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Energy Transition Expertise
Centre

Final Report

Study on Regulatory
Sandboxes in the Energy
Sector

Study on Regulatory Sandboxes in the Energy Sector



Consortium Leader

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Executive Summary

Regulatory sandboxes aim to support innovative solutions and promote regulatory learning, often by giving derogations from certain regulatory provisions to participants for a limited amount of time. Other forms of experimentation (regulatory or otherwise) exist, such as regulatory pilot projects, pilot regulations, living labs and test beds.

Several Member States have already adopted or are considering adopting frameworks for regulatory experimentation in the energy sector, including regulatory sandboxes. A few reports have compared existing regulatory sandboxes in the EU and globally. However, there is limited information on the concrete implementation of these sandboxes, barriers for implementation and best practices, and the concrete impacts. A recent notable exception is the report by the Joint Research Centre (JRC), which represents the first EU-wide overview of regulatory experimentation frameworks for the energy sector.

The main objective of this report is to **analyse existing regulatory sandbox schemes for the energy sector with a focus on the EU Member States regarding their purpose, regulatory/legal basis, format, implementation barriers and best practices, and impacts in fostering regulatory learning and new business cases.**

Our analysis indicates that regulatory sandboxes are useful policy tools to develop regulations and enable the creation of new products and services, even if not all examples have a clear positive impact and many projects awarded under regulatory sandboxes are still ongoing. However, regulatory sandboxes are warranted only in the case where a regulatory exemption is strictly necessary for the innovation to take place. In other cases, different instruments (such as the ones where regulators/authorities supervise and guide the innovative projects) may be more adequate while avoiding the risk of distorting the level-playing field.

Regulatory sandboxes are distinguished from other regulatory experimentation approaches by their more open and often case-by-case approach to granting derogations for projects. Sandboxes also differ in various attributes, including their legal basis, eligible participants, application process format, possible derogations, supervising/administering body, the duration for which derogations are granted, and the knowledge transfer and dissemination process.

The legal basis is the primary prerequisite for the implementation of regulatory sandboxes. Regulators and other authorities require at least a minimum set of legislative provisions mandating or empowering them to implement the sandbox (so-called legal clauses) or more detailed rules for implementation. Such frameworks for regulatory sandboxes (in place or proposed) were identified in 12 Member States (AT, BE, DK, ES, FR, HR, HU, IT, LT, NL, PT, SE), and are being considered in seven more (CZ, DE, FI, LU, LV, PL, SI). The lack of a legal basis can form a primary barrier to the implementation of sandboxes in the EU.

In addition to the lack of a legal basis, we found multiple barriers to the (successful) implementation of sandboxes:

- requested derogations not within competences of implementing entities;
- participation constraints, especially for smaller entities, such as SMEs and start-ups;
- lack of resources and expertise within authorities regulating and/or supervising the sandbox; and
- perception of potential conflicts of regulatory derogations with other binding regulations.

On the basis of these barriers, we also discuss best practices in regulatory sandboxes and lessons learned from regulatory experimentation in other sectors. Following these lessons, we reflect on the impacts and outcomes of ongoing or finished sandboxes.

We also assessed the environmental considerations of regulatory sandboxes in the energy sector. We focused on the extent to which environmental factors are considered in existing frameworks and the extent to which they are implemented during the application phase. During our research, we focused on articles in the sandbox regulations in the field of environmental protection for the energy sector. Although, we, unfortunately, did not find significant concrete outputs in this approach, we had the chance to report the measures taken in various European countries. We share our recommendations on environmental consideration that can be implemented for governments and responsible authorities.

Sustaining the necessary pace of change for the energy transition will require that the EU and Member States develop appropriate regulatory frameworks for the energy sector as well as address interactions with other relevant economic sectors and the environment. Therefore, well-designed regulatory sandboxes have an important role to play in enabling the reform of regulatory frameworks, in combination with other forms of regulatory experimentation.

There are a number of initiatives at the EU level concerning regulatory sandboxes and other forms of regulatory experimentation focused on or including the energy sector. Based on the analysis of regulatory sandboxes and other regulatory experimentation frameworks in Member States and the overview of past and ongoing initiatives at the EU level, we conclude the report with a number of recommendations targeted at the EU level to complement and strengthen these EU initiatives.

List of Acronyms

Abbreviation	Description
ADEME	Agence de la transition écologique
ARERA	L'Autorità di Regolazione per Energia Reti e Ambiente
CEER	Council of European Energy Regulators
CRC	Charge Restriction Condition
CRE	Energy Regulatory Commission “Commission de régulation de l'énergie”
CRU	Commission for Regulation of Utilities
DSO	Distribution System Operator
EEG	Erneuerbare-Energien-Gesetz
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ERDF	European Regional Development Fund
ICT	Information and Communication Technology
ISGAN	International Smart Grid Action Network
JRC	Joint Research Centre
NRA	National Regulatory Authority
OECD	Organisation for Economic Co-operation and Development
RVO	Netherlands Enterprise Agency “Rijksdienst voor Ondernemend Nederland”
SINTEG	Smart Energy Showcases - Digital Agenda for the Energy Transition
SME	Small and medium enterprises
TSO	Transmission System Operator
URE	Energy Regulatory Office “Urząd Regulacji Energetyki”

1 Introduction

The main objective of this report is to **analyse existing regulatory sandbox schemes for the energy sector with a focus on the EU Member States regarding their purpose, regulatory/legal basis, format, implementation barriers and best practices, and impacts in fostering regulatory learning and new business cases.**

A number of Member States have already adopted or are considering adopting frameworks for regulatory experimentation in the energy sector, including regulatory sandboxes. There are a number of reports comparing the existing regulatory sandboxes, which are usually focused on characterising the sandboxes and sometimes conducting case studies. However, there is limited information on the concrete implementation of these sandboxes, barriers for implementation and best practices, and the concrete impacts. A recent notable exception is the report by the JRC (2023)¹, which represents the first comprehensive overview of regulatory experimentation frameworks for the energy sector in the EU.

The report is structured as follows:

- **Chapter 2 identifies existing and planned frameworks for regulatory experimentation in the energy sector**, particularly regulatory sandboxes, with a focus on Member States where no framework was identified by the JRC report;
- **Chapter 3 characterises regulatory sandboxes**, including a discussion on their definition and selected relevant characteristics, linking those characteristics to the different possible objectives of the sandboxes;
- **Chapter 4 identifies barriers, best practices and impacts of regulatory sandboxes** in order to provide information for their deployment and improvement;
- **Chapter 5 identifies environmental considerations in regulatory sandboxes in the energy sector**, especially related to facilitating the development of innovative energy projects while maintaining or increasing environmental protection standards;
- **Chapter 6 overviews past and on-going initiatives at the EU level** regarding regulatory sandboxes for or including the energy sector, and **provides recommendations targeted at the EU level.**

1.1 Methodology

This study was implemented from March to May 2023, and employed desk research, interviews with energy sector stakeholders, and survey responses from Member State ministries.

Desk research on selected national frameworks for regulatory sandboxes employed the consultation of native-language experts within Trinomics as well as direct research employing machine translation of national policy documents.

The stakeholders interviewed comprised the German Ministry of Economic Affairs and Climate Action as well as members of Eurelectric (with representatives from companies active in electricity generation and supply), Eurogas (companies active in heat and gas distribution, supply as well as other activities), and E.DSO (companies active in electricity distribution as well as academics). We also discussed regulatory sandboxes with experts at the JRC. The interviews were semi-structured, with a list of questions shared in advanced to provide a guide to the discussion. The questions (adapted according to the specific interviewee) covered the following topics:

¹ JRC (2023) Making energy regulation fit for purpose. State of play of regulatory experimentation in the EU

- Overview of regulatory sandboxes and other experimentation mechanisms in the EU.
- Barriers faced by the interviewees for participating in regulatory sandboxes.
- Best practices for designing and implementing regulatory sandboxes.
- Impacts of regulatory sandboxes for the development of new business cases by the participants or other companies, as well as for the revision of regulation.
- Examples of co-promotion of environmental protection standards in regulatory sandboxes or barriers due to environmental legislation.

Lastly, with help from DG ENER, a short online survey was sent to the Concerted Action – Renewable Energy Sources Directive group. Respondents were policy advisors and/or officers at various ministries in EU Member States, which provided input on the following topics:

- Innovation and legislative frameworks in the Member States.
- Experience with regulatory experimentation, and sandboxes specifically.
- Input on support and guidelines at the EU level.

2 Frameworks for Regulatory Experimentation in the Energy Sector

2.1 Existing and planned regulatory experimentation frameworks in the EU

This section complements the overview of regulatory experimentation frameworks identified by the JRC (2023)² through desk research and interviews with relevant stakeholders. Figure 1 updates the figure of the JRC (2023) report on existing and future regulatory experimentation frameworks in the Member States, with a focus on regulatory sandboxes. The following additional information has been identified (with more details provided further below in this section):

- In **Finland**, various discussions have taken place and a government report, published in 2022, recommended the introduction of a regulatory sandbox for the energy sector, among other measures. The government is considering the introduction of a regulatory sandbox³, although this has not resulted in concrete legislative proposals yet.
- Draft legislation has been proposed in **Poland** and **Slovenia** for the introduction of regulatory sandboxes.
- In **Germany**, the government is more favourable to the introduction of regulatory sandboxes, with a draft law expected to be presented and discussed in parliament in late 2023. Moreover, the SINTEG and “Reallabore” mechanisms could be considered under certain definitions as regulatory experimentation mechanisms, but not necessarily as regulatory sandboxes.
- While **the Netherlands** began regulatory experimentations rather early in the EU (in 2015), the framework for regulatory experimentation in the energy sector ended in 2019.⁴ Instead, the 2023 Crisis and Recovery Law (“Crisis- en herstelwet”) includes a legal clause on experimentation covering several sectoral regulations, comprising energy but also environmental protection and spatial planning legislation, among others.⁵
- Desk research has identified no evidence of regulatory sandboxes or other regulatory experimentation frameworks in place or proposed in **Ireland**, **Cyprus**, and **Romania**.

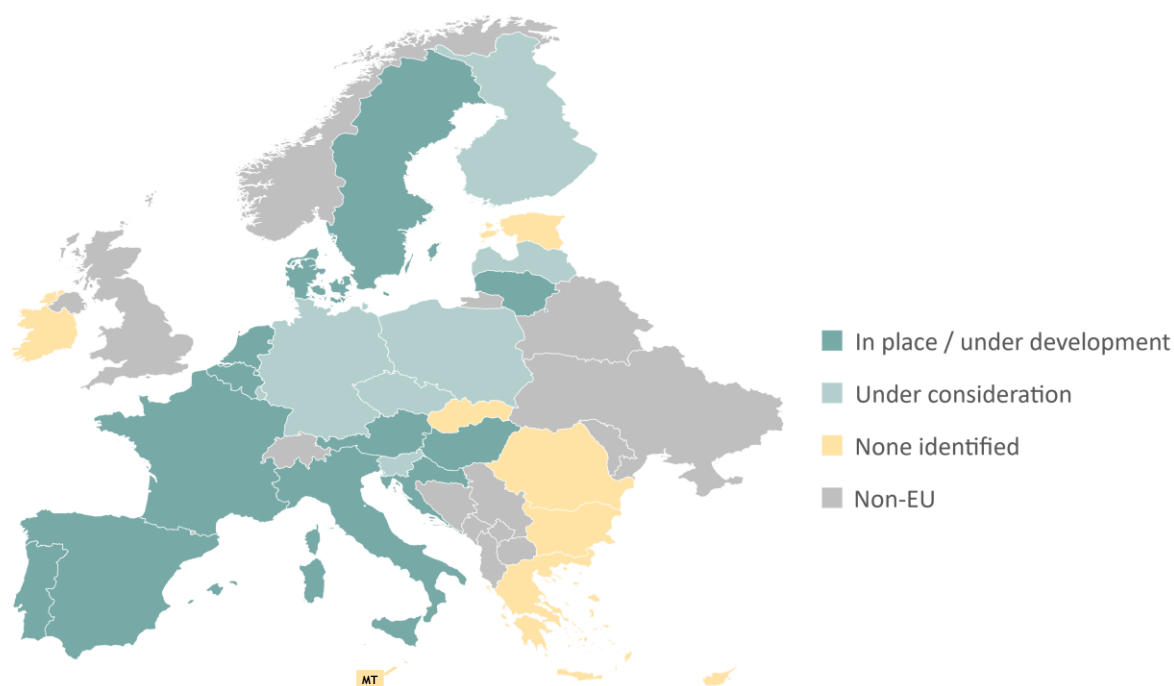
² JRC (2023) Making energy regulation fit for purpose. State of play of regulatory experimentation in the EU

³ <https://tem.fi/-/saantelyn-innovaatiomyonteisyydesta-on-tullut-tarkea-kansainvalinen-kilpailukykytekija>

⁴ <https://www.rvo.nl/subsidies-financiering/experimenten-elektriciteitswet-en-gaswet>

⁵ Article 2.4 of Crisis and Recovery Law. <https://wetten.overheid.nl/BWBR0027431/2023-01-01>

Figure 1 Member States with regulatory experimentation frameworks (in place, under development or under consideration)



Source: own elaboration based on desk research and JRC (2023)⁶

The rest of this section details existing, proposed, or considered frameworks for regulatory experimentation in or including the energy sector identified in the Member States, with a focus on regulatory sandboxes. As the objective was to complement the information of the JRC (2023) study,⁷ the analysis is not exhaustive, focusing instead on the countries for which the JRC could not find information or where the national regulatory authority (NRA) originally indicated to the JRC that no framework existed. Besides the information presented next, our desk research indicates no framework for regulatory experimentation is in place or proposed in **Ireland, Cyprus, and Romania.**

Finland

Some discussions around the establishment of a regulatory sandbox for smart grids have taken place in Finland. In 2019, the Finnish NRA established a Smart Grid Forum to assist with the implementation of smart grid-related articles in the revised Electricity Directive as well as of proposals of the Smart Grid Working Group. During the subsequent two years, the Forum discussed the use of sandboxes to support the implementation of the provisions.⁸

An International Smart Grid Action Network (ISGAN) workshop held in March 2021 saw the participation of the Finnish Ministry of Economic Affairs and Employment, the Energy Authority (i.e. the Finnish NRA) as well as market participants. It was noted on this occasion that “it is considered important to have provisions in national legislation for controlled experiments especially related to electricity and gas”, but that such framework was missing, as “Regulatory bodies lack explicit climate

⁶ JRC (2023) Making energy regulation fit for purpose. State of play of regulatory experimentation in the EU

⁷ JRC (2023) Making energy regulation fit for purpose. State of play of regulatory experimentation in the EU

⁸ https://www.energy-community.org/dam/jcr:5367d00a-8aa2-4ff5-9c76-1a8671d6754e/TRILATWS_Energia_052021.pdf

goals/competences, which reduce room for fostering transformative innovations e.g. by granting regulatory exemptions – there is a need for changing the legal basis for Regulatory bodies (National or State agencies) climate missions.”⁹

Then, a 2022 report by the Finnish Ministry of Economic Affairs and Employment¹⁰ investigated how innovation-friendly regulatory practices could support specific economic sectors, with a dedicated section on the energy sector. The report recommends the development of a strategy or action plan for regulatory experimentation and the creation of a national centre of excellence or network for regulatory experimentation, as well as the creation of a regulatory sandbox specific for the energy sector, to facilitate experiments related to energy communities. The Ministry has also published a guide for lawmakers on Innovation Impact Assessment¹¹ as well as a number of other relevant publications in previous years.¹² Currently, the Finnish administration is considering the introduction of a regulatory sandbox (without specifying if it would be focused on the energy sector).¹³

Germany

The German government, in particular, the responsible Federal Ministry of Economic Affairs and Climate Change¹⁴, underlines that regulatory sandboxes are crucial for Germany's innovation system. Its intention is to create spaces for innovation and regulation, which allow the testing of innovative technologies, products, and services under conditions that are only partially compatible with the existing legal and regulatory framework. The insights gained via these timely and often spatially limited regulatory experiments should provide the ministry and regulatory bodies with the basis for the further development of the legal framework following an evidence-based approach. As part of their role in promoting innovation, regulatory sandboxes can make a significant contribution to sustainability, e.g. by allowing to test innovative climate and other environmentally-friendly technologies, products and business models. Via their participatory character, regulatory sandboxes should also help to foster the acceptance of innovations within the society.

While Germany does not have a framework for regulatory sandboxes, it did develop a number of regulatory experimentation initiatives – such as SINTEG and also recently the energy transition living labs,¹⁵ where funding is provided as part of Germany's 7th Energy Research Programme. Although translated into “regulatory sandboxes” in English,¹⁶ these initiatives rather constitute living labs (real laboratories, “Reallabore”, as named by the German government), since they do not involve the provision of regulatory derogations.¹⁷

Already in 2021, the initiative for developing a legal framework for regulatory sandboxes was launched by the government. However, it is expected only later in 2023 that a draft of the new law will be released and discussed in parliament. In parallel, initiatives in specific areas are making regulatory sandboxes possible. For example, the German Transport Passenger Act has been

⁹ VTT (2021) IEA ISGAN Regulatory Sandbox 2.0–project - 2nd National Workshop/Finland
https://energiavirasto.fi/documents/11120570/73411701/ISGAN+Regulatory+Sandbox+2_0_310321.pdf/dd707b48-2e19-e26c-9e81-8a7e87476902/ISGAN+Regulatory+Sandbox+2_0_310321.pdf?t=1619781963149

¹⁰ Finnish Ministry of Economic Affairs and Employment (2022) Innovaatiomyönteisen sääntelyn käytännöt kasvualoilla
<https://julkaisut.valtioneuvosto.fi/handle/10024/163767>

¹¹ Finnish Ministry of Economic Affairs and Employment (2022) Innovation Impact Assessment
<https://julkaisut.valtioneuvosto.fi/handle/10024/164443>

¹² <https://tem.fi/innovaatiomyonteinen-saantely>

¹³ <https://tem.fi/-/saantelyn-innovaatiomyonteisyydesta-on-tullut-tarkea-kansainvalinen-kilpailukykytekija>

¹⁴ See more details here <https://www.bmwk.de/Redaktion/EN/Dossier/regulatory-sandboxes.html>.

¹⁵ <https://www.energieforschung.de/im-fokus/reallabore-der-energieewende>

¹⁶ For example in <https://www.bmwk.de/Redaktion/EN/Pressemitteilungen/2022/11/20221104-handover-of-grant-to-regulatory-sandbox-jenergiereal-to-foster-sustainable-electricity-and-heat-supply-in-cities.html>

¹⁷ See more details here
https://www.energieforschung.de/lw_resource/datapool/systemfiles/elements/files/CF2BC8F089D5721FE0537E695E869DA4/current/document/Praesentation_F%C3%B6rderkonzept_Reallabore_der_Energieewende.pdf

modified to allow the regulatory body to authorise the practical testing of new transport modes in derogation of the existing legal framework for a maximum period of four years as long as there are no conflicts with the interests of the public transport. Also related to the usage of drones, regulatory sandboxes can be launched.

However, the option for regulatory sandboxes does not yet apply to the energy sector. The living labs for energy transition are a funding format under the Federal Government's Energy Research Programme. Their implementation is possible within the general legal framework, but regulatory experimentation clauses are currently not possible.

Greece

There are no regulatory sandboxes in Greece targeting the energy sector specifically. The Clean energy for EU islands project suggests the implementation of a regulatory sandbox for energy in Greece to “allow specific islands to experiment with, for example, different designs of electricity tariffs (hourly tariff, time of use tariff, etc.)”.¹⁸

The Hellenic Competition Authority of Greece manages the Sustainable Development Sandbox¹⁹ of Greece, which has as a legal basis the Art. 37A of Greek (Competition) Law 3959/2011, as amended in January 2022. However, the main objective of the sandbox is to provide certainty for companies that they will not face investigations for anti-competitive behaviour when implementing approved projects. Therefore, while companies in the energy sector are eligible for the sandbox as any other company, they would not be eligible for derogations from provisions in energy sector regulation. Moreover, companies are not eligible for derogations from competition regulation either, and thus cannot be considered a regulatory sandbox in the strict sense of the definition.

Ireland

The desk research has not identified any existing or proposed regulatory sandbox for the energy sector in Ireland. In 2021, the network operator ESB Networks indicated that the implementation of two phases of their Flexibility Multiyear Plan depended either on the implementation of regulatory sandboxes or on regulatory decisions addressing system service markets and distribution system congestion management. The phases in question are the proof of concept phase (for a local and a market-wide demand side response pilots) and the interim phase (advancing the phase 1 pilots and developing further pilots on e.g. renewable energy support schemes).²⁰ However, the regulator CRU has confirmed to the JRC (2023)²¹ that it is not envisaging the set-up of regulatory sandboxes, opting for implementing the necessary legislation for the electricity sector.

Luxembourg

Luxembourg does not have a regulatory experimentation framework for the energy sector but is considering and discussing with stakeholders and neighbouring Member States potential initiatives on a digital twin of the Luxembourg energy system²², cross-border certification of hydrogen on the

¹⁸ See recommendation 4.3 of the study “Study on regulatory barriers and recommendation for clean energy transition on the islands - Greece” https://clean-energy-islands.ec.europa.eu/system/files/2022-12/PUBLIC_IslandSecretariatII_Study%20on%20barriers%20and%20recommendations%20GREECE_20221214%20clean.pdf

¹⁹ <https://sandbox.epant.gr/en/>

²⁰ Page 33 of [https://www.esbnetworks.ie/docs/default-source/publications/esb-networks-national-network-local-connections-programme-flexibility-multiyear-plan\(2\).pdf?sfvrsn=cd32da02_3](https://www.esbnetworks.ie/docs/default-source/publications/esb-networks-national-network-local-connections-programme-flexibility-multiyear-plan(2).pdf?sfvrsn=cd32da02_3)

²¹ JRC (2023) Making energy regulation fit for purpose. State of play of regulatory experimentation in the EU

²² <https://www.list.lu/en/institute/strategic-priorities/digital-twin/>

level of the Grande Région²³, and in the field of urban farming which could involve regulatory sandboxes.²⁴

Netherlands

While the Netherlands began regulatory experimentations rather early in the EU (in 2015), the government has changed the approach to enable regulatory experimentation in the energy and other sectors. The framework for regulatory experimentation in the energy sector ended in 2019,²⁵ based on advice from the Dutch Council of State.²⁶ Instead, the 2023 Crisis and Recovery Law ("Crisis- en herstelwet") includes a legal clause on experimentation covering several sectoral regulations, comprising energy but also environmental protection and spatial planning legislation.²⁷ Thus, while the inclusion of new provisions in the upcoming Energy Act ("Energiewet") was considered, the Dutch government abandoned the idea due to overlaps with the Crisis and Recovery Law and the risk of market distortion.²⁸

Article 2.4 of the Crisis and Recovery Law indicates that an administration entity can request the Interior Ministry (in consultation with relevant ministries) to grant derogations from certain provisions as an experiment. The implementation of the article is to be defined in a future executive decision. Derogations are possible for a number of legislative acts (and any acts deriving therefrom), namely as indicated in Article 2.4(1):

- a. the Electricity Act 1998 to the extent that this does not affect the proceeds of the energy tax referred to in the Environmental Taxes Act;
- b. section 9.1, first paragraph of the Heritage Act, insofar as it concerns chapter II, paragraph 2, with the exception of section 11, first paragraph of the 1988 Monuments Act;
- c. the Gas Act, on the understanding that the duties assigned to a network operator by or pursuant to that Act are not amended;
- d. the Housing Act 2014;
- e. the Vacant Property Act;
- f. the Heat Act;
- g. the Water Act, with the exception of Chapter 5, Article 6.5 opening words and under c, in conjunction with paragraph 2 of Chapter 6;
- h. the Environmental Law (General Provisions) Act;
- i. the Ammonia and Animal Husbandry Act;
- j. the Soil Protection Act
- k. the Noise Abatement Act
- l. the Odour Abatement and Livestock Industry Act
- m. the Air Pollution Act;
- n. the Environmental Management Act with the exception of Article 5.2b and Articles 5.7 to 5.15 and 5.17 to 5.24, on the understanding that deviations from Articles 5.6 and 5.16 do not affect the construction, use, maintenance, improvement or renewal of roads administered by the State;

²³ <https://www.granderegion.net/En-bref/Territoire>

²⁴ Communication with government representative

²⁵ <https://www.rvo.nl/subsidies-financiering/experimenten-elektriciteitswet-en-gaswet>

²⁶ More information in the latest advice of the Council of State: <https://www.raadvanstate.nl/actueel/nieuws/@135547/samenvatting-advies-energiewet/>

²⁷ Article 2.4 of Crisis and Recovery Law. <https://wetten.overheid.nl/BWBR0027431/2023-01-01>

²⁸ See section 12.2 of supporting arguments to the draft Energy Law.

<https://wetgeving.skalender.overheid.nl/regeling/WGK010483/documenten/Raad%20van%20State/Adviesaanvraag%20aanhangig%20bij%20Raad%20van%20State/1>

- o. the Spatial Planning Act;
- p. the Housing Act.

Poland

As indicated by the EUniversal project (2022), the Polish government proposed amendments to the Energy Law (proposal UC74) which contain provisions establishing a regulatory sandbox allowing “the Polish NRA URE to grant derogations from certain regulations to anticipate the need for new regulations adapted to future developments in the energy sector more quickly and effectively.” The procedure for the NRA to select sandboxes from a list of regulations to which exemptions can be granted and the project procedure itself should be announced, organised, and conducted at least once a year. Following Art. 24b of UC74, eligible project promoters are any legal person or organisation which is not a legal person but is granted legal capacity by a separate act. The list of regulations to which exemptions can be granted is targeted to projects that facilitate the implementation of innovative technologies and services, system user cooperation models, technological or ICT solutions for the benefit of energy transformation, smart grids and infrastructures, development of local balancing, and efficiency of the use of existing infrastructures. The derogations can be granted for a maximum period of three years. They can be extended up to three years, depending on the NRA decision and the stage of development of the project. The NRA URE is responsible for administering the sandbox and conducting inspections of the project implementation. No funding is foreseen in the regulatory scheme, but projects are allowed to facilitate funding through other channels. Periodic reports and a final report will be published online.”²⁹

The original text of the proposed act is available online. As of early April 2023, the proposed legislation went through the legal committee in March 2023, with the next step being the adoption of the act by the Council of Ministers.³⁰

Slovenia

As part of the milestone “Investments to increase energy efficiency in the economy” of its Recovery and Resilience Plan, the Slovenian government indicates that “a regulatory sandbox will be established and made operational to promote demand response technologies. The regulatory sandbox aims to support three pilot projects for innovative technology services that will contribute to the upgrade of the regulatory framework”.³¹ Note that this regulatory sandbox is not mentioned in the implementing decision of the Resilience and Recovery Plan for Slovenia established by the European Council, and thus seems to be an addition to the officially-agreed milestone.

The policy document “Strategic starting points for promoting the use of renewable energy sources and energy efficiency in the economy”³² for implementing the Recovery and Resilience Plan milestone recommends the installation of a regulatory experimentation mechanism (mentioning both the living lab and regulatory sandbox concepts). The document is not clear on whether the mechanism would allow for regulatory exemptions, as it foresees “the institutionalisation of an innovative approach to dealing with test and pilot solutions based on advanced (digital) technologies and advanced energy generation technologies, in the form of a test lab (or regulatory

²⁹ https://euniversal.eu/wp-content/uploads/2022/01/EUniversal_D10.3_Regulatory-recommendations-for-flexibility-options-and-markets.pdf

³⁰ <https://legislacja.rcl.gov.pl/projekt/12347450/katalog/12792158#12792158>

³¹ <https://www.gov.si/en/registries/projects/the-recovery-and-resilience-plan/about-the-recovery-and-resilience-plan/green-transition/renewable-energy-and-energy-efficiency/>

³² <https://www.gov.si/zbirke/projekti-in-programi/nalozbe-v-povecanje-energetske-ucinkovitosti-v-gospodarstvu/>

sandbox). In order to standardise the term and to make the function of such a test lab more understandable, the term regulatory sandbox is used throughout the document”.

A draft law guiding the regulatory experimentation mechanism has been proposed in February 2023.³³ According to the draft law,³⁴ the regulatory sandbox defined in Article 27 is focused on the production of renewable electricity and its storage with a time limit of three years (extendable for two more years). Candidates should, among other things, submit to the ministry responsible for energy “a list of the specific provisions of the regulations that make it impossible or significantly more difficult to implement the project” (Article 27(4)), thus constituting an open approach to which regulatory provisions can be derogated from. The ministry is then responsible for inviting the candidate to submit a definitive application and making a final decision authorising the application after consulting the other relevant authorities (such as other ministries), the affected municipality and the public through public consultations.

2.2 Are frameworks required to enable regulatory innovation?

This section addresses the question whether frameworks for sandboxes or other regulatory innovation mechanisms are explicitly required – or inhibit – regulatory innovation.

We have not identified a case where the absence of a regulatory framework addressing innovation was seen as an advantage for enabling innovation. On the contrary, literature indicates that a regulatory framework is indeed necessary to enable innovation in cases where the innovation requires a regulatory exemption. In cases where an exemption is not required, regulatory frameworks can still promote and facilitate innovation.³⁵

According to literature, there are several reasons why appropriate regulatory frameworks are a pre-condition for considering innovation:

- **Regulatory sandboxes and other related frameworks for innovation provide (at least temporary) legal certainty for innovators.**³⁶ This main purpose of sandboxes and other forms of regulatory experimentation becomes more important as the related products and services reach technological maturity,³⁷ either by providing the necessary exemption or providing guidance to stakeholders on the applicable requirements;
- **Energy regulators and other authorities are otherwise not empowered to implement regulatory experimentation mechanisms, as this is not explicitly mentioned among their competences.** Regulators are often the best placed to implement regulatory experimentation mechanisms, as the piece(s) of legislation or regulations for which exemptions are provided in the experimentation are frequently NRA competences. However, they need legal certainty about having the power to provide exemptions.³⁸ For example, the regulatory sandboxes in France³⁹ and Spain⁴⁰ have, as a legal basis, provisions in primary legislation of the energy sector.

³³ <https://skupnostobcin.si/wp-content/uploads/2023/03/zakon-o-uvajanju-naprav-za-proizvodnjo-elektricne-energije-iz-obnovljivih.pdf>

³⁴ <https://skupnostobcin.si/wp-content/uploads/2023/03/zakon-o-uvajanju-naprav-za-proizvodnjo-elektricne-energije-iz-obnovljivih.pdf>

³⁵ See for example Blind, K., (2016): The impact of regulation on innovation. In: Edler, J., Cunningham, P., Gök, A., et al. (Eds.), Handbook of Innovation Policy Impact. Edward Elgar Publishing, Cheltenham, 450–482.

³⁶ Leimüller and Wasserbacher-Schwarzer (2020) Regulatory Sandboxes – Analytical paper for BusinessEurope; Heymann et al. (2021) Regulatory sandboxes in the energy sector – review and learnings for the case of Switzerland

³⁷ CEPA (2021) Evaluation of the Innovation Link

³⁸ ISGAN (2021) Regulatory Sandbox 2.0 Project – Policy Messages to the Clean Energy Ministerial

³⁹ Article 61 of the Energy-Climate Law. <https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000039355955/>

⁴⁰ Additional disposition 23 of Law 24/2013. <https://www.boe.es/buscar/act.php?id=BOE-A-2013-13645>

The cases of Finland⁴¹ and Austria⁴² are mentioned in the literature as cases where the lack of related provisions on the NRA competences impeded the development of a regulatory sandbox for the energy sector. It must be noted, however, that a regulatory sandbox framework already exists in Austria,⁴³ even if it has a limited scope covering only electricity tariff design;

- **Experimentation must be designed such that it avoids competition distortion effects and protects consumers.**⁴⁴ An appropriate regulatory framework for fostering innovation aims to avoid that such negative effects occur in the context of regulatory innovation experiments – a particular risk as sandboxes, by definition, provide exemptions from certain regulatory requirements.

The Council conclusions of 16 November 2020 refer to the legal basis for such frameworks as legal clauses: “legal provisions which enable the authorities tasked with implementing and enforcing the legislation to exercise on a case-by-case basis a degree of flexibility in relation to testing innovative technologies, products, services or approaches”.⁴⁵ Legal advice for the German government has highlighted the need for experimentation clauses in primary legislation in order to give legislators and regulators sufficient flexibility to derogate from certain provisions, as well as providing guidance on how to draft appropriate experimentation clauses.⁴⁶

New legislation is, however, not always necessary. Based on a survey of energy regulators, CEER (2021)⁴⁷ notes that, although legislative changes are usually needed to give regulators a mandate (such as was the case in France), in Great Britain and the Netherlands regulators could implement regulatory sandboxes using the existing legal framework. The JRC notes this was also the case in Italy. The legislative framework already empowered NRAs to provide certain regulatory derogations in all three examples. But even so, (pre-existing) legal clauses are generally necessary – in the Netherlands, Article 7(a) of the Electricity law was introduced already in 2012.⁴⁸ Paragraph 7(a1) states that “the provisions of or pursuant to this Act may be deviated from by way of an experiment by general measures of the administration”, and the remainder of the article further specifies how such regulatory deviations may be established. In this case, the provision only empowers the Dutch government to establish sandboxes – and not the regulatory authority. Furthermore, even with such legislative clauses, a specific decision of the Dutch government in 2015⁴⁹ was necessary to detail further the rules for establishing the Dutch regulatory sandbox. Note that this clause is expected to be removed with the adoption of the new Energy Law, having been replaced by an experimentation clause in the 2023 Crisis and Recovery Law.⁵⁰

This does not mean that a regulatory framework for experimentation is necessarily effective in promoting innovation. If badly designed, such frameworks can even represent a barrier to innovation, as even though participation in the sandbox is voluntary, they may increase the overall uncertainty for innovators. An example mentioned in the literature includes the timing for adopting

⁴¹ VTT (2021) IEA ISGAN Regulatory Sandbox 2.0–project - 2nd National Workshop/Finland: https://energiavirasto.fi/documents/11120570/73411701/ISGAN+Regulatory+Sandbox+2_0_310321.pdf/dd707b48-2e19-e26c-9e81-8a7e87476902/ISGAN+Regulatory+Sandbox+2_0_310321.pdf?t=1619781963149

⁴² Veseli (2021) Practical necessity and legal options for introducing energy regulatory sandboxes in Austria

⁴³ JRC (2023) Making energy regulation fit for purpose. State of play of regulatory experimentation in the EU

⁴⁴ ISGAN (2021) Regulatory Sandbox 2.0 Project - Policy Messages to the Clean Energy Ministerial; Funseam (2022) Energy transition regulatory sandboxes

⁴⁵ <https://data.consilium.europa.eu/doc/document/ST-13004-2020-INIT/en/pdf>

⁴⁶ Noerr (2020) Umsetzung der BMWi-Strategie „Reallabore als Testräume für Innovation und Regulierung“; Erstellung einer Arbeitshilfe zur Formulierung von Experimentierklauseln (Los 1) https://www.bmwk.de/Redaktion/DE/Downloads/G/gutachten-noerr-erstellung-einer-arbeitshilfe-zur-formulierung-von-experimentierklauseln.pdf?__blob=publicationFile&v=4

⁴⁷ <https://www.ceer.eu/documents/104400/-/-/72eab87d-9220-e227-1d26-557a63409c6b>

⁴⁸ <https://wetten.overheid.nl/BWBR0009755/2022-10-01>

⁴⁹ Besluit experimenteren decentrale duurzame elektriciteitsopwekking. <https://wetten.overheid.nl/BWBR0036385/2015-04-01>

⁵⁰ <https://wetten.overheid.nl/BWBR0027431/2023-01-01>

the SINTEG ordinance in Germany.⁵¹ However, in this case, the framework represents a barrier due to issues in the design of the framework rather than its mere existence. In other words, an effective framework for regulatory experimentation (including the possibility for regulatory derogations if justified) can be preferred to no such framework being in place. However, an ineffective framework can increase uncertainty and act as a barrier to innovation compared to a situation where no framework has been implemented.

Moreover, providing legal certainty to investors often requires clarifying the existing regulatory framework (e.g. through the provision of a guidance) rather than requiring an exemption from an existing regulatory provision.⁵² Therefore, other approaches, such as where the regulator/authorities supervise and guide the innovative projects, may be sufficient to provide this certainty, dispensing in these cases the need for a regulatory sandbox providing exemption to certain regulatory requirements. EU innovation deals are cited as an example of this approach.⁵³

In summary, a well-designed regulatory framework for experimentation can significantly promote innovation. Attention must be given to the fact that regulatory sandboxes are warranted only in the case where a regulatory exemption is strictly necessary for the innovation to take place (be it a reform of the regulation or a new business case). In other cases, different instruments such as a guidance may be more adequate while avoiding the risk of distorting the level-playing field – as indicated by the EU ‘Better Regulation’ Toolbox (tool #69).⁵⁴ Such alternative instruments are in any case often necessary in the energy sector, to at least provide clarification regarding different requirements such as vertical unbundling of activities or consumer protection rules. Furthermore, inadequately-designed regulatory frameworks for experimentation can, of course, fail to promote and even represent a barrier to innovation by, among others, creating uncertainty to innovators – but this does not mean the innovation would take place in the absence of the framework.

⁵¹ p. 46 of Quest et al. (2020) Enter the sandbox – Developing innovation sandboxes for the energy sector

⁵² Ofgem (2018) Insights from running the regulatory sandbox

⁵³ Leimüller and Wasserbacher-Schwarzer (2020) Regulatory Sandboxes - Analytical paper for BusinessEurope

⁵⁴ https://commission.europa.eu/law/law-making-process/planning-and-proposing-law/better-regulation/better-regulation-guidelines-and-toolbox_en

3 Characteristics of regulatory sandboxes

3.1 Definition of regulatory sandboxes

The JRC (2023)⁵⁵ defines three characteristics of regulatory experimentation:

- 1) They are set up to support innovative solutions that require prior live testing to gather additional factual evidence of their risks and benefits;
- 2) They imply the possibility of granting derogations from the current regulatory framework, where the latter represents an obstacle to the feasibility or viability of the innovative solution; and
- 3) They are set up with a view to promoting regulatory learning.

To these characteristics, it could be added that regulatory sandboxes and other regulatory experimentation approaches are usually time-limited, as indicated by CEER (2021),⁵⁶ due to the market distortion risks the provision of regulatory derogations brings.

France differentiates legislative and regulatory experimentation, depending on which provisions need to be updated or derogated from: legislative experimentation requires an appropriate legislative vehicle (usually parliamentary approval), while regulatory experimentation may be conducted by regulators⁵⁷. Article 37(1) of the French constitution provides the legislative clause for regulatory experimentation provisions in laws and regulations.⁵⁸

In our understanding, the defining feature of regulatory sandboxes is the possibility for granting derogations to specific regulatory provisions to innovators experimenting new solutions with the aim to provide lessons for changing the regulatory framework, with close oversight from the regulator or other authority. The derogations are based on a request from the innovators (even though authorities may often limit the scope of provisions for which a derogation is possible, eventually through a call for applications).

This is in line with the definition of sandboxes in the Commission SWD (2022) 187: “a regulatory sandbox is a framework that enables the testing of innovations in a controlled real-world environment, under a specific plan developed and supervised by a competent authority. Sandboxes usually entail a temporary loosening of applicable rules, and feature safeguards to preserve overarching regulatory objectives, like safety and consumer protection.”⁵⁹

The Net Zero Industry Act proposal defines net-zero regulatory sandboxes as “a scheme that enables undertakings to test innovative net-zero technologies in a controlled real-world environment, under a specific plan, developed and monitored by a competent authority” (Article 3(1i)).⁶⁰ Article 26(4) of the proposed act also allows competent authorities to grant regulatory derogations or exemptions, thus fitting the definition presented in this study.

According to the JRC (2023)⁶¹, regulatory sandboxes, regulatory pilot projects, and pilot regulations can be classified based on three dimensions – the innovation approach (how and by whom the regulatory innovation is identified), the way of granting derogations, and the geographical scope of the experimentation (see Figure 2).

⁵⁵ JRC (2023) Making energy regulation fit for purpose. State of play of regulatory experimentation in the EU

⁵⁶ <https://www.ceer.eu/documents/104400/-/-/72eab87d-9220-e227-1d26-557a63409c6b>

⁵⁷ <https://www.modernisation.gouv.fr/transformer-l'action-publique/france-experimentation>

⁵⁸ <https://www.conseil-constitutionnel.fr/le-bloc-de-constitutionnalite/texte-integral-de-la-constitution-du-4-octobre-1958-en-vigueur>

⁵⁹ European Commission SWD (2022) 187 final accompanying the document A New European Innovation Agenda (COM (2022) 332 final)

⁶⁰ European Commission 2023/0081(COD) Proposal for a regulation on establishing a framework of measures for strengthening Europe's net-zero technology products manufacturing ecosystem (Net Zero Industry Act)

⁶¹ JRC (2023) Making energy regulation fit for purpose. State of play of regulatory experimentation in the EU

If a defined set of regulatory derogations will be granted and innovators have no possibility to choose which (although some provisions might not be applicable to them in the first place), the scheme constitutes a regulatory pilot project or a pilot regulation. In the case of regulatory pilot projects, only participants approved by the implementing authority receive the derogation. In the case of pilot regulations, the derogations are available for all who conform to the applicable criteria. It is however worth noting that participation in pilot regulations is always considered voluntary.

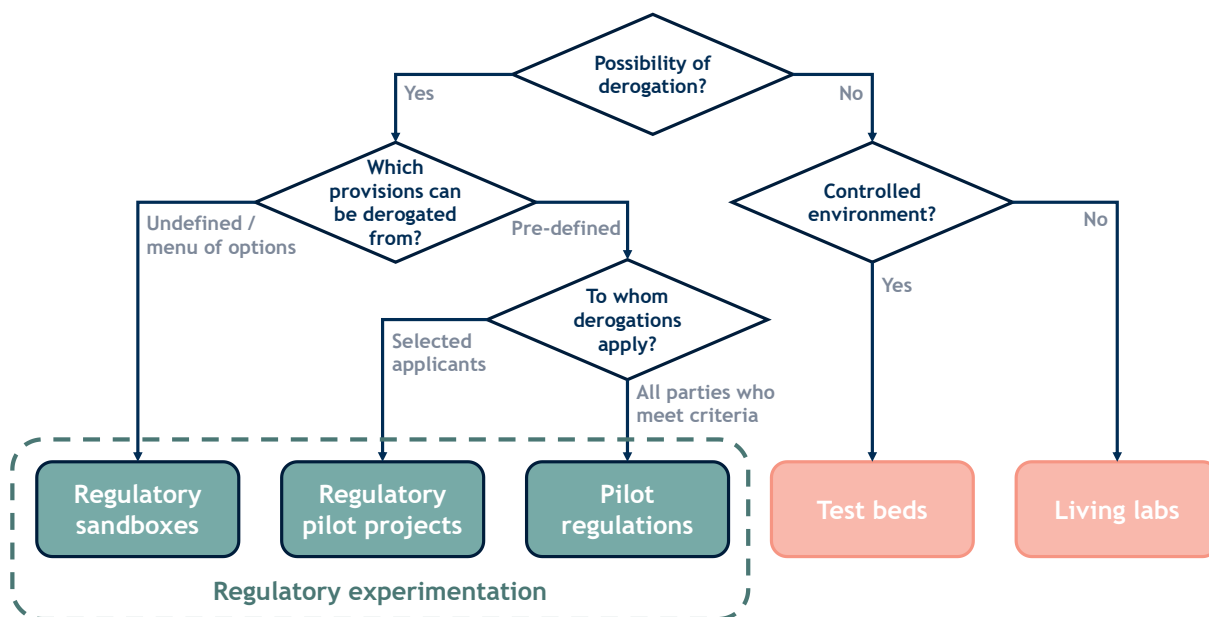
Figure 2 **Characteristics of regulatory experimentation mechanisms according to the JRC (2023)⁶²**

	Regulatory sandboxes		Regulatory pilot projects	Pilot regulations
Innovation approach	Bottom up		Top down	
	The identification of regulatory barrier is initiated by innovators		The regulator identifies legislative provisions for testing and calls for applications by interested organisations	
Way of granting the derogations	Case-by-case basis		Derogations are only granted to the actors that are successful in the application procedure	Derogation automatically applies to all parties that comply with certain eligibility criteria
Geographical scope of the experimentation	Nationwide	Local		Nationwide

Other forms of experimentation exist, such as test beds and living labs (differentiated especially by whether the experiments take place in a controlled environment or not).⁶³ However, while they can also support regulatory learning, these forms of regulatory experimentation differ from sandboxes, regulatory pilot projects and pilot regulations in that they do not require exemptions from specific regulatory provisions. Nonetheless, the lessons learned from living labs and test beds might lead to regulatory changes later on, as has been the case for example with the German SINTEG.

Figure 3 below displays a tentative typology of experimentation approaches – while living labs and test beds may, and often do, provide regulatory learning, they are not classified here as regulatory experimentation approaches as they do not involve the provision of regulatory exemptions or have regulatory learning as (exclusive) main aim.

⁶² JRC (2023) Making energy regulation fit for purpose. State of play of regulatory experimentation in the EU
⁶³ European Commission SWD (2022) 187 final accompanying the document A New European Innovation Agenda (COM (2022) 332 final)

Figure 3 Typology of experimentation approaches

An OECD report⁶⁴ defines regulatory sandboxes as “a limited form of regulatory waiver or flexibility for firms, enabling them to test new business models with reduced regulatory requirements. Furthermore, despite the variety of sandboxes, the report highlights a number of common characteristics:

- The promotion of a genuine innovation or novelty
- An identifiable consumer or social benefit
- The requirement for participants to demonstrate the need for and readiness for sandbox testing
- Defined time, sectoral or geographic limits
- The use of safeguard mechanisms

Despite the above, there is not a commonly agreed definition and characteristics for these experimentation approaches. While such a definition would be welcome (and to an extent necessary when developing new legislation), perhaps a more important aspect is choosing the appropriate experimentation approach for the specific needs.

3.2 Relevant characteristics of regulatory sandboxes

As discussed, regulatory sandboxes are particularly useful when authorities do not know exactly which regulatory provisions represent barriers to innovation or when there is a large number of provisions that need to be potentially updated. If the problem is more clearly defined and thus a more limited number of provisions need to be changed, regulatory pilot projects and pilot regulations may be better fits for the intended regulatory learning. Alternatively, if limited regulatory learning is required and/or innovators face lower uncertainty, a “conventional” direct revision of the regulatory framework is more efficient.

We described earlier the characteristics that distinguish regulatory sandboxes from other experimentation programmes. Here, we review the characteristics that are different among different

⁶⁴ OECD (2020) The role of sandboxes in promoting flexibility and innovation in the digital age

regulatory sandboxes and, where relevant, the connection to the objectives of the sandbox. The characteristics include:

- **Legal basis of the sandbox:** countries vary in their legal basis for sandboxes. In some countries such as France⁶⁵, this basis exists within general regulation on innovation and/or energy, with a basis in the French constitution as indicated in chapter 2. In some contexts, this legal basis can also change over time. For example, in the Netherlands, the legal basis for regulatory experimentations in the energy sector was an executive decree, which was not extended after 2019. Instead, an article was included in the Crisis and Recovery Act (in effect since 1st January 2023) on regulatory experimentation (across various sectors). Thus, countries develop the legal basis for regulatory experiments in different manners.
- **Eligible participants:** these are the stakeholders who can participate in a regulatory sandbox. They can vary in size (from consortia, e.g. in Dutch sandboxes, to single energy utilities, e.g. within the UK's Innovation Link). The size of these participants also impacts the geographical scale of projects, with large expanses covered by large consortia and smaller areas and sometimes only towns covered by smaller participation.
 - a) Eligibility might also be limited to businesses, while some sandboxes may open participation for other entities too. For example, Dutch sandboxes allowed for energy communities and homeowner associations to participate. Extra support may also be provided for SMEs, who may lack the resources to participate effectively.
 - b) Eligibility may be limited to participants within the regulated market (such as DSOs and/or TSOs) or allow access for all market participants.
 - c) Eligibility might also be limited based on technical criteria; as examples, Italian "sandboxes" for aggregator projects (which may although be considered a different form of experimentation due to their limited scope) limit entry to balance-responsible parties⁶⁶, and Portuguese sandboxes on flexibility services allow for only large (above 1MW capacity) consumers who are connected to the higher-voltage grid to participate.
 - d) Eligibility might be connected to various funding mechanisms developed to support innovative projects.
- **Format of application processes,** in particular whether they are done on an ongoing basis or have specific fixed calls. As an example, France had initially set up fixed time periods with deadlines but has moved in mid-2022 to a rolling-admission system. Moreover, the process for updating and reformatting the call for proposals can differ between sandboxes, France recently taking a more dynamic approach. The choice between the two approaches will depend on the resources available to the implementing authority, the amount of flexibility given to applicants (as calls allow authorities to specify sandbox requirements in more detail compared to a rolling-admission approach), and how the regulatory sandbox is improved (with calls usually implying modifications based on lessons learned, although the rolling-admission system should also be periodically evaluated and improved). Rolling calls may also react to market changes caused by previous sandbox projects. Applications may also be fast-tracked in some cases, such as in the case of reciprocity when a business requests entry into a sandbox where a competitor has already entered and begun projects.
- **Possible derogations,** which depends on the authorities responsible for the regulations related to sandboxes. These can be set rather narrowly, as is often the case with Italian projects (which may be instead considered pilot regulations due to their limited scope), or rather broadly, as is the case with France's "France Expérimentation".⁶⁷ The latter can thus address the many

⁶⁵ Law nr. 2019-1147 of 8 November 2019. Available at: <https://www.legifrance.gouv.fr/loda/id/JORFTEXT000039355955/>

⁶⁶ A balance-responsible party is an electricity market participant who balances the input and output of electricity at each time.

⁶⁷ <https://www.modernisation.gouv.fr/transformer-l'action-publique/france-experimentation>

interactions of energy projects with not only energy legislation and regulation, but also environmental permitting, spatial planning, safety, and other regulations, while increasing sandbox complexity and risks of limited consumer protection and market distortion.

- **The supervisor and/or administrator of the sandbox**, which can, for example, be an NRA (e.g. Ofgem in the UK's Innovation Link), an agency (e.g. ADEME in some French energy sandboxes), and/or (a part of) a ministry (e.g. the Netherlands Enterprise Agency – RVO – in the Dutch sandboxes). Sometimes, a combination of different organisations may be responsible for managing the sandbox; in Spain's sandboxes, for example, a committee composed of the ministry and the NRA is responsible. This choice is often motivated by the group of derogations considered under the sandbox scheme.
- **Duration of sandbox** (and derogations), which can vary greatly, although sandboxes with a duration of longer than 10 years are rare. Generally, shorter time periods (1-2 years) are preferred in cases where market distortion concerns are high and the intent is more to learn about market outcomes and effects of digital or economic novelties, e.g. in smart charging projects in the Italian ARERA's experimentation (although these experimentations may be too limited in scope to be considered a sandbox). Longer time periods are more beneficial for projects involving more significant investments, for which higher regulatory certainty is necessary, and allow for better regulatory learning. However, market distortion concerns exist, as has been discussed in the context of the Netherlands' experimentations.
- **Type of knowledge transfer** of the sandbox, i.e. how the sandbox's outcomes are transferred. The primary variables here refer to the practical aspects, such as how often reports and knowledge-sharing meetings are held, which stakeholders and authorities are informed of knowledge-sharing activities, and when results and lessons learned are shared. These activities can be optional or set as a mandatory requirement for participation in or implementation of the sandbox. Moreover, this knowledge transfer can differ in terms of how transparent and accessible it is to stakeholders and the public.

4 Barriers, Best Practices and Impacts of Regulatory Sandboxes

The development and implementation of regulatory sandboxes lead to experiences and outcomes. In this chapter, we discuss the barriers, lessons learned, and impacts from the experiences from previous and ongoing sandboxes.

The content of this chapter builds on the JRC report by collecting details from other published reports, presentations, and academic papers on regulatory experimentation. Moreover, expert interviews provide additional input on regulatory sandboxes in the energy sector.

Learning from other regulatory sandboxes and regulatory learning programmes in other sectors would also be valuable to inform regulatory sandboxes in the energy sector. A later section (4.5) in this chapter discusses this matter.

4.1 Input from stakeholders

Within the context of this project, we held interviews and meetings with experts on regulatory sandboxes and other relevant stakeholders. The intent was to complement the input from the JRC (2023) report, which primarily relied on inputs from interviews with NRAs. We thus contacted industry associations in the energy sector to get the general perspective of other stakeholders for regulatory sandboxes. We also discussed the JRC's findings with experts at the JRC, and also covered the point of view of policymakers with a regulation expert at the German Ministry for Economic Affairs and Climate Action. Lastly, we gathered input via an online survey distributed to the EU Member States and Commission representatives of the "Concerted Action on the Renewable Energy Directive". Details for these interviews and survey were described earlier in Section 1.1.

Much of the input from the interviews confirmed the findings of the JRC (2023) report. Perceived barriers, impacts, best practices, and potential role for the EU were rather similar among those interviewed in this study as well. In addition, we highlight a few key aspects that complement the JRC (2023) report's findings:

- **There are differences in the level of understanding of the concept of regulatory sandboxes** in particular, and regulatory experimentation in general. It was often not clear to interviewed participants what regulatory sandboxes are, in terms of their function, goals, and procedures. In some instances, references were made to projects that fell under regulatory pilot projects, did not contain regulatory derogations at all (i.e. were testbeds), or referred to regulatory changes the stakeholders would like to see implemented but for which a clear case for derogation did not exist. There were a few exceptions, such as that of a French gas sector actor, who had significant experience with sandboxes, which may be due to the maturity of regulatory experimentation in the French energy sector. On a similar note, interviews also highlighted that the industry may sometimes be unaware of regulatory sandboxes and what derogations are possible under them.
- **Most interviewees agreed that regulatory sandboxes can promote innovation and that EU guidelines would be useful.** Less commonly, interviewees highlighted that guidelines may not be effective enough, and more binding regulation could be better at ensuring the right setting for regulatory sandboxes. Nonetheless, all participants highlighted the differences in experience between countries, which could be well-addressed by initiatives at the EU level. Participants especially highlighted the potential usefulness of EU-level knowledge transfer initiatives. Lastly, a few participants highlighted that a regulatory toolkit could also be useful for Member State authorities in setting up their own sandboxes.

- **Interviewees indicated diverse viewpoints on the preferred duration for derogations under sandboxes.** Participants working with assets with long payback periods, such as grid operators, emphasised that a sufficiently long period of derogation is needed for sandboxes to be a viable option for consideration. These interviewees emphasised this as one of the primary reasons for less participation in regulatory sandboxes.
- On the other hand, participants with a regulatory or policy background emphasised the potential negative impacts of longer durations of the derogations. These concerns were primarily focused on market distortion and consumer protection, which are detailed in Section 4.5. These participants also emphasised the risk-averse nature of regulators, with concerns about these impacts thus potentially preventing the creation of sandboxes.
- **Interviewees could not indicate any specific example of environmental considerations addressed in the sandboxes.** The interviews collect examples that can give an impression of the interaction of environmental laws with projects supported by sandboxes or other experimentation mechanisms. Environmental aspects are often irrelevant for the projects under the sandboxes. On the other hand, it is understood that environmental considerations have been considered in other pilot or test applications that cannot be considered as energy regulatory sandboxes. These are detailed in Section 5.

4.2 Barriers to (successful) implementation of regulatory sandboxes

Barriers may prevent the creation of a regulatory sandbox, participation within a sandbox, or achievement of a sandbox its intended objectives. Our initial desk review highlighted multiple barriers, which were mainly similar to those of the JRC report. Moreover, interviewed experts generally confirmed these barriers and clarified the importance of each one of them. We find that the most important barriers to successful sandboxes are:

- **The absence of a legal basis.** Member State regulatory authorities, ministries and private stakeholders show enthusiasm for using regulatory sandboxes. However, derogation from regulations, as needed within sandboxes, require a specific legal framework. This requirement, and thus sandboxes, are not envisioned within the regulatory schemes of many Member States. Nonetheless, some Member States do already have frameworks in national regulations; for more Member States, there are proposals under discussion on this crucial facilitator for creating sandboxes.
- **Requested derogations not within competences of implementing entities.** Sandboxes in the energy sector may be set up by a ministry, a regulatory authority, or by another national governmental institution. Relevant provisions that applicants might need derogations from may, however, fall under the authority or supervision of other entities. This can impede the development of certain applications and create confusion for project promoters.
- **Participation constraints.** Interviews especially highlighted multiple issues concerning how participation becomes possible in sandbox programmes. Generally, larger companies had an easier time setting up participation in sandboxes, while smaller companies were left out. The participation issues were multifaceted, including lack of awareness of existing sandbox programs, confusion regarding the goals and outcomes, and low internal capabilities for developing proposals, carrying out sandbox projects, and complying with the sandbox's requirements.
- **Lack of resources and expertise.** Many authorities may be short on resources and/or the skills necessary to develop a regulatory sandbox. Resources and skills may be limited at any step of the process of a sandbox and can threaten the achievement of expected outcomes in terms of regulatory learning and advancing innovation. Often, concerns about the lack of financial and human resources are worsened by the missing legal basis, which could otherwise serve as a framework for allocating specific resources to regulatory experimentations. Furthermore,

authorities often have to develop all processes and technical documentation from zero, and documentation from other sandboxes, in particular from other Member States, is frequently not available (as documentation is typically accessible only while an application call is open);

- **Perception of potential conflicts with other binding (especially EU-level) regulations.** Stakeholders may perceive a high risk that derogations granted at a national level for regulatory sandboxes conflict with regulations set at the EU level. This was, for example, especially a concern in the Dutch case, where the Council of State expressed concern about derogations given under Dutch sandboxes which may have had some tensions with competition regulations determined at the EU level.^{68,69} These concerns are especially high in the energy sector, as binding EU energy market regulations also provide a framework for the activities of regulated entities and market participants. Thus, both energy-sector market regulations and general competition regulations (at both EU and national level) set a limit for special permissions and derogations granted within national sandboxes.

4.3 Best practices in regulatory sandboxes

Similar to barriers, our desk research (primarily citing ^{70,71,72}) and interviews confirmed and complemented the best practices listed in the JRC report. Based on experiences from past and current sandboxes, best practices are:

- **Verify that regulatory sandboxes are the best tool** for the desired objectives and the context. There are multiple types of experimentation possible, and others (such as test beds or pilot regulations, or simply a modification of existing legislation) may be better suited to achieve the intended goals within the context of the relevant projects. Possibly, direct funding schemes might be more efficient and effective with projects that do not demand regulatory experimentation.
- **Provide competent authorities with the mandate of providing exemptions / derogations for experimentation.** This should come from national legislation, but guidelines and assistance to this end can be developed at the EU level.
- While designing a sandbox, the most important aspects are **choosing suitable authorities for administering the sandbox and granting derogations**. The choice can be driven by which derogations can be granted and thus in which areas innovation and regulatory learning can be established. In the energy sector, sandboxes need to also consider and include relevant non-energy sector derogations, especially regarding environmental regulations. France's experimentations are a good example here, where the far-reaching framework allows for considerations of and potential derogations to environmental laws, such as air quality standards. As highlighted by Beckstedde et al. (2022), in this context "...Best practices ... are twofold: including multiple regulatory entities in the administration process and having an open approach towards regulatory derogations while highlighting interesting innovations to sandbox applicants."⁷³ In interviews, some stakeholders expressed their support for broader regulatory sandboxes, containing either multiple energy regulation provisions from which a derogation is possible, or no specific mention being given (with thus derogations being possible for a broad range of national provisions).
- **Develop transparent, clear, and detailed planning.** Multiple aspects of the planning element include:

⁶⁸ CEER (2021) Regulatory benchmarking workstream: Monitoring NRA's independence

⁶⁹ JRC (2023) Making energy regulation fit for purpose. State of play of regulatory experimentation in the EU

⁷⁰ Heymann et al. (2021) Regulatory sandboxes in the energy sector – review and learnings for the case of Switzerland

⁷¹ Beckstedde et al. (2022) Regulatory Sandboxes: Do They Speed Up Innovation in Energy?

⁷² ISGAN (2021) Regulatory Sandbox 2.0 Project - Policy Messages to the Clean Energy Ministerial

⁷³ Beckstedde et al. (2022) Regulatory Sandboxes: Do They Speed Up Innovation in Energy?

- **Choosing suitable timelines** (durations and call times/rolling approvals) can be highly impactful in the participation and the innovation aspects of the approved projects. Experts highlighted that some specific technologies might require a longer timeline for derogations than others, due to the business case. Some stakeholders (in particular in the energy sector) are also more experienced with longer-term projects (e.g. where heavy investments are needed in infrastructure), and thus would require longer timelines for project proposals to be possible. Moreover, longer innovative projects may require different amounts of research and development efforts, thus requiring different timelines.
- **Develop the eligibility criteria** well in advance and with comprehensive participation of all stakeholder groups. This would ensure that the relevant stakeholders are informed and can smoothly participate in the sandbox and/or understand its impact on them. Participation in sandboxes should only be limited by criteria that are necessary, but otherwise remain open to all participants to minimise market distortion effects and improve learning and innovation outcomes. For example, Italy's ARERA limits "sandbox"⁷⁴ participation based on necessary technical criteria. In a "sandbox" targeting aggregators of flexibility, being balance-responsible parties is required for participation. However, as a derogation from existing regulation, the necessary size for participation in ancillary markets is reduced, thus opening the market for more flexibility aggregators.)
- **Set up an appropriate monitoring and evaluation scheme** for the sandbox and the results of the experimentations within the sandbox, including developing suitable indicators for both the progress and the outcomes of the sandbox. This aspect ties into the resources needed for monitoring and evaluating sandboxes by the supervising authority. As with other matters of planning, transparent and accessible monitoring and evaluation can significantly improve the outcome of sandboxes for both regulators and other stakeholders.
- **Set up a precise but robust procedure for transitioning** the results of the sandbox into real permanent regulation. Transitioning to prior regulation is also possible and requires similarly precise planning. This planning is necessary to minimise market distortion and uncertainty for project promoters, other market participants, and other relevant stakeholders. Although becoming relevant towards the end of a sandbox, this procedure should be defined in advance of the sandbox's implementation and be transparent to all participants and possibly external stakeholders. A good example of this is Lithuania's sandbox, where the authority is set to identify and propose (if deemed suitable) a change in regulation within 6 months of assessing project results.
- Lastly, **regulatory sandboxes tend to be more successful when they are part of a larger sectoral strategy**, either as part of an energy transition policy or a general venture towards regulatory experimentation. There are multiple benefits to this, including the potential reallocation of scarce (human or financial) resources, providing better clarity about outcomes and intents to stakeholders, and providing better coordination among authorities and administrators related to the sandbox.

4.4 Impacts of regulatory sandboxes

The JRC report highlights that "As far as the effectiveness of the reviewed forms of experimentation is concerned, it is not possible to draw any general conclusion, as national schemes are difficult to compare and there is a very limited evidence base on their impacts. Most interviewees, however,

⁷⁴ Although these experimentations are referred to as sandboxes, they have attributes of both regulatory pilot projects and sandboxes. The experimentation's scope is rather less open than is expected of a sandbox, hence the quotation marks.

view regulatory experimentation as a promising tool in the hands of regulators to promote the adoption of new solutions and to inform regulatory change.... The assessment of national experiences, however, requires further work and analysis, possibly also including the point of view of innovators and consumers."⁷⁵ Our analysis confirms this viewpoint, and verifies that experimentations across different countries and frameworks within the energy sector are varied and diverse. However, a few common impacts from the regulatory experimentations emerge; the positive impacts are:

- **Advancing innovation in businesses.** This is one of the two primary goals of sandboxes and is also reflected as the most commonly-required intent of a regulatory derogation. Innovations and regulatory experimentations are expected to be more common in distributed energy resources, renewable gases, flexibility, energy retail, and network operation.⁷⁶
- **Advancing innovation in regulation and regulatory learning,** which is more possible and thus more of a benefit within regulatory sandboxes compared to other types of regulatory experimentation. Sandboxes can highlight areas where regulations need to change, and also identify gaps where new regulation is needed.
- Even when updates in regulation take place before a regulatory sandbox project is concluded, the project may still provide the opportunity for learning and feed into the regulatory update. This is illustrated by the second French regulatory sandbox (with projects started from June 2022 onwards), where certain applicants producing gases from biological origin have been deemed ineligible as the regulation was updated between their application (closing in January 2022) and the decision by the NRA. The sandbox was still useful as previous rounds were important for regulatory learning and interaction between stakeholders.⁷⁷
- Moreover, clear and well-implemented knowledge-sharing practices within sandboxes can **improve coordination and collaboration** between the administrative entity and other national authorities and stakeholders. This would be beneficial for innovators, and in particular smaller ones such as SMEs and start-ups, which tend to face more difficulties in terms of the administrative burden for joining sandbox programmes.

Negative impacts, or risks, follow from the barriers that often prevent sandboxes from developing fully, or inhibit their benefits:

- **Disrupting competition,** which was the most commonly discussed risk generated by regulatory sandboxes. Sandboxes usually allow for regulatory derogation for some, rather than all market participants, and thus can create market distortions. If maintained for too long, or otherwise incorrectly, these market distortions can disrupt competition in part of the energy sector of the country. In addition, firms that participate in sandboxes generally face lower compliance costs, leading to an implicit benefit that could also distort competition, not just versus existing users, but creating higher barriers for market entry even after a sandbox has ended. Transparency is a general solution for this issue: transparent eligibility criteria, objective and transparent selection criteria, and clear (and well-implemented) knowledge-sharing obligations.
- **Consumers could be negatively affected by derogations.** Often, to prevent this, safeguards are an eligibility criterion for submitted projects.

⁷⁵ JRC (2023) Making energy regulation fit for purpose. State of play of regulatory experimentation in the EU

⁷⁶ Beckstedde et al. (2022) Regulatory Sandboxes: Do They Speed Up Innovation in Energy?

⁷⁷ Interview with gas network operators

4.5 Lessons learned from other sectors

The experiences with regulatory sandboxes from other sectors can help to understand the realised and potential impact on the approach for regulatory sandboxes considering their similarities and differences compared to the energy sector.

The analysis of regulatory sandboxes has its origin, and still has, its focus on the financial sector or the fintech in particular, which is characterised by a high level of regulation, mainly having its origin at the European level. Following the pioneering paper by Zetsche et al. (2017)⁷⁸, we can summarise the general advantages and disadvantages of regulatory sandboxes as follows.

In general, the communication between the regulators and the regulatees can benefit by setting up and implementing regulatory sandboxes. On the one hand, regulators can explain to the regulatees their objectives and intentions related to the general regulatory framework and the specific conditions of the sandbox. Moreover, and even more important, is the opportunity for firms to communicate their regulatory needs to the regulators, e.g., flexibility needed to successfully introduce their innovative technologies, products, services, or platforms in the regulated market. Overall, efficient communication also pushes the legitimacy of the sandboxes in general (Alaassar et al. 2020).⁷⁹ However, the threat of regulatory capture, i.e. influencing the setting of regulations by specific interest groups at costs of the public interest, has to be considered (Allen 2020).

Therefore, regulatory sandboxes can generate more openness for innovation, e.g. by restricting suppliers' liability. Furthermore, they can facilitate the market entry of newcomers, e.g. start-ups, into already existing markets. Consequently, competition is also encouraged within a specific sandbox. In addition, different sandboxes can also compete against each other, eventually leading to improvements in the regulatory framework allowing more and better innovation in the first place and overall more competition within and even between different markets. On the other hand, the competition between regulatory sandboxes can also lead to a race to the bottom, i.e. reducing the regulatory requirements for companies at the cost of protecting public interests (Allen 2020).⁸⁰

Eventually, regulatory sandboxes allow the assessment of the benefits and risks of innovation in the early stages of their introduction into the markets defined by the sandboxes before they are commercialised on a larger scale at national or global markets.

In the context of risks, the possible threats for consumers, and, in particular, related to the financial markets, the stability of the whole system could be endangered by setting up regulatory sandboxes. This might create negative signals for the demand side, which might stay away, eventually leading to a stagnation of these initially promising markets.

Whereas the establishment of a new regulatory framework requires the non-recurring investment of mainly fixed costs both for the regulators and for those implementing the regulation, regulatory sandboxes do not benefit from this cost-saving effect. On the one hand, further costs are needed to transition from the regulatory sandbox into a permanent regulation, particularly since the conditions of a regulatory sandbox are not always scalable to the whole market (Bischoff et al. 2020).⁸¹ On the other hand, those firms participating in the sandbox have, as all other firms in the

⁷⁸ Zetsche, Dirk Andreas and Buckley, Ross P. and Arner, Douglas W. and Barberis, Janos Nathan, *Regulating a Revolution: From Regulatory Sandboxes to Smart Regulation*. 23 *Fordham Journal of Corporate and Financial Law* 31-103 (2017).

⁷⁹ A. Alaassar, A.L. Mention, T.H. Aas: *Exploring how social interactions influence regulators and innovators: the case of regulatory sandboxes*, *Technol. Forecast. Soc. Change*, 160 (2020), p. 120257.

⁸⁰ Hilary J. Allen, *Sandbox Boundaries*, 22 *Vanderbilt Journal of Entertainment and Technology Law* 299 (2020)

⁸¹ Bischoff TS, von der Leyen K, Winkler-Portmann S, Bauknecht D, Bizer K, Englert M, Führ M, Heyen DA, Gailhofer P, Proeger T, Vogel M (2020) *Regulatory experimentation as a tool to generate learning processes and govern innovation—An analysis of 26 international cases*. *sofia-Diskussionsbeiträge*, Bd. 2017. Sonderforschungsgruppe Institutionenanalyse, Darmstadt.

market, a similar cost burden for their implementation. Therefore, some question the incentives to participate in regulatory sandboxes (e.g. Brunekreeft et al. 2022).⁸²

If there is a lack of transparency, the playing field between those organisations participating in the regulatory sandbox and those not involved is biased. This bias is crucial if they compete directly in the same markets. Therefore, the details of the advantages provided by participation in the sandbox, e.g., relief of compliance or specific incentives to innovate, must be disclosed in time and up to date. This transparency does not necessarily solve but addresses the level playing field concerns of those firms still being regulated. Furthermore, risks for consumers and more systemic risk concerns are made transparent. Eventually, sufficient transparency promotes legal certainty, whereas a lack of it generates legal uncertainty.

While transparency is necessary to level the playing field between regulated and unregulated entities, it is not sufficient to ensure a balance. Therefore, further provisions have to be taken, e.g., by opening the regulatory sandbox to companies originally not involved to avoid entry barriers from the beginning (Poncibò and Zoboli 2022).⁸³ Furthermore, the balance must also be found concerning the interests of the consumers, e.g., being protected from risks (Brown and Pirsoka 2022).⁸⁴ Here, an adequate representation of consumers is required (Schneiders 2021), but also balanced solutions related to liability. Nevertheless, critical voices question whether regulatory sandboxes, particularly those associated with Fintech innovations, can ensure the adequate protection of consumers' interests (Razzano 2019).⁸⁵

Finally, according to the assessment of regulatory sandboxes, the scheme has to follow rigorous methodological rules (Bischoff et al. 2020; Ranchordás 2021).⁸⁶ For example, control groups and randomisation measures should be used to gain representative and robust results. Furthermore, testing several design options in regulatory experiments would generate further insights. Nevertheless, one has to be careful while trying to transfer lessons learned within one regulatory sandbox to other contexts. However, replication studies and large-scale surveys are options to improve the external validity of regulatory experiments (Bischoff et al. 2020).

⁸² Brunekreeft, G., Buchmann, M. & Kusznir, J. (2022): Regulatorische Experimente und Anreizregulierung – Erfahrungen mit der SINTEG-V. Z Energiewirtschaft. 46, 195–206.

⁸³ Cristina Poncibò & Laura Zoboli, (2022): The Methodology of Regulatory Sandboxes in the EU: A Preliminary Assessment from a Competition Law Perspective, Stanford-Vienna European Union Law Working Paper No. 61, <http://ttf.stanford.edu>.

⁸⁴ Eric Brown & Dóra Pirsoka (2022) Governing Fintech and Fintech as Governance: The Regulatory Sandbox, Riskwashing, and Disruptive Social Classification, *New Political Economy*, 27:1, 19-32,

⁸⁵ Matthew J. Razzano (2019): An Unsafe Sandbox: Fintech Innovation at the Expense of Consumer Protection? *UNIVERSITY OF ILLINOIS LAW REVIEW ONLINE*, 132-139.

⁸⁶ Ranchordas, Sofia (2021): Experimental Regulations for AI: Sandboxes for Morals and Mores (May 4, 2021). University of Groningen Faculty of Law Research Paper No. 7/2021

5 Environmental considerations in regulatory sandboxes in the energy sector

This section focuses on the environmental considerations in regulatory sandboxes in the energy sector and other aspects of regulatory innovation affecting energy projects. This part aims to identify, evaluate, and demonstrate what environmental concerns exist before and during the implementation process of the sandboxes. Therefore, the project team investigated related regulations, legislations, case studies, and gathered data via interviews with energy sector stakeholders.

The outcomes of the desk research could not identify a specific example of environmental considerations in energy sandboxes. However, examples exist of laws covering multiple regulatory frameworks, including those on energy and environmental protection. An example of this is the Dutch legislation on regulatory sandboxes, which regulates experiments in several fields, covering the electricity and gas laws as well as laws on water, ground protection, and noise pollution.⁸⁷ Another example is that of France Expérimentation, which allows innovators to apply to legislative and regulatory derogations and is detailed below.⁸⁸

Nevertheless, the common practice shows that it is rare to find a regulatory sandbox in the energy sector that also focuses on environmental considerations. Therefore, the text in this section is mainly based on consultation with stakeholders.

Based on the common opinions gathered during the interviews, there is no specific consideration on the environmental aspects either in regulatory sandboxes or in other similar experimentation schemes, such as living labs and test beds. There are only regulations/legislations that have been published by authorities for the implementation of a certain type of energy technology such as wind, solar, hydrogen, green gas, etc., to generate energy.

In the interviews, examples are gathered which give an idea about the environmental legislation related interactions either in sandboxes or similar structures. In many cases, environmental considerations are not decisive factors at all. The representative of Eurelectric expressed that in some cases, authorities request an Environmental Impact Assessment (EIA) before the testing and deployment of new energy technologies in a regulatory sandbox. An EIA is a process that evaluates the potential environmental impacts of a proposed project or activity, including the potential impact on air, water, land, and biodiversity. It is a crucial tool for identifying and assessing potential environmental risks and developing appropriate mitigation measures. In cases where the regulatory sandbox involves the use of energy technologies that may have significant environmental impacts, an EIA may be required to ensure that the testing is conducted in a manner that is environmentally responsible and sustainable. The need for an EIA will depend on the specific environmental regulations and standards of the country or region where the regulatory sandbox is being implemented. In the case of energy sector regulatory sandboxes, this obligation is imposed on investors not because it is an energy sector regulatory sandbox, but because it is an application using a specific energy technology or resource. On the other hand, there are no cases identified during the desk research, where projects have been subject to different EIA requirements than for regular energy projects.

⁸⁷ Article 2.4 of Crisis and Recovery Law. <https://wetten.overheid.nl/BWBR0027431/2023-01-01>

⁸⁸ <https://www.modernisation.gouv.fr/transformer-l'action-publique/france-experimentation>

The environmental regulations considered in energy regulatory sandboxes depend on the specific jurisdiction in which the sandbox operates. Generally speaking, the regulations aim to ensure that the new products, services, or business models being tested in the sandbox do not cause significant harm to the environment or violate existing environmental laws. In many cases, it is the responsibility of the regulatory authority overseeing the sandbox to ensure that all applicable environmental regulations are taken into consideration. Some of the findings of the desk research are listed below as the examples:

- In France, the Energy Regulatory Commission (CRE) has established an innovation sandbox to promote the development and testing of new energy products and services. The sandbox takes into consideration a range of environmental regulations, including the Law on Energy Transition and Green Growth, which sets targets for the reduction of greenhouse gas emissions and the increase in renewable energy production. The French regulatory sandbox for the energy sector ("*dispositif d'expérimentation réglementaire*")⁸⁹ should contribute to the objectives of the French energy policy⁹⁰, which includes the protection of the environment as mentioned in section 2.2. However, the policy objectives listed in Article 100-1 of the French energy code are numerous⁹¹, and therefore, the environmental protection objective is not a focus of the sandbox since the CRE regulatory decision did not mention any environmental protection objective focusing on energy sandboxes⁹². Moreover, as part of the second regulatory sandbox window for project applications, the CRE had in 2022 evaluated the application of a biomass-based electricity producer aiming to increase its production capacity in periods of peak demand. Namely, the producer asked for an exemption from the 2017 French support mechanism for biomass as well as from the regulation on major accidents⁹³. CRE has denied the application, ruling that the related regulatory provisions were not part of the ones for which it was possible to request an exemption within the regulatory sandbox. While we do not question CRE's decision, it exemplifies that the legal basis for regulatory sandboxes in our view is always limited to the energy sector regulatory framework (and often a sub-set of provisions therein) and does not include environmental legislation provisions.
- Also in France, the mechanism France Expérimentation has since 2016 allowed innovators to apply for derogations in order to facilitate and accelerate the implementation of the 'right to innovate' of the French Constitution Article 37(1). Our research has not identified a project where a derogation is related both to the energy and environmental aspects, but an example does exist related to energy and building air quality / health aspects. Namely, in the first call the use of mechanical ventilation through insufflation was authorised in the climatic zone H1

⁸⁹ <https://www.cre.fr/Transition-energetique-et-innovation-technologique/dispositif-d-experimentation-reglementaire>

⁹⁰ Article 61 of the Energy-Climate Law. <https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000039355955/>

⁹¹ The energy policy:

1° Promotes the emergence of a competitive economy rich in jobs through the mobilisation of all industrial sectors, particularly those of green growth, which is defined as a mode of economic development that respects the environment, is both low-energy and efficient in the consumption of resources and carbon, is socially inclusive, supports the potential for innovation and guarantees the competitiveness of businesses;

2° Ensures security of supply and reduces dependence on imports;

3° Maintains an internationally competitive and attractive energy price and keeps consumers' energy costs under control;

4° Preserves human health and the environment, in particular by combating the worsening of the greenhouse effect and major industrial risks, by reducing citizens' exposure to air pollution and by guaranteeing nuclear safety;

5° Guarantees social and territorial cohesion by ensuring that all households have the right to access energy without excessive cost in relation to their resources;

6° Fight against fuel poverty;

7° Contributes to the establishment of a European Energy Union, which aims to guarantee security of supply and to build a decarbonised and competitive economy, through the development of renewable energies, physical interconnections, means of flexibility of the electricity system, support for the improvement of energy efficiency and the establishment of instruments for the coordination of national policies.

⁹² <https://www.cre.fr/Documents/Deliberations/Decision/mise-en-oeuvre-du-dispositif-d-experimentation-reglementaire-prevu-par-la-loi-relative-a-l-energie-et-au-climat>

⁹³ https://www.cre.fr/content/download/25382/file/220331_2022-90_Eligibilite_bac_a_sable_reglementaire.pdf

for a period of three years through a decree issued in 2019⁹⁴, while the French building code authorised such technique only in the H2 and H3 climatic zones.⁹⁵

- In Germany, the Federal Network Agency (“Bundesnetzagentur”) has established an innovation structure to promote the development and testing of new business models and technologies in different areas that include energy transition, electric mobility, etc. While sometimes inaccurately translated as a “regulatory sandbox”, the program does not grant regulatory derogations and is thus closer to a living lab. In this application, environmental regulations, including the Renewable Energy Sources Act (EEG) which incentivises the generation of electricity from renewable energy sources, were taken into consideration.⁹⁶
- In the United Kingdom, the Office of Gas and Electricity Markets (Ofgem) has established a regulatory sandbox to enable innovators to test new business models and technologies in a controlled environment (the Innovation Rollout Mechanism, which was overtaken by the Innovation Link). One of the environmental regulations taken into consideration in the sandbox is the Carbon Plan, which focuses on the reduction in carbon emissions while creating environmental benefits on top of the technology proposed in the sandbox⁹⁷. It is also indicated in the “Decision on the 2019 Electricity Distribution Innovation Roll-out Mechanism” that to evaluate a sandbox to be eligible under CRC 3D.8, the Authority must be satisfied that the activity funded through the Relevant Adjustment and the investor will deliver Carbon Benefits or any wider environmental benefits⁹⁸.

If necessary, policymakers can take additional measures to minimise environmental impacts and ensure that the testing is conducted in an environmentally responsible manner. On the other hand, additional measures could increase the administrative burden for the project promoters in the regulatory sandboxes, which could disincentivise all project promoters, and especially SMEs. Moreover, it would not make sense to require a higher level of environmental protection standards for energy applications than for normal projects that are not covered by the regulatory sandbox. Therefore, a right balance must be struck between environmental requirements and ease of implementation.

The lack of specific provisions on environmental considerations in energy regulatory sandboxes could lead to several negative outcomes. Here are a few possible examples:

- **Negative environmental impacts:** Without clear regulations or guidelines on environmental considerations, energy regulatory sandboxes may be more likely to overlook or ignore potential negative impacts on the environment in the case of the usual environmental protection requirements not being applied. This could result in negative impacts on air and water quality, biodiversity, and ecosystems.
- **Uncertainty for industry participants:** The absence of clear regulations on environmental considerations could create uncertainty for industry participants, who may not know what environmental regulations they need to meet or what the consequences will be if they fail to meet them. This could discourage innovation and investment in new energy technologies and services.

⁹⁴ <https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000039095501>

⁹⁵ French Economy and Finance Ministry (2017) Expérimenter pour Innover https://www.entreprises.gouv.fr/files/files/directions_services/politique-et-enjeux/simplifications/france-experimentation-les-projets-retenus-dossier-de-presse-mars2016.pdf

⁹⁶ Making space for innovation: The Handbook for Regulatory sandboxes, The Federal Ministry for Economic Affairs and Energy (BMWi), 2019.

⁹⁷ “Decision on SP Transmission Limited’s submission to the 2015 Innovation Rollout Mechanism application window”, Ofgem IRM Implementation Team, 2015; <https://www.ofgem.gov.uk/publications/decision-sp-transmission-limiteds-submission-2015-innovation-rollout-mechanism-application-window>

⁹⁸ “Decision on the 2019 Electricity Distribution Innovation Roll-out Mechanism”, Ofgem Electricity Distribution, 2019; <https://www.ofgem.gov.uk/publications/decision-2019-electricity-distribution-innovation-roll-out-mechanism>

- **Inconsistent approaches across different jurisdictions:** Without consistent regulations on environmental considerations, energy regulatory sandboxes in different jurisdictions may take different approaches to managing environmental risks. This could create confusion for industry participants and lead to uneven environmental outcomes since the project promoters are more inclined to prefer test sites with lower requirements.
- **Lack of public trust:** If energy regulatory sandboxes do not adequately consider environmental considerations, this could erode public trust in the energy innovation process. This could lead to public opposition to new energy technologies and services, which could slow down their adoption and deployment.

Overall, the absence of environmental considerations in energy regulatory sandboxes could undermine the goals of these sandboxes, which are to encourage innovation and promote the development of new energy technologies and services in a safe and controlled environment.

From a policy perspective, environmental considerations are an important factor in the development and operation of energy regulatory sandboxes. Governments need to ensure that any new energy technologies or services that are tested in the sandbox are consistent with existing environmental policies and regulations. Furthermore, here are some specific environmental considerations that could be considered in the context of energy regulatory sandboxes:

- **Monitoring and evaluation of environmental impacts:** Policymakers could monitor and evaluate the environmental impacts of new energy technologies or services that are tested in the sandbox. This includes assessing their impact on greenhouse gas emissions, air and water quality, waste generation, and land use.
- **Mitigation of negative environmental impacts:** If new energy technologies or services are found to have negative environmental impacts, governments could incentivise that appropriate mitigation measures are put in place to reduce impacts beyond the limits established by existing environmental requirements. This may include additional requirements for pollution control equipment, waste management plans, or habitat restoration projects.

Overall, governments need to balance the need for innovation and economic growth with the need to protect the environment. Energy regulatory sandboxes can help to strike this balance by providing a controlled environment for the development and testing of new energy technologies and services, while also ensuring that environmental considerations are covered, and even that environmentally-friendly solutions are incentivised while minimising the administrative burden of the participating projects.

6 Role of the EU regarding regulatory sandboxes

The analysis presented in the previous chapters indicates that regulatory sandboxes are useful methods to develop regulations and enable new products and services, even if not all examples have a clear positive impact and that many projects awarded under regulatory sandboxes are still ongoing. The current high pace of change in the energy sector should remain for decades to come, with the decarbonisation of all carriers, increased decentralised renewable energy production, storage and consumption, reform of existing and development of new system services, and further coupling between carriers.⁹⁹ This will be combined with the challenge of increasingly involving energy consumers while maintaining adequate levels of consumer protection, especially for vulnerable consumers. Sustaining this pace of change will require that the EU and Member States adapt their regulatory frameworks in a timely manner. Therefore, well-designed regulatory sandboxes have an important role to play in enabling the reform of regulatory frameworks, in combination with other forms of regulatory experimentation.

There are already a number of initiatives at the EU level concerning regulatory sandboxes and other forms of regulatory experimentation focused on or including the energy sector. As indicated by the JRC (2023)¹⁰⁰ and other sources, these comprise:

- The **2020 European Council conclusions on regulatory sandboxes**¹⁰¹ support the use of regulatory sandboxes as well as experimentation clauses, including in EU legislation;
- The **revised Better Regulation Toolbox published** in 2021, where regulatory sandboxes were included as part of Tool #69: Emerging methods and policy instruments, with best practices for its implementation;
- The **EU legislation amendments proposed with the REPowerEU communication** introduce a new paragraph to the recast Renewable Energy Directive: “2a. Member States shall promote the testing of new renewable energy technologies in pilot projects in a real-world environment, for a limited period of time, in accordance with the applicable EU legislation and accompanied by appropriate safeguards to ensure the secure operation of the electricity system and avoid disproportionate impacts on the functioning of the internal market, under the supervision of a competent authority”;
- The **Commission's recommendation on permitting procedures and Power Purchase Agreements** encourages Member States “to put in place regulatory sandboxes to grant targeted exemptions from the national, regional or local legislative or regulatory framework for innovative technologies, products, services or approaches, to facilitate permit-granting in support of the deployment and system integration of renewable energy, storage, and other decarbonisation technologies, in line with Union legislation”;
- The 2022 communication **“A new European Innovation Agenda”**¹⁰² indicates that the Commission will publish in 2023 a guidance document on experimentation mechanisms, including regulatory sandboxes. The Agenda indicates also resources from Horizon Europe and the Interregional Innovation Investments Instrument under the European Reconstruction and Development Facility will be dedicated to promote collaboration between regions, covering among others regulatory sandboxes;

⁹⁹ Beckstedde et al. (2022) Regulatory Sandboxes: Do They Speed Up Innovation in Energy?

¹⁰⁰ JRC (2023) Making energy regulation fit for purpose. State of play of regulatory experimentation in the EU

¹⁰¹ <https://www.consilium.europa.eu/en/press/press-releases/2020/11/16/regulatory-sandboxes-and-experimentation-clauses-as-tools-for-better-regulation-council-adopts-conclusions/>

¹⁰² <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52022DC0332&from=ES>

- The **Net-Zero Industry Act proposed in 2023** includes a specific article on regulatory sandboxes, enabling Member States to establish net-zero regulatory sandboxes, following modalities and conditions to be defined through subsequent implementing acts.

Based on the analysis of regulatory sandboxes and other regulatory experimentation frameworks in the Member States and the overview of past and ongoing initiatives at the EU level, we identify some possibilities to further regulatory sandboxes and other experimentation frameworks in the EU, in synergy with the EU initiatives mentioned above:

- 1) The Commission could inform Member States and their competent authorities on how to best provide guidance to innovators, including through mechanisms other than regulatory sandboxes, such as by living labs or national authorities providing clarifications to stakeholders on applicable regulations. This would allow Member States to be better informed on the available regulatory experimentation mechanisms, the conditions under which each of them is warranted, and thus help ensuring that derogations under regulatory sandboxes are provided only when strictly necessary;
- 2) The Commission could further investigate how to provide guidance on regulatory experimentation in the energy sector as part of broader experimentation in various sectors, as while limited experience has been identified regarding the interaction between environmental legislation and regulatory experimentation in the energy sector, a trend can be observed with Member States enacting experimentation clauses which cover not only the energy but a larger range of sectors;
- 3) The Commission could include in the regulatory sandboxes guidance and/or implementing acts of the Net-Zero Industry Act (Article 26) guidelines to ensure regulatory learning while minimising the risk of market distortion, such as on:
 - Avoiding market distortion in the internal energy market due to unfair advantages to participants of regulatory sandboxes, as national authorities indicate the perception of this risk is a frequent barrier to implementing regulatory sandboxes;
 - The considerations for setting the (range of) duration for the derogations, given too long or too short duration can reduce the benefits or increase the risks of sandboxes;
 - Keeping the regulatory scope of the sandboxes broad through a menu of possible derogations or not specifying the possible provisions to be derogated, while guiding innovators and providing examples of potential applications. Pilot regulatory projects and pilot regulations can still be used for more clearly identified regulatory needs;
 - Reporting, monitoring and evaluation processes, including interim reporting and evaluation for large-scale projects of long duration, in order to promote regulatory learning (a main aim of regulatory sandboxes) and reduce the risks of competition distortion;
 - Facilitating the continuation of new businesses and services after the sandbox end (potentially through an update of the regulatory framework informed by the lessons learned), given this is a main point of interest for participants and thus an incentive for applying to the sandbox.
- 4) The Commission could facilitate the development of regulatory sandboxes by governments and regulators. This recommendation would promote overall exchange of best practices besides supporting especially those implementing entities with more limited resources. Actions could include, for example:
 - Maintaining a register of regulatory sandboxes in the EU, including contact points and possibly a repository for reports and other documentation, and potentially providing resources such as templates for application forms, evaluation guides for authorities assessing the received applications and the experimentation plan (as documents for past national calls are often not available after their closure, as mentioned in chapter 4);

- Reporting on regulatory experimentation initiatives and their results across the Members States, to improve knowledge sharing between Member States with more experience in experimentation and those getting started or whose experimentation plans are in development;
- Promoting the coordination between authorities, the exchange of best practices and knowledge exchange missions supporting the objectives of Article 26(8) of the proposed Net-Zero Industry Act on cross-border cooperation.

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