EPTA REPORT 2025 – TRANSFORMING THE ENERGY MIX IN BELGIUM

Spiral Research Center, Liège University. Belgium and Walloon Region
Authors: Sacha Frenay, Céline Parotte, Matthias Sabbe

As a preamble, we would like to endorse Fressoz's stark observation (2024): there is no such thing as an energy transition. On the one hand, energy sources tend to accumulate rather than replace one another, as is confirmed in the last Belgian energy data overview (FPS Economy, 2025a). Hence, the increase in the share of renewables in both energy production and consumption has not led to any reduction in the use of fossil fuels. On the other hand, at the European and Belgian level alike, energy policies aimed at reducing GHG emissions display both implementation and ambition gaps (EU JRC, 2025). Further, the shift towards the (far-)right in global politics is demonstrating, day after day, detrimental effects on the prominence of environmental policies. This translates into clear setbacks, or concessions, regarding commitments needed to limit global warming to 1.5 °C above pre-industrial levels, including but not limited to: the recurring and increasingly persistent calls to 'pause' environmental regulations, the heavy reliance on 'flexibilities' – such as carbon credits – in setting objectives, the preservation of commercial interests rather than ecological ones (e.g., as evidenced by the European Commission's recent commitment to purchase €700 billion worth of fossil and nuclear fuels from the US over the next three years), or else the promotion and support of techno-solutionist options (e.g., Small Modular Reactors and transmutation, Carbon Removals and Carbon Capture Use and Storage, etc.).

Belgium is no exception to this trend. Further, energy policy responsibilities and controls in the country are shared between the Federal Government and the three Regions. As a result, the country has four energy ministers, each supported by their own administration, and four regulators. This fragmentation of competences leads to substantial coordination challenges and exacerbates political inertia on these issues. For instance, despite already being a year behind schedule, Belgium has still not submitted its updated National Energy-Climate Plan (NECP) to the EU Commission due to a lack of agreement between the four concerned entities. Belgium is currently the last country without such plan, alongside Poland, and the Commission threatens to initiate infringement proceedings.

Nonetheless, a number of Belgian energy policies are still aimed towards achieving carbon neutrality and will be the focus of this report. A significant part of the analysis that follows is derived from a recent literature review on energy policy in Belgium conducted by three members of the Spiral research centre (see Sabbe et al., *forthcoming*).

1. Belgian Energy Mix and the Carbon Neutrality Objective (2050)

1.1 **Energy demand**: Net energy imports remained high, mainly from oil products (63.5%) and natural gas (27.4%). Besides, in 2024, energy dependence – i.e., the ratio of net imports to the sum of gross domestic consumption and energy supplied for international maritime transport – stood at 75.9%, well above the EU average (FPS Economy 2025a). While the Coronavirus pandemic then the Russian invasion of Ukraine had led to a decline in energy consumption the previous years, in 2024, both primary and final energy consumption increased compared to 2023. Petroleum products continue to account for the largest share of total final consumption, at 48.2% (the vast majority of which is used in the transport sector); followed by natural gas at 25,2%. Electricity (including from renewables) stands at 17,2%, renewables (excluding electricity) at 6,2%, while a negligible proportion of solid fossil fuels and heat top it off (FPS Economy 2025a).

1.2 **Current composition of the energy mix**: The Belgian energy sector is characterised by a corporatist structure, with electricity and gas production largely in the hands of private companies (Van de Graaf et al. 2022). In 2024, the Belgian gross energy production mix was composed of nuclear energy (41.3%), natural gas (17.7%), renewables (mainly wind, solar, solid biomass: 34.2%) and, to a lesser extent, solid fossil fuels and steelmaking gases (2.9%), petroleum products (0.3%) and other sources (including pumped hydropower, recovered heat, non-renewable waste and others: 3.6%) (FPS Economy 2025a). The Federal Public Service (FPS) Economy emphasises that the most notable increase over the last decade has been in renewable energy, where production has increased by 79.3% (+11.5 TWh) compared to 2015 (FPS Economy 2025a, 31). Yet, contrary to the historical trend of a 225% increase between 2015 and 2023, renewable electricity production decreased by 5.7% (-1.6 TWh) between 2023 and 2024. Further, the share of renewable energy in final energy consumption was 14.0%. in 2024: if that meets the baseline (13%) imposed by European regulation, it remains well below both the EU average and Belgium's target of 21.7% renewable energy by 2030 (FPS Economy 2025a).

1.3 **Current pathways to achieve decarbonisation:** Overall, Belgium's transition to climate neutrality relies on energy efficiency and reduced consumption, as well as electrification - supported by the development of renewable energy sources - wherever possible. For sectors that are difficult to fully decarbonise (e.g., industry or waste) compensating measures are envisioned, such as carbon removals and sequestration (FPS Health, 2020). Legal, technical, financial, participatory instruments are regularly adopted to sustain the Belgian energy transition. Below are some of the measures - in 2023 alone, Belgium reported a total of 241 single policies addressing climate change (European Commission 2024) - that have been attended to in academic literature regarding Belgium.

<u>Support instruments</u>: In Belgium, renewable electricity generation is primarily promoted through market-based instruments under the form of Tradable Green Certificates (TGCs) (Carton 2016). Belgium has four distinct TGC programs, emitted by relevant energy regulators: one for each regional government and one managed by the federal government to reward offshore wind generation. Although TGCs were intended to create a market favouring green energy solutions, they have sparked controversies (see section 3.3). Besides, measures have also been taken to reduce energy consumption in the transport sector, which remains

one of Belgium's most energy-intensive sectors (IEA 2022). Significant improvements were achieved, notably through the implementation of support policies for electric passenger cars (Dolge et al. 2023). Although e-mobility remains marginal amid increased road traffic, electric vehicle registrations grew to reach 3.1% of the passenger car fleet (IEA 2022).

Energy-saving incentives: Despite recent progress, Belgium's energy intensity remains significantly higher than the EU average. This low energy efficiency performance (Lu and Lu 2019) is often attributed to an aging, inefficient building stock (e.g., Singh et al. 2013; Coppens et al. 2022). The federal and regional governments have taken measures to improve the energy efficiency of residential buildings, such as minimal requirements for roof insulation in Flanders, or financial incentives to promote residential building stock efficiency.

Experimental regulatory sandboxes: At regional and federal levels and besides public subsidies and taxes, Belgium innovates with the introduction of regulatory sandboxes to boost experimental energy transition innovations (e.g., local energy, flexible participation in electricity markets, distribution network tariffs) and regulatory learning through derogations (Beckstedde et al. 2023).

Integrating the final consumers: Many energy transition instruments focus on integrating the final energy consumer, or prosumer, into the process. Key issues include understanding consumers' behaviour and their degree of consciousness (Van de Velde 2009) as well as their capacity to change their behaviour accordingly, moving from passive to active citizens (Campos et al. 2020). One of the most studied participatory instruments in Belgium are the *(renewable) energy communities* (REC) (Bauwens 2019; Bonfert 2024; Conradie et al. 2021), also known as *community-driven energy* (Van Summeren et al. 2020), or *collective action initiatives* (Gregg et al. 2023). These initiatives are seen as key energy transition drivers (Van Summeren et al. 2020; Bauwens and Devine-Wright 2018) which introduce "logics of proximity, spatial selectivity and collectivity" (Juwet 2019, 1902) essential for the creation of *transition cities* and to build resilient local communities (Kenis and Mathijs 2014).

1.4 Assessment of these evolutions are updated every six months by the Federal Public Service Economy. The Spiral Research Center recently conducted a literature review on Energy Policy in Belgium that identifies the main consequences of technological choices and social challenges regarding energy issues (Sabbe, Frenay & Parotte *forthcoming*) – mobilized in the next sections. The Center is currently working on four energy research projects: (1) the vanguard visions of small modular reactors (NUVanguard Project 2024-2026), (2) the mundane decay of nuclear infrastructures (2022-2025 MUNDEC project), (3) low carbon and labour transitions (2020-2025 Belspo LAMARTRA project), (4) Carbon Capture Utilisation and Storage for highly emitting infrastructures (FNRS project 2024-2028). We identify three potential avenues for future interdisciplinary research programs on energy policy in Belgium:

(1) Investigate the development of, and expectations associated with, advanced energy technologies such as small modular reactors (SMRs), nuclear transmutation for high-level radioactive waste management, green hydrogen, cross-border offshore hybrid hubs, and their socio-technical consequences for energy systems.

(2) Investigate the purposive phase-out of existing technologies and to focus on aging infrastructures that need to be repaired, replaced or transformed.

(3) Fostering inclusive and coordinated energy governance. In Belgium, there is still a need to comprehensively map and compare public engagement with energy and net zero. This ranges from "dominant practices" (e.g., public surveys viewing the public as consumers) to the formation of *diverse participation collectives* (such as energy communities), and *emergent and overflow* forms of participation (e.g., digital and mundane publics) (Chilvers and Longhurst, 2016).

2. Consequences of Technological Choices

2.1. The main technical or operational challenges for a more diversified energy mix

As already mentioned, Belgium is characterized by a long-standing dependence on primary energy imports (Dallenes et al. 2023) due to limited indigenous primary energy resources and a high degree of energy intensity (Faraji Abdolmaleki et al. 2023). Over the years, this historic dependence on imported energy sources have led to technical and operational choices to ensure the security of energy supply – which has long been, and remains, a dominant frame of reference in Belgian energy governance (Sabbe et al. *forthcoming*) - that now have strong implications for achieving and managing a diversified energy mix.

Ever since the 1973 oil crisis, Belgian policymakers have sought to diversify the sources and geographical origin of primary energy sources to guarantee the security of supply. While the diversification strategy for crude oil imports originally focused on "switching from the Middle East to the North Sea (Norway and the UK) and the former Soviet Union" (Brown et al. 2014, 73), it now focuses on compensating "the loss of the Russian share (about 30%)" (FPS Economy 2025b, 39) ever since its subjection to European embargo. Similarly, by the early 2000s, most natural gas imports originated from the Netherlands, Norway, Algeria, and the UK (Shenk 2008). In 2019, the gradual phase-out of the Groningen gas field in the Netherlands led to an increase in Liquified Natural Gas (LNG) imports from Russia. Since 2022, Belgium has further diversified its natural gas imports "by increasing the share of gas in liquefied form" (FPS Economy 2025b, 43). Over the years, his long-lasting reliance on diversified gas and oil imports required the development of extensive energy infrastructure which includes pipelines, refineries, and an LNG terminal at Zeebrugge. As a result, Belgium became a major international hub for the redistribution of fossil fuels in North-western Europe. In particular, following the decrease of Russian gas imports, "the proportion of gas transiting through Belgium towards the east of Europe has increased since 2022, reaching 70% in 2023" (FPS Economy 2025b, 43). This prominent role as a transit hub has deepened Belgium's infrastructural and economic entanglement with fossil energy, creating a significant lock-in in favour of fossil energy sources.

Another key challenge for maintaining a diversified energy mix in Belgium lies in the (poorly coordinated) decommissioning of major energy infrastructures. This is not a new phenomenon: the once-prominent coal industry disappeared with the closure of the last exploitation in Flanders in 1992 (Van de Graaf et al. 2022). More recently, electricity generation from solid biomass declined sharply (–18.6%) following the closure of Belgium's largest biomass power plant in 2023 (FSP Economy 2025, 33). Nuclear energy provides a further illustration. Adopted as a central pillar of Belgium's electricity system in 1968 (Söderholm, 1998), nuclear power has remained a key contributor to the country's electricity mix. In 2003, following the entry of the Green Party into government in 1999, the federal government opted for a gradual nuclear phase-out policy by 2025 (see subsection 3.3). However, the shutdown of Doel 1 and Doel 2 was postponed by ten years in 2015 due fears of electricity shortages. In 2022 the federal government decided to extend the operation of Doel 4 and Tihange 3 until 2035 in response to the energy crisis. Ultimately, the 2003 phase-out law was repealed in May 2025, marking a decisive reversal of the country's nuclear exit strategy after the decommissioning of two reactors: Doel 3 in September 2022 and Tihange 2 in January 2023. This policy shift introduces pressing challenges, particularly the maintenance and repair of nuclear reactors that are, and will continue to be, subject to mundane decay, especially when kept in operation beyond their originally planned lifespan (See: MUNDEC, subsection 1.4). The nuclear example illustrates how <u>poorly coordinated decommissioning efforts can undermine both diversification and long-term stability</u> in Belgium's energy system.

Similarly, without any clear preferences on end-of-life strategies for energy infrastructures, the decommissioning of windfarms (Goethals and Maes 2023) or PV panels (Van Opstal and Smeets 2023) and the associated waste management remains a blind spot in Belgian energy transition. Indeed, over the past decades, the country's renewable electricity generation capacity has increased considerably, reaching 13.8 GW or 50.6% of the total installed electricity generation capacity in 2023 (FPS Economy 2025b). Although beneficial for the environment, this strong investment in solar and wind energy sources also entails challenges for grid management, as production remains intermittent. For instance, while between 2022 and 2023 "wind-based production increased by 25.0% thanks to high wind speeds in 2023" (FPS Economy 2025b, 33), it then fell by 9.5% in 2024 due to unusually low wind speeds (FPS Economy 2025a, 33). Seasonal vulnerabilities also remain acute, as shortages are most likely to occur during winter periods of high demand and limited (solar) output. To mitigate such shortage risks, the federal government has introduced a Strategic Reserve (SR) in 2014, mobilized only as a force majeure. In 2021, a Capacity Remuneration Mechanism (CRM) was established to ensure adequate resources from the winter of 2025–2026 onwards and stimulate long-term investment in new capacity (Mastropietro et al., 2024). Unlike the SR, which targets urgent shortfalls, the CRM is a market-based instrument providing support to a broad range of solutions – including generation, storage, and demand management – thus aiming to secure supply while incentivizing structural investment (Vandorpe, 2022). <u>Beyond intermittency, Belgium's energy infrastructure is also exposed to broader climate risks</u> which should be integrated in long-term energy policy planning (e.g. Brajkovic et al., 2025). Such risks notably include floods, such as those experienced in Wallonia in 2021, and recurrent droughts that increasingly test the resilience of energy production, transport, and distribution systems as well as bear economic impacts that may not only persist but intensify over time (Usman et al., 2025).

2.2. Measures being implemented or considered to enhance demand-side flexibility (e.g. time-of-use tariffs, demand response)?

We have not specifically covered this topic in our analysis. Please, see relevant information in other subsections. Time-of-use tariffs, however, can serve as an insightful illustration of the different rhythms of energy policy in Belgium: while 'dynamic' electricity pricing has already been in place in Flanders for three years, it is being progressively implemented in Wallonia since mid-June. Brussels-Capital is still lagging behind but could have this option by the end of this year.

2.3. Evolution of Electricity and gas infrastructure (e.g. grid capacity, reliability, cross-border flows):

In the past decades, Belgium has also increased the share of renewables as part of the EU 2020 (2009/28/EC) and 2030 (EU/2023/2413) targets to reduce EU-Wide greenhouse gas (GHG) emissions. This mainly resulted from <u>increased solar and wind capacity supported by federal and regional public subsidies</u> (e.g., Boccard and Gauthier 2021; Delbeke et al. 2023). <u>Offshore wind-based production, in particular, is set to gain in prominence</u>. Since 2020, Belgium has an operational offshore wind capacity of 2.26 GW as part of the Modular Offshore Grid (MOG) I. In 2021, federal authorities have agreed to the development of an additional 281 km² wind zone in the North Sea in view of expanding total offshore wind capacity to 5.4-5.8 GW by 2030 (Penneman et al. 2023). In 2023, the federal government also approved the launch of the MOG II project, including the construction of the world's first artificial energy island – the Princess Elisabeth Island - which will host the offshore electricity transmission infrastructure. MOG II seeks to form "the cornerstone of the future integrated European offshore grid" (Elia, 2025) by improving interconnection with other offshore wind projects in the North Sea. However, MOG II is <u>facing soaring costs</u>: in just a few years, the budget has increased from €2,2 billion in 2021 to an estimated €7-8 billion today (CREG, 2025). While these overruns can be partly explained by design choices and initial underestimations of investment costs, supply chain pressures, rising raw material prices and inflation due to the geopolitical tensions are proving to be the main reasons for the increase (Creg, 2025).

Following the 2022 energy crisis – exacerbated by the Russian invasion of Ukraine and the end of Russian gas imports – the Belgian Government announced its inclination to <u>mitigate the risk of power outages by extending the operating life of the Doel 4 and Tihange 3 nuclear reactors</u>. In December 2023, an agreement with Engie was reached to keep Doel 4 and Tihange 3 operational for ten years beyond their planned closure in 2025, requiring an investment of 1.6 to 2 billion euros (ENGIE 2023).

Over the years, Belgium achieved <u>greater cross-border interconnections with neighbouring countries' high voltage grids</u> (COM/2015/080). Furthermore, as a result from a gradual integration to the EU energy market and its well-developed gas infrastructure (see subsection 2.1), Belgium is favourably positioned to attract and redistribute natural gas flows to north-western European markets (CREG 2023).

3. Social Acceptability of the Energy Transition

3.1. State coordination, Public acceptance and Social drivers

Social research on the drivers and constraints of energy transition in Belgium focuses on two main trends. As outlined in section 3.4, the first concerns the coordination challenges arising from the multiplicity of private and public actors involved, and the legal, technical, financial, and participatory instruments adopted for the energy transition (Sabbe et al. *forthcoming*). Researchers also explore how inadequate bureaucratic and stigmatizing state social assistance practices (Bartiaux et al. 2018), and a complex institutional structure (Bartiaux et al. 2021) can hinder changes in individual energy consumption behaviour. As such, energy-saving practices and renewable energy consumption remain strongly related to individual cultural and socio-economic status (Bartiaux et al. 2016; Albrecht and Hamels 2021; Dallenes et al. 2023). Vulnerable groups, facing limited access to economic and cultural resources (Dallenes et al. 2023), also suffer energy policy inequalities and structural barriers to embracing green energy practices. In other words, it is harder for these groups to adopt energy saving practices (Bartiaux et al. 2016); to make renovation investments (Albrecht and Hamels 2021); or to oppose fossil fuels and nuclear energy (Dallenes et al. 2023). As presented in the following subsection, the 2022 energy crisis also had a considerable impact on energy (transition) policy perceptions

3.2. To what extent has the energy price crisis of 2022 influenced perceptions of energy policies and climate commitments?

Due to Belgium's structural dependency on energy imports, households were deeply affected by the 2022 energy price crisis (CREG, 2023), further exacerbating pre-existing socio-economic fragilities in the country. Household electricity prices reached about €0.38/kWh in the second semester of 2022, compared to €0.20/kWh a year earlier, while natural gas prices more than doubled in the same period (Eurostat, 2025).

Specifically, this rise in energy prices accentuated long-standing energy poverty issues. In previous decades, energy market liberalization efforts had not produced the expected price reductions and exposed households to higher price volatility (Tõnurist et al. 2015; Meyer et al., 2018; Huybrechs et al. 2011). This issue is further compounded by an aging housing stock which drives high heating expenditures due to poor insulation and low energy performance – particularly in Brussels and in Wallonia where a majority of dwellings predate 1981 (Bartiaux et al., 2021). Although there are no official figures on energy poverty in Belgium, it is estimated that about 10% of Belgian households spent over 10% of their income on maintaining comfortable indoor temperatures in 2021 (Antunes et al. 2023). By 2022, the King Baudouin Foundation (KBF) reported that the share of households affected by energy precarity had increased to 21.8%, nearly seven percentage points higher than the year before. This rise especially affected Wallonia (29.2%) and Brussels (28.2%), compared to Flanders (16.4%). This also coincided with a sharp rise in self-reported energy poverty (KBF 2024).

Consequently, the 2022 crisis affected both public perceptions of energy policy and national climate commitments. On the one hand, it highlighted the risks of external dependency and the social costs of delayed investment, thus reinforcing public support for structural measures. The European Investment Bank (EIB) yearly climate survey indicates that in 2022 nearly two-thirds of Belgians (63%) believed that the war in Ukraine and increasing fossil fuel prices should accelerate the green transition (EIB, 2022). Likewise, according to the 6th edition of the International Observatory on Climate and Public Opinion, public support for nuclear energy rose from 43% in 2021 to 56% in 2024 (Obs'COP 2024), ultimately culminating with the 2025 repeal of the 2003 Belgian nuclear phase-out law. On the other hand, immediate concerns due to rising prices may have temporarily overshadowed decarbonation and energy efficiency objectives, as evidenced by the government's decision to permanently reduce the VAT – from 21% to 6% – on electricity and gas for household consumption. Short-term relief measures, such as expanded social tariffs and tax cuts, also gained strong political and public support to mitigate hardship.

3.3. Controversy and public resistances on specific technologies

Nuclear energy in Belgium has long been the object of controversies and frictions. The 1970s and 1980s were marked by several accidents (Three Mile Island in 1979 and Chernobyl in 1989) and local scandals (i.e., the 1987 Transnuklear affair) that fuelled the antinuclear sentiment in Belgium: first among Green parties, trade unions, then followed by other parties (Eggermont et al. 2007). With the participation of Green parties in the Verhofstadt I government in 1999, the coalition agreement included a plan for a gradual nuclear phase-out, justified by a commitment to environmental sustainability and energy diversification (Dumont and De Winter 1999). In January 2003, a law was enacted to gradually phase-out nuclear energy for electricity generation by 2025. However, Belgium's phase-out policy saw various revisions in the following decades. In 2015, amid fears of an electricity supply shortage, the federal government postponed the shutdown of Doel 1 and 2 reactors by ten years (de Frutos Cachorro et al. 2019). In March 2022, it was decided to keep Doel 4 and Tihange 3 in service until 2035 to bolster security of supply. Most recently, in May 2025, Belgian authorities repealed the gradual nuclear phase-out law, enabling the continued operation of these reactors beyond the initial planned closure in 2025. Although no formal commitments were made, this also reopens the possibility of developing new nuclear capacity in the future, including with Small Modular Reactors (SMRs). As outlined in subsection 3.2, this intervenes in a context of increasing public support for nuclear energy in Belgium.

Studies have also highlighted local controversies over the siting of wind energy projects. In particular, the LACSAWEP project (Van Rompaey et al. 2011) found that among residents near proposed onshore wind projects, visual landscape degradation, noise, shadow flicker, and proximity are recurring reasons for opposition, with symbolic values attached to land often weighing more than economic benefits. Similarly, the Superior Health Council's advisory report acknowledged that, although not proven to cause serious health damage, wind turbines may affect the quality of life in residential areas, thus leading to local resistance (SHC 2013). Furthermore, the legal procedure structuring the implantation of windfarms was also found to be a possible catalyser of frustrations, fuelling distrust of developers and authorities (Rossignol et al. 2017; Van Rompaey et al. 2011).

Some controversies have also erupted over the support schemes for household solar photovoltaic (PV) installation. While the introduction of Tradable Green Certificates (TGCs) did not result in widespread PV adoption, this changed in 2006 with the introduction of a generous premium support (Tõnurist et al. 2015; Collard 2012). However, overgenerous subsidies led to a significant financial burden on regions – necessitating reductions in PV premiums until 2015 (De Groote et al. 2016) – as well as a perverse *rebound effect* in energy consumption among PV owners (Boccard and Gauthier 2021). Additionally, Bartiaux et al. (2016) noted that such a support scheme, financed by direct and indirect taxes on all citizens, had increased social inequalities because only those with greater financial resources can afford PV panels.

3.4. Ongoing public, parliamentary debate and state coordination regarding the realism, cost, or social equity of the energy transition:

Since the third reform of the Belgian State in 1988, the elaboration of energy transition policies has been complicated by fragmented competences between federal and regional governments (Jay 2010). This complex articulation has produced a patchwork of policies and recurrent coordination challenges (Happaerts 2015; Van Opstal and Smeets 2023) as illustrated by the six-year required to reach a burden-sharing agreement to comply with the 2020 EU renewables target agreement in 2015. Over the years, the need for improved coordination gave rise to various intergovernmental initiatives, such as the ENOVER/CONCERE concertation platform and the National Climate Commission. In 2017, the Inter-federal Energy Pact further reflects regional and federal ministers' willingness to articulate a concerted vision for EU 2030 and 2050 targets. Yet, despite these efforts, the NECP revision reveals persistent difficulties in aligning federal and regional energy transition policies.

Lately, Belgian authorities have also shown interest in innovative technologies for supporting the energy transition. In 2022, the federal government granted SCK-CEN – the national nuclear research centre – €100 million for research on SMRs over the 2023-2028 period. These advanced reactors are presented as a cheap, flexible, reliable, and decarbonized option to replace ageing nuclear capacity. However, early (over)optimism may gradually fade as international experts point possible profitability issues and uncertain feasibility regarding large-scale factory production and deployment (Böse et al. 2024). Federal and regional authorities have likewise advocated the development of green hydrogen (Sapnken et al., 2023), which, though still at an early stage, is featured among policy priorities. Cross-border hybrid hubs – transforming the North Sea in the "green power plant of Europe" (De Croo 2023) by integrating renewables, hydrogen and carbon capture, utilisation and storage (CCUS) – are also promoted as cornerstones of the future energy system, with potential to advance energy transition, security, diversification, and accessibility.

Some scholars question this stance, arguing that "disruptive or 'breakthrough' technologies" (Coppens et al. 2022, 11) are not necessarily needed to achieve mitigation objectives. They suggest *doing without, doing with less* as new innovation horizons (Goulet and Vinck 2022), introducing exnovation policies – the purposive termination of existing energy infrastructures and practices – as the flipside of innovation (David and Gross 2019). For example, Fossati et al.'s (2022) study of Brussels' Low Emission Zone highlights exnovation as a relevant policy instrument for redefining networks and rationales through the purposive phase-out of internal combustion engines.

In the same vein, there is also a necessity of ensuring public and stakeholder involvement in the process. For instance, nuclear energy research indicates that decommissioning was often overlooked in the design and financial planning of current nuclear reactors. Likewise, anticipating high-level waste management and the associated hosting sites generate a host of social, economic, and technical challenges. Lessons from these experiences may therefore help to *systematically* anticipate and assess discontinuation policies for current and future energy infrastructures, including former coal burning plants but also renewables.

Current research (e.g., Delvenne et al. *forthcoming*; Sabbe et al. *forthcoming*) also stresses that the maintenance, repair, and decommissioning of energy infrastructures require sound policy choices and an adaptation of socio-technical practices. Suh issues merit careful consideration in Belgium, a country that has experienced several phases of de-industrialization and inherits ageing energy infrastructures. Just like roads and railways, nuclear reactors, high voltage lines, and hydraulic turbines are ready-made infrastructures that usually escape attention and recognition, yet require considerable investment and daily care. In Belgium, special attention should be given to the extension of nuclear reactor operation, as material and human constraints (e.g., micro-fissure management, recruitment and retention of maintenance staff) are vital to maintain safe operation. Organizing the phase-out and decommissioning of such infrastructures is and will remain a challenging issue.

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