections as an interim solution

If applied as an interim solution, non-firm connections **increase grid connection capacity until grid development**. Due to the increase in network issues (and particularly, congestion) across Europe, new parties, be they generators or (large) consumers, can make limited or no use of the network, because certain network segments have no available capacity. Also, industrial grid users may not be able to expand their contracted capacity, which will increasingly become necessary to decarbonise industrial processes by electrification. Grid reinforcement is often inevitable, but until the grid is reinforced, it is desirable that the existing grid capacity is used as efficiently as possible. For regular connection requests, system operators must consider situations with maximum possible feed-in and/or withdrawal. However, the number of hours per year when this maximum capacity is utilised is often very low, thus leading to available grid capacity outside peak hours.

As network congestion and other issues, such as voltage problems, are increasingly leading to transmission system operators (TSOs) and DSOs being unable to grant firm connection requests based on their capacity calculations, the interest in alternative forms of connection has been rising. For example, non-firm connection rights could be granted outside peak times, in addition to the existing firm connection rights. System users can use the network capacity that is available outside moments of peak network usage. However, this requires a certain degree of flexibility from system users and might not be an interesting or viable option for all system users as their supply and/or demand is inflexible.[16] This aspect of non-firm connections underlines the special relationship this type of third-party network access agreement has with flexibility services: they benefit from the same resource, a kind of flexibility in the behaviour of the party requesting the connection. Since certain aspects of flexibility can be monetised only once per value chain, this inevitably results in alternative connection agreements removing flexibility from flexibility markets.[17]

There could also be opportunities to increase the available transport capacity by introducing new transport conditions. There are system users that reserve more transmission capacity than they use. This may result in a discrepancy between contractual and physical grid usage and purely contractual congestion. Since grid operators cannot rule out that contracted grid users who do not use their full capacity will increase their usage in the future, so-called “use-it-or-lose-it” (UIOLI) contracts can be concluded. Under such contracts, which are also considered as alternative connection agreements, system users are obliged to return unused capacity to the network operator.

[16] For this (and several other) reasons, households do not belong to the target group of flexible connections. For other reasons see the Ofgem Access SCR Decision, p.6, where Ofgem did not consider flexible connections suitable for small, domestic households.
[17] The link between flexible connection agreements and market-based flexibility procurement will be elaborated on in Chapter 3.

1.2.2 Non-firm connections as a permanent solution

In other cases, alternative connection agreements might even cancel out the need for grid reinforcement. Under certain conditions, the efficiency gain might be of such volume that the need for grid development might be questioned, if (certain types of) grid users, such as distributed energy resources (DER),[18] are successfully incentivised to align with network conditions using their available flexibility. This could include equipping distributed PV with batteries, advanced inverter functionalities,[19] or behavioural changes. It is also conceivable that certain grid users may not wish to change their connection agreements to firm ones, as they may be flexible and willing to shift their network use in return for a discount on connection charges.

As will be described in Section 4.3, the differentiation between a temporary and permanent alternative connection agreement is a design choice. Further design choices for alternative connection agreements will be elaborated on also.

1.3 Objective

In this paper, CEER aims to explore the current practices of some MS regarding alternative connection agreements, identify potential risks and advantages of such arrangements, and, where possible, outline best practices for the implementation of alternative connection agreements from the regulators' point of view.

To achieve this, the paper addresses the following questions:

1. What are alternative connection agreements, and what types of different alternative connection agreements exist?
2. What is laid down in European legislation?
3. What is the relationship between alternative connection agreements and other measures for DSOs to access flexibility?
4. What are the challenges in implementing alternative connection agreements, and what are the lessons learnt?

While there are several technical and organisational challenges concerning the implementation of alternative connection agreements - including load and production profile forecasting for needs and capabilities to limit network usage - these challenges lie largely in the hands of the system operators. The NRAs' main responsibility is to ensure that these are solved in ways that comply with the regulatory principles. Therefore, further consideration of such implementation challenges is out of scope for this paper. The NRAs can define general guidelines for offering alternative connection agreements and set standards for reporting under, for example, smart grid indicators or the distribution network development plans (NDPs).

[18] DER usually comprise of renewable generation, batteries and demand response.
[19] As is elaborated, for example, in "Advanced Inverter Functions to Support High Levels of Distributed Solar", National Renewable Energy Laboratory (NREL), November 2014. Retrieved from: https://www.nrel.gov/docs/fy15osti/62612.pdf.

1.4 Approach

The information and analysis in this paper is based on a review of available literature and policy and regulatory documents, and on a number of case studies submitted by NRAs. On 7 October 2022, a workshop was also held by CEER with European NRAs to gather further input. Specific references are inserted on the occasions where existing literature and documents have been used. The case studies were submitted by NRAs that were either represented in the drafting team (Austria, Finland, France, Hungary, the Netherlands, Sweden) or by NRA representatives in CEER's Distribution System Working Group who were interested and willing to do so (Belgium (Wallonia region), Luxembourg, Norway). Information on Great Britain was gathered from available literature and to the best of the authors' knowledge.

The approach does not include a definitive analysis regarding when and how to implement alternative connection agreements in each of the EU MS, but instead is limited to providing an overview of the possibilities and relevant considerations for NRAs that are exploring the implementation of alternative connection agreements.

The analysis does not make a distinction between new connections and existing connections that require an upgrade, as DSOs must treat these cases in a non-discriminatory way compared to each other.

1.5 Structure of the paper

Section 2 describes the relevant legal framework regarding connection agreements at the EU level. Section 3 illustrates how the instrument of alternative connection rights is related to other mechanisms for the DSO to access flexibility, for the purpose of efficient use of available network capacity and efficient network expansion. Section 4 presents the different forms of alternative connection agreements and lists the relevant principles when considering the implementation of some form of alternative connection agreement. Section 5 describes the legal and regulatory framework in EU MS and some of the existing use cases of alternative connection agreements. Section 6 summarises the key observations and recommendations and Section 7 provides the final conclusions.

2 LEGAL FRAMEWORK AT THE EU LEVEL

This section describes the relevant legal framework at the EU level. As this paper addresses the topic of alternative connection agreements at the DSO level, the focus in this section will be on the legal framework for DSOs.

2.1 Third party access – Article 6

As laid down in Article 6 of the Electricity Directive, all system users have a right to obtain a connection and contract transport capacity. This rule lays down the European right to non-discriminatory access to electricity networks. Grid operators can only refuse access if they lack the necessary capacity. In EU MS, the European right of access has generally been elaborated through a connection and transport right for parties. The right for a connection ensures that system users are connected to the network in a non-discriminatory manner and within a reasonable timeframe. The right for transport provides for a non-discriminatory right to transport for all system users unless there is no transport capacity available.

2.2 Flexibility procurement – Article 32 (1-3)

The first two paragraphs of Article 32 set obligations for MS to incentivise their DSOs to use flexibility services "in order to improve efficiencies in the operation and development of the distribution system". This is to be interpreted in connection with several paragraphs of the recital, wishing to enable (or to improve) the participation of DER in the power markets. Since they might also be able to provide flexibility for the grid, which can be beneficial for the network, Article 32 also paves the way for these market players. Paragraph (3) stipulates requirements for DSOs' NDPs, where DSOs "shall provide transparency on the medium and long-term flexibility services needed" and a five-to-ten-year investment plan, with a particular emphasis to connect new generation capacity and new loads.

The provision that links together the flexibility needs in the NDPs and the procurement of flexibility services is the second phrase of paragraph (1): "In particular, the regulatory framework shall ensure that distribution system operators are able to procure such services from providers of distributed generation, demand response or energy storage and shall promote the uptake of energy efficiency measures, **where such services cost-effectively alleviate the need to upgrade or replace electricity capacity** and support the efficient and secure operation of the distribution system." In this sense, paragraph (1) and paragraph (3) together suggest that the use of flexibility should be considered before deciding on wire-based grid reinforcement.

Paragraph (1) sets out what sort of actors shall be enabled to provide flexibility services in particular (distributed generation, demand response or energy storage) and that the procurement procedures must be established in a transparent, non-discriminatory and **market-based manner**.[20] Exemptions from the market-based procurement may be made if the regulatory authorities have established that market-based procurement for flexibility is not economically efficient, or would lead to severe market distortion or higher congestion. This possible derogation shows that market-based flexibility procurement presents the base-case to be implemented but is not always feasible and efficient. Thus, there may be cases where it is decided at national level to implement non-market-based flexibility procurement.

[20] These fundamental principles are further described in Section 3 of this paper.

While paragraph (1) sets the conditions of the procurement procedure and potential exemptions, paragraph (2) focuses on the operational design of the procurement process, where DSOs or NRAs "shall establish the specifications for the flexibility services procured and, where appropriate, standardise market products for such services, at least at a national level". The paragraph also grants an adequate remuneration for DSOs to allow for cost recovery for the procurement of flexibility services.

The directive format of this particular piece of legislation ensures that MS are able to tailor their regulatory designs to their country's particular national circumstances, however, this also leads to considerable room for different interpretations. These differences might occur prominently in NRAs assessing the existence of the conditions for the deviation from the market-based procurement of flexibility services and the regulatory measures following such an assessment.

2.3 Other relevant provisions

In the current EU legislation, there are other elements of relevance with regard to flexible connections. The first to mention is Article 42 of the Directive. In this article, the legislator foresees a situation where the TSO would want to refuse connection based on the prospect of a future network limitation (such as congestion in distant parts of the TSO network). However, it already offers a derogation from this rule when stating that the above-mentioned prohibition: "shall be without prejudice to the possibility for transmission system operators to limit the guaranteed connection capacity or to offer connections subject to operational limitations, in order to ensure economic efficiency regarding new generating installations or energy storage facilities, provided that such limitations have been approved by the regulatory authority", where the article determines the principles based on which the regulatory authority may approve the capacity limitation.[21] Where the generating installation or energy storage facility bears the costs related to ensuring unlimited connection, no limitation shall apply.

A second provision of interest is paragraph 7 of article 13 of the Electricity Regulation (EU) 2019/943, where it generally lays down that in the case of non-market based redispatching, it shall be subject to financial compensation by the T/DSO requesting the redispatching, "except in the case of producers that have accepted a connection agreement under which there is no guarantee of firm delivery of energy", that is, who have an alternative connection agreement.

Another piece of legislation that includes alternative connection agreements (non-firm in its wording, and as a tool to solve congestion), is the Agency for the Cooperation of Energy Regulator's (ACER) Framework Guideline on Demand Response, where in paragraph (87) it stipulates that: "The new rules shall provide that when facing congestion, the [system operator] shall always choose the most economically efficient option or combination of options of the different tools at its hands, such as congestion management, grid investments, non-firm connection agreements or bidding zone review, optimising the resulting social welfare. The new rules shall specify principles for the use of congestion management products as described in paragraph (86) on the one hand, and non-firm connection agreements on the other, ensuring that markets are not unduly distorted."[22]

[21] "The regulatory authority shall ensure that any limitations in guaranteed connection capacity or operational limitations are introduced on the basis of transparent and non-discriminatory procedures and do not create undue barriers to market entry."
[22] "Framework Guideline on Demand Response", ACER, 20 December 2022. Retrieved from: https://acer.europa.eu/sites/default/files/documents/Official_documents/Acts_of_the_Agency/Framework_Guidelines/Framework%20Guidelines/FG_DemandResponse.pdf.

3 DSOs' ACCESS TO FLEXIBILITY

This section provides further context to the topic of alternative connection agreements by presenting the different mechanisms available for DSOs to access flexibility. This section builds further upon two previous CEER papers that have identified connection agreements as one of the possible mechanisms for DSOs to access flexibility.[23]

The different mechanisms identified in the previous CEER papers are described in Section 3.1. Section 3.2 covers the various typologies and terminology used to refer to alternative connection agreements. Section 3.3 discusses the interaction between alternative connection agreements and other mechanisms to access flexibility and Section 3.4 lays out the core principles for designing alternative connection agreements.

3.1 Mechanisms for DSOs to access flexibility

Figure 2 repeats the types of mechanisms available to DSOs to deal with grid problems in the distribution networks, from the 2020 CEER Paper on DSO Procedures of Procurement of Flexibility. Below follows a brief description of the four different mechanisms for DSOs' access to flexibility, as alternatives to grid reinforcements to solve grid problems.

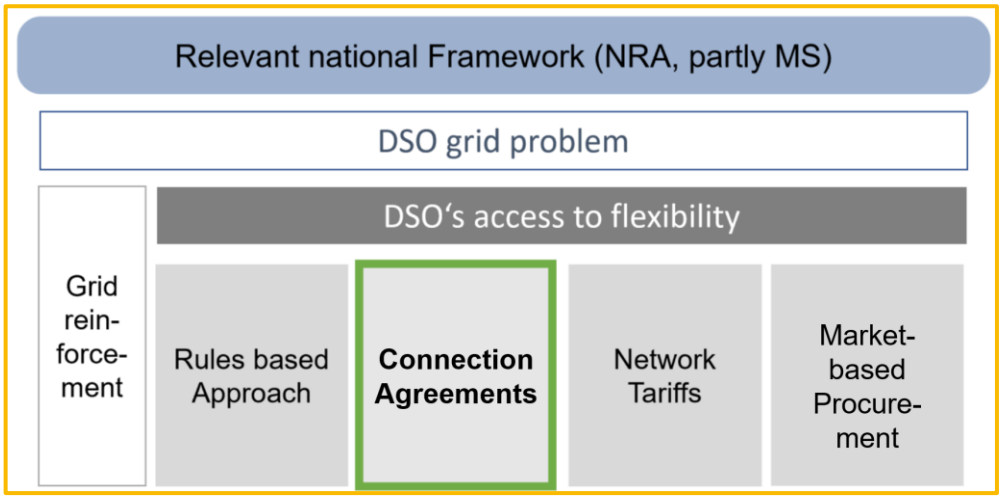


Figure 2 – Mechanisms for DSOs to access flexibility[24]

[23] See CEER Conclusions Paper on Flexibility Use at Distribution Level, 17 July 2018, Ref: C18-DS-42-04 ('2018 CEER Conclusions Paper on Flexibility Use at Distribution Level'), and CEER Paper on DSO Procedures of Procurement of Flexibility, 16 July 2020, Ref: C19-DS-55-05 ('2020 CEER Paper on DSO Procedures of Procurement of Flexibility').

[24] This figure is an adapted version of Figure 1 in the 2020 CEER Paper on DSO Procedures of Procurement of Flexibility.

3.1.1 Rules-based approach

The rules-based approach refers to all connection requirements for system users as laid down in grid codes, connection codes, and other forms of codes and rules that may be imposed on the MS level. This option concerns a technical approach in which network users may be confronted with some costs related to required installations, equipment or settings. In its Paper on DSO Procedures of Procurement of Flexibility, CEER already argued that from the perspective of enabling DSOs to access flexibility available with system users, imposed rules under this approach should not be unduly restrictive and should only be considered if other possible solutions cannot be implemented at lower system cost.

3.1.2 Connection agreements

Connection agreements that DSOs need to offer to system users across the EU have generally concerned agreements with firm capacity rights. This implies that system users should be able to always access their contracted capacity for the full 100%. Alternative connection agreements can generally be thought of as a deviation of this firm capacity right on different dimensions: they may vary from firm capacity rights that are valid part of the time (i.e. time-specific) to non-firm capacity rights all of the time. This option is the core topic of this paper and is extensively discussed in the following sections.

3.1.3 Network tariffs

Network tariffs[25] can be designed to provide incentives to system users to change their behaviour in such a way that it benefits efficient distribution system operations by the DSO. For example, a more dynamic network tariff with time- and/or location-dependent tariff components may encourage system users to be more efficient in their use of available network capacity and thereby reduce the need for network reinforcements or reduce congestion in the network. However, the impact of a particular tariff structure on the actual behaviour of system users inherently has a degree of uncertainty regarding its actual impact, because system users may show different behaviours than expected or may not be able to shift or reduce their demand for network capacity.[26]

[25] Network tariffs in general cover both the connection charges and use-of-system charges that system users pay to the DSO in order to cover its cost of connecting and distributing electricity. The network tariff does not include the retail tariffs users pay for their consumed electricity to their suppliers.
[26] A more extensive review on future tariff design can be found in the CEER Paper on Electricity Distribution Tariffs Supporting the Energy Transition, 20 April 2020, C19-DS-55-04 ('2020 CEER Paper on Electricity Distribution Tariffs Supporting the Energy Transition').

3.1.4 Market-based procurement

DSOs can explicitly procure flexibility that benefits the grid services from the market(s). The flexibility services could be procured from the market in various ways. The DSO could, for example, set up a competitive tender for the specific flexibility needs and enter bilateral contracts[27] with the most competitive bidder. Alternatively, the DSO could, for example, procure flexibility services via an existing market platform or other forms of interfaces, as long as there is enough liquidity and arrangements for the market-based procurement to not unduly distort markets and comply with unbundling rules.[28]

3.2 Other typologies and terminology used for flexibility at the DSO level

Although this paper adopts the terminology that was developed in earlier CEER papers, it should be kept in mind that related but different typology and terminology are sometimes used in literature and policy or regulatory documents. Whereas this paper refers to 'mechanisms' for DSOs to 'access flexibility', other literature may refer to 'regulatory mechanisms', 'coordination mechanisms', or 'regulatory tools'[29] for DSOs 'to obtain', 'to use', or 'to source' flexibility.'

Also, the four mechanisms as CEER defines them can be referred to using different terminology. For example, 'connection agreements' are also known as 'flexible grid connection arrangements',[30] 'flexible grid connection schemes'[31] or 'flexible access and connection agreements.'[32]

Mechanisms for DSOs to access flexibility can also be categorised as being 'implicit' or 'explicit.'[33] According to EUniversal,[34] implicit mechanisms refer to the reaction of system users to price signals (for example given by dynamic network tariffs). System users can adapt their behaviour in terms of network use by, for example, shifting load and/or generation to periods of low network use. They define explicit mechanisms as mechanisms that involve the provision of committed, dispatchable flexibility that can be traded on the different energy markets (wholesale, balancing, congestion management, etc.). They consider this type of flexibility dispatchable, and it can be tailored to the markets' exact needs (size and timing), for example to the need for flexibility by DSOs.

[27] A bilateral contract between a DSO and a flexibility service provider that is not based on a competitive tender might not be considered 'market-based procurement'.
[28] For a more extensive review of the option of market-based procurement, the 2020 CEER Paper on DSO Procedures of Procurement of Flexibility is recommended. It provides an overview of the most fundamental preconditions needed to procure flexibility and manage congestion in a market-based way. It also discusses the main elements and potential content of market-based procedures of procurement of flexibility.
[29] See "Deliverable: D1.1 Characterisation of current network regulation and market rules that will shape future markets", EUniversal, 28 July 2020. Retrieved from: https://euniversal.eu/wp-content/uploads/2020/08/EUniversal_D1_1.pdf.
[30] "Unlocking the Potential of Distributed Energy Resources", International Energy Agency (IEA), May 2022 ('2022 IEA Report'). Retrieved from: https://iea.blob.core.windows.net/assets/3520710c-c828-4001-911c-ae78b645ce67/UnlockingthePotentialofDERs_Powersystemopportunitiesandbestpractices.pdf.
[31] "Flexibility Connections: Explainer and Q&A, Version 1", Energy Network Association (ENA) August 2021 ('2021 ENA Guide'). Retrieved from: https://www.energynetworks.org/industry-hub/resource-library/on21-prj-open-networks-flexibility-connections-explainer-and-q-and-a-(19-aug-2021).pdf.
[32] "Deliverable: D1.3 Challenges and opportunities for electricity grids and markets", EUniversal, 28 July 2022 ('EUniversal Deliverable D1.3 Report') Retrieved from: https://euniversal.eu/wp-content/uploads/2021/08/EUniversal_D1.3_Challenges-and-opportunities-for-electricity-grids-and-markets.pdf.
[33] EUniversal Deliverable D1.3 Report.
[34] EUniversal Deliverable D1.3 Report.

3.3 Interaction between connection agreements and other mechanisms

The four different mechanisms for DSOs to access flexibility are different in numerous aspects, may interact with each other, and are not necessarily mutually exclusive.[35] Network reinforcement traditionally has been the sole mechanism for DSOs in the management of networks, which is sometimes referred to as a 'fit-and-forget' approach. The increasing penetration of distributed generation and new consumer technologies has led policymakers, regulators and DSOs to realise that in order to achieve efficient management of distribution networks, a different approach is needed. This involves a more active network management where network reinforcements are still a dominant mechanism but no longer the only one. Over time, the mechanisms available to the DSO in efficiently managing its network have been extended and better specified. Examples of such are the implementation of specifications for flexibility procurement by DSOs in the Electricity Directive, and regulators and DSOs increasingly experimenting and implementing different time- and/or location-specific elements in the structure of network tariffs. The increasing interest in connection agreements should be seen from this perspective.

Alternative connection agreements should also be assessed from the perspective of being a welcome addition to the 'toolbox' of the DSO. To what degree, and in which form alternative contracts could (or should) be implemented should be assessed at the EU MS level by NRAs.

Regardless of further developments in the thinking around alternative connection agreements and their implementation, it must always be considered as only one of the several mechanisms available for DSOs to access flexibility and efficiently manage their networks. It is underlined that no generalizable hierarchy in the preferences of DSOs in using these mechanisms can be given.[36]

As outlined in the 2018 CEER Conclusions Paper on Flexibility Use at Distribution Level: "Codes and rules, which impose detailed flexibility requirements, network tariffs, connection agreements details and rules for market-based procurement should not be defined at EU-level but should be defined by the Member State or the NRA and be consistent with national provisions and national practices (principle of subsidiarity)."[37]

When considering the implementation of the mechanism of alternative connection agreements, regulators should be aware of: 1) the differences of this mechanism compared to the other mechanisms already available to the DSO, and 2) the impact that the implementation of alternative connection agreements may have on other mechanisms already used and in place. Table 1 below provides an overview of the different characteristics that the different mechanisms have.

[35] 2020 CEER Paper on DSO Procedures of Procurement of Flexibility.
[36] 2020 CEER Paper on DSO Procedures of Procurement of Flexibility.
[37] 2018 CEER Conclusions Paper on Flexibility Use at Distribution Level, section 2.3.

Flex category	Frame	Financial	Timeframe	Delivery
Rules based	EU network codes/guidelines and/or national rules	Possibility shifts of costs from DSO to network user; typically no compensation	As defined in framework (usually continuously)	Binding
Connection agreement	National rules; contract may be individual	Possibly reduction of cash flow from network user to DSO, possibly higher/lower costs network user, initial or when change (e.g. capacity)	As defined in framework (usually continuously; could also be time-limited)	Usually binding
Network tariff	National rules; may include options for network users; may differ per region, DSO etc.	Reduced cash flow network user to DSO	As defined in framework, periodically/(pre)determined periods (typically monthly with yearly changes)	Usually not binding; interruptible; could be binding
Market based procurement	National rules (based on EU legislation)	Typically DSO to flexibility provider Reservation: initial/periodically/without Activation: per delivery; Freedom of design includes: Fixed prices/caps, obligations regarding availability, accessibility etc.	Agreed period Optional/As long as bid is available	Usually binding

Table 1 – Overview of the characteristics of mechanisms for DSOs to access flexibility[38]

From the point of view of the connecting users, these options could be argued to carry varying degrees of optionality. At one end, there are rules-based mechanisms that remove any optionality from end users. At the other end, there are network tariffs which may only incentivise certain behaviour but not enforce it. In between, there could be alternative connection agreements, which, depending on the chosen bundle of options for the connection agreement, could lean either way in terms of network users' freedom to behave a certain way in case of a network (congestion) issue.

It is also conceivable that a system user could have both a flexible connection agreement (for example time-dependent) *and* provide particular flexibility services to a DSO (and/or a TSO). This could, for example, be the case for a system user with substantial storage capacity.

A table from the 2021 ENA Guide is inserted as Table 2 below. It demonstrates that both the options of alternative connection agreements, and flexibility services provided via market-based procurement by the DSO, can be used for largely similar purposes. However, a key difference is that market-based procurement can also be used for upward regulation (to avoid curtailment of generation). Moreover, perhaps over time, new product possibilities may emerge leading to more identical products being delivered via alternative connection agreements and flexibility services.

[38] This table is an adapted version of Table 2 in the 2020 CEER Paper on DSO Procedures of Procurement of Flexibility.

	Flex Connections (ANM)	Flexibility Services
Used for Thermal Constraints	✓	✓
Used for Voltage Constraints	✓	✓
Used for Fault Level Constraints	×	× (1)
Controls Real Power	✓	✓
Controls Reactive Power	× (2)	✓
Export turn-down	✓	×
Export turn-up	×	✓
Import turn-down	× (3)	✓
Import turn-up	×	✓
Current Likely Utilisation Periods	Times of high renewable output and low demand	Peak demand, planned outages, network faults.

(1) Not currently used; being tested in a range of innovation trials
(2) ANM systems are usually capable of providing the signalling necessary to control reactive power
(3) Done for "Timed" and "SGANM" Flex Connections

Table 2 – Comparison of the different uses of flexible connections (i.e., alternative connection agreements) and flexibility services (i.e., market-based procurement)

3.4 Principles for designing alternative connection agreements

When making regulatory choices, NRAs consider several design principles, some of which follow directly from EU legislation, and some of which are considered good practice. For example, a list of guiding principles for designing tariffs was discussed in the 2020 CEER Paper on Electricity Distribution Tariffs Supporting the Energy Transition. In addition, a report from the EU project, EUniversal, identifies relevant principles when designing mechanisms for accessing flexibility.[39] Below follows a brief description of all relevant principles from these sources. It should be noted that the listing order is rather arbitrary and does not represent a particular hierarchy of importance. The only exceptions to this are the principles that follow directly from EU legislation, which are considered to be more important from a legal point of view than the principles that follow from regulatory practice (i.e., the CEER paper) and literature (the EUniversal report).

Firstly, several principles follow directly from EU legislation.

1. Alternative connection agreements should be voluntary

   Any alternative connection agreement offered by a DSO to a system user is voluntary, as the primary right of any system user to obtain grid access against firm capacity conditions still holds under Art. 6 of the EU Directive. Therefore, the freedom is granted to the extent that: a) the grid user does not accept and sign the alternative connection agreement if it dislikes it, and therefore, has to wait to be connected; b) the user accepts and signs the alternative connection agreement; or c) the user does not accept the alternative connection agreement because the user pays for (mostly, the full) cost of grid reinforcement to be connected firmly ahead of time.

[39] "Deliverable: 5.1 Identification of relevant market mechanisms for the procurement of flexibility needs and grid services", EUniversal, 30 January 2021 ('EUniversal Deliverable 5.1 Report'). Retrieved from: https://euniversal.eu/deliverable-5-1-identification-of-relevant-market-mechanisms-for-the-procurement-of-flexibility-needs-and-grid-services/.

2. Non-discrimination should apply when implementing alternative connection agreements

   When regulators set the conditions for flexible connection agreements, and when DSOs offer alternative connection agreements to system users, the principle of non-discrimination as laid down in EU and national legislation should be upheld. This implies that a distinction between system users can only be made if done on the basis of an objective criterion. Network use could be such an objective criterion, as an objective distinction could be made between system users with a fixed and flexible demand profile, consumers and producers, and existing and prospective customers.

3. DSOs should be able to recover efficient costs

   Following the EU Directive, the regulatory framework should allow DSOs to recover their efficient cost of managing the distribution networks. The introduction of a particular alternative connection agreement may raise issues regarding the network tariff that should be offered in this agreement. As an alternative connection agreement contains more uncertainty for a system user regarding the actual availability of network capacity, a reduction or discount on standard network tariffs may be argued for. System users may (partly) switch from firm connection agreements to alternative connection agreements. This substitution effect should be accounted for when regulators set the allowed revenues or network tariffs that are required to lead to (efficient) cost recovery of DSOs.

4. Alternative connection agreements should not unduly distort the functioning of markets

   As specified in Art. 32 of the EU Directive, the design of mechanisms to procure flexibility should not unduly distort decisions of system users regarding use of the network and behaviour in energy markets. Concerning alternative connection agreements, there might be an issue of system users behaving strategically in concluding flexible connection agreements and making use of the network. In addition, the design and scope of alternative connection agreements could affect the behaviour of system users that are at the same time flexibility service providers to the DSO.

The 2020 CEER Paper on Electricity Distribution Tariffs Supporting the Energy Transition specifies a total of seven principles of distribution tariff design that also might be applied to the design of alternative connection agreements. Three of those principles (non-discrimination, DSO cost recovery, non-distortion of markets) have already been described above as they directly follow from the EU Directive. In addition, the following principles are mentioned:

5. Cost-reflectivity of network tariffs

   For efficient use and development of the network, as far as practicable, tariffs paid by network users should reflect the cost they impose on the system and give appropriate incentives to avoid future costs. This principle is generally accepted for network tariffs and should also be considered when designing the appropriate network tariff for alternative connection agreements. Deviating from this principle could result in network use behaviour that is inefficient from a network or electricity system perspective. However, deviations from this principle could be considered, for example, if multiple principles compete and good arguments can be made to do so.

6. Transparency

   DSOs should be fully transparent on the alternative connection agreements they offer. Full information on terms and conditions of different alternative connection agreements should be available to all system users. This, for example, concerns the process that DSOs follow in deciding when and how to offer alternative connection agreements. Also, the methodology used to determine the network tariff for such agreements, and the information procedures DSOs follow in the case of fully flexible connection agreements, should be clear and understandable for system users.

7. Predictability

   It is important that system users can effectively predict when, where and how alternative connection agreements can be entered into and benefited from. Their availability may be, for example, linked to the degree and nature of congestion in the network.

8. Simplicity

   To the extent possible, alternative connection agreements should be easy to understand and implement. The simpler they are, the easier they are for system users to enter into and use to their advantage (and to that of the DSO).

The EUniversal Deliverable 5.1 Report specifies an additional number of principles, which partly overlap with the principles described above. For example, the principle of economic efficiency mentioned in that report, partly overlaps with the above principles of cost-reflectivity, non-distortion of markets and non-discrimination of different system users with possibly different technologies, and also the principle of transparency is mentioned. Other, additional principles include the following:

9. Equity

   The term equity refers to fairness and justice and distinctly differs from the term equality. Whereas equality implies that every system user is treated the same, equity implies that system users may be treated differently by public policy to compensate for different circumstances. For example, household consumers are treated differently from large users in terms of consumer protection. The EUniversal Deliverable 5.1 Report describes this principle by specifying three distinct equity criteria: allocative equity, distributional equity and transitional equity. Allocative equity is the criterion that evaluates if identical usage of network capacity is charged equally. The main implication of allocative equity is that network tariffs reflect the marginal cost of providing this capacity. The distributional equity criterion evaluates if the network tariff charged is proportional to the system user's economic capability. The transitional equity criterion is relevant when a new mechanism - such as an alternative connection agreement is introduced.

10. Reliability

    Electricity generation and consumption with fluctuating access to network capacity should not risk the secure operation of the grid.

11. Network users' engagement

    DSOs should take an active role in offering alternative connection arrangements when they are viable, and clearly communicate the terms, benefits and implications of these contracts to network users.

12. Implementation concerns (implementation cost, complexity, effectiveness)

    Implementation concerns can relate to the cost of implementation, complexity of implementation, and the effectiveness. The cost of implementation may refer to the transaction costs involved and the cost of digitalising the network and adopting communication mechanisms and procedures. Forms of alternative connection agreements may differ in complexity, for example regarding the procedures involved. The effectiveness criterion acknowledges that the capability of the different forms of alternative connection agreements in contributing to the goal of efficient use of available network capacity may vary.

4 FIRM VS. ALTERNATIVE CONNECTION AGREEMENTS

This section provides an overview of the different types of alternative connection agreements that can be observed in literature and in practice. The purpose of this section is not to be exhaustive, but rather to illustrate the possible spectrum of alternative connection agreements. Section 4.1 first describes the default regime of firm connection agreements. Thereafter, Section 4.2 identifies specific forms of connection agreements and Section 4.3 attempts to provide a generic approach to alternative connection agreements by discussing the various attributes that can vary between different types of alternative agreements.

4.1 Firm connection agreements

In practice, the network access conditions specified in national network codes across EU MS are based on firm access conditions (i.e., firm connection agreements). This means that a system user can always use the transport capacity that they have contracted and if they are not able to do so, they will receive compensation. System users are free to specify how and at what time they wish to use their firm connection agreements. Firm connection agreements thus provide customers a capacity guarantee. There can only be a transport interruption in the case of malfunctioning or maintenance at single, non-redundant connections. In the event of malfunctions (longer than a certain period), system users are entitled to compensation. This means that once a system user has a contracted right, this right is, in principle, retained and cannot be unilaterally (without compensation) curtailed or taken away by the grid operator.

DSOs must take firm connection agreements into account in their network planning and network reinforcement. To calculate the network load, DSOs use consumption profiles and look at the actual network usage of system users. The contracted firm capacity is therefore not the starting point for calculating the network load. Congestion occurs if the physical network load based on the connection agreements is equal to, or greater than, the total available network capacity.

4.2 Specific forms of alternative connection agreements

This section demonstrates that alternative connection agreements can take many forms. Without aiming to be exhaustive, some specific forms identified in practice and literature are described. To be considered an alternative connection agreement there should be a clear deviation from the default of a firm connection agreement. The different forms of alternative connection agreements described in this section are:

- Temporary firm connection agreements;
- Fully flexible connection agreements;
- Time-limited firm connection agreements;
- Combination of fully flexible and time-limited firm connection agreements;
- Shared connection agreements;[40]
- 'Dynamic operating envelopes';[41] and
- Use-it-or-lose-it (UIOLI) or use-it-or-sell-it (UIOSI).

[40] "Options for reform of access rights for distribution and transmission – discussion note", Ofgem, August 2019 ('2019 Ofgem Discussion Note'). Retrieved from: https://www.ofgem.gov.uk/sites/default/files/docs/2019/09/summer_2019_-_working_paper_-_access_right_note_final_nd.pdf.
[41] 2022 IEA Report.

Firm connection agreements with temporary capacity limitation

Grid operators with insufficient available capacity to grant a new system user the full contracted capacity required for that user, could temporarily offer firm capacity for only a part of the required capacity. After the grid operator has realised the required network upgrade, the temporary connection agreement could be adapted to the full firm capacity that the system user initially applied for. This type of alternative contract, which by definition is temporary, enables the grid operator to use available network capacity to the maximum extent possible. Whether such temporary lower-than-actually-needed capacity contracts are worthwhile for a system user depends on their load and/or injection profile and their capability to temporarily downscale operations. Compared to other types of alternative connection agreements, temporary firm connection agreements seem to have less implementation issues as these contracts are obviously similar to firm connection agreements.

Fully flexible connection agreements[42]

Fully flexible connection agreements give system users the right to use the grid to the extent that capacity is available. They ensure that system users can use the capacity available in the network at non-peak times. They do not provide system users with certainty about whether their required capacity can be met as it depends on the amount of remaining capacity that is available and the number of system users that make use of fully flexible connection agreements. The more system users make use of fully flexible connection agreements, the less transport capacity might be available per system user, depending on the actual time of use.
Fully flexible connection agreements ensure that more system users can be connected to the network without necessarily expanding network capacity. The available network capacity is thus used more efficiently. Implementation of this form of alternative connection agreements could raise issues such as:

- How to determine the appropriate level of network tariff in relation to the network tariff of firm connection agreements;
- How DSOs in practice will determine the available remaining network capacity at different moments in time;
- Which rules should be applied concerning the allocation of flexible connection agreements over interested system users (i.e., prioritisation);
- The level of transparency and the communication from the DSO to system users; and
- How to decide on the prioritisation of system users in cases where more than one user has an alternative connection agreement.

[42] The 2022 IEA Report refers to this option as ‘Active Network Management’: “Active network management (ANM) is a more advanced form of flexible connection in Great Britain. This scheme monitors all constraints on a network in real time and allocates the maximum amount of capacity available to each customer in that area, curtailing other energy exports as required to avoid exceeding the network limits”.

Time-limited firm connection agreements

With time-limited firm connection agreements, a system user's network use is linked to a predetermined, fixed time slot (i.e., specific hours, days, weeks of the year). During that time slot, the contracted capacity is firm. Because the time-limited capacity is firm, time-limited fixed transmission rights give customers more certainty about their network use than fully flexible connection agreements. Also, the term 'timed export/import connection arrangement' is sometimes used for this type of flexible connection agreement.[43]

Grid operators are currently already working with estimated consumption profiles of system users. Based on these profiles, they estimate how system users will use the network and calculate the expected network load. Customers are not obliged to behave in accordance with these profiles. Customers with firm connection agreements can always claim their contracted firm capacity. In addition, the consumption or injection of system users may increase, or the peaks may shift. With new system users, the uncertainty about their consumption or injection profile is often even larger. Time-limited firm connection agreements in fact determine the system user's consumption or injection profile. This provides both the network operator and the system user with certainty about the moment of consumption or injection. This may lead to a more efficient use of available network capacity compared to the situation where a grid operator can no longer grant new system users grid access due to uncertainty about expected consumption or injection profiles of existing system users. However, if multiple (new) system users acquire comparable time-limited firm connection agreements with overlapping network use, then the network will still be congested.

Combination of firm, fully flexible and/or time-limited firm connection agreements

Combined connection agreements are also conceivable (see e.g., the Walloon case study description in section 5). Firm connection agreements can be supplemented with fully flexible connection agreements or time-limited firm connection agreements. Firm time-limited connection agreements can also be extended with fully flexible connection agreements. These combinations can be of interest for system users with a fixed or time-limited base load and a need for additional, but flexible peak load. Combinations of multiple types of connection agreements can give system users certainty regarding their actual required network capacity.

Combined connection agreements can lead to a lower base load on the grid. System users that currently cover their base load and peak load demand with a firm connection agreement can switch to a combination of a firm connection agreement that covers their base load demand and a flexible connection agreement that covers their peak load demand. When calculating the grid load, the system operator, in principle, does not need to take into account the peak load associated with the flexible connection agreement. This peak load can only be used by the system user when remaining capacity is available. As a result, the network can be used more efficiently. If existing system users with firm connection agreements switch to combined connection agreements, this may also mean that capacity may become available on the network. This may create capacity for new customers or expansion.

[43] This is used by both the IEA and ENA.

Shared connection agreements

System users may also consider sharing capacity and management of their demand and/or generation and thereby reduce their combined peak use of network capacity. The option of shared connection agreements was one of the options considered by Great Britain's NRA, Ofgem, in its significant review of network access and forward-looking charges. Shared access agreements may involve the sharing of a physical connection at one location by multiple system users or may involve the sharing of network access across multiple sites within a particular area. These sites would coordinate to ensure that they maintain their access within the limits set out in their shared access agreement with the DSO. Examples of shared access could include a group of demand users keeping to an aggregated import capacity, a group of generators keeping to an aggregated export capacity, or a local energy scheme balancing both demand and generation to keep within aggregated import or export capacity.[44]

The sharing of a connection at one specific location appears to be a relatively straightforward option to implement, if the system users involved agree on a shared management of the use of the connection. This, for example, could involve a solar field project being combined with a storage project at one new connection in the distribution network, or an energy community. Whether the sharing of connection capacity by multiple system users in a larger distribution network area is a viable option to increase efficient use of available network capacity is more uncertain. Ofgem did not take this latter option further because the benefit in terms of more efficient network use was not certain and because of practical issues and challenges.[45]

'Dynamic operating envelope'

The 2022 IEA Report mentions a 'dynamic operating envelope' as a form of alternative connection agreement. This form of connection agreement is implemented in Australia and is described as follows: "Dynamic operating envelopes vary import and export limits [of a system user] over time and location based on the available capacity of the local network or power system as a whole."[46]

[44] See 2019 Ofgem Discussion Note.
[45] See "Electricity Network Access and Forward-Looking Charging Review: Open Letter on our shortlisted policy options", Ofgem, 9 March 2020. Retrieved from: https://www.ofgem.gov.uk/publications/electricity-network-access-and-forward-looking-charging-review-open-letter-our-shortlisted-policy-options.
[46] See "Dynamic Operating Envelopes Working Group Outcomes Report", Australian Renewable Energy Agency (ARENA), March 2022. Retrieved from: https://arena.gov.au/assets/2022/03/dynamic-operating-envelope-working-group-outcomes-report.pdf.

UIOLI/UIOSI condition to firm connection agreements

Another form of alternative connection agreements are firm capacity contracts with a UIOLI condition. This type of condition could, for example, require a system user to consistently use their maximum contracted capacity during a given time window and if they fail to do so, the contracted capacity is adjusted downwards. A UIOLI condition could be imposed in different forms with system users, for example, losing contracted capacity permanently or only temporarily. UIOLI conditions are commonly used in gas transport capacity contracts. In the gas market, UIOLI conditions are generally imposed to remove the perverse incentive for system users to book (much) more capacity than required, so that competitors cannot access the market. Imposing UIOLI conditions thus leaves grid operators more capacity to admit new system users to the grid. Implementing UIOLI-based contracts could lead to various implementation choices and issues, including: what an appropriate network tariff would be for connection agreements with UIOLI access; how to specify the exact conditions under which capacity is actually 'lost'; and what form of compensation would be required.

4.3 Varying attributes of flexible connections

On a generic level, the various alternative connection agreements deviate from the standard firm connection agreement regarding several attributes for which different choices can be made. In the process of its Significant Code Review (SCR) Ofgem described a system user's access rights as a combination of different access choices regarding:

- Level of firmness;
- Time profile (continuous or non-continuous); and
- Level of connection (shared or individual).

Furthermore, based on CEER's review of relevant literature, four additional choices can be distinguished:

- Connection fee (standard, with or without compensation/reward for flexibility);
- Geographical scope (across all networks, or only in congested areas?);
- Type of system users (all system users or a particular type of system user?); and
- Length of the contract (indefinite, a limited period, until firm capacity is available, etc.)

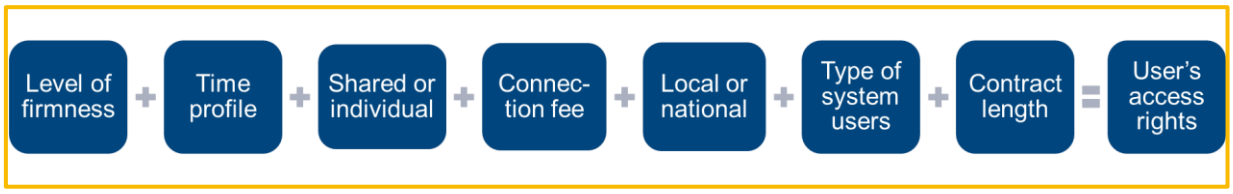


Figure 3 – Access rights are a combination of different access choices[47]

[47] Adapted from 2019 Ofgem Discussion Note, with additions by CEER.

5 LEGAL AND REGULATORY FRAMEWORKS AT THE NATIONAL LEVEL AND EXISTING CASES FOR ALTERNATIVE CONNECTIONS

This section describes the existing legal and regulatory frameworks and use cases for alternative connection agreements at the level of analysed European countries. This section draws on country case study descriptions for Austria, Belgium (Wallonia region), Finland, France, Hungary, Luxembourg, the Netherlands, Norway and Sweden. Additionally, the available literature is reviewed for the current status of alternative connection agreements in Great Britain.

5.1 Legal and regulatory framework at the national level

At the national level, all the analysed European countries demonstrate interest in adopting some form of alternative connection agreements, but only some already explicitly allow for them in the current legal and regulatory framework.

At one end, some MS, such as Hungary, France, the region of Wallonia in Belgium, Great Britain and Norway already have a legal framework that explicitly allows for non-firm connections at the DSO level. However, even in these countries the use of non-firm connections sometimes needs to have economic justifications and in France the total amount of curtailment cannot exceed certain limits.

At the other end, countries, such as Finland and the Netherlands, have strict rules about a connection agreement being a firm one from the start, and the connection capacity always being determined by the peak power requirement. In Finland, any potential flexibility to the connection will have to happen via an additional service agreement (without compensation) or a tariff which allows for the DSO to modulate the connection as needed.[48] In the Netherlands, system users in (near) congestion areas are allowed to enter into capacity limitation contracts with associated compensation on top of existing firm connection agreements. It could be argued, however, that a firm connection agreement with a flexible additional service agreement could be categorised as an alternative connection agreement. In Luxembourg, the existing regulatory codes in principle only allow for firm capacity contracts but there are exemptions granted on a case-by-case basis.

In between, there are countries like Sweden and Austria with less well-defined legislation, where the laws and the regulatory frameworks do not explicitly restrict the use of alternative connection agreements and limited information is available on their prevalence.

[48] However, the same tariff needs to be offered to the whole region where the DSO operates, while the 'flexibility need' of a connection may be highly local.

5.2 Country by country description and use cases

In the **region of Wallonia in Belgium**, an obligation has been in place since 2014 for all electricity producers with a generation capacity of 250 kVA and above to have the capabilities to modulate their injection capacity if the system operator so requires. This has enabled the use of flexible connections where, depending on the capacity limits of the network, a new connection can either be offered grid access on a firm or a flexible basis, or a combination of the two. A cost-benefit analysis, performed by the regional regulator, CWaPE, is triggered in cases where either: a) the sum of producers' injection profiles (including modulated portion) in the local network exceeds the maximum injection capacity of the local grid[49] at any given time, or b) the expected modulation of the new connection is above 5% of the expected connection request's annual generation output. The cost benefit analysis evaluates the case of flexible access against the case of reinforcing the grid. In 2022, the legislation was further amended to require the potential modulation of a flexible connection to be expressed in annual volume terms (MWh/year) rather than in instantaneous capacity terms (MW). This aimed to mitigate the uncertainty around curtailment risk faced by producers. As said, all applicable connections are required to modulate, if needs be, 5% of the total annual output without compensation during the contractual phase. Therefore, a combination of a rules-based mechanism and alternative connection agreements are used to procure flexibility to solve network issues.

In **Norway**, new legislation, which took effect in 2021, allows for DSOs and end-users to bilaterally enter into an agreement for flexible connection. This applies for new consumption connections and the legislation explicitly states that no compensation shall be given to the end-user upon entering into such an agreement. Therefore, the main benefits for the end-user are: 1) faster connection, and 2) lower connection charge. These types of contracts are voluntary from both sides and the private agreement must outline the criteria for disconnection or curtailment, and the rights, duties and consequences of the agreement for both parties. Similar agreements between producers and DSOs have been a part of the regulation since 2019.

Literature review: Great Britain's grid code changes to further accommodate non-firm access rights.
Great Britain has recently undergone a significant grid code review for grid access and forward-looking charges to accommodate the transition to a low-carbon energy system at the lowest cost.[50] Alternative connection agreements were possible, even before these code changes, to help connect faster or more cheaply, but the arrangements may have been loosely defined or required the user to face an undefined amount of curtailment. The amendments ensure that there is a standardised option available for non-firm access for larger network users going forward, and that the flexible connection agreements will have clear curtailment limits and end dates for non-firm access arrangements. Crucially, smaller network users have been deemed out of scope. These changes are also accommodated by significant changes to the distribution connection forward-looking charges[51] where, going forward, the need to contribute to wider network reinforcement costs is removed for demand connections and reduced for generation connections. This will reduce the overall connection charges for those connecting to the distribution network, and demand connections are only charged for network expansions.

[49] Before 2022, the grid capacity was assessed for the N-1 scenario, whereas since 2022 it is being assessed for the N scenario (all local grid capacity available).
[50] Ofgem Access SCR Decision.
[51] In Great Britain, network charges are allocated between forward-looking charges and residual charges. Residual charges reflect sunk costs, such as past network investments, while forward-looking charges reflect the marginal cost of adding each additional unit of capacity to the network in the long run.

The details on the implementation of the recommended changes are now being finalised by the industry, including calculations for curtailment limits, to be effective by 1 April 2023, in line with the start of RIIO-ED2. For the next price control period, Ofgem is also introducing incentives and reporting requirements around alternative connection agreements.[52]

In **France**, flexible connections are already utilised for DER producers especially at the transmission level. The regulator, CRE, has also introduced a regulatory sandbox, where some DSOs are currently testing flexible connections for DER producers. The current legal framework allows the DSO and TSO to propose a non-firm connection for producers in three distinct cases:

1. "Anticipated connection", where the DSO or TSO allows the connection of the power plant, with power modulation pending the construction of the distribution or transmission network. The regulatory framework introduced by CRE specifies the terms that should be included in the contract including the maximum number of hours of power limitation and the duration of network construction.
2. "Alternative offer", where, in response to a request by a producer, the DSO or TSO can propose a flexible connection to optimise the investment and reduce the price of the connection. Any curtailment within the agreed limits is not compensated for. The regulatory framework sets out rules that should be adhered to by the network operator in order to propose an alternative offer. These rules include that the curtailed energy cannot exceed 5% of the annual production of the installation and the guaranteed connection injection power cannot be less than 70% of the power requested.
3. "Intelligent offer", where, within the regulatory sandbox zones, the DSO can propose to connect a producer on a saturated primary substation/power transformer without creating any new capacity (adding additional transformers). In return, the producer is curtailed with compensation in case of congestion.

In **Hungary**, the existing regulatory codes allow for non-firm capacity contracts, but only for a limited circle of system users (new power plants and storage providers) and for a fixed purpose (economic efficiency). The DSO has a relatively high level of freedom to design the contents of the alternative connection agreement. Data and information on existing use cases and the number and contractual provisions of alternative connection agreements is scarce or not available for the regulator.

The Netherlands currently only allows for firm connection agreements but is, as of the beginning of 2023, consulting on the implementation of alternative connection agreements. In addition, the Network Code was recently modified to expand the possibilities for congestion management at the DSO level. This allows DSOs to enter 'dispatch limitation contracts' with system users to temporarily limit the use of their contracted firm capacity. These capacity limitation contracts include negotiated compensation for the system user. This enables a more efficient use of the available network capacity and faster connection to the grid for new users. It could be argued that a firm connection agreement with a connection limitation contract could be similar (if not identical) in practice to a flexible connection agreement.

[52] "Consultation: Distribution System Operation Incentive Governance Document", Ofgem, 12 October 2022. Retrieved from: https://www.ofgem.gov.uk/sites/default/files/2022-10/DSO%20Incentive%20Governance%20Document%20Consultation.pdf.

In **Finland**, although a connection agreement must be based on firm capacity, the NRA is aware of one case where the DSO has agreed with an existing larger consumption connection on an additional flexibility service agreement that requires the user to modulate its consumption based on the DSO's instructions. This is very similar to the Netherland's bilateral contracts described above. No compensation is allowed for modulation, but this has allowed the user to connect the additional demand to the network before grid reinforcements could be finalised.

In **Austria**, flexible connections in the form of bilateral agreements between power generators (primarily, but not exclusively, wind power) and grid operators are utilised in cases where generation units cannot be granted firm access to the grid in the required schedule. In these cases, the flexible connection allows the user to be connected to the network earlier than otherwise, while grid operators can ensure secure operation of the grid by obtaining the right to impose limits to grid injection when necessary. There is no financial compensation for generators in case of DSO-requested downward regulation.

Luxembourg is in the process of amending the national legal and regulatory framework and is considering whether to accommodate the use of flexible connections. While this is work in progress, there are existing cases where exemptions from the current legal framework have been made. These include the connection of certain bus depots, where a higher connection capacity during night-time was allowed for fleet charging, to allow for greater utilisation of the grid. It is expected that these exemptions will form the basis for future legislative amendments concerning flexible connections.

6 CEER'S OBSERVATIONS AND RECOMMENDATIONS

This section provides a synthesis of the information that was gathered from NRAs via the questionnaire, earlier publications on the regulatory framework for DSOs' access to flexibility and literature on alternative connection agreements. This section presents the key observations and highlights recommendations for NRAs that are considering the implementation of alternative connection agreements.

6.1 Large differences between countries in the uptake of alternative connection agreement

The information received via the questionnaire has been used to draw a synthesis figure (Figure 4 below) that describes the current state of play of alternative connection agreements in the countries included in this paper. At the far left-hand side of this figure is the NRA that assesses the implementation of alternative connections agreements as an additional instrument for DSOs to efficiently use their networks. The second 'column' in the figure highlights three factors that seem most relevant in explaining the countries' differences regarding the consideration and implementation of alternative connection agreements.[53] These factors are: 1) the degree to which countries experience network issues, such as congestion; 2) the direction of regulatory decision and the level of development concerning flexibility markets and market-based procurement of flexibility by the DSO; and 3) the current legal status of alternative connection agreements. At the right-hand side, the figure illustrates where countries included in this paper can be placed on these three explanatory factors which are described as follows:

1. **Degree to which countries experience network issues**, which determines the urgency of action and hence the necessity of using all possible means to optimally use available network capacity.

2. **The direction of regulatory decision and the level of development concerning flexibility markets and market-based procurement of flexibility by the DSO.** This describes whether the regulatory framework and market developments have been successful in developing local flexibility markets and allows DSOs to procure market-based flexibility. If this is not yet the case in the jurisdiction as a whole, or for parts of the distribution network specifically, then the regulator may decide to introduce the non-market-based approach of alternative connection agreements. However, based on the questionnaire input, most NRAs have not made this decision yet.

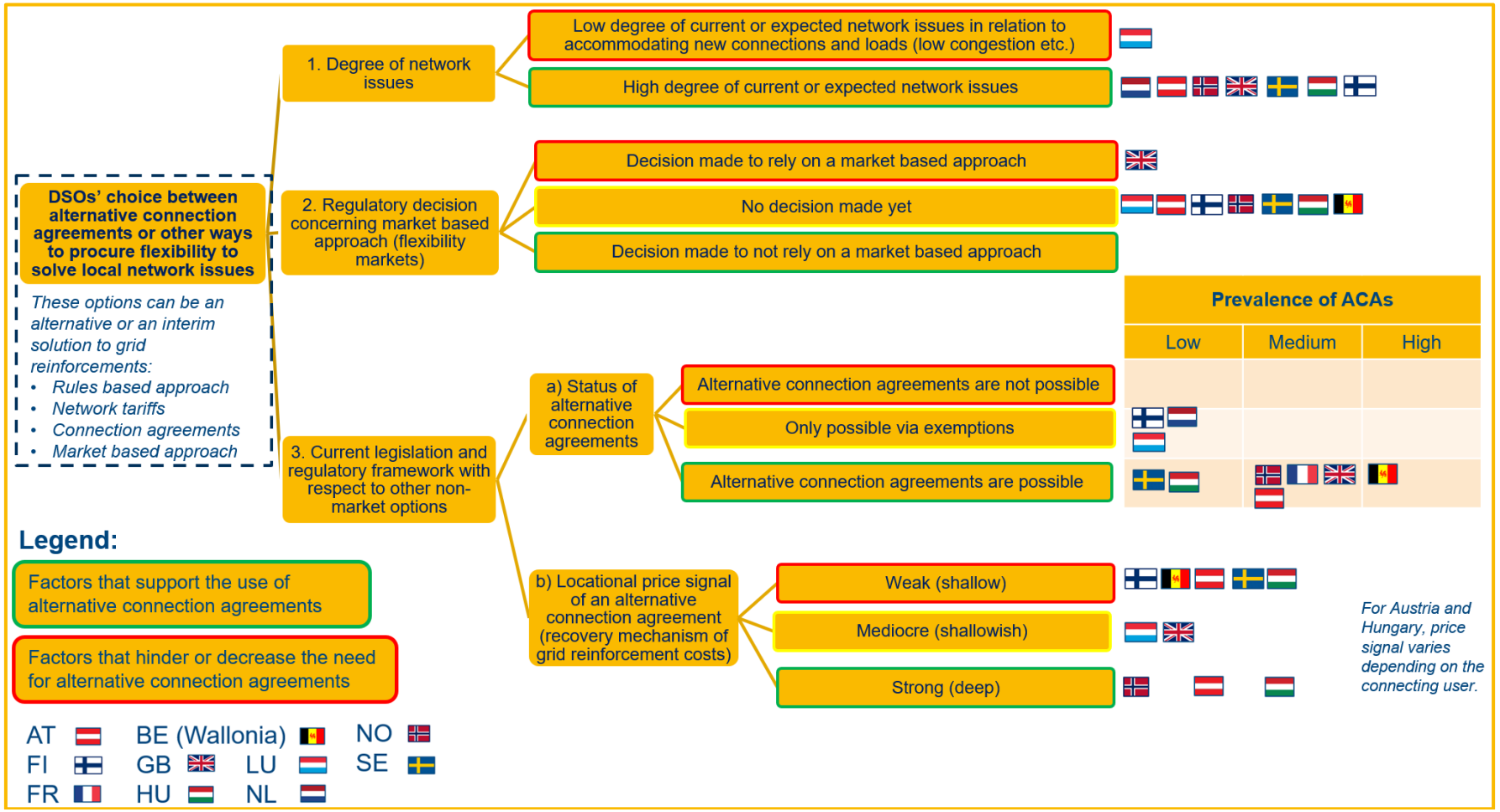
3. **The current legislation and regulatory framework**, which determines the actual **status of alternative connection agreements** and whether they are able to be used (and under which circumstances and for what purposes) in practice. Additionally, **the current cost-recovery mechanism of grid reinforcement costs** determines the strength of the price signal of avoiding triggering grid reinforcement via an alternative connection agreement. The decision may also be impacted by the underlying regulatory approach, which may somewhat differ country by country.

It should be noted that the three identified explanatory factors depicted in Figure 4 are not necessarily exhaustive, there may be other relevant factors that affect the decision-making on alternative connection agreements. Figure 4 is intended to be used as a general guideline that

[53] It should be noted that there may be more factors at work that affect regulatory decision-making regarding alternative connection agreements and that the listed factors are not aimed to be exhaustive.

can help illustrate differences and similarities between countries and identify countries that are currently in somewhat similar situations concerning the implementation of alternative connections agreements.

The subsequent subsections provide further detail on the three above-listed explanatory factors and identify several recommendations.



1 Figure 4 – Illustration of key factors impacting the regulatory application of alternative connection agreements as a tool for DSOs to access flexibility and mapping of some European countries (and region)

6.2 Network issues are the dominant driver for alternative connection agreements

The gathered questionnaire input demonstrates that urgent or foreseeable network issues, i.e., the **present or impending inability to accommodate new connections into the grid**, are the dominant driver for NRAs to consider the implementation of alternative connection agreements.[54] Countries that do not (yet) face this issue generally do not consider the implementation of alternative forms of connection agreements, presumably because grid reinforcement appears as a suitable and adequate default approach. For countries that increasingly experience congestion and voltage problems in their network, even to such a degree that new connection applications can no longer be granted until lengthy network reinforcements are realised, the DSOs will have a strong interest in initiating any alternative approaches to the regulatory framework to relieve these issues. The willingness of an NRA to then proceed with adapting the regulatory framework conceivably depends on the frequency and geographical scale of these network issues i.e. do the benefits of adapting the regulatory framework outweigh the regulatory costs of implementation?

6.3 Alternative connection agreements as an alternative or supplement to market-based flexibility procurement

Earlier CEER papers have demonstrated that connection agreements are only one of the four mechanisms available for DSOs to access flexibility available with system users connected to their network. **When considering the implementation of alternative connection agreements, NRAs need to consider the interaction that this mechanism has with market-based mechanisms for DSOs to access flexibility**, as Article 32 of the EU Directive prescribes market-based procurement as the primary mechanism for DSOs to access flexibility. As alternative connection agreements are a non-market-based mechanism, NRAs need to assess whether the use of this mechanism should be facilitated. If DSOs are in practice able to access flexibility of system users via market-based mechanisms, alternative connection agreements might negatively affect flexibility markets by reducing liquidity and creating market distortions. When both mechanisms are allowed to be used by the DSO at the same time, there is the risk that the flexibility available with system users is no longer offered to the local flexibility market (either via a platform or via a bilateral contract) but 'locked' in alternative connection agreements. [55]

[54] Specific policy objectives that might potentially entail future network issues might induce the application of alternative connection agreements as well, for example in Belgium's Wallonia region.

[55] As is also noted in the 2022 IEA Report: "A limitation of flexible connection arrangements is that DERs are compensated indirectly for providing flexibility to mitigate network congestion with either faster and more affordable grid connection (in Great Britain) or the right to export more energy to the grid (in South Australia). In contrast, local flexibility markets can enable DSOs to publish their flexibility needs in advance and procure them from DERs in a competitive and transparent manner. This approach would reveal the actual value of flexibility services more clearly and ensure they are adequately paid for, while enabling DSOs to procure best-value services".

Although the impact of either entering alternative connection agreements or market-based procurement of flexibility on the network is similar, the distribution of costs and benefits is very much different and could lead to a loss in social welfare and sub-optimal network investments as a result. If a DSO procures flexibility through a market-based mechanism, the system user that can offer the service (that is, the required flexibility) at the lowest cost is chosen. Based on the cost of procuring this market-based flexibility and the frequency of the congestion it resolves, the DSO may consider whether it is more cost-efficient to reinforce the network or to continue to apply congestion management. However, when alternative connection agreements are allowed, the DSO could also choose not to procure the flexibility from the market, but rather enter into such an alternative connection agreement with a system user. Then it is uncertain whether the associated compensation for this system user - whether at a regulated or bilaterally negotiated tariff - reflects the true value for the flexibility implicitly delivered to the DSO. Moreover, the incentive for the DSO to reinforce the network might then also be distorted, giving rise to sub-optimal network development from a social welfare perspective.

Another detrimental aspect of alternative connection agreements is that, when applied to intermittent renewable power plants, they establish power generation curtailment as a standard approach for congestion management. In contrast, market-based flexibility procurement offers the opportunity of ramping up flexible loads if high solar or wind power generation necessitates precautionary or remedial measures.

From a DSO's perspective, the main advantages of an alternative connection agreement over procurement via flexibility platforms include the guaranteed availability and exclusive right to utilise the grid user's flexibility. However, it is also possible to arrange long-term contracts and provide DSOs with 'priority access' to local flexibility sources at platforms serving multiple purposes (i.e., DSO and TSO services and wholesale markets). 'Revenue/value stacking' (i.e., offering flexibility services to various requesters) may also be possible under an alternative connection agreement if there are coordinated market sequences. However, it is unlikely that limitations to revenue stacking can be eliminated entirely. Compared to flexibility markets designed to facilitate revenue/value stacking, this may lead to inefficiencies and welfare losses.

Considering the above considerations, the key question is: which circumstances make it relevant for NRAs to implement alternative connection agreements? This seems to be the case in one of the following three circumstances:

- The (local) market for flexibility is lacking or still underdeveloped;
- There is a considerable risk of strategic bidding due to predictability of local congestions; or
- Alternative connection agreements are used as a temporary solution to connect new users or existing users that require larger connection capacity until planned network reinforcements are realised.

If local flexibility markets are not yet present or are underdeveloped, NRAs could consider introducing alternative connection agreements as one of the possible mechanisms for DSOs to access flexibility, with the other mechanisms being the rules-based approach and network tariffs (see Table 1 on page 19). As these options have different financial, legal and temporal attributes, NRAs need to choose the best available option (or a combination of options) for the DSOs to use, pursuant to local particularities and regulatory objectives. Allowing for the implementation of alternative connection agreements under these circumstances should be conditional on the state of the local market for flexibility. When this market is further developed there would no longer be a need for alternative connection agreements as market-based alternatives will then become available. This implies that the actual state of a local flexibility market should be monitored. When local flexibility markets are competitive enough, DSOs should be mandated to no longer use alternative connection agreements but rather use market-based procurement.

Strategic bidding, especially 'increase-decrease gaming', is often considered a main risk of local flexibility markets. This is also acknowledged in Article 32 of Directive (EU) 2019/944, where economic inefficiency is defined as a legitimate reason for NRAs to stipulate non-market-based flexibility procurement.

In the case of congested distribution networks, alternative congestion agreements may be considered a viable temporary solution to allow new users that cannot be connected to the grid on a firm basis until planned network reinforcements are realised. By doing so, some social welfare loss due to new users not being connected to the network may be avoided. There may still be issues relating to the interaction between alternative capacity agreements and market-based procurement of flexibility by the DSO in these cases, but possible adverse impacts may be limited in practice, as its use cases are limited to constrained areas waiting for network reinforcement. NRAs will need to be careful in assessing the benefits and risks of implementing alternative connection agreements in these types of use cases and, where possible, be as precise as possible about the conditions under which DSOs can enter into alternative connection agreements with new users that cannot yet be connected firmly. More insights into this practice are likely to be gained in the upcoming years by the different NRAs that are currently investigating the option of alternative connection agreements.

6.4 Important issues regarding the implementation of alternative connection agreements

The following issues are relevant for NRAs that are considering the implementation of alternative connection agreements in the regulatory framework:

- For DSOs to be able to offer alternative connection agreements, they need to digitalise their network and implement real-time grid monitoring, in order to have deep insight and control over network flows;
- For NRAs to make the correct regulatory decision, the DSOs need to be transparent and share relevant data with the NRA; and
- NRAs need to carefully consider the degree of regulation (e.g., standardisation vs. 'laissez faire') regarding alternative connection agreements, both at introduction and over time.

For DSOs to make efficient and effective use of alternative connection agreements they need to have deep insight and control over network flows. This is necessary for identifying the degree and location of network issues in their networks, the particular need for market-based flexibility procurement (frequency, duration, period, etc.) and specifying the alternative connection agreements that may still be offered to new system users based on remaining capacity outside the hours of congestion or voltage quality issues.

For NRAs to be able to make informed decisions on the optimal regulatory framework to deal with the network issues DSOs are faced with, the NRAs need to have access to all relevant data at the appropriate level of detail. This concerns both information needed to investigate the particular need or usefulness of alternative connection agreements ex ante, and information on how existing alternative connection agreements are functioning in practice. NRAs could, for example, consider monitoring: 1) those cases where the DSO cannot grant a firm connection, and 2) the existence, number and essential parameters of alternative connection agreements, such as degree of firmness, conditions for curtailment, compensation agreed in return for non-firmness, etc.

As was mentioned in Section 1.3, in most cases on the regulator's part, there is no sufficient (i.e., regularly provided and properly arranged) data on the exact types of technical challenges the DSOs are facing. Therefore, a monitoring exercise might also aim to include these. In line with Article 59 of the Directive, a set of smart grid indicators could also track the progress of the development of smart grids for each grid operator, and in this paper's context, in relation to alternative connection agreements. These indicators could contribute to identifying and solving any obstacles related to DSOs' ability to procure flexibility and help formulate changes to the existing legal and regulatory framework. Given that, pursuant to Article 32 (3) of the Directive, the distribution NDPs "shall also include the use of demand response, energy efficiency, energy storage facilities or other resources that the distribution system operator is to use as an alternative to system expansion", the data necessary for the above-mentioned possible monitoring exercises, might be well-placed in the NDPs. Alternatively, the data might be captured as part of the derogation process under Article 32 (1) of the Directive pursuant to which the NRA determines that the procurement of flexibility services is not economically efficient or that such procurement would lead to severe market distortions or to higher congestion.

NRAs need to carefully consider the regulatory choices regarding alternative connection agreements, both at their introduction and over time. If an NRA considers alternative connection agreements to be a necessary or useful addition to the current regulated DSO practice of solely offering firm connection agreements, the NRA will need to decide: 1) which attributes (e.g. connection fees, length, amount of allowed curtailment) of these connection agreements are strictly defined and/or standardised by the NRA, and 2) which aspects do the contractual parties have the freedom to agree on bilaterally. Therefore, the choice on the degree of freedom is a trade-off between too restrictive standardisation potentially hindering usefulness of these connection agreements, versus a more laissez-faire approach potentially failing to sufficiently protect against the risk of e.g. market power abuse. All of the above leads to the need for NRAs to consider the typical problem use case with which they are confronted with - such as the type of new connection, e.g. generation or load, typical voltage level of connection, typical capacity volumes of connection requests - and a wealth of possible solutions (see Section 4), so that they can compare the available options to solve the problem and arrive at an optimal regulatory framework.

In addition, NRAs will need to adopt a dynamic regulatory approach towards alternative connection agreements as circumstances change over time. This might be due to changes in the legal framework, developments within the distribution networks concerning increasing DER penetration and network issues, or developments in the local markets for flexibility providing more options for market-based procurement of flexibility by DSOs, etc. For example, jurisdictions that are only experiencing network issues to a limited degree, and already have in place a sandbox scheme that allows for experiments to be carried out in the short term, could relatively quickly learn by doing and implement a targeted approach. On the other hand, jurisdictions that are confronted with network issues on a very large scale and have no existing framework for connection agreements other than firm connection agreements, will feel pushed to come up with a more standardised, regulated approach aimed at short-term results. Jurisdictions that already have both an enabling legal and regulatory framework and experience with alternative connection agreements, in practice may only need to 'finetune' their approach over time, for example because flexibility markets are becoming more competitive.

Finally, signals on how alternative connection agreements function in practice may also lead to NRAs re-considering their regulatory approach. Discrimination of network users by the DSO might, for example, be an issue in relation to prioritisation of users that want to be connected, the tariff specified in the alternative connection agreement, or the frequency and actual amount of curtailment that is enforced by the DSO.

6.5 The current legal and regulatory status of alternative connection agreements affects implementation

Information obtained through the questionnaire shows that the current legal and regulatory framework largely varies across countries and directly affects how NRAs start off when considering their regulatory approach towards alternative connection agreements.

Firstly, national frameworks either explicitly allow or disallow alternative connection agreements, while others are somewhere in-between because alternative connection agreements are interpreted to be implicitly allowed or are implemented under derogations.

Secondly, another factor in the regulatory framework that seems to impact the NRA approach to alternative connection agreements is the current cost recovery mechanism that is applied. The cost recovery mechanism of network reinforcement costs that are triggered by new connections or loads can vary from being shallow to deep. A lower network connection charge, alongside faster connection time, were seen by many NRAs as the main potential benefits for the user when being offered an alternative connection agreement. However, the currently applied cost recovery mechanisms vary country by country from shallow to deep. The different choices across countries presumably relate to different underlying ideological views on how network (connection) costs should be distributed and may reflect different preferences or weighting of regulatory principles such as fairness or economic efficiency.

National frameworks with a shallow cost recovery approach for grid reinforcement costs may therefore lend themselves better to utilising and providing stronger locational signals for flexibility via e.g., network tariffs rather than connection agreements. For example, as part of its grid code review, Great Britain is amending its distribution network charges to better fit the needs of alternative connection agreements. In Finland, connection pricing must be largely based on the actual construction costs of expanding the network, which in turn are based on the peak power requirement of the connection. In this case, grid reinforcement costs are almost completely borne equally by all connected users in the network, and connection fees therefore provide little room for a locational price signal to incentivise new users to connect flexibly from the network's point of view.

An additional question that was raised in the input from NRAs, was whether a lower lump sum connection fee for a new connection resulting from an alternative connection agreement, can fully reflect the lifetime value of the flexibility that this connection may provide, as the lifetime value was likely to be highly uncertain at the time of the agreement.

Lastly, as is illustrated best in the case of Wallonia', regulatory policy objectives might in themselves prove sufficient to consider alternative connection agreements. They could be a most fit-for-purpose regulatory tool used to avoid and monitor potential future network issues resulting from an ambitious renewable generation deployment.

7 CONCLUSIONS

There are large differences between countries in the implementation, prevalence and regulation of alternative connection agreements.

These differences can be evaluated through the following key factors:

1. Degree to which countries experience network issues, which determines the urgency of action and hence the necessity of using all possible means to optimally use available network capacity.
2. The direction of regulatory decisions and the level of development concerning flexibility markets and market-based procurement of flexibility by the DSO, which describes whether the regulatory framework and market developments have been successful in developing local flexibility markets and allows DSOs to procure market-based flexibility.
3. The current legislation and regulatory framework, which determines the current status of alternative connection agreements and whether they are able to be used (and under which circumstances and for what purposes) in practice.

NRAs need to carefully assess the interaction between alternative connection agreements and other, especially market-based, mechanisms for DSOs to access flexibility when considering their implementation.

As demonstrated in earlier CEER papers, there are multiple mechanisms for DSOs to access flexibility. As Article 32 of the Directive prescribes market-based procurement as the primary mechanism for DSOs to access flexibility, NRAs need to assess whether the use of this mechanism should be facilitated in practice. If DSOs are already able to access flexibility of system users via market-based mechanisms, alternative connection agreements might negatively affect the market for flexibility by reducing liquidity and creating market distortions. Although the impact of either entering alternative connection agreements or market-based procurement of flexibility on the network is similar, the distribution of costs and benefits is very much different and could lead to a loss in social welfare and sub-optimal network investments as a result.

Alternative connection agreements should be considered in the case of underdeveloped (local) flexibility markets, to prevent strategic bidding in local flexibility markets, or as a temporary instrument to connect new users that can only be connected on a firm basis once ongoing network reinforcements are realised.

Taking the above considerations about alternative connection agreements negatively affecting market-based procurement of flexibility into account, the key question is: which circumstances make it relevant for NRAs to implement alternative connection agreements? When local flexibility markets are underdeveloped, DSOs could be allowed to use alternative connection agreements as a mechanism to access flexibility, as market-based options are not sufficiently available. Alternatively, alternative connection agreements can be an effective temporary instrument to connect new users, or existing users that require larger connection capacity, until planned network reinforcements are realised. This would avoid some of the social welfare loss that results from system users not being connected timeously.

Successful implementation of alternative connection agreements requires smart grid operation by DSOs, a well-informed NRA and a fit-for-purpose regulatory design.

Firstly, for DSOs to be able to use alternative connection agreements effectively and efficiently, their network needs to be digitalised. More detailed information on flows and capacity is needed to remain in control of the network and enable optimal use of network capacity. Secondly, for NRAs to make informed decisions on the optimal regulatory framework to solve network issues that DSOs are faced with, NRAs should have access to enough data at the appropriate level of detail. This information could be arranged via, for example, congestion reporting and NDPs. Thirdly, NRAs need to carefully consider the regulatory choices (e.g., regarding alternative connection agreements) both at their introduction and over time. NRAs will need to decide which attributes (e.g., connection fees, length of contract and amount of allowed curtailment) of these connection agreements are strictly defined and/or standardised by the NRA and which aspects the contractual parties will have the freedom to agree on bilaterally.

The current legal and regulatory status of alternative connection agreements affects implementation.

Information obtained through the questionnaire shows that the current national legal and regulatory framework largely varies across countries and directly affects how NRAs start off in considering their regulatory approach towards alternative connection agreements. Firstly, national frameworks either explicitly allow or disallow alternative connection agreements or are somewhere in-between because alternative connection agreements are interpreted to be implicitly allowed or are implemented under derogations. Secondly, the cost recovery mechanism in place in the existing regulatory framework may impact the NRA's approach to alternative connection agreements. Thirdly, other regulatory policy objectives and the different weighting of regulatory principles might directly influence regulatory decision making concerning alternative connection agreements.

ANNEX 1 – LIST OF ABBREVIATIONS

Term	Definition
ACER	Agency for the Cooperation of Energy Regulators
ARENA	Australia Renewable Energy Agency
CEER	Council of European Energy Regulators
DER	Distributed energy resources
DSO	Distribution system operator
ENA	Energy Network Association
IEA	International Energy Agency
MS	Member State(s)
NDP	Network development plan
NRA	National Regulatory Authority
Ofgem	Office of Gas and Electricity Markets (Great Britain's NRA)
RES	Renewable energy sources
TSO	Transmission system operator
UIOLI	Use-it-or-lose-it
UIOSI	Use-it-or-sell-it

ANNEX 2 – ABOUT CEER

The Council of European Energy Regulators (CEER) is the voice of Europe's national energy regulators. CEER's members and observers comprise 39 national energy regulatory authorities (NRAs) from across Europe.

CEER is legally established as a not-for-profit association under Belgian law, with a small Secretariat based in Brussels to assist the organisation.

CEER supports its NRA members/observers in their responsibilities, sharing experience and developing regulatory capacity and best practices. It does so by facilitating expert working group meetings, hosting workshops and events, supporting the development and publication of regulatory papers, and through an in-house Training Academy. Through CEER, European NRAs cooperate and develop common position papers, advice and forward-thinking recommendations to improve the electricity and gas markets for the benefit of consumers and businesses.

In terms of policy, CEER actively promotes an investment friendly, harmonised regulatory environment and the consistent application of existing EU legislation. A key objective of CEER is to facilitate the creation of a single, competitive, efficient and sustainable Internal Energy Market in Europe that works in the consumer interest.

Specifically, CEER deals with a range of energy regulatory issues including wholesale and retail markets; consumer issues; distribution networks; smart grids; flexibility; sustainability; and international cooperation.

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More information is available at www.ceer.eu.