European Commission

INVESTORS DIALOGUE ON ENERGY

WG 1 ENERGY PRODUCTION

Working Group Report on Meeting N.1
Barriers to Investments

September 2022

European Commission

Executive summary

- The European energy sector is being shaped by the EU's increasingly ambitious decarbonisation and energy security agenda. As part of the European Green Deal, the Fit for 55 Package proposed lowering EU-level GHG emissions by 55% compared to 1990 levels by 2030 and reaching carbon neutrality by 2050. Energy generation and production will be heavily impacted by the new decarbonisation measures. The revised Renewable Energy Directive (REDII) proposes a RES share target in the energy mix of at least 40% by 2030, recently increased to 45 % by the REPowerEU plan as a means of reducing the reliance on fossil fuels of Russian origin. For comparison, the share of renewables in the energy mix in 2020 was 22.1%.
- The average annual investment needs estimated in the "Fit for 55" core scenarios (in energy system incl. transport) to achieve the 55% target are projected to reach 1051 bn/year in the 2021-30 period and thus some 390 bn higher than what was needed in the past decade (2011-2020). On top of that, meeting REPowerEU targets requires €210 billion of investments between 2022 and 2027. These additional investments include €113 billion for renewables (€86bn) and key hydrogen infrastructure (€27bn) as well as €37 billion to increase biomethane production by 2030.
- To achieve these investment amounts, several kinds of barriers first need to be addressed, while bearing in mind technology readiness levels (**TRLs**) of energy generation technologies.
- The top challenges of emerging technologies (TRLs 1 to 7) are **technology risk** and **access to finance.** WG participants named these two challenges as the most relevant barriers because investors prefer to put capital in technologies that are mature enough to ensure low risks on invested capital. As such, developers see public resources as the main driver to increase the TRL of these technologies. Emerging technologies are also vulnerable to the absence of **commonly accepted** standards as regulatory bodies are often unable to keep up with the rapid pace of technological development, leading to a fragmentation and duplication of regulatory efforts at different governance levels.
- The most acute barriers for mature technologies (TRLs 8 to 11), are **regulation & policy** and **permitting** according to stakeholders. They point out that access to finance is facilitated by the presence of a stable and predictable regulatory environment which must also be receptive to inputs from EU Directives and Regulations. Compliance with environmental requirements and spatial planning constraints are the most acute factors slowing down or outright blocking project development and are endangering MS's ability to meet their renewables targets. The lack and inadequacy of human capacities in permitting authorities has been identified as one of the main reasons behind permitting issues. **Grid and infrastructure risk** has been also identified as acute for mature technologies. The network is facing substantial challenges in incorporating new incoming technologies and different sources of energy. The lack of visibility on the planning and development of transmission grids, in addition to the increasing pressure to develop renewable generation, poses a risk of saturating grid capacity.
- The most acute barriers to transition technologies, are **regulation & policy risk, permitting**, and **social acceptance,** as identified by stakeholders. While the first two are linked to the fact that these technologies are also classified as mature, thereby sharing the same relevant barriers identified for this category, **social acceptance constitutes** a risk due to the controversial nature of these technologies, especially nuclear.

Disclaimer: *The information and views set out in this report/ study are those of the Investors Dialogue on Energy and do not necessarily reflect the official opinion of the Commission or individual Members of the Investors Dialogue on Energy. The Commission does not guarantee the accuracy of the data included in this report/study. Neither the Commission nor any person acting on the Commission's behalf may be held responsible for the use which may be made of the information contained therein.*

1. Introduction

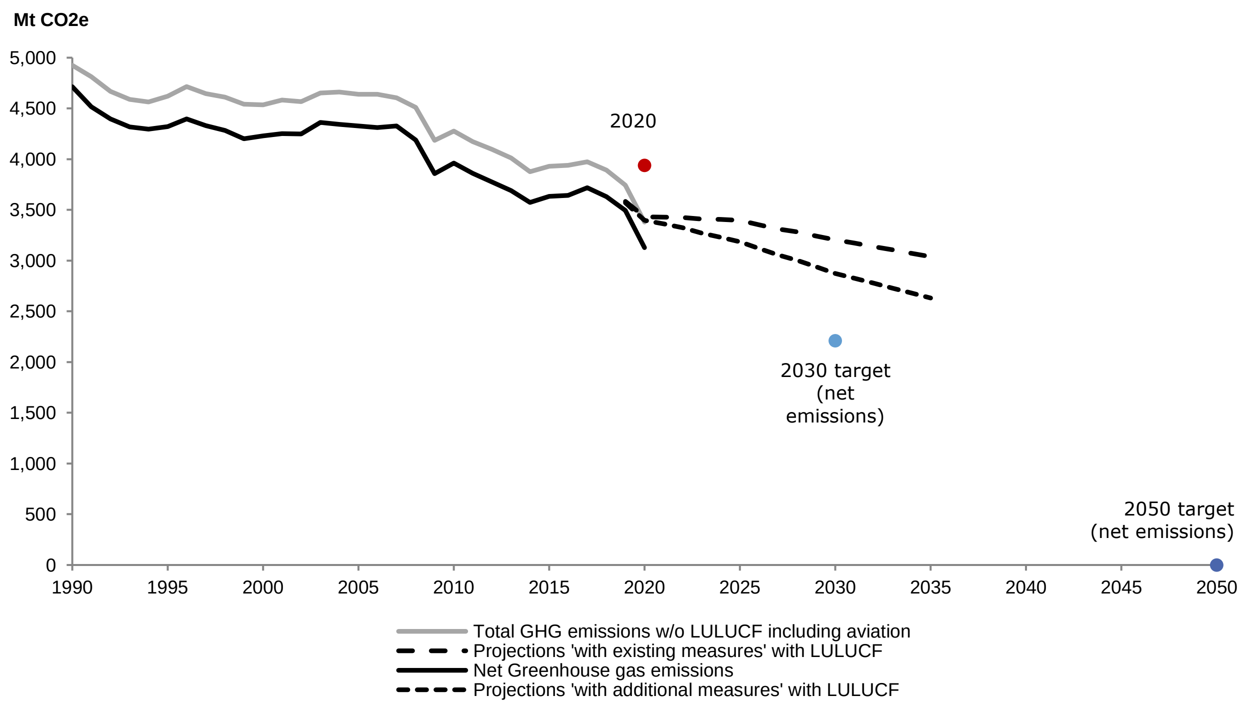
This report refers to the 1st meeting of the Investors Dialogue on Energy - Working Group 1 (Energy production), held on June 22, 2022, in a hybrid mode in the PwC office in Brussels, Belgium office and on WebEx, for those joining virtually. The purpose of the WG Report is to document the entire cycle of the WG lifetime, in terms of input provided, the discussion that was held, and the main conclusions derived from the deliberations (and in this case, from the follow-up survey).

The first Working Group meeting focused on the topic of barriers to investment in energy production. The topic of barriers to investment will be recurring throughout the planned meetings of the Working Group, but it took centre stage for the inaugural gathering of the participants in order to kick-off the Working Group's deliberations on the matter and to provide an opportunity to align from the start. This will be the basis for the research to be carried out by the Investors Dialogue team on currently available investment schemes and financial instruments and analysis of their effectiveness in supporting investment in energy production projects.

2. Context

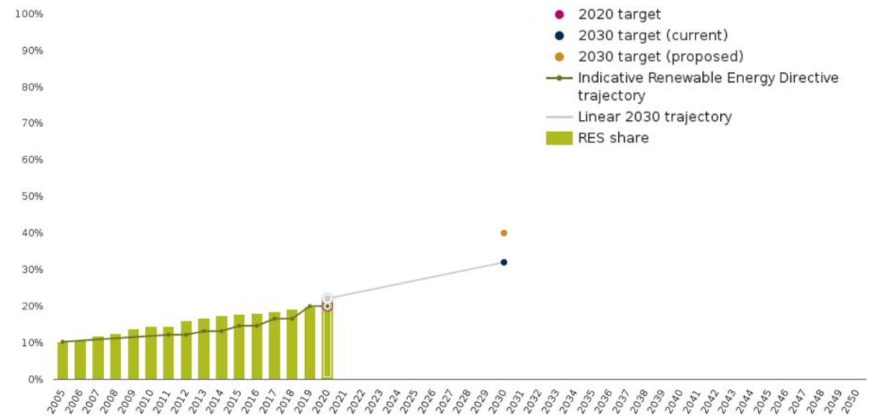
The European energy sector is being shaped by the EU's increasingly ambitious decarbonisation and energy security agenda. As part of the European Green Deal, the Fit for 55 Package proposed lowering EU-level GHG emissions by 55% compared to 1990 levels by 2030 and reaching carbon neutrality by 2050.

FIGURE 1 HISTORICAL TRENDS AND FUTURE PROJECTIONS OF GREENHOUSE GAS EMISSIONS IN THE EU



SOURCE: EEA (2021) TRENDS AND PROJECTIONS IN EUROPE

FIGURE 2 PROGRESS TOWARDS RENEWABLE ENERGY TARGETS FOR EU-27 (EEA)



Energy generation and production will be heavily impacted by the new decarbonisation measures. The EU Emissions Trading System (ETS) is one such measure as it aims at a 61% reduction in GHG emissions from the EU ETS covered sectors (including energy generation) compared to 2005 emission levels. Currently the EU ETS has achieved a 21% reduction of regulated emissions in 2020. Energy generation and production is also impacted by the EU-level target for the share of renewable energy in the overall energy mix by 2030. In 2021, the revised Renewable Energy Directive (REDII) proposed a target of at least 40% by 2030, up from the previous 32%, and the 2022 REPowerEU Plan proposed an increase to 45% as a means of reducing reliance on fossil fuels of Russian origin. For comparison, the share of renewables in the energy mix in 2020 was 22.1% (see Figure 2).

In the "Fit for 55" core scenarios the average annual investment needs (in energy system incl. transport) to achieve the 55% target are projected to reach 1051 bn/year in the 2021-30 period and thus some 390 bn higher than what was needed in the past decade (2011-2020). On top of that, meeting REPowerEU targets requires €210 billion of investments between 2022 and 2027[1]. These additional investments include €113 billion for renewables (€86bn) and key hydrogen infrastructure (€27bn) as well as €37 billion to increase biomethane production by 2030. The 2021-2027 MFF and NGEU programmes with their combined weight of over €1.8 trillion, are designed to bridge the financing gap and attract private and public resources into investments in a number of policy areas, including measures that enable the EU to meet its 2030 energy and climate objectives.

Notwithstanding, several kinds of barriers have the potential to hamper, delay or prevent investments and initiatives, thus posing a threat to the EU's ability to deliver on its targets. While some barriers can be efficiently addressed by financial instruments and schemes, other barriers require more systemic policy, regulatory, or market design, or other solutions. The purpose of this chapter and the following are to stimulate a discussion and draw insightful conclusions on the range and acuteness of barriers affecting investments in energy production, and the ways in which barriers can be efficiently addressed via financial instruments and schemes.

[1] REPowerEU: A plan to rapidly reduce dependence on Russian fossil fuels and fast forward the green transition, *European Commission*, 18 May 2022.

3. Barriers to investment - Overview

Barriers to investments in energy production and electricity generation[2] can be broadly grouped into the following 4 areas:

- **Political / Regulatory Risk,** associated with risks and barriers concerning inadequately designed or unreliable markets and legal frameworks, market failures which are left untreated by national regulations, issues related to adequate compliance with the regulatory and policy frameworks in place, the permitting framework, as well as social acceptance of these projects on behalf of the general population;
- **Economic,** associated with risks and barriers deriving from economic factors like market risk and organisation, access to capital, transaction costs, off-taker risks and incentive schemes;
- **Technical,** associated with risks arising from the energy production technology (esp. in the case of unproven or immature technologies) and resource availability;
- **Energy market development,** barriers emerging from the immature or emerging nature of the market for a given technology such as shortage of qualified labour, inadequate and underdeveloped supply chains, etc.

TABLE 1: LONG-LIST OF POTENTIAL BARRIERS TO INVESTMENT IN ENERGY PRODUCTION

Risk Group	Barrier	Description
Political / Regulatory Risk	**Regulation & policy risk**	*Changes in legal or regulatory policies that have significant adverse impacts on project development or implementation (e.g., retrospective changes in support regimes, interconnection regulations, etc.).*
	Lack of commonly accepted standards	*Lack of standards aimed at expanding the available market and counteracting market fragmentation.*
	Compliance with EU State Aid & other competition regulation	*Issues arising from compliance of RES generating projects (concerning especially low TRL technologies) with the EU rules that prevent government support actions which may have distortive effects on the internal market.*
	Social acceptance & citizen engagement	*Resistance on behalf of the wider public opinion to the implementation of RES generation projects (e.g., NIMBY effect).*
	Administrative requirements (permitting)	*Risk of delays, increased costs and / or project failure generated by the necessity to comply with administrative requirements and acquisition of the necessary permits for implementing and operating the project (e.g., environmental permits).*
Economic	**Market risk**	*Risk deriving from energy price fluctuations on the input side (increase in the price of inputs) and / or on the output side (increase in the price of the sold energy).*

[2] For the purpose of this project, the energy production technologies considered include electricity generation (solar, wind offshore and onshore, hydro, ocean, geothermal) as well as production of biomass, production of decarbonised gases incl. hydrogen, e-gas and biomethane. The selected technologies refer to the Tender specifications for this project (ENER/A4/SER/2020/754) and to the strategy proposed by the REPowerEU, which puts accent on diversifying fossil gas supplies and reducing its overall usage, on accelerating biomethane and clean hydrogen production and on the further increase of wind and solar in the energy generation mix.

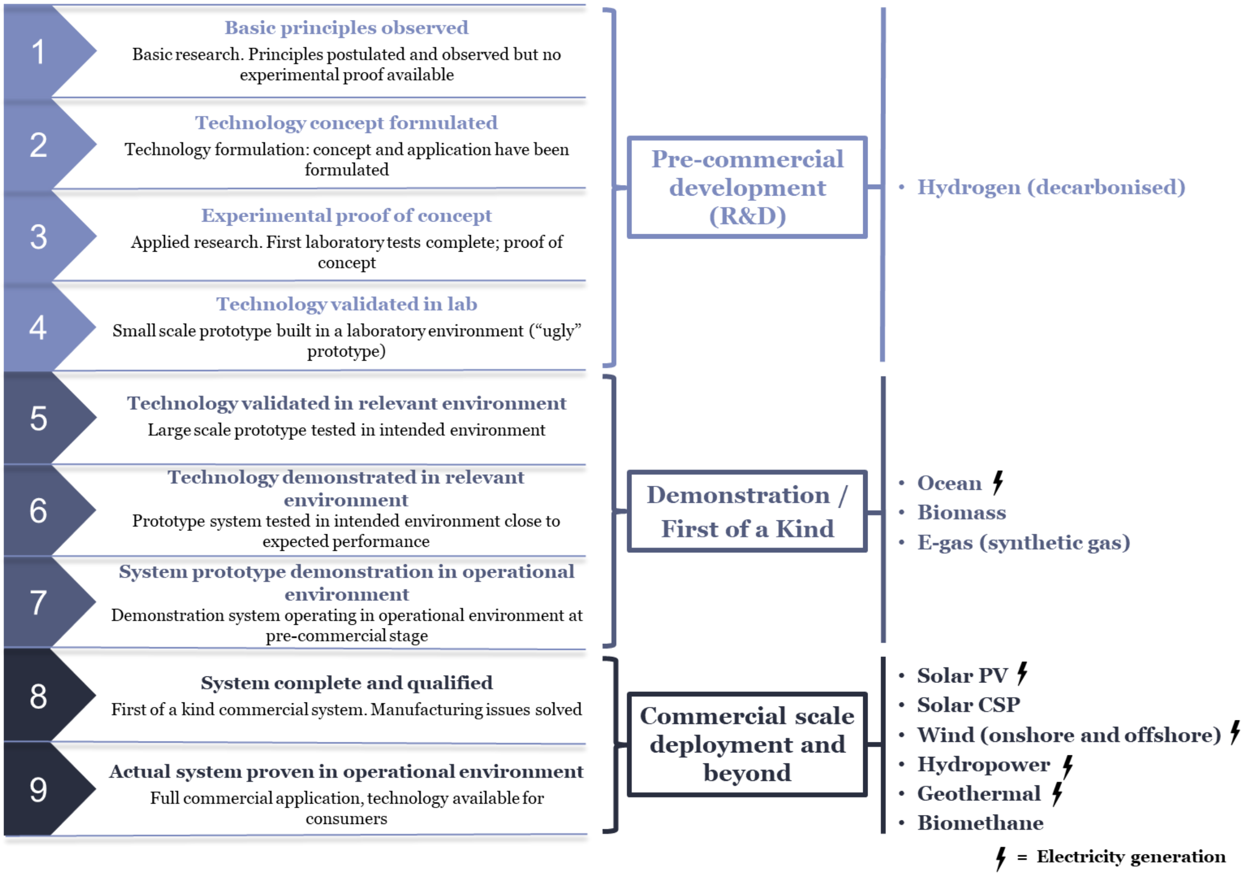
Risk Group	Barrier	Description
	Counterparty / Off-taker risk	*Risk that the counterparty in a financial transaction (e.g., PPA) may default on its obligations or stop paying.*
	Availability of finance & access to finance	*A form of market failure whereby financial flows are limited by the fact that capital markets are not used to making certain types of investment and accurately pricing risk.*
	Liquidity risk / Long payback periods	*Operational liquidity issues caused by revenue shortfalls or mismatches between the timing of cash receipts and payments.*
	High upfront costs	*Barriers arising from excessively high levels of CAPEX requirements that characterise energy production projects at the beginning of their life cycles.*
	Unduly high borrowing costs or cost of capital	*Barriers arising from excessively high interest rate that project sponsors face on their debt financing.*
Technical	**Weak planning and preparation capacities**	*Associated with public authorities' limited or insufficient capacity for defining clear and transparent planning strategies concerning the implementation of energy generation investments.*
	Technology risk	*Associated with performance uncertainty of nascent technology or inexperienced and unskilled labour deploying it.*
	Resource risk	*Associated with uncertainties around the availability, future price and/or supply of the renewable energy resource.*
	Grid, transmission and infrastructure risk	*Refers to limits on grid, pipeline of other infrastructure connection of energy generation projects in a manner that hinders the project's ability to sell and / or monetise the energy produced.*
Energy market development	**Small size of projects and high transaction costs**	*Refers to the fact that transaction and due diligence costs tend to be similar for all project sizes, driven by administrative procedures, the 'over-the-counter' nature of contractual documentation, and low degrees of standardisation in contracting.*
	Scarcity of investment ready projects	*Related to the shortage of investment-ready or bankable projects with an attractive value proposition that financiers willing to invest face.*
	Inadequate or underdeveloped supply chain & industrialisation	*Refers to disruptions in the supply of components or raw materials that can hinder investments in energy generation.*
	Inadequate supply of labour	*Refers to the novel nature of emerging energy production technologies, which will require major upskilling and reskilling.*

While it is true that different technologies may be affected by different barriers, we use the logic of the **Technology Readiness Level** (TRL) to investigate the most relevant barriers impacting technologies at different maturity levels. For example, technologies with a low TRL are likely to be more affected by *technical* and *energy market development* barriers, while technologies with a high TRL (including mature technologies) are likely to face barriers of a legal, permitting or social acceptance type. For simplicity, we group the 9 TRLs into 3 clusters:

- *Pre-commercial development* (TRLs 1 to 4)
- *Demonstration / First of a kind* (TRLs 5 to 7)

- *Commercial scale deployment and beyond* (TRLs 8 to 9 and technologies beyond TRL range).[3]

FIGURE 3 TRL CLUSTERING AND GENERATION AND PRODUCTION TECHNOLOGIES RELEVANT FOR THIS STUDY



SOURCE: PUBLICATIONS OFFICE OF THE EUROPEAN UNION (2019, 2020). FOR MORE DETAILS, SEE BIBLIOGRAPHY

[3] Acknowledging that the TRL was not designed to include high maturity technologies, the last cluster is constructed in a way that includes technologies that are sufficiently mature to be positioned outside the TRL range.

4. Barriers to investment – Insights from the WG

The WG participants discussed the relevance and impact of different types of barriers on investments and projects in the field of energy production**.** The discussion was aimed at identifying those barriers that can be effectively and efficiently addressed through financial instruments. More specifically, the discussion focused on the characteristics and causes of barriers to investments in different EU Member States, and at the features of existing financial instruments that successfully tackled one or more barriers. The discussion was also completed by an online survey that collected 11 responses in total.

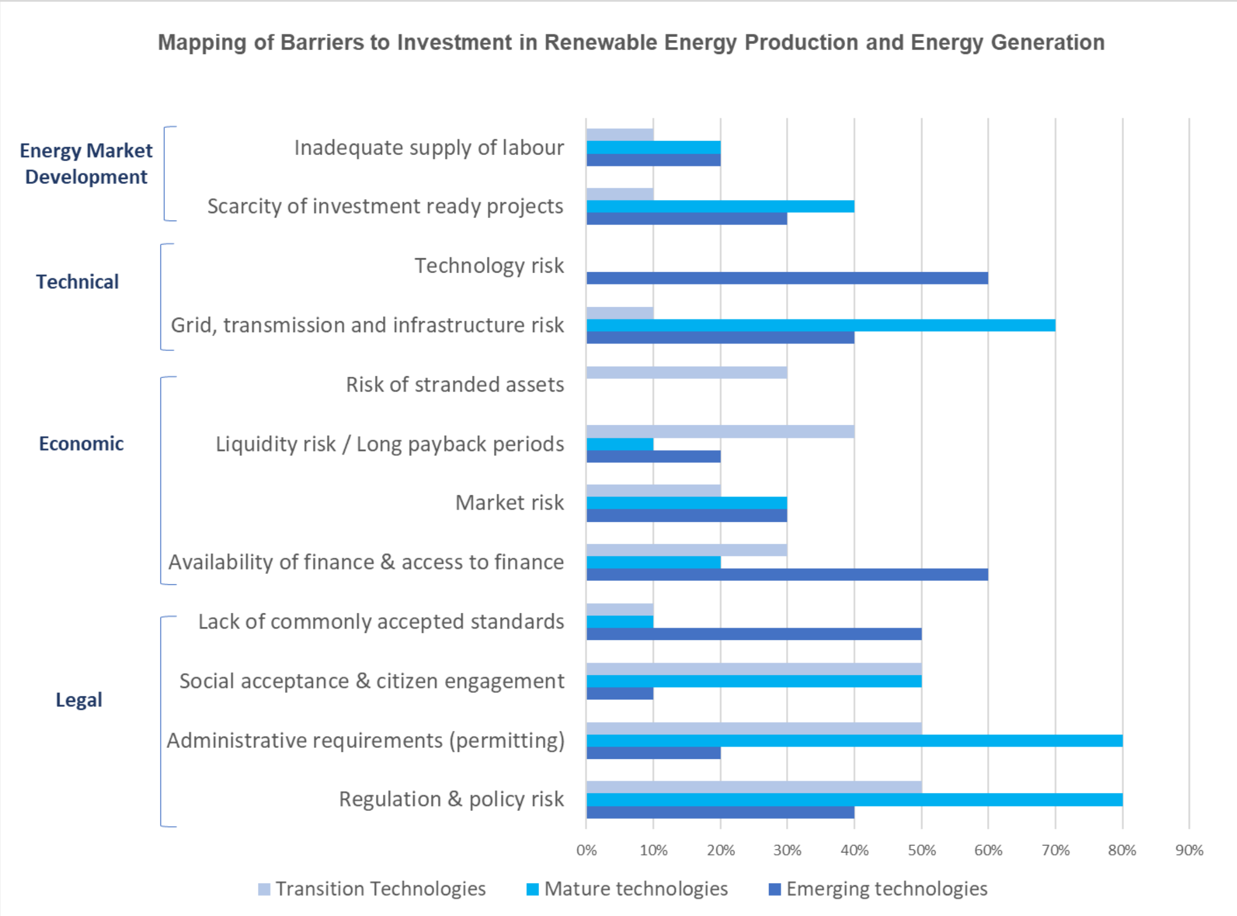
Table 2 provides an overview of the barriers identified as most acute, or most relevant, for each technology type based on the survey. WG participants confirmed the initial assumptions that **financing is a relevant bottleneck for projects in energy production**. However, WG participants also agreed that **it is not the only relevant barrier**. That is to say, availability of finance mainly affects emerging technologies, i.e. technologies that are not yet commercially available and that are still being developed. Notably, it is only a secondary barrier for mature and transition technologies, which tend to be more affected by legal and regulatory barriers, particularly in terms of permitting and applicable regulation. Infrastructural and technical risks are particularly relevant for mature technologies. Although they are not considered the main barriers for any of the technology clusters, energy market development barriers affect all technology types.

TABLE 2: MAPPING OF BARRIERS TO INVESTMENT IN RENEWABLE ENERGY PRODUCTION AND ENERGY GENERATION

Risk Group	*Barrier*	*Technology type[4]*		
		Emerging technologies	*Mature technologies*	*Transition Technologies*
Legal	*Regulation & policy risk*	40%	80%	50%
	Administrative requirements (permitting)	20%	80%	50%
	Social acceptance & citizen engagement	10%	50%	50%
	Lack of commonly accepted standards	50%	10%	10%
Economic	*Availability of finance & access to finance*	60%	20%	30%
	Market risk	30%	30%	20%
	Liquidity risk / Long payback periods	20%	10%	40%
	Risk of stranded assets	0%	0%	30%

[4] The three categories are defined based on the TRL scale adopted by the IEA in the Clean Energy Technology Guide of 2020 according to the following: **Emerging technologies comprise** TRLs 1 to 7 and include: Hydrogen production (seawater electrolysis, chemical looping, thermochemical water splitting, solid oxide electrolyser cell electrolysis), Hydrogen energy generation (hybrid fuel cell-gas turbine system), Ocean (salinity gradient, thermal wave), Production of Biogas (micro-algae and macro-algae) and Biomethane (biomass gasification and biological/catalytic methanation), Solar (perovskite, organic thin-film), Wind (airborne energy system) Geothermal (enhanced geothermal system, Kalina process) and Tidal (tidal stream, ocean current). **Mature technologies** comprise TRLs 8 to 11 and include: Hydrogen energy generation (hydrogen-fired gas turbine, high-temperature fuel cell), Hydrogen production (polymer electrolyte membrane electrolysis, alkaline electrolysis), Solar (thin-film, solar tower, parabolic trough, crystalline silicon, concentrated PV), Production of Biogas (non-algae feedstock) and Biomethane (biomass gasification – small-scale, anaerobic digestion and catalytic methanation with hydrogen), Tidal (tidal range), Wind (onshore, offshore), Geothermal (organic Rankine cycle, dry system, flash process) and Hydropower. **Transition technologies** include: Nuclear (light water reactor-based small modular reactor, large-scale light-water reactor) and Gas.

Technical	*Grid, transmission and infrastructure risk*	40%	70%	10%
	Technology risk	60%	0%	0%
Energy market development	*Scarcity of investment ready projects*	30%	40%	10%
	Inadequate supply of labour	20%	20%	10%



In the sections that follow, we provide more detailed information about the participants' views of the barriers, as well as several examples of the effects that these barriers have on energy generation.

4.1. Legal Barriers

Regulation & policy barriers derive from changes in legal or regulatory policies that have significant adverse impacts on project development or implementation (e.g., incentive programs, interconnection regulations, permitting process). As evidenced by the EIB, barriers to investments concerning regulation originate from two main issues[5]:

- **Regulatory uncertainty.** Certainty and predictability of the regulatory framework is essential for investments such as renewable energy generation projects, which are

[5] Breaking Down Investment Barriers at Ground Level - Case studies and other evidence related to investment barriers under the third pillar of the Investment Plan for Europe, *European Investment Bank*, *European Investment Fund*, 2016.

characterised by high upfront fixed costs. In these contexts, regulation has an important role in determining the costs and benefits of investing through the implementation of incentive and support schemes. Unbalanced and unstable regulatory frameworks can compromise investor confidence in the credibility of the frameworks, leading to investors deciding not to invest.

- **Regulatory fragmentation.** Regulatory fragmentation refers to situations where different levels of government of one country (local, regional and national) are not harmonised in terms of regulation and policy. The issue can also arise from differences between regulations of different countries or EU member states which can hamper the development of cross-border renewable projects.

Example: Retroactive cuts to incentives for renewables in France and Italy

The early stages of large-scale solar deployment in Europe saw a boom of generous feed-in-tariffs (FIT) regimes with the goal of bridging the economic viability gap for renewable energy projects. In recent years, however, some EU countries scaled back those regimes by implementing retroactive changes thus inflicting damage on those who invested based on those incentives.

One example is **France** where, on the 13th of November 2020, the French National Assembly adopted an amendment tabled by the government that led to the "retroactive" reduction of the electricity purchase tariff for large-scale PV installations (with a capacity above 250 kWp) concerning contracts signed between 2006 and 2010. The cut was set to affect 800 out of the 235,000 solar power purchase contracts that have been concluded in that period, affecting specifically medium-sized PV projects commissioned between 2007-2008 and 2011-2012[6].

Another relevant example is **Italy**, which at several instances retroactively cut down incentives to renewables following a generous incentives regime implemented between 2003 and 2011. In 2011 Italy started to pass a series of measures aimed at reducing the electricity bill of consumers, including cutting the minimum guaranteed price paid to renewable developers that applied under the incentive scheme. These regulatory changes led to foreign investors bringing several claims against Italy. The event was repeated in 2014 following the so-called “Spalma Incentivi Decree” of 2014 and associated changes to the “Conto Energia” regime dedicated to incentivising PV projects. Broadly speaking, the Decree significantly reduced the FiT levels guaranteed to grid-connected PV power plants with a nominal capacity exceeding 200 kW, subject to express stabilisation agreements between PV electricity producers and the relevant state-owned entity (the Gestore dei Servizi Energetici S.p.A., or GSE). This unexpected change affected the project finance obtained by most solar PV projects in Italy and prevented numerous investors from servicing their debt.[7]

The most recent attempt of reducing incentives retroactively is represented by a 11-month retroactive incentive cut on PV systems over 20 kW, which will apply from 1st of February 2022, to 31st of December 2022, and will reduce the tariffs paid to PV system operators under the “Conto Energia” regime, depending on the zonal energy price, with the incentive reduction being proportional to the increase in energy prices. Although the Government has justified this move with the intent to help consumers and businesses reduce their energy bills (which finance directly the incentive regimes), great concern has been expressed by several Italian trade bodies with warnings that this move might undermine the credibility of the country towards investors in renewable energy[8].

Similar retroactive changes to renewables support schemes have been adopted in Spain, the Czech Republic, Romania, Bulgaria and Slovakia. The overall concern is that this might compromise investment in renewables and slow the EU's progress towards its decarbonisation objectives. In fact, one scientific paper[9] raises the argument that “a retroactive subsidy change decreases the investment rate by approximately 45% for PV and 16% for onshore wind” and that “once the seed of mistrust is sown, it is likely to have a lasting impact”. The study further indicates

[6] Retroactive cuts for solar feed-in tariffs, *Dentons.com*, November 2020.

[7] Broken promises: Legal recourse for retroactive FIT cuts, *PvMagazine.com*, January 2020.

[8] Italy introduces 11-month retroactive incentive cut on PV systems over 20 kW, *PvMagazine.com*, January 2022.

[9] Sendstad L.H., Hagspiel V., Jebsen Mikkelsen W., Ravndal R., Tveitstøl M., The impact of subsidy retraction on European renewable energy investments, *Department of Industrial Economics & Technology Management, Norwegian University of Science & Technology*, 2022.

"that a stable policy environment with credible policy commitments is crucial for incentivising investments made by private firms".

The WG discussions and survey results suggest that regulation and policy is seen as the most acute barrier to investments in energy generation. Some 80% of participants consider it relevant for mature technologies, with this view converging broadly among both the supply- and demand-side of stakeholders including project developers, IPPs, investors and industry associations. 50% of stakeholders also consider this barrier relevant for transition technologies. Although not the main concern, it is also rated a relevant barrier for emerging technologies with 40% of the votes. Participants expressed the need to have a regulatory framework that can anticipate future issues and ensure long-term stability and security. Developers, in particular, affirm that as long as the regulatory context can ensure stability and security, access to finance is not an issue for high TRL technologies. Participants also referred to the difficulties of some Member States in transposing EU directives at the MS level in a timely and precise fashion. As a concluding remark, participants agree that regulatory sandboxes present the **most effective solution** against this barrier, particularly for **low TRL technologies**.

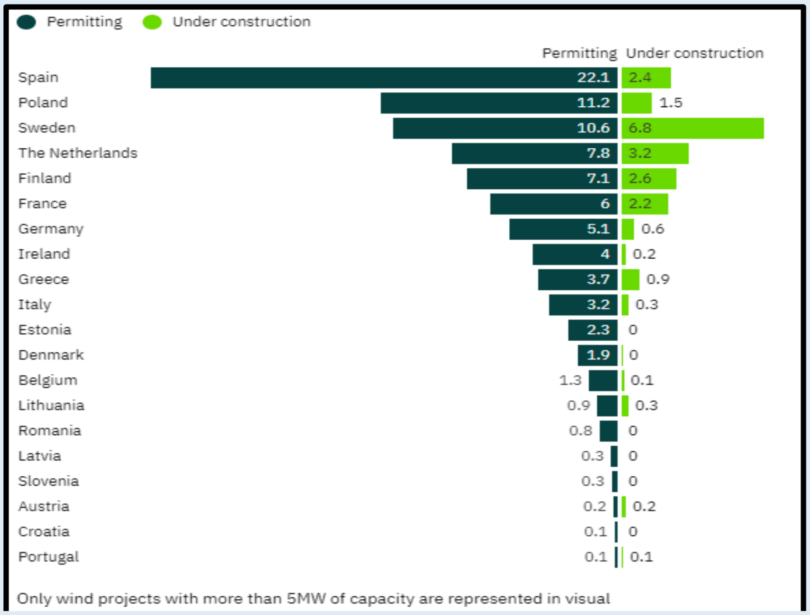
Unduly burdensome **administrative requirements (permitting)** are considered another major barrier to investments in energy generation, with 80% of participants converging on the opinion that it affects mature technologies and 50% affirming that it affects transition technologies. Stakeholders both on the demand- and supply-side of financing agree that this is the biggest concern for mature technologies, while it is much less relevant for emerging technologies. Respondents also agree that compliance with environmental requirements and spatial planning constraints are the most acute factors slowing down or outright blocking project development . These constraints are also endangering each Member States' ability to meet their renewables targets. Offshore projects were identified as particularly vulnerable to permitting issues, especially as it concerns marine planning constraints. Participants additionally identified the lack and inadequacy of human capacities in permitting authorities as one of the main reasons behind permitting issues. One **solution** proposed by participants is to perform **environmental assessments of entire zones / areas** where RES generation projects can be implemented thereby avoiding the need to perform individual assessments for each project (a measure already proposed by the REPowerEU, the so-called *dedicated 'go-to' areas for renewables*). Other proposed **solutions** concern the **simplification** of permitting procedures and the **limitation of possibility of recourse** by local inhabitants.

Permitting slows down the development of EU wind energy

As evidenced in an analysis by Energy Monitor and Global Data[10], the EU has **four times** more wind capacity stalled in the permitting phase than under construction. Figure 4 illustrates the disproportion between active wind energy projects and those still waiting for approval. This disproportion is particularly important in Spain, Poland and Sweden.

A report from the consulting firm eclareon[11] found that no EU country has effective policies in place that would ensure the necessary deployment of wind and solar farms. The most serious problems are linked to bureaucracy, the report says, "especially the high complexity, long duration and low transparency of administrative procedures".

Figure 4: Top 20 EU countries by wind pipeline capacity broken down by development stage



SOURCE: DATA INSIGHT: THE PERMITTING PROBLEM FOR EU WIND FARMS, ENERGY MONITOR. APRIL 2022

The current situation is summed up by the following considerations by Wind Europe: "Most EU countries have ambitious national targets for the expansion of wind energy. But permitting remains the main bottleneck. Europe is not permitting anything like the volumes of new wind farms needed. And almost none of the Member States meets the deadlines for permitting procedures required in the EU Renewable Energy Directive. The permitting rules and procedures are too complex. Permitting authorities are not always adequately staffed."[12]

Social acceptance & citizen engagement is analysed in the RENAISSANCE survey on renewable energy and community solutions[13] through the following dimensions:

- **socio-political acceptance** - the acceptance of renewable resources as viable energy resources, with government support for RES generation development via support policies.
- **market acceptance** - inclusion in the market of RES by market operators such as private investors, financial institutions and consumers.
- **community acceptance** - the acceptance of specific renewable energy projects by the hosting communities (the so-called NIMBY effect).

50% of WG members consider this a relevant barrier, both for mature and transition technologies, with views broadly shared by both demand- and supply-side stakeholders. For emerging technologies, this barrier is not seen as relevant. The most relevant issue in this category that came out of the WG discussions is the increasing proximity of RES generation plants to populated centres, particularly in rural areas and in densely populated MSs. Nuclear technologies are particularly exposed to social opposition on a broad scale (i.e., going beyond NIMBY effect). The

---

[10] Data insight: The permitting problem for EU wind farms, *Energy Monitor*, April 2022.

[11] Barriers and best practices for wind and solar electricity in the EU27 and UK, *eclareon GmbH*, March 2022.

[12] Europe's building only half the wind energy it needs for the Green Deal, supply chain is struggling as a result, *WindEurope*, February 2022.

[13] RENAISSANCE survey on renewable energy and community solutions, *RENAISSANCE project*, 2020.

WG participants also brought up the prominent social opposition related to the use of land and the effects on biodiversity of RES projects. The issue most often comes up in offshore wind energy projects in the Nordics and in the Baltics, where social opposition to these projects is quite high.

Public resistance to renewable wind energy projects in in Germany

German wind energy has been struggling in the last years with increasing public acceptance issues. One example of such opposition can be seen near the town of Nauen, about 50 kilometres west of Berlin, where the planned extensions of Ketzin 1 and Ketzin 2 wind farms have raised strong public opposition with a lawsuit launched against the expansion justified by the small distance between the project and the village of Falkenrehde, just 600 meters away, and by concerns about the impact on the local fauna. There are other examples of similar lawsuits against other wind power generation projects caused by their proximity to residential areas. This has led to initiatives on behalf of German regional authorities, like the regional government of the southern German state of Bavaria, which has imposed a so-called 10H ban on new installations stipulating that the distance between a turbine and a settlement must be a minimum of 10 times the height of the turbine. Environmental concerns about the turbines' impact on wildlife also contribute to the public opposition. BWE's findings suggest that about 300 turbines with a total capacity of 1,200 MW are currently being blocked by legal objections based on alleged threats to endangered birds and bats.[14]

Lack of commonly accepted standards at the EU level and the necessity to meet different standards between different MSs, or even within MSs between different regional governments, leads to market fragmentation and hampers the ability of technologies to reach scale / enter new market segments. This is among the foremost barriers identified for emerging technologies, with 50% of votes. It is not perceived as relevant for mature and transition technologies. Emerging technologies are particularly exposed to this barrier as regulatory bodies are often unable to keep up with the rapid pace of technological development, leading to a fragmentation and duplication of regulatory efforts at different governance levels.

4.2. Economic Barriers

Availability of finance & access to finance refers to the effect of capital market failures whereby capital markets are not used to making certain types of investment and accurately pricing risk (fi-compass, 2014). Because of this, emerging technologies tend to depend on high levels of subsidised or no-cost finance to be set in place.

60% of participants consider the availability and access to finance as relevant for emerging technologies, making it the most significant barrier for this group of technologies. More specifically, on the demand-side of financing, developers affirm that low TRL technologies have more difficulty in securing capital as opposed to high TRL technologies. Some participants also argued that low TRL technologies are affected by the scarcity of public resources in R&D projects and initiatives, since this is the main source of financing at this level of maturity.

This barrier is less relevant for transition technologies, which received 30% of the votes, mostly from investors, reflecting some degree of concern regarding the impact of the EU Taxonomy regulation and PR risk on investments in gas generation. For mature technologies, WG participants agreed that access to finance is not a relevant issue, as long as regulatory and policy frameworks are favourable.

Market risk refers to risk deriving from energy price fluctuations on two fronts:

- **Input side** caused by the increase of the price of commodities or in the availability of other inputs;

[14] German wind energy stalls amid public resistance and regulatory hurdles, *DW.com*, September 2019.

- **Output side** caused by a decrease in the price of the electricity sold.

On the input side, a typical risk is the rise in the price of gas for energy generation in gas-power turbines. On the output side, the inability to hedge against fluctuations of the price of electricity sold (via e.g. a PPA contract or a financial hedge) generates difficulties in creating reliable future earning models.

This barrier has not been identified as critical for one technology cluster in particular but has received some degree of concern across all technology types, acquiring 30% of the votes for both emerging and mature technologies and less concern for transitional technologies with 20% of votes. In fact, concern has been prevalently expressed on behalf of the supply side of financing with investors concerned that fluctuations in the price of commodities and of sold electricity might impact the bankability of both low-TRL and high-TRL projects. Some concern has also been expressed by regulation and association stakeholders.

Liquidity risk / Long payback periods arise from operational liquidity issues caused by revenue shortfalls or mismatches between the timing of cash receipts and payments. The main reason for this is represented by the high upfront costs that need to be sustained to implement the projects which generate negative cash flows for the first years of the projects. Thus, the issue is relevant in the first years but can still occur after the break-even has been reached. Furthermore, the issue is influenced by the energy generating technology that is considered. Natural gas and nuclear projects have high upfront and operational costs and thereby a high payback period, typically between 8.5 and 15 years.[15] Renewable energy projects have lower upfront costs and lower operational costs with payback periods ranging from 1 to 4 years for PV[16] and 3 to 4 years for wind turbines.[17]

Concern over liquidity of renewable energy projects on behalf of institutional investors

As reported by Capital Monitor,[18] institutional investors made up just 2% of total direct investment in renewables in 2018, according to the International Renewable Energy Agency (IRENA). From its study of almost 6,000 investors over the past two decades, IRENA found that although a fifth of institutional investors have invested in renewable energy funds, just 1% have invested directly in clean energy projects. Capital Monitor also highlighted that concerns over liquidity risk are growing: a survey performed by an energy utility found that 43% of 100 institutional investors saw liquidity as the biggest challenge in 2020, compared with just 19% in 2019.

This barrier is most relevant for transition technologies, with 40% of the votes, and less relevant for emerging and mature technologies. More specifically, for transition technologies like nuclear, investors are concerned about liquidity risks arising from high upfront costs to construct power plants, a problem which is accentuated by the long time period before power plants can start operating. Moreover, the ability of new transition technology projects to remunerate investments in a timely manner arise due to their very nature of being transition technologies. Ultimately, they are set to gradually be replaced by renewables.

---

[15] Carvalho, R., Hittinger, E., Williams, E., Payback of natural gas turbines: A retrospective analysis with implications for decarbonising grids, 2021.

[16] Bhandari, K., P., Collier, J., M., Ellingson, R., J., Apul, D., S., Energy payback time (EPBT) and energy return on energy invested (EROI) of solar photovoltaic systems: A systematic review and meta-analysis, 2015.

[17] Wind Turbine Payback Period, *Enerpower*, 2011.

[18] Renewable energy: Why institutional investors are finally bullish, *Capital Monitor*, 2021.

Although not relevant for emerging technologies, participants in the WG discussions have highlighted how lending from some International Institutions can be slow due to bureaucratic complexity and long lead times, thus generating issues in the cash flows of low-TRL projects. The recent rise in interest rates (+2% on EUR swap rates since 1/1/2022) can have an impact on projects that are concerned by long payback periods where debt costs represent a prominent part of the Profit & Loss during the exploitation phase.

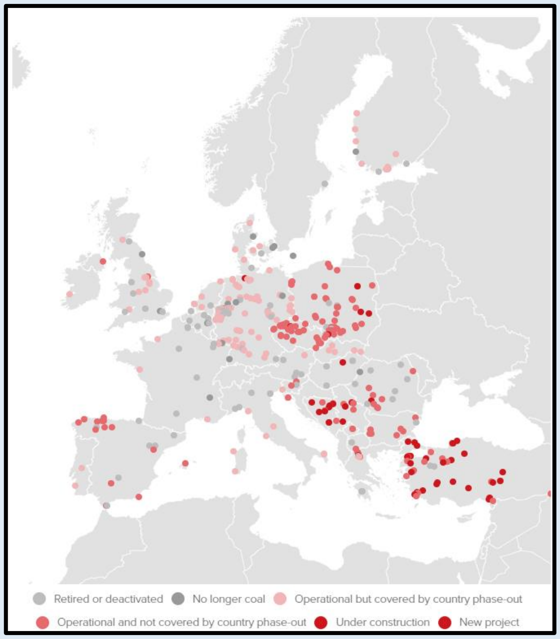
Stranded assets risk refers to unanticipated or premature write-downs, devaluation or conversion to liabilities of power generation assets, which is set to happen to some degree in the transition to a low-carbon economy, as reported by IRENA.[19] This risk has been considered as relevant only for transitional technologies by 30% of respondents, implying relevant concern on behalf of stakeholders for conventional generation assets, especially for gas power plants. Concern has been expressed mostly by the supply side (i.e., providers of capital), as investors are growing increasingly uncertain about the ability of new or recent projects to remunerate investments in a timely manner while respecting the decarbonisation goals set by the EU. Uncertainty has been added by the EU taxonomy with the labelling of gas and nuclear as "transitional technologies" implying that investments in these technologies may be less remunerative with the acceleration of the decarbonisation process. Concern has been expressed also by regulatory bodies.

Decarbonisation and the risk of stranded assets

The ambitious renewable energy and emission reduction targets embedded in Fit for 55 and the REPowerEU Plan are expected to put some conventional generation assets at risk of becoming stranded, especially coal and gas fired power plants. As illustrated in Figure 5, most Western European countries have either reconverted or placed under phase-out procedure existing coal power plants without investing into new ones. In such countries stranded assets risk is low, as opposed to eastern European countries where some coal generation power plants are under construction or planned to be constructed, despite the EU's push for decarbonisation. Concerning gas generation projects, the "transition technology" label attributed by the EU taxonomy has left the door narrowly open for investments in new gas generation capacity. New investments are especially expected to take place in Eastern European countries which envisage gas as the main substitute to compensate for the phasing out of coal in the circumstance of slower renewable energy development. For such investments, stranded assets risk is high, as the rush to reach climate neutrality by 2050 at the EU level may mean the decommissioning of new assets before they will be able entirely recoup the full initial investments. In addition, the escalation of the Russian military aggression against Ukraine has led to gas supplies declining markedly. It has impacted gas and electricity prices and may further deteriorate security of supply in the coming years. National plans for new investments in gas generation capacities will have to take these circumstances into account.

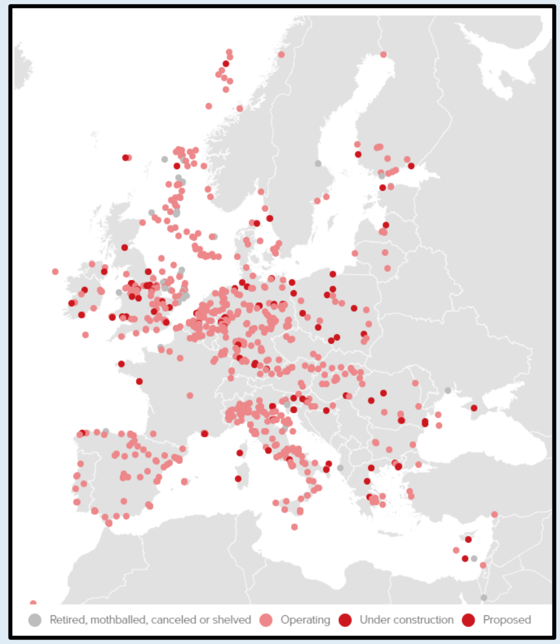
[19] Stranded assets and renewables: how the energy transition affects the value of energy reserves, buildings and capital stock, *International Renewable Energy Agency (IRENA)*, Abu Dhabi, 2017.

Figure 5: Location of major coal power plants



Source: Oroschakoff. K., Guàrdia, A., B., Europe's stranded assets: Mapped, Politico.eu, June 2020.

Figure 6 Location of gas power plants, gas extraction areas and LNG terminals



Source: Oroschakoff. K., Guàrdia, A., B., Europe's stranded assets: Mapped, Politico.eu, June 2020.

4.3. Technical Barriers

Grid, transmission and infrastructure risk refers to limits on grid, pipeline or other infrastructure connection of energy generation projects in a manner that hinders the project's ability to sell and / or monetise the energy produced. These problems might relate to permitting issues. Slow administrative procedures concerning grid construction often cause delays in upcoming energy projects. Problems might also relate to a lack of clarity as to who is in charge of developing and maintaining certain areas of the grid, causing delays and interruptions. Finally, some energy generation projects might require grid retrofitting which is not always possible, or extremely costly, thereby putting the feasibility of the project at risk.

The EU hydrogen strategy depends on the development of a European hydrogen infrastructure 'backbone'

A major barrier on the development of an EU green hydrogen market is the absence of transportation infrastructure, since the existing fossil gas infrastructure is not suited to transport hydrogen, and other forms of transport are too expensive. To address this issue, a group of eleven European gas infrastructure companies presented in July 2020 a plan to create a dedicated hydrogen pipeline network of almost 23,000 km by 2040, to be used in parallel to the natural gas grid.[20] The "European hydrogen backbone" was presented in a vision paper developed by transmission system operators Enagás, Energinet, Fluxys Belgium, Gasunie, GRTgaz, NET4GAS, OGE, ONTRAS, Snam, Swedegas (Nordion Energi), Teréga, and consultancy company Guidehouse. The plan affirms "the cost of such a European Hydrogen Backbone can be very modest compared to the foreseen size of the hydrogen markets". In fact, this is partly due to the assumption that 75% of the network will consist of retrofitted natural gas pipelines – which are gradually expected to become redundant as volumes of natural gas decrease in the future. Despite this, green hydrogen

[20] Gas grid operators unveil plan for European hydrogen infrastructure 'backbone', *Euractiv.com*, July 2020.

generation will only develop according to the pace with which the “hydrogen backbone” is developed. Delay in the retrofitting process at the localised and at the EU level has the potential of stalling also green hydrogen generation projects.

This barrier has been voted as relevant for mature technologies by 70% of respondents, with supply-side stakeholders expressing slightly more concern than demand-side stakeholders. More specifically, participants agreed on the lack of visibility on planning and development of the transmission grids, pointing out that, in light of the increasing pressure on developing renewable generation, there is a risk of saturating grid capacity. Participants also pointed out that investments in the grid need to be compatible with RES generation targets, warning that, in absence of grid connection, all other projects are at risk of becoming temporarily stranded with grids becoming a development bottleneck. For both permitting and grid issues, participants identify **market interventions** as the most effective **solution**, although highlighting the risk of market distortions as a downside.

Grid, transmission and infrastructure risk has also been classified as relevant for emerging technologies by 40% of respondents. Connecting low TRL generation plants might require an upgrade of T&D networks or might prove difficult because of the location of the generation plants. In this case, concern was evenly spread among investors, developers, regulatory bodies and industry associations.

Technology risk is associated with uncertain future performance of nascent technology, or inexperienced and unskilled labour deploying it. Some of the challenges may include:

- Lack of developed industry standards where parties do not know exactly how the final asset will operate.
- Heavy reliance on both: (i) scaling up demonstrator technology, where assumptions are necessarily made as to output and build cost and complexity; and (ii) feasibility studies, leaving parties unsure whether the project will meet financial projections in the long term.
- Any approval delays may lead to an owner/operator losing its ‘place in the queue’ with a supplier for fabrication or construction.

Disputes concerning renewable energy emerging from technology risk

A few examples of the disputes that can arise from technology risk concerning renewables are provided[21]:

- **Floating offshore wind**: given the novel nature of certain technology (e.g. increased blade length, specialised gearboxes, higher towers[22]), defects may appear after only completion of the works, with the owner needing to rely on warranties for design life.
- **Hydrogen**: there is a tension between the supply and demand market for hydrogen projects: developers of hydrogen projects may be reluctant to invest in building facilities where demand for the product is uncertain. By the same token, without a secure supply (and potential high prices), off-takers may be reticent to invest too. Therefore, when these projects do start, the owner will be under considerable pressure to meet the commercial operation date to ensure it can meet its offtake agreement obligations: any delays to that commercial operation date caused by technology issues could create disputes in the construction phase and at the off-taker level.

[21] Risks associated with new technology on renewable energy projects, *Freshfields Bruckhaus Deringer*, March 2022.

[22] Green energy: Insuring a renewables future, *Allianz*, July 2019.

This barrier represents the most relevant risk for emerging technologies as voted by 60% of WG participants. This is consistent with findings that emerging technologies entail higher risk with respect to mature technologies since they need to undergo further testing and standardisation in order to reduce the risk of critical flaws. As such, private investors prefer to invest in higher TRL technologies, leaving the task of guiding technologies away from the “valley of death” mostly to public support. Some participants also point out that new technology is becoming mandatory in the construction of generation plants (e.g., in Portugal, environmental legislation demands that new bioenergy plants be built with carbon capture and storage). The high investment costs and uncertainty on performance that are linked with the use of this new technology might stop projects from going forwards in the absence of strong financial incentives.

4.4. Energy market development

Scarcity of investment-ready projects is a barrier which mostly concerns the supply side: financiers willing to invest face a shortage of investment-ready or bankable projects with an attractive value proposition. IRENA notes that the origins of this barrier can be attributed to the inadequate availability of initiation and facilitation tools for project promoters. This would signal to investors that a pipeline of deals is becoming available in the near future, making it worth their while to develop internal capacity. The technical complexity of clean energy production projects, and delays in feasibility and spatial planning, tend to further aggravate the issue of project scarcity. Technical assistance and grant funding for project development and document preparation can increase the renewable energy deal flow and improve the pipeline of projects ready for investment.

This barrier is considered relevant for mature technologies by 40% of respondents and for emerging technologies by 30% of respondents, while it is not considered relevant for transition technologies. It is expected to find scarcity in investment-ready projects for emerging technologies due to the high-risk profile that these technologies entail, however, mature technologies are likely to be more afflicted by planning complexity and delays which is part of the project finance cycle.

Inadequate supply of labour is a risk driven in large part by the novel nature of emerging energy production technologies, which will require major upskilling and reskilling. Educational systems may not be able to keep up. This risk is exacerbated by demographic decline and / or brain drain, whereby some MSs may face a shortage of labour at a more systemic level.

Skills shortage threatening the EU wind industry

WindEurope reports that the total number of jobs in the wider field of energy could increase from 58 million in 2017 to 100 million globally by 2050, an almost 100% increase from current levels. Of this, today wind energy employs 1.2 million people globally and 300,000 people in Europe alone. WindEurope estimates that in order to meet the EU decarbonisation targets will require approximately 450,000 workers by 2030 representing an increase of 50% from today[23].

Such rapid development carries the risk of enveloping the wind industry into a skills crunch if fast and ambitious measures are not applied. Such measures, described in an article from K2Management[24], take resources and time to overcome considerable obstacles like:

---

[23] LearnWind: WindEurope launches educational hub to tackle skills gap, *WindEurope,* September 2021.

[24] What you need to know about the skills shortage threatening the UK offshore wind industry, *K2Management*, December 2021.

- Reskilling workers from the oil & gas industry: although representing a fix in the long term, reskilling is limited in the short term due to the high demand of fossil fuels, which has maintained an increasing trend despite decarbonisation initiatives. Such a high demand implies that workers are unlikely to transition into renewable energy roles at the required rate. To add to this, the transition role attributed to natural gas in the EU decarbonisation context and the disruptions in the phase-out of coal cause by the war in Ukraine will further slow this process down.
- "Brain drain" effect of skilled workers from the EU to other parts of the world where project pipelines on fossil fuels are set to grow and skills are in demand (USA, China).
- Lack of encouragement for local production of wind turbine parts opposed to importation in order to increase the range of opportunities offered to skilled workers in the EU.
- Lack of awareness initiatives in universities and schools on behalf of the stakeholders of the EU wind industry with the aim of attracting school-leavers and graduates to the industry.

This barrier, although not critical for any of the technology clusters, has raised some degree of concern across the board, especially for emerging and mature technologies with 20% of votes for each. Concern has been expressed mostly by investors and could be linked to uncertainties generated by the changes that the fast pace of decarbonisation could have on the labour market.

5. Next steps

The WG Report will be used to develop studies and reports for the identification of effective and new financial instruments to support projects in energy production and generation, in the context of the Investors Dialogue on Energy. The Report will also feed the preparation of future Issue Papers for WG meetings dealing with topics relevant to barriers to investments.

Bibliography

Bellini, E., Italy introduces 11-month retroactive incentive cut on PV systems over 20 kW, *PvMagazine.com*, January 2022

https://www.pv-magazine.com/2022/01/28/italy-introduces-11-month-retroactive-incentive-cut-on-pv-systems-over-20-kw/

Breaking Down Investment Barriers at Ground Level - Case studies and other evidence related to investment barriers under the third pillar of the Investment Plan for Europe, *European Investment Bank & European Investment Fund,* 2016

Carrara, S., Shortall, R., Uihlein, A., Geothermal Energy Technology Development Report 2020, EUR 30508 EN, *Publications Office of the European Union*, Luxembourg, 2020

Communication from the Commission: Stepping up Europe's 2030 climate ambition; Investing in a climate-neutral future for the benefit of our people, COM/2020/562 final.

https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0562&from=EN

EU Emission Trading System (EU ETS), *Florence School of Regulation*, February 2021

https://fsr.eui.eu/eu-emission-trading-system-eu-ets/#:~:text=The%20emissions%20cap%20of%20the,the%20EU's%20Paris%20Agreement%20commitment

Ex-ante assessment methodology for financial instruments in the 2014-2020 programming period, *fi-compass*, May 2014

Fit for 55: The EU's plan for a green transition, *Council of the EU and the European Council*, 25 March 2022

https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/

Levelised Cost of Electricity: Renewables Clearly Superior to Conventional Power Plants Due to Rising CO2 Prices, *Fraunhofer Institute for Solar Energy Systems ISE*, June 2021.

https://www.ise.fraunhofer.de/en/press-media/press-releases/2021/levelized-cost-of-electricity-renewables-clearly-superior-to-conventional-power-plants-due-to-rising-co2-prices.html

Magagna, D., Ocean Energy Technology Market Report 2018, EUR 29924 EN, *European Commission*, Luxemburg, 2019

Meagher, D.,R., Broken promises: Legal recourse for retroactive FIT cuts, *PvMagazine.com,* January 2020

https://www.pv-magazine.com/2020/01/23/broken-promises-legal-recourse-for-retroactive-fit-cuts/

Padella, M., O'Connell, A., Prussi, M., Konti, A., Sustainable Advanced Biofuels: Technology Development Report 2020, EUR 30502 EN, *Publications Office of the European Union*, Luxembourg, 2020

Pinsky, R., Sabharwall, P., Hartvigsen, J., O'Brien, J., Comparative Review of Hydrogen Production Technologies for Nuclear Hybrid Energy Systems, *Science Direct*, March 2020

REPowerEU: A plan to rapidly reduce dependence on Russian fossil fuels and fast forward the green transition*, European Commission*, 18 May 2022

https://ec.europa.eu/commission/presscorner/detail/en/IP_22_3131

Scarlat, N., Fahl, F., Heat and Power from Biomass Technology Development Report 2020, EUR 30505 EN, *European Commission Joint Research Centre*, Luxembourg, 2020

Share of energy consumption from renewable sources in Europe, *European Environment Agency*

https://www.eea.europa.eu/ims/share-of-energy-consumption-from

Taylor, N., Jäger-Waldau, A., Photovoltaics Technology Development Report 2020, EUR 30504 EN, *Publications Office of the European Union*, Luxembourg 2020

Telsnig, T., Wind Energy Technology Development Report 2020, EUR 30503 EN, *Publications Office of the European Union*, Luxembourg 2020

Trends and projections in Europe 2021, *European Environmental Agency,* December 2021

https://www.eea.europa.eu/publications/trends-and-projections-in-europe-2021/file

Unlocking Renewable Energy Investment: The Role of Risk Mitigation and Structured Finance,' *IRENA*, 2016

What is the impact of increasing commodity and energy prices on solar PV, wind and biofuels?, *International Energy Agency (IEA)*, December 2021.

https://www.iea.org/articles/what-is-the-impact-of-increasing-commodity-and-energy-prices-on-solar-pv-wind-and-biofuels

INVESTORS DIALOGUE ON ENERGY

European Commission