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Exploring regulatory strategies for accelerating the development of sustainable hydrogen markets in the European Union

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The development of sustainable hydrogen markets will play a vital role to achieve energy sovereignty and climate neutrality by 2050. The article analyses what tools and methods are available to contribute to the development of such markets. To identify these tools and methods, the article elaborates on goals and principles of good regulation, and argues for the consideration of flexibility in the regulatory framework to be responsive to technological, societal and economic changes. Considering Germany and the draft EU hydrogen and decarbonised gas market package as case studies, the article develops the argument that legislators should consider regulatory experimentation and apply comparative methods to develop well-working regulatory strategies and an appropriate set of rules for the development of the markets.

Keywords: sustainable hydrogen; energy trilemma; comparative law; best practices approach; goals and principles of good regulation; regulatory strategies; regulatory experimentation; pure hydrogen grids; hydrogen and decarbonised gas market package

1. Introduction

1.1. *Background and problem statement*

Up to today, Russia's war against Ukraine has emphasised the European Union (EU)'s dependence on energy imports to maintain a steady and affordable energy supply for the EU's economy and society almost on a daily basis. Among several other policy instruments,[1] the development of a hydrogen market could play a vital role to reduce the dependence from natural gas imports. Hence, it is no surprise that the European Commission includes the import of green[2] hydrogen from third countries as a main pillar of its strategy to addressing the challenges resulting from the changing political landscape due to Russia's aggression.[3] At the same

1 See European Commission, 'REPowerEU Plan' COM (2022) 230 final
2 See for a definition Saskia Lavrijssen and Blanka Vitéz, 'Make Hydrogen Whilst the Sun Shines: How to Turn the Current Momentum into a Well-Functioning Hydrogen Market?' [2020] CCLR, 266, 268
3 See European Commission, 'EU External Energy Engagement in a Changing World' JOIN (2022) 23 final, 4ff. Nevertheless, the literature emphasises the need for policymakers to not only focus on green

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time, aiming at climate neutrality in 2050, the transition of the energy system remains a main goal in the EU.[4] Also in this regard, the creation of a sustainable (green and blue)[5] hydrogen market can become a key lever, and contributes to the EU Green Deal.[6] Developing sustainable hydrogen markets is therefore at the centre of attention for the EU and the national legislators and businesses, but at the same time also poses a big challenge.

This challenge consists of scaling up markets while the amount of generation of hydrogen in general and sustainable hydrogen in particular is still low.[7] In 2018, for example, global demand for hydrogen in its pure form was slightly over 70 million tonnes per year.[8] Against this background, the projected costs of developing hydrogen facilities are also very uncertain, which leads to companies hesitating to invest in building hydrogen infrastructure and to changing the situation (*investment risk*).[9] Nonetheless, the global green hydrogen market was calculated to have had a total revenue of US$257,700,000 in 2020; predictions project a compound annual growth rate of 54.7 per cent, leading to a total revenue in the market of US $9,834,300,000 by 2028.[10] This is a growth by more than 38 times in only eight years. While, for example, there are coherent and comprehensive competition law and data protection rules in the EU in place that apply in every member state, there is no harmonised EU legal framework specifically related to rules for the hydrogen market yet. This leads to the general question on how to stimulate, develop and regulate markets for sustainable hydrogen.[11] Specific rules on hydrogen markets that apply in all member states in an equal way would assist in creating an EU-wide single market for hydrogen. The tool for this is EU secondary law that sets common standards for all member states. In the light of this, it is energy law that constitutes the tool for setting up the right incentives for scaling up the deployment

hydrogen. This is because electrolysers are needed for the production of green hydrogen, while the production capacity for electrolysers is also limited: Dawud Ansari, Julian Grinschgl, and Jacopo Maria Pepe, 'Electrolysers for the Hydrogen Revolution. Challenges, Dependencies, and Solutions' (SWP Comment 2022/C 57, 29 September 2022) <www.swp-berlin.org/publikation/electrolysers-for-the-hydrogen-revolution> accessed 29 August 2023, 1, 8

4 See the REPowerEU Plan (n 1), 2 and 20

5 See for a definition Lavrijssen and Vitéz (n 2), 266, 268; a more detailed 'color scheme' can be found in Marcel Linnemann and Julia Peltzer, *Wasserstoffwirtschaft kompakt. Klimaschutz, Regulatorik und Perspektiven für die Energiewirtschaft* (Springer 2022), 71ff

6 REPowerEU Plan (n 1), 7f; European Commission, 'A Hydrogen Strategy for a Climate-Neutral Europe' (2020) COM 301 final, 1ff; Lavrijssen and Vitéz (n 2), 266, 266ff; see also Ansari and others (n 3), 1, 8

7 IEA, 'The Future of Hydrogen. Seizing Today's Opportunities' (2019) <https://iea.blob.core.windows.net/assets/9e3a3493-b9a6-4b7d-b499-7ca48e357561/The_Future_of_Hydrogen.pdf> accessed 29 August 2023, 32

8 IEA (n 7), 17f

9 See Laurent Ruseckas, 'Europe and the Eastern Mediterranean: The Potential for Hydrogen Partnership' (SWP Comment 2022/C 50, 29 August 2022) <www.swp-berlin.org/en/publication/europe-and-the-eastern-mediterranean-the-potential-for-hydrogen-partnership> accessed 29 August 2023, 6

10 Green Hydrogen Market by Type (Proton Exchange Membrane Electrolyzer, Alkaline Electrolyzer, and Solid Oxide Electrolyzer), Application (Power Generation, Transport, and Others), and End-use (Food & Beverages, Medical, Chemical, Petrochemical, Glass, and Others), and Regional Analysis (North America, Europe, Asia-Pacific, and LAMEA): Global Opportunity Analysis and Industry Forecast, 2021–2028 <www.researchdive.com/8502/global-green-hydrogen-market> accessed 29 August 2023

11 See for regulation as a facilitative concept Robert Baldwin and others, *Understanding Regulation – Theory, Strategy, and Practice* (Oxford Scholarship Online 2011), 3

of markets for sustainable hydrogen.[12] Energy law is pro-active economic law providing for ex ante regulatory rules and focusses on the steering instruments to build energy markets and to protect consumers. Nonetheless, other areas of law, such as competition law, are also important and will contribute to the shape of the hydrogen markets as well.

1.2. *Gap in research, research question and method of the analysis*

Based on existing literature on the regulation of hydrogen markets that have already elaborated regulatory gaps, market failures and regulatory challenges for sustainable hydrogen markets as well as the role of regulatory sandboxes to achieving good regulation,[13] this article intends to analyse what legislators can undertake to accelerate the creation of a well-functioning sustainable hydrogen market in the EU, also in the broader context of facilitating the energy transition. For this, the article looks at what regulatory strategies, including experimental regulatory sandboxes, legislators have in their toolbox and which comparative methods legislators can apply to get the right inspiration for their country's legal framework (in the case of the EU legislator: for the secondary law that shall apply in the whole EU).

The article discusses various regulatory strategies for the regulation of sustainable hydrogen grids and their challenges and benefits, based on an analysis of existing literature regarding regulatory principles. It goes beyond the state of the art, as it combines the findings from regulatory theory and good governance principles, and applies these to the analysis of the framework of Germany. In this way the article contributes legal thoughts to the current process of finding an appropriate regulatory framework for the integration of the new energy carrier hydrogen into the European energy system and concludes that both the German as well as the proposed framework at the EU level have the potential to include more of the necessary flexibility. In this context, the article also showcases Germany's opt-in regime for hydrogen grid operators as an experimental, principle-based framework.

The article is based on a literature review as well as doctrinal legal research.[14] To limit the scope of the analysis, the article will focus on the regulation of pure hydrogen grids. This scope is chosen due to the special significance of pure hydrogen grids for the development of hydrogen markets. Figuratively speaking, a 'hydrogen backbone'[15] is needed to run up the markets: a grid infrastructure makes sustainable

12 See Raphael J. Heffron and Kim Talus, 'The Development of Energy Law in the 21st Century: A Paradigm Shift?' [2016] 189 J World Energy Law Bus, 201

13 Lavrijssen and Vitéz (n 2), 266; Gökçe Mete and Leonie Reins, 'Governing New Technologies in the Energy Transition – The Hydrogen Strategy to the Rescue?' [2020] 3 CCLR, 210; Sofia Ranchordás, 'Experimental Regulations and Regulatory Sandboxes – Law Without Order?' [2021] LaM; Kanerva Sunila and Ari Ekroos, 'Regulating Radical Innovations in the EU Electricity Markets: Time for a Robust Sandbox' [2023] 41(1) Journal of Energy & Natural Resources Law, 5

14 See for a brief explanation Brenda Espinosa Apráez, 'Dealing with Data: A Study on the Regulatory Challenges of Data-Driven Innovation and Data Sharing in the Digitalized Utilities and How to Deal with Them' (PhD dissertation, Tilburg University 2022) 32 and references therein <https://research.tilburguniversity.edu/en/publications/dealing-with-data-a-study-on-the-regulatory-challenges-of-data-dr> accessed 29 August 2023

15 See eg the European Hydrogen Backbone (EHB) initiative <https://ehb.eu/> accessed 29 August 2023

hydrogen easily accessible,[16] is a storage tool itself[17] and facilitates the integration of sustainable hydrogen into the energy system as a whole.[18] To further narrow the analysis, the article focusses on unbundling and third-party access as regulatory instruments to target market failures in hydrogen markets.

1.3. *Outline of the analyis*

This article first elaborates the role of and need for regulating grid infrastructure for accelerating the creation of a sustainable hydrogen market. Afterwards, it addresses goals and principles of good regulation to describe what needs to be taken into account when drafting the regulatory framework for hydrogen markets. Further, it discusses different regulatory strategies to find out what tools a legislator has at hand to reach the goals of good regulation. Then, the article focusses on which comparative methods a legislator can rely on to obtain the necessary inspiration and to learn from experience to draft good regulation. In the next step, the article looks at the case of Germany and the draft hydrogen and decarbonised gas market package, investigating these frameworks in the light of the introduced theoretical framework and drawing concrete conclusions for legislators on which regulatory strategies can accelerate the creation of a well-functioning sustainable hydrogen market in the EU. The final conclusion discusses what can be learned from the comparative methods, how flexibility is incorporated into the German and draft EU legal framework for hydrogen markets, and why experimentation and flexibility is the key feature for good regulation of new technologies such as sustainable hydrogen.

2. The need for regulation of hydrogen grids

This section elaborates on the role of and need for regulating grid infrastructure to accelerate the creation of a sustainable hydrogen market. It provides the necessary background information for understanding why specific hydrogen market regulation is needed on top of existing competition law, data protection law, etc.

2.1. *Hydrogen transport via pipelines as natural monopoly*

Hydrogen can be transported via pipeline, truck, train, and ship, and can be generated from different sources such that many different locations can become generation sites.[19] Also, for blue hydrogen,[20] it must be ensured that captured CO_2 can be transported to the designated place.[21] The question of whether hydrogen transport via pipeline infrastructure has to be considered a natural monopoly is fundamental, because if this were the case, there might be a need for regulation to address possible market

16 IEA (n 7), 70, 76f
17 IEA (n 7), 32f
18 Lavrijssen and Vitéz (n 2), 266, 266f
19 Lavrijssen and Vitéz (n 2), 266, 270 and references therein
20 Blue hydrogen can be defined as hydrogen resulting from steam reforming with natural gas including CO_2 capture; see Ansari, Grinschgl and Pepe (n 3), 1; Linnemann and Peltzer (n 5), 73
21 Lavrijssen and Vitéz (n 2), 266, 270

failures (see below). If the question of whether hydrogen infrastructure constitutes a natural monopoly cannot be answered generally but only specifically for each EU country, then an EU 'one size fits all' approach might be detrimental to the building of a hydrogen market.

While the European Commission assumes in general that existing and future hydrogen networks will establish natural monopolies,[22] the German national regulatory authority (NRA), the *Bundesnetzagentur*, is differentiating between industrial demand clusters in which existing pipeline infrastructure delivers hydrogen to industrial consumers, and clusters that do not address the particular demand of an industry: in hydrogen markets in the network areas of the industrial demand clusters, the transport through the pipelines is considered a natural monopoly as this transport can be considered being cheaper than transport via alternative routes (eg by truck); also, it cannot be observed that other market players intend to build another pipeline under the given circumstances.[23] In contrast, in hydrogen markets in the network areas outside these industrial demand clusters, alternative transport is considered cheaper (as there is not enough demand and supply to make the pipieline cost efficient);[24] thus, no natural monopoly can be established.[25] Nevertheless, these assumptions of the German NRA are based solely on a qualitative assessment of the issue; the quoted study itself mentions that a thorough sector analysis is needed to identify the concerned markets outside the mentioned industrial demand clusters, and a qualitative assessment is needed to identify the existence of natural monopolies on a more profound basis.[26]

In consequence, it seems difficult at the current stage to make assumptions for the markets outside industrial demand clusters without basing them on a thorough economic and market analysis. This observation may be addressed through enough flexibility in the legal rules to take into account the economic characteristics of the developing hydrogen market, with the aim to avoid costly overregulation.[27] As those assumptions are of an economic nature, this conclusion applies to the whole EU and even countries outside of it.

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22 European Commission, 'Proposal for a Directive of the European Parliament and of the Council on Common Rules for the Internal Markets in Renewable and Natural Gases and in Hydrogen' COM (2021) 803 final, 7; likewise eg Linnemann and Peltzer (n 5), 150. For the definition of a natural monopoly see Richard Whish and David Bailey, *Competition Law* (10th edn, OUP 2021) 12, or Baldwin and others, *Understanding Regulation* (n 11), 16

23 Bundesnetzagentur, 'Regulierung von Wasserstoffnetzen. Eine Bestandsaufnahme der Bundesnetzagentur' (2020) <www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Energie/Unternehmen_Institutionen/NetzentwicklungUndSmartGrid/Wasserstoff/Wasserstoffpapier.pdf?__blob=publicationFile&v=2> accessed 29 August 2023, 62ff. See Linnemann and Peltzer (n 5), 150, who consider every pipeline a natural monopoly, without distinguishing between network areas of industrial demand clusters and network areas outside these clusters

24 Laura Heidecke and others, 'The Revision of the Third Energy Package for Gas' (2022) Ecorys Report PE 734.009, 44f

25 Bundesnetzagentur (n 23), 62ff. See for the assumption that large-scale local supply clusters are most competitive also here: Hydrogen Economy Outlook. Key Messages, 30 March 2020 <https://data.bloomberglp.com/professional/sites/24/BNEF-Hydrogen-Economy-Outlook-Key-Messages-30-Mar-2020.pdf> accessed 29 August 2023, 4

26 Bundesnetzagentur (n 23), 62f

27 See Lavinia Tanase and Ignacio Herrera Anchustegui, 'EU Hydrogen and the Decarbonized Gas Market Package: Unbundling, Third-Party Access, Tariffs and Discounts Rules at the Core of Transport of Hydrogen' (2023) <https://ssrn.com/abstract=4431113> accessed 29 August 2023, 26

2.2. *Advantages and disadvantages of the regulation of hydrogen grids*

In order to promote the desired development of sustainable hydrogen markets, European legislators must take a decision whether and, if so, to what extent the infrastructure for transmission (long-distance transport) and the distribution (local/regional transport) of green hydrogen shall be regulated.[28] Because regulation gives a framework for the interactions on a market,[29] it is necessary that the rules for market action are clear so that market players can adapt their business models accordingly. It should be emphasised that as there is not much pure hydrogen pipeline infrastructure yet, regulation may be created before big hydrogen infrastructure projects are finalised.[30]

At the current stage of the development of hydrogen markets, it is difficult to give a clear answer to whether hydrogen networks – in addition to being subject to cross-sectoral competition and data protection rules – should be regulated, and if so how.[31] On the one hand, the regulation of hydrogen grids can prevent and address market failures, in particular a possible abuse of market power.[32] Also, in particular, mandatory third-party access can contribute to the creation of supply and demand.[33] This is because suppliers and consumers of hydrogen would then have greater planning certainty, but can also assume that – due to regulation – no monopoly prices can be charged for transport in the long term.[34] This way, regulation provides a stable framework in the ramp-up phase of the markets. But then, on the other hand, regulation may inhibit network development due to the regulation's inherent costs, regulatory failures and inefficiencies.[35] Network operators would have to be accountable to the regulator and, depending on the scope of the reporting obligations, there would be additional personnel, consulting and information technology costs, and the responsible regulatory authority would have to evaluate the transmitted data, define reporting obligations and, if necessary, approve fees.[36] Also, the enforcement of the new rules would result in additional legal service and court costs on both sides.[37] Inefficiencies depend on the design of the regulation: if profits of network operators were linked to the size of the network, network operators would have an incentive to set up a network that was too large.[38] If regulation is accompanied by unbundling obligations, this would also restrict opportunities for cooperation between network operators and suppliers and consumers of hydrogen,[39] although direct agreements between actors in the value chain may be particularly important during the market ramp-up in order to implement

28 See Max Baumgart and others, 'Der Regulierungsrahmen für Wasserstoffnetze. Eine ökonomische und rechtliche Einordnung vor dem Hintergrund des angestrebten Markthochlaufs' [2021] 135 Recht der Energiewirtschaft – RdE, 141
29 Lavrijssen and Vitéz (n 2), 266, 271
30 Tanase and Herrera Anchustegui (n 27), 3
31 Baumgart and others (n 28), 135, 141
32 Lavrijssen and Vitéz (n 2), 266, 267 and references therein; Baumgart and others (n 28), 135, 141; Linnemann and Peltzer (n 5), 150
33 Linnemann and Peltzer (n 5), 156
34 Baumgart and others (n 28), 135, 137f, 141
35 *Ibid*, 135, 138, 141
36 *Ibid*, 135, 138
37 *Ibid*
38 *Ibid*
39 *Ibid*

innovative applications and business models and to ease coordination along the value chain.[40] Unbundling reduces the incentive to favour integrated companies over others, but may also lead to internal synergy and thus efficiency losses.[41] Additional requirements may also hinder the scope of action for innovation.[42]

Once it is decided to draft a comprehensive set of rules to regulate hydrogen grid operation, a crucial decision to make is who shall be in charge of operating the hydrogen pipelines.[43] One possibility is to transfer the task to the transmission and distribution system operators for gas as they already own a pipeline system and have experience with operating the gas grids. Once the market develops to such a scale that hydrogen is not only provided to large industry consumers but also to households, distribution system operators may play a vital role in transporting the hydrogen from large transmission pipelines to a variety of consumers. Transmission pipelines transport large-scale amounts of hydrogen either to distribution grids or directly to large industry consumers. Another argument in favour of operation by the current gas system operators is that they basically have the incentive to efficiently integrate existing pipelines into a hydrogen network that is to be set up.[44] The gas grid in general may be retro-fitted for pure hydrogen transport, which is considered cost efficient.[45] If pipelines were to be separated from the system operators' asset base, which would otherwise be necessary, there would be a risk of inefficiencies that could hamper and slow development.[46] In addition, the possibility of simplifying the coordination of network development by setting up a higher-level hydrogen network operator would remain unused.[47]

It is important to weigh these advantages and disadvantages against each other when deciding on (the final) regulation of the hydrogen network operators and to determine the legal embedding in the existing legal framework.[48] As many EU member states and the EU have already enacted or are preparing specific sets of rules for the regulation of pure hydrogen grids, member states have already taken the decision to regulate hydrogen infrastructure. The European Commission complemented its decision with preparatory economic analyses, carried out by external experts.[49]

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40 Thomas Haug and Lorenz Wieshammer, 'Implikationen der Dekarbonisierung für die Gasnetzregulierung' [2020] emw Heft 04/2020, 2, 4; Baumgart and others (n 28), 135, 138

41 Lavrijssen and Vitéz (n 2), 266, 276

42 Baumgart and others (n 28), 135, 138

43 See *ibid*, 135, 141

44 *Ibid*

45 ACER, Transporting Pure Hydrogen by Repurposing Existing Gas Infrastructure: Overview of existing studies and reflections on the conditions for repurposing, 16 July 2021 <https://acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/Transporting%20Pure%20Hydrogen%20by%20Repurposing%20Existing%20Gas%20Infrastructure_Overview%20of%20studies.pdf> accessed 29 August 2023; IEA (n 7), 183f; Heidecke and others (n 24), 10, 43, 49f

46 Baumgart and others (n 28), 135, 141

47 *Ibid*

48 *Ibid*

49 See Anthony Vautrin and others, 'METIS Study on Costs and Benefits of a Pan-European Hydrogen Infrastructure: In Assistance to the Impact Assessment for Designing a Regulatory Framework for Hydrogen' (2021) METIS 3, Study S3 <https://data.europa.eu/doi/10.2833/736971> accessed 29 August 2023; Jan Cihlar and others, 'Hydrogen Generation in Europe: Overview of Costs and Key Benefits' (2021) <https://data.europa.eu/doi/10.2833/821682> accessed 29 August 2023

2.3. *Conclusion*

To foster the development of sustainable hydrogen markets, hydrogen market-specific regulation may play an important role to address market failures and coordinate supply and demand. In this regard, the regulation of pure hydrogen grids becomes especially vital as pipeline infrastructure is a fast and efficient way to transport hydrogen in a climate-neutral way from the supplier to the demander. Even though regulation can itself create costs and inefficiencies, legislators in Europe such as the EU and German legislative bodies have already opted for the regulation of pure hydrogen grids. In this respect, there are advantages and disadvantages that need to be considered whether the task to operate the pure hydrogen grids is assigned to system operators for gas or not.

3. Goals and principles of good regulation in the energy sector

This section addresses goals (targeting market failures; enabling affordability, accessibility and sustainability; incorporating energy justice) and principles (flexibility and responsiveness; participation; transparency; accountability; independence; effectiveness; efficiency) of good regulation to describe what needs to be taken into account when drafting the regulatory framework for hydrogen markets.

Drafting a legal framework that will actually be successful in regard to creating a market is a challenge, as the creation of the market may take a while. However, the principles of good regulation form a good basis for the design and evaluation of regulatory frameworks. These principles have already proven effective and/or efficient in the history of energy regulation, contributed to the emergence and interconnection of the energy markets within the EU and also contributed to the successful regulation of other network sectors.[50] Principles of good regulation provide a quality framework for good regulation that fosters a good investment climate, and gives orientation for regulators involved in market design.[51] The principles aim to enhance the quality of regulation so as to ensure that goals of regulation can be realised. Therefore, the principles of good regulation could play a role in the evaluation of the legislative framework in place as well as of conducted regulatory experiments.

Before diving into the principles of good regulation, the following section first reminds us of the goals of good regulation.

3.1. *Goals of good regulation*

On the theoretical level, from the *law and economics* perspective, regulation primarily aims at addressing market failures.[52] From the *law and technology* perspective, regulation is a desirable legislative tool to also protect human rights and social solidarity and to resolve conflicts.[53]

50 See Lavrijssen and Vitéz (n 2), 266, 267

51 *Ibid*, 266, 267, 272 and references therein

52 Anna Butenko and Pierre Larouche, 'Regulation for Innovativeness or Regulation of Innovation?' [2015] 7(1) Law, Innovation and Technology 52, 52, 62; see Lavrijssen and Vitéz (n 2), 266, 267

53 Baldwin and others, *Understanding Regulation* (n 11), 16, 22f and references therein; Butenko and Larouche (n 52), 52, 58, 64 and references therein; Ronald Leenes, 'Regulating New Technologies

a) **Availability, affordability and sustainability of hydrogen supply**

In energy markets, traditionally, regulation aims at the goals of availability, affordability and sustainability. As these aspects of the so-called energy trilemma[54] also include social goals such as affordability and sustainability, the question of how to justify energy market regulation must be regarded from the law and technology perspective. Availability aims at providing both short-term and long-term security of supply.[55] Affordability includes economic efficiency, industry competitiveness and the possibility for all energy consumers to purchase energy at reasonable prices.[56] Environmental sustainability refers to maintaining environmental quality both by keeping greenhouse gas emissions across the energy value chain as low as possible[57] and by preserving nature itself.[58] Sustainability can and must further be read as going beyond the narrow understanding of environmental sustainability.[59] For example, sustainability as a term of international law and policy has social, political and economic dimensions, focussing on lasting prosperity for all humans and on people's autonomy.[60] The United Nations (UN) 2030 Agenda goals can be used to further interpret the notion of sustainability.[61] In its goal 7, the UN 2030 Agenda for Sustainable Development specifically mentions reliable and modern energy services, the increase of the share of renewable energy in the global energy mix and energy efficiency.[62] Sustainability can be achieved through renewable energy: green hydrogen as an energy carrier can decarbonise other sectors (eg when used for producing steel); and green energy supply can in itself be considered sustainable.[63]

As not all aspects of the energy trilemma can be achieved equally, a balance between the three energy trilemma goals – affordability, availability and sustainability of energy supply – needs to be found.[64] This also applies for production and supply of sustainable hydrogen.[65] The different goals can be or are very often in tension with each other. This means balancing of interests needs to be transparent – how the specific balance is found, how it is determined by the respective legislator

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in Times of Change' in Leonie Reins (ed), *Regulating New Technologies in Uncertain Times* (Springer 2019), 3, 13; see Peter Alexiadis and Martin Cave, 'Regulation and Competition Law in Telecommunications and Other Network Industries' in Robert Baldwin and others (eds), *The Oxford Handbook of Regulation* (OUP 2013), 500, 502

54 See in the context of electricity distribution system operators Marga Edens and Saskia Lavrijssen, 'Balancing Public Values During the Energy Transition: How Can German and Dutch DSOs Safeguard Sustainability?' [2019] 128 Energy Policy 57ff; with some legal scholars advocating for a 'energy rectangle' including participation/acceptance: Daniela Winkler, Max Baumgart, and Thomas Ackermann, *Europäisches Energierecht* (Nomos 2021), 27

55 Edens and Lavrijssen (n 54), 57, 60

56 *Ibid*

57 *Ibid*, 57, 60 and references therein

58 See Martin Nettesheim, 'AEUV Art. 191' in Eberhard Grabitz and others (eds.), *Das Recht der Europäischen Union* (77th edn, CH Beck 2022) para 123

59 See Herbert Zech, 'Nachhaltigkeit und Digitalisierung im Recht' [2022] 123 ZfDR 124f

60 United Nations, 'Transforming our World: The 2030 Agenda for Sustainable Development' Resolution adopted by the General Assembly on 25 September 2015, A/RES/70/1; see Zech (n 59), 123, 124f

61 Zech (n 59), 123, 131

62 *Ibid*, goal 7

63 See for this consideration in the context of digitalization *ibid*, 123, 127

64 See Alexiadis and Cave (n 53), 500, 515; Edens and Lavrijssen (n 54), 57, 60

65 See in the context of electricity distribution system operators *ibid*, 57, 57ff

and/or regulator.[66] Here, the principles of good regulation (as discussed below) can also play a role in balancing the different stakeholders' interests in a transparent way. Availability, affordability and sustainability are usually also embedded in the overarching concept of energy justice,[67] which is explained in the next paragraph.

b) **Energy justice**

Some scholars argue for the consideration of elements of the so-called energy justice concept when regulating energy markets.[68] The EU legislator is already aware that energy justice elements play a role in EU energy policy.[69] Energy justice is a concept rooted in environmental and climate justice movements and described in the social sciences, but is as yet scarcely explored from a legal perspective.[70] It is widely understood as aiming at 'establishing a more equitable, just and sustainable energy sector', being a concept that can guide legislators and other decision makers in the development of energy law and policy to find more integrated and just solutions.[71]

c) **Addressing market failures**

A main market failure that is relevant for the regulation of the hydrogen markets is market dominance. Market power leading to a dominant position in a market may harm competition as monopolies and duopolies can set prices without fearing to lose market shares to competitors.[72] This is a category of market failure that may threaten the availability and affordability of hydrogen. Addressing market failures can be relevant for pure hydrogen infrastructure regulation as at least the operation of grid infrastructure for industry demand clusters appears to have characteristics that may indicate the existence of a natural monopoly (see above, section 2.1).

Accessible, accurate and affordable information is needed for consumers to be able to evaluate competing offers for the supply of hydrogen.[73] This is relevant for the availability of hydrogen in general as well as other factors such as the safety of the product.[74] Information asymmetry, in contrast, is considered a market failure.[75]

There is also the problem that since a market is not yet well developed, market players may not see a reason to invest in the market because the ratio of costs for investment and expected outcome is too low (*investment risk*; see above, section

66 Edens and Lavrijssen (n 54), 57, 60; see Heffron and Talus (n 12), 189, 192f and 201f

67 See the ten principles developed for a framework of energy justice: Laura Kaschny 'Energy Justice & the Principles of Article 194(1) TFEU Governing EU Energy Policy' [2023] Transnational Environmental Law, 6f and references therein

68 *Ibid*, 3ff

69 See the examples and brief description in *ibid*, 4 and references therein

70 *Ibid*, 3f, and references therein

71 *Ibid*, 4 and 22 and references therein

72 Baldwin and others, *Understanding Regulation* (n 11), 16f

73 See *ibid*, 18f, and references therein

74 Safety of the product cannot solely be classified as a subtype of information asymmetry. There are other types of market failures that may justify health and safety regulation, see Baldwin and others, *Understanding Regulation* (n 11), 23 and references therein.

75 Jose Luis Moraga and others, 'Future Markets for Renewable Gases & Hydrogen – What Would Be the Optimal Regulatory Provisions?' (2019) CERRE Report, 39 and references therein; see Brian Hillier, *The Economics of Asymmetric Information* (Red Globe Press 1997) 26

1.1). This can also be due to the insecurity whether other market players are willing to invest so that in the long run a profitable market will be created.[76] Against this background, among other regulatory incentives, subsidies could achieve the aim to stimulate investments in sustainable hydrogen. For example, the Netherlands are envisaging introducing a purchase obligation for green hydrogen.[77] These considerations also justify EU subsidies for the building of hydrogen infrastructure.[78]

3.2. *Principles of good regulation*

This section explains seven principles of good regulation that are considered important by the authors and that can form the basis of the evaluation of existing legal frameworks and potential experiments. They proved to be working to achieve the goals of good regulation in the energy sector. Six of them were also already highlighted as important to guiding decision makers in earlier legal literature.[79]

A regulatory regime must contain *flexibility and responsiveness* in order to be responsive to technical, societal and economic changes, so that the law does not fall behind the market needs; only with a certain degree of flexibility it is possible to adapt the regulation to remain consistent with its initial goals.[80] While, on the one hand, a strict regime may stimulate market players' want for regulatory certainty, on the other hand market developments are still very uncertain, and this requires the regulatory regime to be flexible enough for businesses and regulators to adapt in this fast-changing environment to prevent wrong regulatory choices and the hampering of innovation.[81] One might also consider guaranteeing flexibility within experimental regulation to allow for a range of different experiments.[82] It can be distinguished between flexibility for member states, which is reduced in order to achieve an internal market for energy, and flexibility in EU regulation regarding its content and mechanisms. Currently, it can be observed that EU energy regulation tends to reduce flexibility for member states rather than increasing it, in order to complete the internal market for energy, reducing market distortion risks and possible harm for consumers.[83]

Regulation might also consider *participation* as an ongoing process that requires decision makers to be open to input from the outside (such as from market players);

76 See the 'planning' problem described by Baldwin and others, *Understanding Regulation* (n 11), 21f

77 See David Duijnmayer, 'Jetten kiest voor afnameverplichting groene waterstof om afzetmarkt te stimuleren' (2 June 2022) <https://energeia.nl/energeia-artikel/40102354/jetten-kiest-voor-afnameverplichting-groene-waterstof-om-afzetmarkt-te-stimuleren> accessed 29 August 2023

78 Heidecke and others (n 24), 53ff

79 Lavrijssen and Vitéz (n 2), 266, 273

80 See the 'Pacing Problem' described eg by Butenko and Larouche (n 52), 52, 66f; Kanerva and Ari (n 13), 7.; and Leigh Hancher and others, 'Principles of Good Market Governance' (2003) os-4(4) Journal of Network Industries 355–67 and 376 (in the context of the telecommunications sector). 'Responsiveness' is here not meant in the sense of Baldwin and others, *Understanding Regulation* (n 12), ch 12 and references therein, where responsive regulation is described as a perspective on the enforcement of the set of rules: regulators need to adapt their enforcement strategies according to the behaviour of regulates

81 Lavrijssen and Vitéz (n 2), 266, 267

82 Tim Schittekatte and others, 'Regulatory Experimentation in Energy: Three Pioneer Countries and Lessons for the Green Transition' (2021) 156 Energy Policy 7f and references therein

83 *Ibid*, 7

it might include not only the input of ideas, but also the input of resources through financial participation or local ownership by consumers.[84] This latter part is especially relevant for the energy market and in relation to energy citizen initiatives. Participation may lead to an increase in the legitimacy and acceptance of regulatory outcomes.[85]

The *transparency* principle intends for regulators and market participants to provide information about their objectives and practices.[86] It finds its roots in the principle of democracy,[87] makes regulation more effective,[88] and increases predictability for market players.[89] It also addresses information asymmetry. Transparency might also be an important factor in regulatory experimentation, allowing other market players to benefit from the lessons learned by a company taking part in the experiment.[90]

Accountability means to justify actions.[91] It requires grounds on which these actions can be valued,[92] and also consequences in case of bad approaches.[93] It also needs to be clear who is responsible for what. Within the EU energy architecture, non-compliance with the rules can be sanctioned: member states can be held accountable through infringement procedures according to Article 258ff of the Treaty on the Functioning of the European Union (TFEU) when they do not comply with EU law, eg the European Network of Transmission System Operators (ENTSO) for Gas is monitored by the European Union Agency for the Cooperation of Energy Regulators (ACER) (see Article 4(2) Regulation (EU) 2019/942; Article 24 new EU gas package), and the national regulatory authorities ensure compliance by the market participants (see Article 41(1)(b) Directive 2009/73/EC; Article 25 new EU gas package). The legal framework also requires several stakeholders to issue reports that then shall lead in taking action if necessary (compare Article 41(1)(e) and (g) Directive 2009/73/EC; Article 48(6) Directive 2009/73/EC; Article 52 Directive 2009/73/EC).

84 Lavrijssen and Vitéz (n 2), 266, 274 and references therein; Madeleine Wahlund and Jenny Palm, 'The Role of Energy Democracy and Energy Citizenship for Participatory Energy Transitions: A Comprehensive Review' [2022] 87 Energy Research & Social Science 102482, 102482ff

85 Alberto Alemanno, 'Unpacking the Principle of Openness in EU Law – Transparency, Participation and Democracy' (2014) 39(1) European Law Review 72, 82 and references therein; Lavrijssen and Vitéz (n 2), 266, 274

86 See Lavrijssen and Vitéz (n 2), 266, 273

87 *Ibid*; Sacha Prechal and others, 'Transparency: A General Principle of EU Law?' in Ulf Bernitz and others (eds), *General Principles of EC Law in a Process of Development* (Kluwer Law International 2008) 205

88 Lavrijssen and Vitéz (n 2), 266, 273; Margot Aelen, *Beginselen van Goed Markttoezicht – Gedefinieerd, Verklaard en Uitgewerkt Voor Het Toezicht op de Financiële Markten* (Boom Juridische Uitgevers 2014), 333f

89 OECD, *The Governance of Regulators, OECD Best Practice Principles for Regulatory Policy* (OECD Publishing 2014), 83; Lavrijssen and Vitéz (n 2), 266, 273

90 European Commission, 'Regulatory Learning in the EU. Guidance on Regulatory Sandboxes, Testbeds, and Living Labs in the EU, with a Focus Section on Energy' (2023) SWD 277 final, 35f; Schittekatte and others (n 82), 5f

91 Deirdre Curtin and Andre Nollkaemper, 'Conceptualizing Accountability in International and European Law' [2007] 36 Netherlands Yearbook of International Law, 3, 7ff and references therein; Lavrijssen and Vitéz (n 2), 266, 273; Bronwen Morgan and Karen Yeung, An Introduction to Law and Regulation: Text and Materials (CUP 2012), 221

92 Lavrijssen and Vitéz (n 2), 266, 273

93 OECD, *Governance of Regulators* (n 89), 84f; Curtin and Nollkaemper (n 91), 3, 7f; Hancher and others (n 80), 339, 369; Lavrijssen and Vitéz (n 2), 266, 273 and references therein

The *independence* principle refers to the independence of the regulator and the markets. This includes not being subject to undue political influence by the state, although this is quite a controversial issue.[94] In effect, a strong amount of independence of the regulator increases trusts in the actions taken by a regulator.[95]

Effectiveness requires taking decisions at the most appropriate level, that is also related to the principle of subsidiarity.[96] It also requires that all actions taken are suitable.[97] In this sense and taken legally, effectiveness is limited by the principle of proportionality.[98] The principle of effectiveness could be used as a benchmark to assess whether the long-term goal of well-functioning sustainable hydrogen markets is met.

The *efficiency* principle refers to an efficient market organisation. Efficient market organisation requires taking action by the best-placed actors[99] and with the most appropriate instruments. In this regard, the principle refers to the ratio of time, financial and personal investment, etc. to the outcome. This way, efficiency aims at saving economic resources.

3.3. *Conclusion*

Regulation in energy markets and thus also regulation in sustainable hydrogen markets is not a goal in itself. Regulation aims at addressing market failures and other goals such as affordability, accessibility and sustainability of hydrogen supply. It may even go beyond this enumeration and include energy justice as an overarching regulatory goal. Legislators, when drafting the final legal framework or experimenting with rules, should consider the principles of good regulation that have already proven successful in creating energy markets. These principles can be used for evaluating existing frameworks as well as conducted regulatory experiments.

4. Regulatory strategies

To achieve the outlined goals of good regulation in the energy sector, a legislator may rely on various regulatory strategies. These different regulatory strategies are discussed in this section. They lie between the two extremes of command-and-control regulation and principle-based regulation. Many variations are possible and strategies are usually combined.[100] Choosing and combining the right regulatory strategies for the legal framework to create sustainable hydrogen markets will depend on the consideration of the aforementioned principles of good regulation.

94 OECD, *Governance of Regulators* (n 89), 47f; Lavrijssen and Vitéz (n 2), 266, 273
95 OECD, *Governance of Regulators* (n 89), 47; Lavrijssen and Vitéz (n 2), 266, 273
96 Lavrijssen and Vitéz (n 2), 266, 274
97 *Ibid*; see OECD, 'Recommendation of the Council on Regulatory Policy and Governance' (2012) <www.oecd.org/governance/regulatory-policy/49990817.pdf> accessed 29 August 2023, 13
98 Lavrijssen and Vitéz (n 2), 266, 274
99 *Ibid*, 266, 274f
100 Baldwin and others, *Understanding Regulation* (n 11), 119 and references therein

4.1. *Command-and-control*

Command-and-control regimes are regulatory regimes in which the regulator influences behaviour by imposing rules backed by sanctions.[101] One important manifestation of this regime that is also applied in the energy sector consists of licensing processes to screen entry and exit to market activity and the regulation of the quality of a service, manner of production, allocation of resources, products, commodities and price.[102] Licensing processes may contribute to choosing the best-placed actors for the market and thus to the efficiency principle. Command-and-control regimes, in a first analysis, seem to also offer the most effective way to secure a desired behaviour. Nonetheless, when applied in a strict sense, the regime may lead to over-regulation and thus produce unnecessary complexity and inflexibility of rules.[103] Especially when working in a fast-changing environment, command-and-control regulation may not sufficiently address the problem at stake.[104] Command-and-control regimes are not very flexible and therefore may not sufficiently adapt to new developments in the technology and the markets.[105] This may be particularly true for energy markets, with their fast-changing developments, and especially the ramp-up phase for sustainable hydrogen markets. The two tools particularly discussed in this paper, unbundling and third-party access, can be classified as command-and-control rules.[106] But other tools that are well known from traditional energy regulation, such as tariff regulation to combat excessive pricing, may also constitute a form of command-and-control regulation.[107] In all of this, efficient enforcement[108] as well as a well targeted regulation is key for a working command-and-control system.

4.2. *Principle-based regulation*

Principle-based regulation includes principles in the regulatory set of rules that set out regulatory objectives and values, but leaves the addressees to develop their own approaches to addressing the outlined principles.[109] Thus, the addressees are not bound to a detailed set of rules.[110] From this it follows that the regulator does not focus on the compliance of the market players with a detailed set of rules but looks at the instruments the market players develop for serving the set-out principles and values.[111] Here, the principle-based approach mainly contrasts to the command-and-control approach. However, there may also be hybrid forms of regulatory strategies, for example when the principle-based approach includes some minimum standards in the form of command-and-control regulation, and leaves the achievement of higher standards to the market participants by only defining the principles.

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101 *Ibid*, 106 and references therein; Morgan and Young (n 91), 80f
102 Baldwin and others, *Understanding Regulation* (n 11), 106f and references therein
103 *Ibid*, 108 and references therein
104 *Ibid*, 109 and references therein
105 See *ibid*, 110
106 See Lavrijssen and Vitéz (n 2), 266, 276
107 *Ibid*
108 See Baldwin and others, *Understanding Regulation* (n 11), 110
109 *Ibid*, 302; Julia Black, Forms and Paradoxes of Principles Based Regulation (23 September 2008), LSE Legal Studies Working Paper No. 13/2008, 9
110 Baldwin and others, *Understanding Regulation* (n 11), 303; Black (n 109), 10
111 Baldwin and others, *Understanding Regulation* (n 11), 303

Principle-based regulation requires constant communication between the regulator and the addresses regarding the interpretation of the principles and values and the way to achieve them,[112] meaning that appropriate governance and procedural mechanisms should be designed. It also requires a lot of trust in the competence and responsibility of the addresses.[113] Principle-based regulation focusses on the overall performance of the market players and not on detailed compliance with certain rules and thus also adapts better to an environment where the circumstances in the market change quickly.[114] This can also lead to more discretionary powers for the regulator.[115] On the other hand, it may give more options for misuse and circumvention for the market players without fear of violating a detailed set of rules.[116] To guarantee the desired outcome, principle-based regulation should be accompanied by responsive regulation: in case the regulates – even despite having engaged in a regulatory dialogue – do not aim at realising the principles, the regulatory regime must be flexible enough to adapt to this situation and introduce (further) elements of command-and-control regulation to make sure the principles will be achieved.

4.3. *Design solutions, direct action and incentive-based regimes*

A design solution strategy may be nudging: nudging strategies structure the possibilities of actions in such a way that one decision – the desired decision – is easier for decision makers to choose than other decisions – the not desired ones – although the decision is still left to the decision makers.[117] One example could be that hydrogen network operators are subject to a certain set of rules but have the option to opt out of them (compare the opposite opt-in solution for hydrogen network operators to be subject to the regulation by the German legislator: section 6.1 in this article). This way, nudging has an influence on the markets' independence from political influence, but still guarantees the independence principle to a great extent.

Direct action strategies in energy markets usually take the form of subsidisation, when public money is used to assist firms rather than to penalise firms for undesired behaviour.[118] Subsidisation may come with the disadvantage that subsidies may distort competition and they might lead to the effect that innovation is then driven not by the market but by the regulator.[119] Another example of direct action, applied to sustainable hydrogen markets, may be a state-owned enterprise in charge of parts of the hydrogen market.[120] However, this may also lead to less innovation, as a state-owned company may have less incentive for innovation because it counts on the security provided by the owner.[121]

112 *Ibid*; Black (n 109), 9
113 Baldwin and others, *Understanding Regulation* (n 11), 303
114 *Ibid*; Black (n 109), 10
115 See in this context Saskia Lavrijssen, 'Towards a European Principle of Independence: The Ongoing Constitutionalisation of an Independent Energy Regulator' [2022] 16(1) Carbon and Climate Law Review, 25
116 Baldwin and others, *Understanding Regulation* (n 11), 303
117 *Ibid*, 123; see Richard H. Thaler and others, 'Choice Architecture' (2010) <http://ssrn.com/abstract=1583509> accessed 29 August 2023, 4
118 See Baldwin and others, *Understanding Regulation* (n 11), 121; Morgan and Young (n 91), 87f
119 Baldwin and others, *Understanding Regulation* (n 11), 121f
120 Lavrijssen and Vitéz (n 2), 266, 276
121 *Ibid*, 266, 276 and references therein

Incentive-based regulation[122] may lower entry barriers to attract more market players and to prevent the emergence of a monopolist, for example tax incentives for producers of green hydrogen; more market players could be attracted when consumers are invited for participation in the markets through the possibility to own networks or sustainable hydrogen production sites themselves.[123] Nonetheless, it is necessary to prove the causal connection between an incentive and the effect in order to provide effective regulation.[124]

4.4. *Market-harnessing controls*

Market-harnessing control regimes, especially in the form of the application of competition law to a market,[125] can support limited command-and-control systems but also other regulatory strategies.[126] The advantage is that competition law can be applied to all sectors and that there is no need for sector-specific regulation; consistent principles for all sectors can be developed.[127] There may also be less intrusion into the market players' internal decisions, because competition law does not regulate behaviour in detail but sets some clear boundaries for market behaviour, and more flexibility in the industry.[128]

Nonetheless, with the general application of competition law to energy markets such as sustainable hydrogen markets, there come disadvantages: competition law principles may be too broad, so they may not provide solutions for the operational or technical level or commercial level.[129] A specialised regulatory authority may develop a great level of expertise and present guidelines etc. to offer transparency and thus reduce uncertainties for business operations on the markets.[130] While competition law can be used where a command-and-control regime tends to be excessive, command-and-control regimes can impose structures and rules where competition law enforcement is too slow due to its case-by-case decision basis.[131]

Especially in phases such as the current one in regards to hydrogen markets, where no regulatory regimes or only optional regulatory regimes are yet in place, competition law plays an important role. The nature of it as law that is generally applicable to all markets can prevent market power abuse and the formation of monopolies. In this context, it is to highlight that the German Competition Authority, the *Bundeskartellamt*, allowed the cooperation of several operators of natural gas pipelines to set up a hydrogen network infrastructure.[132] Nonetheless, the *Bundeskartellamt* underlines

122 See Baldwin and others, *Understanding Regulation* (n 11), 111 and references therein; Morgan and Young (n 91), 86ff
123 Lavrijssen and Vitéz (n 2), 266, 276
124 See Zech (n 59), 123, 133f
125 Baldwin and others, *Understanding Regulation* (n 11), 114
126 See Alexiadis and Cave (n 53), 500, 501, 511ff
127 Baldwin and others, *Understanding Regulation* (n 11), 115
128 *Ibid*
129 *Ibid*
130 *Ibid*
131 *Ibid*, 116; Lavrijssen and Vitéz (n 2), 266, 276 and references therein
132 Bundeskartellamt, press release of 27 April 2023 <www.bundeskartellamt.de/SharedDocs/Meldung/EN/Pressemitteilungen/2023/27_04_2023_Get%20H2.html;jsessionid=91E9D3215891B6D5B1132D63B914C3B4.1_cid381?nn=3591568> accessed 29 August 2023

that '[t]he hydrogen market is undergoing dynamic development and it is not possible at this stage to predict future market conditions. Individual aspects of cooperation projects may have to be reassessed in future'.[133]

4.5. *Regulatory sandboxes*

A regulatory sandbox is not another regulatory strategy that stands next to the earlier mentioned regulatory strategies. Rather, a regulatory sandbox is a space, a forum, to try out different regulatory strategies. More concrete, regulatory sandboxes – or 'laboratories of innovation'[134] – are 'schemes that enable firms to test innovations in a controlled real-world environment, under a specific plan developed and monitored by a competent authority'.[135] The recently published Commission Staff Working Document on 'Regulatory Learning in the EU' illustrates regulatory sandboxes (among so-called 'testbeds' and 'living labs') as 'experimentation spaces'.[136] As experimental tools, regulatory sandboxes are temporary regimes, often derogating from existing rules.[137] Usually regulatory sandboxes are set up also in a way that the regulation can adapt quickly,[138] for example containing so-called sunset clauses, which means expiring rules.[139] Regulatory sandboxes grant leeway to trying out new or different approaches, and thus create a space for future regulatory innovation.[140] Thus, regulatory sandboxes also create the space for regulatory experiments on the right regulatory strategy mix and the consideration of the principles of good regulation.[141]

Sandboxes can provide for regulatory learning,[142] and the necessary regulatory dialogue[143] that is needed in the context of principle-based regulation. Nevertheless, command-and-control regulation continues to be a major instrument for regulators, given the need to also protect fundamental rights. However, there is a growing tendency to develop other forms of regulation: legislators assign responsibilities to private actors to shape the regulatory framework, for example by developing or enforcing norms prescribed in private regulation instruments such as technical standards, certifications, and codes of conduct.[144] Most of the time, the rules also contain a lot

133 *Ibid*

134 Sunila and Ekroos (n 13), 15; Kerstin Tews, 'Europeanization of Energy and Climate Policy: The Struggle Between Competing Ideas of Coordinating Energy Transitions' (2015) 24(3) Journal of Environment and Development 267–70

135 European Commission, 'Better Regulation' toolbox 2021, <https://commission.europa.eu/system/files/2023-02/br_toolbox-nov_2021_en.pdf> accessed 29 August 2023, 597 and references therein; see also European Commission, 'Regulatory Learning in the EU' (n 90), 6; Kanerva and Ari (n 13), 7; see also Article 3(1)(i) draft Net Zero Industry Act, COM (2023) 161 final

136 European Commission, 'Regulatory Learning in the EU' (n 90)

137 Mete and Reins (n 13), 210, 215, 230; Lavrijssen and Vitéz (n 2), 266, 279); Ranchordás, Experimental Regulations (n 13), 2 and references therein; see for further literature on experimental legislation Sofia Ranchordás, 'Innovation-Friendly Regulation: The Sunset of Regulation the Sunrise of Innovation' [2015] 55 Jurimetrics J. 201–44; Schittekatte and others (n 82), 1

138 Lavrijssen and Vitéz (n 2), 266, 279; Schittekatte and others (n 82), 7

139 Ranchordás, Innovation-Friendly Regulation (n 137), 201, 201

140 Lavrijssen and Vitéz (n 2), 266, 279; Schittekatte and others (n 82)

141 Lavrijssen and Vitéz (n 2), 266, 279

142 European Commission, 'Regulatory Learning in the EU' (n 90), 6

143 See Kanerva and Ari (n 13), 16, 24; Lavrijssen and Vitéz (n 2), 266, 279); see Ranchordás Experimental Regulations (n 169), 2 and references therein

of flexibility that in the end leads to innovation.[145] The possibility of testing a business model can reduce uncertainty and thus enhance market development.[146] Sunset provisions also are options to address uncertainty and offer flexibility.[147] It is important to stress that, due to the legal hierarchy,[148] experiments cannot deviate from EU law.[149] Because of this, several voices call for the introduction for a framework to allow regulatory sandboxes in EU law.[150]

In the light of the above, it may be concluded that regulatory sandboxes are also useful for sustainable hydrogen markets so that the right regulatory framework, mix of strategies and consideration of principles of good regulation can be tested.[151] Regulatory sandboxes could be a useful addition to the described toolbox of strategies.[152] Regulatory sandboxes and other experimental regulatory strategies provide room to experiment with the different strategic approaches. The quick technical, societal and economic changes require the need for flexibility in applying the regulatory framework by the responsible regulators and a certain leeway for the addressees of regulation in general and the addressees of sustainable hydrogen regulation in particular. Regulatory sandboxes or at least another flexible regulatory regime can create experiences that then are considered within the revision of the regulatory regime, in order to find the best regulatory regime possible.[153] Regulatory sandboxes could be aligned with first practical experiments to supply households with hydrogen.[154] Last but not least, any new form of regulation that builds on the results of regulatory sandboxes may need to be flexible enough itself to incorporate new developments and circumstances.

4.6. *Conclusion*

There are several regulatory strategies that can accelerate the creation of a well-functioning sustainable hydrogen market in the EU. Command-and-control regulation alone may not be the right strategy for accelerating the creation of a hydrogen market, because leeway to experiment and room for adjusting to new circumstances, for example in the context of regulatory sandboxes, is needed in light of the current uncertainties on the markets, and command-and-control policy may take too long to

144 See eg the tasks referred to the European Network of Transmission System Operators for Electricity ('ENTSO for Electricity') under Article 39 Regulation (EU) 2019/943

145 Lavrijssen and Vitéz (n 2), 266, 279

146 *Ibid*

147 Leenes (n 53), 3, 6

148 See Iyiola Solanke, *EU Law* (2nd edn, CUP 2022); Case 26/62 *van Gend&Loos* [1963] ECLI:EU:C:1963:1

149 See European Commission, 'Regulatory Learning in the EU' (n 90), 6 and 9; Kanerva and Ari (n 13), 15 and references therein; Schittekatte and others (n 82), 7

150 Kanerva and Ari (n 13), 7f and references therein, 15 and references therein; Schittekatte and others (n 82), 8f

151 Lavrijssen and Vitéz (n 2), 266, 279

152 Schittekatte and others (n 82), 8

153 See also Kanerva and Ari (n 13), 16 and references therein

154 See for first projects in the Netherlands that supply private households with hydrogen: <www.acm.nl/en/publications/acm-gives-green-light-pilot-project-involving-distribution-hydrogen-homes> accessed 29 August 2023; <www.vakbeursenergie.nl/nl/nieuws-item/Na-september-eerste-huizen-met-waterstof-verwarmd/> accessed 29 August 2023

adapt to the changes in technology and in the markets. There are plenty of ways to connect the various regulatory strategies with the principles of good regulation that can all be tried out in an experimental framework: command-and-control regulation can on the one hand contribute to the efficiency of a market (compare with licensing processes), but can also be too strict and thus undermine efficiency. Principle-based regulation may contribute to flexibility, but may lead to less transparency and accountability. Incentive-based regimes have an influence on market independence and can involve consumer participation. However, experiments should be in line with certain goals and principles and within the boundaries of EU law. Usually, a mix of strategies is needed. Also, legislators should stay realistic about the level of performance that can be achieved by regulation.[155] In this regard, it should also be remembered that any good regulation may only be as good as it is enforced. Furthermore, the market parties should also feel responsible for realising certain goals and principles with their actions. It will be important to keep them involved and committed to certain values and rules.

5. Comparative methods for creating good regulation

This section explains the concept and aims of comparative law and how it can be linked to the use of regulatory strategies, the incorporation of the principles of good regulation, and thus the creation of sustainable hydrogen markets. It focusses on what comparative methods a legislator can rely on and their role for the necessary inspiration and the learning from experience to draft good regulation, to apply different strategies and to comply with the principles of good regulation.

5.1. *The use of a comparative law perspective*

Legal literature classifies the purpose of comparative law in three main clusters: knowledge and understanding, practical use at the national level, and practical use at the international/supranational level.[156] Indeed, comparative law has not only theoretical but high practical use for the applicant: the legislator can apply the comparative law perspective to see how well a foreign set of rules works in addressing a specific issue, with the purpose of strengthening the country's position in regulatory competition and/or to reforming its legal order.[157] Assessing how well a foreign set of rules works in approaching a particular problem is, in consequence, even more useful when it comes to regulating a specific problem for the first time: comparative law can inspire legislators with ways to address a particular issue.[158] Nonetheless, the concrete solution for a country needs to consider its national socio-economic context as this may differ among countries. On the international level, the comparative

155 Baldwin and others, *Understanding Regulation* (n 11), 130f

156 Mathias Siems, *Comparative Law* (3rd edn, CUP 2022), 'Introduction: Why Compare Laws. The Purposes of Comparative Law'

157 *Ibid*, 'Practical Use at the Domestic Level'

158 Heinz-Peter Mansel, 'Rechtsvergleichung und Europäische Rechtseinheit' [1991] JuristenZeitung, 529 and references therein; Uwe Kischel, *Rechtsvergleichung* (CH Beck 2019) 57ff; Siems (n 156), 'Practical Use at the Domestic Level'

law perspective can help in creating unified rules.[159] Thus, it is a method of particular interest for the EU legislator when drafting a common framework for the internal market.[160] It is expected that hydrogen markets will be European or even global markets because supply and demand will be better matched on this scale than in national markets.[161] This leads to the necessity of good interconnection infrastructure between national market areas and the possibility of international trade, and also that regulatory fragmentation between EU member states is undesirable.[162]

A comparative law perspective can be taken among the EU member states' domestic legal orders, as well as between EU members states' and EU legislation. This is especially true as long there is no harmonising and binding EU law in place that renders the domestic set of rules inapplicable.[163] Similar to the situation for hydrogen market regulation, the legislative process for the Digital Markets Act (DMA) was accompanied by different EU member state legislation that address the issues in digital markets as well and that may now in part be considered invalid since the DMA is in force.[164] The comparative law perspective can therefore be used as an instrument to influence EU law when applied to already enacted national law, even if it is only a temporary legal regime till the EU enacts its own legislation.

5.2. *The best practices approach*

The best practices approach is a method repeatedly used in public administration research.[165] While the comparative law perspective focusses on the comparison of different sets of legal rules, the best practices approach focusses on 'how to improve actual performance through identification and codification of something typically referred to as a "best practice"',[166] thus a particular action itself. Public administration literature calls for two conditions that need to be met to be able to identify a best practice: (1) there has to be a complete set of cases; and (2) these cases must be comparable, meaning that there is 'a complete and accurate statement of causal relationships linking inputs and outputs'.[167] It is highlighted that it is only possible to identify a 'best' practice if all practices are included in the sample; otherwise it is not possible to identify the best approach but only the best approach that is included

159 Mansel (n 156), 529, 530; Siems (n 156)
160 See Siems (n 156), 'Practical Use at the International Level'
161 Lavrijssen and Vitéz (n 2), 266, 270f and references therein; Heidecke and others (n 24), 47; see IRENA, 'Hydrogen: A Renewable Energy Perspective' (2019) <www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Sep/IRENA_Hydrogen_2019.pdf?rev=99c1fc338b5149eb846c0d84d633bccd> accessed 29 August 2023, 35–37
162 Lavrijssen and Vitéz (n 2), 266, 271
163 The notion of EU law primacy explained eg in Solanke (n 148), 244
164 See for this discussion Andreas Grünwald, 'Gekommen, um zu bleiben? – § 19a GWB im Lichte des DMA-Entwurfs' [2021] Neue Zeitschrift für Kartellrecht – NZKart, 496; Jasper van den Boom, 'What Does the Digital Markets Act Harmonize? – Exploring Interactions between the DMA and National Competition Laws' [2022] European Competition Journal; Jens Brauneck, Der Digital Markets Act (DMA) – das neue, bessere digitale EU-Wettbewerbsrecht? [2023] Recht Digital – RDi, 27
165 Stuart Bretschneider, Frederick J Marc-Aurele, Jr and Jiannan Wu, '"Best Practices" Research: A Methodological Guide for the Perplexed' [2005] 15(2) Journal of Public Administration Research and Theory 307
166 *Ibid*, 307
167 *Ibid*, 307, 311

in the limited sample.[168] The two conditions are of course difficult to meet, but they can do groundwork in evaluating best practices studies in order to judge whether those studies truly identified a best practice. If not understood purely as an evaluation tool for studies that allegedly identified a best practice, the best practices approach demands a procedure for selecting the limited sample of cases, as in most cases it is hardly achievable to comply with the two mentioned conditions to create the perfect scenario. Thus, it is necessary to apply a selection procedure for the cases that may not promise the perfect result but come close to a 'not ideal but good' practice or that provide a high chance for having identified the best practice.

5.3. *Conclusion*

Three arguments can be developed: first, the best practices approach can be applied to regulatory sandboxes where market players are not very restricted by the legal framework.[169] Second, if the comparative law method wants to identify the 'best' set of rules, it must include all sets of rules that are dealing with the same problem and not only selected legal regimes. Third, as it is, in practice, very difficult to select all sets of rules that are dealing with the same problem, a choice through a selection procedure for the limited set of cases has to be made that promises results that may not be perfect but indicate a high probability to come up with a good or even the best practice. Relevant factors for the selection of the compared legal regimes may be that the compared frameworks belong to countries within the EU (due to the applicability of EU law) and that those countries have a similar economic structure. The procedure may need to be designed on a case-by-case basis and requires justification. The cases should be evaluated on the basis of whether the strategies used have already created working sustainable hydrogen markets. If this cannot be done because the timeframe for the creation of working sustainable hydrogen markets was too short, it should focus instead on how the principles of good regulation were implemented, as indicators for successful market development.

6. The case of Germany

The following two sections look at the German hydrogen grid regulation regime and the intended hydrogen grid regulation under the draft hydrogen and decarbonised gas market package (European Commission draft),[170] evaluating the regulatory strategies they include on the basis of the goals and principles of good regulation. The sections investigate the frameworks in the light of the introduced theoretical considerations and draw concrete conclusions for legislators on which regulatory strategies can accelerate the creation of a well-functioning sustainable hydrogen market in the EU. While the EU regime

168 *Ibid*, 307, 310

169 See also Ranchordás, Experimental Regulations (n 13), 10, 19

170 European Commission, 'Proposal for a Directive of the European Parliament' (n 22); European Commission, 'Proposal For a Regulation of the European Parliament and of the Council on the Internal Markets for Renewable and Natural Gases and for Hydrogen' COM (2021) 804 final. See for the legislative status of the regulation <https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2021/0424(COD)&l=en> accessed 29 August 2023; for the legislative status of the directive <https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2021/0425(COD)&l=en> accessed 29 August 2023

is important for all member states in the EU, the German regime is discussed because it was one of the first specific hydrogen grid regulation regimes in the EU.[171] Due to the article's limitations,[172] the sections will focus on the role of unbundling and third-party access, as these topics concern two important issues of market design. The two instruments are linked, although it might be sufficient to introduce consistent third-party access and network tariffs regulation without extensive unbundling.[173] Less stringent unbundling rules may also facilitate the market entry of companies that do not yet have a corresponding or easily adaptable infrastructure.[174] On the other hand, extensive unbundling may allow a less stringent third-party access and network tariff regulation and may prevent possibly inefficient, parallel infrastructures.[175]

6.1. *An opt-in regime as principle-based regulation*

Germany introduced optional[176] but specific hydrogen grid regulation with sections 28j to 28q of the German *Energiewirtschaftsgesetz* (EnWG). The regulatory regime's essential provisions are only applied if the grid operator wishes (Section 28j(1) EnWG). To opt for the application of the regime, the operator must submit a declaration to the German NRA (Section 28j(3) EnWG). Seemingly, up to today, only one company has requested to be subject to regulation.[177] Once opted in, there is no possibility for the hydrogen grid operator to opt out, since the opt-in declaration is irrevocable (Section 28j(2) sentence 3 EnWG). It is conceivable, however, that a hydrogen network operator could evade further applicability of the regime through rearranging its corporate structure. Yet, this is not foreseen by the law. The German regulation is intended to accompany the market ramp-up of hydrogen only to the extent that this is necessary; this is why grid operators are free to decide whether they are subject to the regulation or not.[178] Grid operators decide for themselves whether the application of the regulation supports their market model, for example by making it more attractive through non-discriminatory third-party access.[179] In this light, the German model is a type of principle-based regulation, offering the market players two options to achieve the desired goal of developing the market. Nevertheless, the regulation is to be understood as transitional at the beginning of the market ramp-up and shall be applied until future requirements at the EU level are implemented.[180] In this regard, the German framework is a type of experimental

171 Gesetz zur Umsetzung unionsrechtlicher Vorgaben und zur Regelung reiner Wasserstoffnetze im Energiewirtschaftsrecht, BGBl. I 2021 S. 3026. Also, other countries do not want to wait for the EU package, see eg Belgium`s new law on the transport of hydrogen through pipelines, <https://www.e-justice.just.fgov.be/cgi_loi/change_lg.pl?language=fr&la=F&cn=2023071102&table_name=loi> accessed 25September 2023

172 See section 1.2 of this article

173 Bundesnetzagentur (n 23), 69

174 *Ibid*

175 *Ibid*

176 See Lukas Assmann, '§ 28j' in Lukas Assmann and Max Peiffer (eds), *BeckOK EnWG* (4th edn, CH Beck, 1 June 2022), recitals 12–18

177 See <www.energate-messenger.de/news/220458/bundesnetzagentur-bestaetigt-erstes-opt-in-fuer-wasserstoffnetz> accessed 29 August 2023

178 Document of the German Bundestag (BT-Drs.) 19/27453, 118

179 German Bundestag (n 178), 118. For further reasons for the opt-in from the perspective of the network operator, see Linnemann and Peltzer (n 5), 148f

regulation. The German legislator acknowledges the fact that the potential for discrimination increases with the size of the hydrogen network.[181] Thus, Germany may submit all hydrogen grid operators to the regulation in the medium term,[182] reducing flexibility. Instead of an opt-in regime, Germany could have chosen for an opt-out regime that would – as a strategy of nudging – require market players to take action to not be subject to the regime. With an opt-out regime, probably, more market players would have applied the regime as the option to not be subject to the regime would have required a higher effort than the opposite.

6.2. *Unbundling as command-and-control regulation*

Section 28m(1) EnWG obliges hydrogen grid operators who chose to be subject to the regulation, in accordance with Section 28j EnWG, to ensure transparency and non-discriminatory design and execution of network operations. In order to achieve this goal, they must ensure that network operation is independent of hydrogen production, hydrogen storage and hydrogen sales. In the case that they are subject to the regulation, hydrogen grid operators are not permitted to own, construct or operate hydrogen production, hydrogen storage or hydrogen distribution facilities (*vertical unbundling*; Section 28m(1) sentence 2 and 3 EnWG). [183] Thus, Section 28m(1) EnWG sets out the basic requirement for ensuring transparent and non-discriminatory grid operation in the case that hydrogen grid operators chose to be subject to the regulation.[184] Hydrogen grid operators must then make their grids available to all network users on a non-discriminatory basis and present the conditions of grid operation in a transparent manner.[185] In the case of opting in, according to Section 28m(2) EnWG and without prejudice to legal obligations to disclose information, hydrogen grid operators must ensure that the confidentiality of commercially sensitive information of which they become aware in the course of their business activities is maintained (*informational unbundling*, Section 28m(2) sentence 1 EnWG).[186] If hydrogen network operators disclose information about their own activities, they must then also ensure that this is done without discrimination: Section 28m(2) sentence 2 EnWG stipulates further that the hydrogen grid operators subject to the regulation, when disclosing information on their own activities, must make them available to all market players on a non-discriminatory basis. Pursuant to Section 28m(2) sentence 3 EnWG, they then shall, in particular, ensure that commercially sensitive information vis-à-vis affiliated companies is treated confidentially.[187] The German legislator does allow pure hydrogen network operators to also be operators of gas pipelines (no *horizontal unbundling*). In this case, they need to create separate accounts for the two businesses, to prevent discrimination and cross-subsidies (see Section 28k(2) sentence 1 EnWG). Section 28m EnWG is supported by the regulations on accounting unbundling in

180 Document of the German Bundestag (n 178), 118
181 *Ibid*
182 *Ibid*
183 See *ibid*, 120
184 *Ibid*
185 *Ibid*
186 *Ibid*
187 *Ibid*

Section 28k EnWG.[188] According to Section 28k(2) EnWG, the operation of the hydrogen network must also be kept separate from all other activities in order to avoid cross-subsidies.[189] Together with the accounting unbundling obligation in Section 28k EnWG,[190] the vertical unbundling regulated in Section 28m(1) EnWG aims to prevent cross-subsidies.[191] In fact, the German legislator eases the re-dedication of gas pipelines to pure hydrogen pipelines with Sections 43(1) EnWG and Sections 113a ff EnWG.[192]

6.3. *Third-party access as command-and-control regulation*

Section 28m EnWG provides for third-party access obligations in the case that the grid operator chose to apply the regulatory regime. According to Section 28n(2) EnWG, operators of hydrogen networks must then grant third parties connection and access to their hydrogen networks under reasonable and non-discriminatory conditions if the connection or access is necessary for third parties.[193] Network access, including related aspects of network connection, shall be granted through negotiated access. According to Section 28n(3) EnWG, hydrogen grid operators subject to the regulation must publish their applicable terms and conditions on the internet, an action that considers the transparency principle. The type of negotiated network access is a tool that was initially introduced in the gas sector in 1998,[194] but soon turned out to be a light regulatory tool: competition was not developing in a satisfactory way as the rather limited growth in the volume of gas transported made it uneconomic for competitors to invest in additional pipeline infrastructure.[195] Also, such investment was difficult due to the near impossibility of constructing additional pipelines in densely populated areas. [196] Further, decoupled entry–exit pricing in some gas markets required the use of a very specific pipeline.[197] Last but not least, from a more global perspective, an integrated system of transmission networks provided for an efficient use of the existing infrastructure.[198] Therefore, the updated gas market directive did not provide for the choice anymore and established regulatory network access only.[199] The explanatory memorandum to the EnWG contains no justification as to why Germany, against this background, nevertheless opted for negotiated network access only in Section 28n EnWG.[200] Before the introduction of the regulatory regime, there was no specific

188 Steffen Riege and Martin Schacht, '§ 28m' in Assmann and Peiffer (n 176), recital 1
189 See also Julia Möller-Klapperich, 'Die Regulierung reiner Wasserstoffnetze nach der EnWG-Novelle', [2021] Neue Justiz – NJ, 390 and references therein
190 German Bundestag (n 178), 119
191 Steffen Riege and Martin Schacht, '§ 28m' in Assmann and Peiffer (n 176), recital 5
192 See also Möller-Klapperich (n 189), 390, 391f
193 Linnemann and Peltzer (n 5), 156
194 Article 14ff Directive 98/30/EC
195 See Floris Graper and Christof Schoser, 'Network Regulation and Third Party Access' in Christopher Jones and William-James Kettlewell (eds), *EU Energy Law. Volume I: The Internal Energy Market* (Claeys & Casteels, 2021) 20f
196 See Graper and Schoser (n 195), 20f
197 See *ibid*
198 See *ibid*, 21
199 While Article14ff Directive 98/30/EC allowed for member states to choose between negotiated and regulated network access, there was no choice anymore with the subsequent directives, see Article18 Directive 2003/55/EC

regulatory regime for pure hydrogen grids in Germany; thus, third-party network access to hydrogen lines or networks could only result from the general requirements of antitrust law from Section 19(2) No. 4 Competition Act (*essential facilities doctrine*).[201]

6.4. *Assessment and conclusion*

The German approach supports the market ramp-up of hydrogen in general, supporting the attractiveness of the business model and hindering cross-subsidies. While the admixture of hydrogen to natural gas is subject to the gas regulation provisions, pure hydrogen grids now have their own regulatory framework under German law. The law opts for separate regulation of hydrogen grid tariffs instead of a joint regulation of hydrogen and gas network tariffs and the applicability of the regulation to any hydrogen type regardless of the energy input for its production. Remarkably, it gives grid operators a scope of assessment whether the regulatory framework including unbundling and mandatory third-party access benefits their business model by opting in. In this regard, the German approach provides for flexibility through a type of principle-based regulation, but at the same time recognises that the regulatory framework may be made mandatory in the future and that it may be replaced by a regulation based on EU law. Germany thus uses a unique and flexible approach, that – once a grid operator chooses to be subject to the regulation – makes use of a command-and-control regime, providing the means to address market failures, especially market power. The unbundling rules provide for transparency and independence, while the third-party access regulation creates efficiency, as market players do not need to rely on competition law to gain access. As the application of the regulation is irrevocable after a successful application to be subject to the regulation (see Section 28j(3) sentence 3 EnWG), the room for experimentation by a hydrogen network operator is limited.

The new rules on pure hydrogen grids will be evaluated by the *German NRA* by 30 June 2025, according to Section 112b EnWG. The evaluation will cover market activity, the European regulatory framework and the existing regulatory framework, and be based on indicators such as the number of market players in the hydrogen producer and consumer groups; volumes produced/traded; and length and geographical distribution of hydrogen networks.[202] It is also intended to compare the German developments with developments in the European hydrogen market,[203] which is a crucial step from the perspective of this article, which strongly advocates for applying comparative methods. The German regulatory framework will be assessed for its continued suitability, including an analysis of the efficient operation of the networks and the need to introduce further incentives.[204]

200 See German Bundestag (n 178), 120
201 *Ibid*, 118; Lukas Assmann, '§ 28j' in Assmann and Peiffer (n 176), recital 2; for more on the essential facilities doctrine see Whish and Bailey (n 22), 737ff
202 German Bundestag (n 178), 87
203 *Ibid*, 87
204 *Ibid*, 87

7. A harmonised framework for hydrogen markets in the EU

As mentioned before, this section will apply the same analysis as in the case of Germany to the EU draft hydrogen and decarbonised gas market package.

7.1. *Unbundling as command-and-control regulation*

Chapter IX Section 4 of the draft hydrogen and decarbonised gas market directive introduces specific rules for dedicated hydrogen network operators. Regarding *vertical unbundling*, according to Article 62(1) of the draft hydrogen and decarbonised gas market directive, member states shall ensure that from after one year of the transposition, hydrogen network operators are unbundled in accordance with the rules for natural gas transmission system operators set out in Article 56(1)–(3) of the draft hydrogen and decarbonised gas market directive. This means independence at least in terms of their legal form, organisation and decision-making from other activities not relating to transmission, distribution, transport and storage.

Where on entry into force of the directive the hydrogen network belonged to a vertically integrated undertaking, a member state may decide not to apply the unbundling obligation (Article 62(3) of the draft hydrogen and decarbonised gas market directive).[205] In such a case, the member state concerned shall designate an independent hydrogen network operator unbundled in accordance with the rules on independent system operators for natural gas set out in Article 55 of the draft hydrogen and decarbonised gas market directive. Hydrogen network operators and transmission system operators for gas unbundled in accordance with Article 54(1) of the draft hydrogen and decarbonised gas market directive can act as independent hydrogen network operators, subject to the requirements pursuant to Article 63. Until 31 December 2030, according to Article 62(4) of the draft hydrogen and decarbonised gas market directive, member states may designate an integrated hydrogen network operator unbundled in accordance with the rules on independent transmission operators for natural gas set out in Section 3 of Chapter IX.[206] Such designation shall expire by 31 December 2030 at the latest.[207] The provision allows almost a decade for the businesses to adapt to the new unbundling regime, in the case that the EU member state chooses to opt for this transitional period. But as the hydrogen market ramp-up is needed now, in this regard a transition period does not contribute to the market ramp-up. Nevertheless, from a legal perspective, the transition period may be needed to guarantee conformity with fundamental rights such as the freedom of ownership in light with the principle of proportionality. Regarding account unbundling, according to Article 64 of the draft hydrogen and decarbonised gas market directive, member states shall ensure that the accounts of hydrogen system operators are kept in accordance with Article 69.

Regarding *horizontal unbundling*, in the new Article 63 of the draft hydrogen and decarbonised gas market directive, the law proposes that where a hydrogen network operator is part of an undertaking active in transmission or distribution of natural

205 See Tanase and Herrera Anchustegui (n 27), 10
206 See *ibid*
207 See *ibid*, 6 and 10f

gas or electricity, it shall be independent at least in terms of its legal form.[208] This is criticised, as it may hinder synergies between gas and hydrogen networks while creating an inefficient duplicating of structures.[209] In consequence, the European Parliament suggests to change the European Commission's proposal in regard to not including horizontal unbundling in the directive, as they proposed to strike out Article 63.[210] The European Parliament suggests instead an Article 85(2) that includes a clear obligation to incorporate an opinion on dedicated horizontal unbundling in the general 31 December 2030 review.[211]

7.2. *Third-party access as command-and-control regulation*

Chapter IV Section 2 of the draft hydrogen and decarbonised gas market directive regulates the access to hydrogen infrastructure. The proposal refines the principles of directive 2009/73/EC and extends their scope to cover hydrogen networks: member states shall ensure the implementation of a system of regulated third-party access to hydrogen networks based on published tariffs and applied objectively and without discrimination between any hydrogen network users (Article 31(1) of the draft hydrogen and decarbonised gas market directive). Until 31 December 2030, a member state may decide not to apply this obligation (Article 31(4) of the draft hydrogen and decarbonised gas market directive).[212] In such a case, the member state shall ensure the implementation of a system of *negotiated* third-party access to hydrogen networks in accordance with objective, transparent and non-discriminatory criteria. Recital 71 of the draft directive explains that this option is chosen 'to ensure the necessary flexibility for operators and to reduce administrative costs during the ramp-up phase of the hydrogen market'. In the literature, it is argued that negotiated network access should be available for the distribution level (by discretion of the member state) in order to provide for further flexibility for the accommodation of different regional circumstances.[213] In the case of negotiated third-party access, the regulatory authorities shall take the necessary measures for hydrogen network users to be able to negotiate access to hydrogen networks. The parties shall then be obliged to negotiate access to hydrogen networks in good faith. Where negotiated access is used, regulatory authorities shall provide guidance to hydrogen network users on how negotiated tariffs will be affected when regulated third-party access is introduced. The first version of the gas market directive contained the option for negotiated third-party access.[214]

208 See *ibid*, 11

209 Nationaler Wasserstoffrat (Stellungnahme 4.2.2022) <www.wasserstoffrat.de/fileadmin/wasserstoffrat/media/Dokumente/2022/2022-02-04_NWR-Stellungnahme_Gasmarktpaket.pdf> accessed 29 August 2023, 3

210 Report on the proposal for a directive of the European Parliament and of the Council on common rules for the internal markets in renewable and natural gases and in hydrogen (recast), <www.europarl.europa.eu/doceo/document/A-9-2023-0035_EN.html#_section2> accessed 29 August 2023

211 *Ibid*

212 See also Linnemann and Peltzer (n 5), 157; Tanase and Herrera Anchustegui (n 27), 6 and 9

213 Catherine Banet, 'Building Europe's Hydrogen and Renewable Gas Markets' (2023) CERRE Report, 69

214 Article 14f Directive 98/30/EC

7.3. *Assessment and conclusion*

The new gas package provides for flexibility for member states from the perspective of temporarily waiving explicit rules on unbundling and third-party access. After 2030, the rules will become more harmonised across the EU, allowing less flexibilty.[215] This lack of flexibility regarding unbundling models after 2030 is highly criticised.[216] This is a very limited part of flexibility and also does not consider the EU's principle of subsidiarity to the fullest extent.[217] Further, in the light of the experiences that were made with the gas market directive, it is questionable whether the temporary option to opt for negotiated third-party network access is really needed. On the contrary, if inefficient, it may already lead to the establishment of dominance in the markets till 2030. If this were the case, it is highly questionable whether the intended flexibility and reduction of administrative costs would counterweight this disadvantage.

According to the explanatory memorandum of the draft hydrogen and decarbonised gas market package, ACER will conduct annual reporting on pure hydrogen markets, and the European Commission will make an evaluation on the measures within a given timeline of approximately five years after the entry into force of the package, including the effectiveness, efficiency, continuing coherence and relevance of the proposals. This evaluation can lay the ground for future legislative changes of the hydrogen and decarbonised gas market directive and regulation, such as leading to an earlier phase-out of negotiated network access. The review may also help in investigating whether the goals of good regulation, as described above, were adequately achieved with the framework.

On 16 March 2023, the European Commission, with the draft Net Zero Industry Act,[218] proposed legal rules that allow member states to create regulatory sandboxes with regard to the manufacturing capacity for net-zero technologies before their placement on the market (Article 26 of the draft Net Zero Industry Act).[219] But Article 26(4) sentence 1 draft Net Zero Industry Act states that authorities shall (only) consider granting derogations or exemptions to the extent allowed by the relevant EU or national law. As the draft new EU gas package does not provide for exemptions, it is highly questionable whether the EU sandbox approach can be applied to the transport and distribution of hydrogen through pure hydrogen grids. Some clarification in the legislative process would be appreciated.[220]

8. Final conclusion and recommendations

To achieve energy sovereignty and climate neutrality by 2050, there is still a lot of work to be done by the responsible legislators and regulators. For them, the present article laid out what tools and methods are available to contribute to the development of sustainable hydrogen markets that are a key institution to address the aforementioned challenges. It is crucial, when drafting the necessary regulatory framework,

215 Tanase and Herrera Anchustegui (n 27), 6
216 *Ibid*, 14 and references therein
217 *Ibid*, 16
218 Draft Net Zero Industry Act (n 135)
219 For further details, see European Commission, "Regulatory Learning in the EU' (n 90), 47f
220 See European Commission, 'Regulatory Learning in the EU' (n 90), 19

to keep in mind the goals and to consider the principles of good regulation, and to evaluate the right regulatory strategies to achieve the policy aims based on those principles too. The right mix of strategies, an adequate balance of competing interests and the sufficient consideration of the principles of good regulation can be tried out in regulatory sandboxes and through other means of regulatory experimentation. Looking into other legal frameworks and cases for best practices provides legal inspiration, and enables legislators to learn from the experiences of others. Comparative methods such as the use of the comparative law perspective as well as the best practices approach are key to finding a good set of regulatory rules to support the ramp-up phase of sustainable hydrogen markets as a key player in the energy transition, and to secure the EU's energy independence from Russian fossil fuels. With these methods, legislators can become inspired by different sets of rules and regulatory strategies to draft good regulation, without losing sight of the social–economic context in which regulatory regimes are applied. But legislators are not limited to inspiration and learning from experiences: they can also use comparative methods for the evaluation of regulatory strategies. In particular, the best practices approach enables legislators to identify good action by market players in a regulatory experiment, to be able to codify them in a next step and to adapt the legislative framework accordingly. Both methods need to align with flexible regulation so that lessons learned from the gained experience can be easily introduced in the current state of the regulatory framework. Definitive choices regarding the best mixture of regulatory strategies cannot be made yet. Legislators are advised to create procedures to identify best practices, for assessing and for applying the regulatory strategies. The principles of good regulation shall be considered guiding principles in this process of evaluating the 'best' regulatory practices, because they proved to work well in the past and thus can give indication where strong economic parameters of how well the markets developed do not yet exist.

Against this background, the present article looked into the German framework for hydrogen markets as well as into the draft EU framework: the German model combines a type of principle-based regulation with a strong command-and-control regime once market players decide to opt in. Otherwise, competition law as a market-harnessing control stays in place. Design solutions such as nudging could have been considered more. In contrast to this, the EU model is to draft an even stricter command-and-control regime that gives clear guidance for the markets but does not allow much flexibility. Flexibility in a regulatory framework can mean both that the EU leaves a certain choice to the member states and that the regime allows the market players to choose to be subject to regulation or not. The German hydrogen regulation leaves the choice to the market players. Where there is flexibility under the EU regime for third-party access rules in the timeframe of the transition period, it disregards the lessons learned from gas regulation. Both approaches provide for an evaluation of the sets of rules, focussing on effectiveness and efficiency. Unbundling and third-party access rules are part of a command-and-control regime. Unbundling provides to address market power, whereas the third-party access regulation creates efficiency, as market players do not need to rely on competition law to gain access. Both negotiated and regulated third-party access are accompanied by rules on the transparency of the terms and conditions. The German model allows for horizontal operation and thus provides the opportunity for the hydrogen markets to learn from acquired experience in gas network operation. In contrast to this, the European Commission proposal is intended to introduce horizontal unbundling rules.

This article's analysis shows in particular that a regulatory regime needs a certain degree of flexibility in order to be responsive to technological, societal and economic changes so that the law does not fall behind the market needs. In this regard, for the time being, it seems to be a well-working model to let the network operators choose whether they want to apply the regulatory regime, as it is done in Germany, because the regulatory uncertainty that is created due to the not-yet-enacted but already proposed EU framework allows the companies to decide what they think is best for them. Nevertheless, if it had been an opt-out instead of an opt-in regime, the potential of nudging could have been used too. Also, if grid operators had the chance to re-decide and – maybe with a transitional period – to choose to not be subject to the regulatory regime anymore, this would allow the German legislator in particular and European legislators in general to create a real experimental regulatory regime and also evaluate why grid regulators might have chosen to be subject to the regulatory regime in the first place, but reconsidered later. This way, the full potential of flexibility could be made useful, especially regarding the German legislator's intention to make the regulatory framework mandatory for all grid operators on the hydrogen market in the middle time frame. The EU legislator includes flexibility in that there are several tools member states can apply during the transition phase, but this does not seem sufficient to address the expected quick development of sustainable hydrogen markets. Rather, the EU legislator relies on a strict command-and-control regime.

The regulator's role is to provide a stable framework so that markets can enfold. Experiments are important, but clear conditions regarding how they are conducted are needed. If the incumbents are given too much leeway within the experiment, the experimental phase could already be used to create undesired monopolies. Thus, the regulatory framework needs to ensure that it maintains several market players in the ramp-up phase of sustainable hydrogen markets. Especially in phases such as the current one, where no regulatory regimes or only optional regulatory regimes are yet in place, attention to the enforcement of competition law can prevent market power abuse and the formation of monopolies, also outside of industrial demand clusters.

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