BARRIERS TO CLEAN ELECTRIFICATION SERIES
PLANNING AND PERMITTING

Streamlining planning and permitting to accelerate wind and solar deployment

Version 1 | January 2023

Energy Transitions Commission

Insights Briefing

The Energy Transitions Commission (ETC) is a global coalition of leaders from across the energy landscape committed to achieving net-zero emissions by mid-century, in line with the Paris climate objective of limiting global warming to well below 2°C and ideally to 1.5°C.

Our Commissioners come from a range of organisations – energy producers, energy-intensive industries, technology providers, finance players and environmental NGOs – which operate across developed and developing countries and play different roles in the energy transition. This diversity of viewpoints informs our work: our analyses are developed with a systems perspective through extensive exchanges with experts and practitioners. The ETC is chaired by Lord Adair Turner who works with the ETC team, led by Faustine Delasalle (Vice-Chair), Ita Kettleborough (Director), and Mike Hemsley (Deputy Director).

The ETC's *Streamlining planning and permitting to accelerate wind and solar deployment* was developed by the Commissioners with the support of the ETC Secretariat, provided by SYSTEMIQ. This report constitutes a collective view of the Energy Transitions Commission. Members of the ETC endorse the general thrust of the arguments made in this publication but should not be taken as agreeing with every finding or recommendation. The institutions with which the Commissioners are affiliated have not been asked to formally endorse this briefing paper.

The ETC team would like to thank the ETC members, member experts and the ETC's broader network of external experts for their active participation in the development of this insights brief.

The ETC Commissioners not only agree on the importance of reaching net-zero carbon emissions from the energy and industrial systems by mid-century but also share a broad vision of how the transition can be achieved. The fact that this agreement is possible between leaders from companies and organisations with different perspectives on and interests in the energy system should give decision-makers across the world confidence that it is possible simultaneously to grow the global economy and to limit global warming to well below 2°C. Many of the key actions to achieve these goals are clear and can be pursued without delay.

Learn more at:

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Barriers to Clean Electrification Series

The ETC's *Barriers to Clean Electrification* series focuses on identifying the key challenges facing the transition to clean power systems globally and recommending a set of key actions to ensure the clean electricity scale-up is not derailed in the 2020s. This series of reports will develop a view on how to "risk manage" the transition – by anticipating the barriers that are likely to arise and outlining how to overcome them, providing counters to misleading claims, providing explainer content and key facts, and sharing recommendations that help manage risks.

An Insights Briefing will be developed for each barrier, covering the context and major challenges, and assessing the impact of deploying key solutions. These Insight Briefings will be accompanied by a series of Solution Toolkits, which lay out a set of key actions that need to be taken by the most important group of stakeholders (e.g., governments, renewables developers, grid operators, civil society) and outlines supporting case studies.

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Introduction

Clean electrification is the backbone of a transition to net-zero. The ETC's *Making Clean Electrification Possible* report highlights that the electricity system will need to grow by 3–5x globally – from 27,500 TWh today, to up to 130,000 TWh by 2050 [Exhibit 0.1]. Wind and solar will need to expand to cover 75–90% of power generation, up from just 10% today, with annual installations growing 5–7x by 2030.[1] Scaling clean electricity supply will be crucial to:

- Decarbonise existing electricity grids and provide for growing global electricity demand;
- Electrify new use case areas, such as light-duty transport and residential heating (e.g., heat pumps);
- Decarbonise harder-to-abate sectors, including via the production of green hydrogen [Exhibit 0.2].

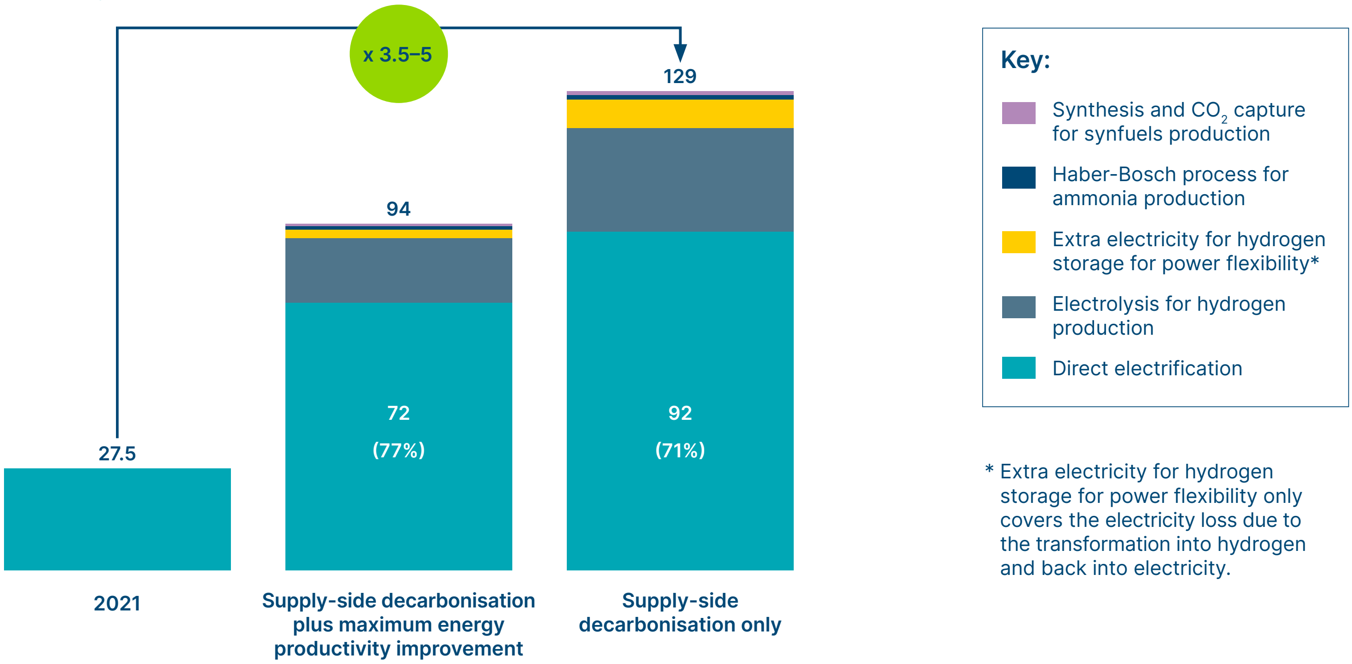
To meet the clean electrification scale-up required for a net-zero economy by 2050, the next decade will be critical. By 2030, annual installations of wind and solar will need to rise to over 600 GW per year in the ETC scenario, up from 280 GW per year in 2021, and wind and solar should reach 40% of power generation.[2] Currently, while renewables deployment is reaching record rates – 2022 capacity deployment is expected to be 25% above the previous year[3] – there are some barriers which threaten to derail the speed and scale of the transition required in the power sector. These barriers include issues around foundations for developing project pipelines (e.g., market design and pricing elements), but most significantly, issues around execution (e.g., planning and permitting delays, supply chain disruptions, and lack of grid availability).

Gross electricity generation will reach ~90,000 to ~130,000 TWh/year

Exhibit 0.1

Total electricity generated by 2050 in the ETC indicative pathways

000 TWh/year



* Extra electricity for hydrogen storage for power flexibility only covers the electricity loss due to the transformation into hydrogen and back into electricity.

Note: Assumes 85% green hydrogen production in 2050.

Source: Systemiq analysis for the Energy Transitions Commission (2021); EMBER (2022), *Global Electricity Review* (2022).

1 ETC (2021), *Making Clean Electrification Possible*.

2 BNEF (2022), *Global Installed Capacity*.

3 BNEF (2022), *Global Installed Capacity*.

This Insights Briefing focuses on one of the most pressing execution challenges to the rapid scale-up of clean electrification – slow planning, permitting, and land acquisition. While this set of challenges affects multiple clean energy technologies, the focus in this report will be on utility-scale solar photovoltaics (PV) (e.g., ~1 MW or above in size) and onshore and offshore wind, as the critical "backbone" zero-carbon generation technologies. After providing context on renewables deployment trends and current challenges, this Insights Briefing will develop an in-depth assessment of major planning and permitting barriers across project stages. It will then provide an overview of solutions, analysing the potential to shorten wind and solar development timelines at different stages whilst maintaining strong environmental and social safeguards.

This briefing will cover the following sections:

1. Wind and solar deployment is increasing but needs to accelerate to hit net-zero targets
2. Planning and permitting barriers add significant delays to wind and solar development across project stages
3. Regulatory, administrative, and societal support solutions are critical to deploying renewables at speed and scale
4. Regional considerations: challenges vary across countries
5. Conclusion: action required in the short term, with a critical role for governments

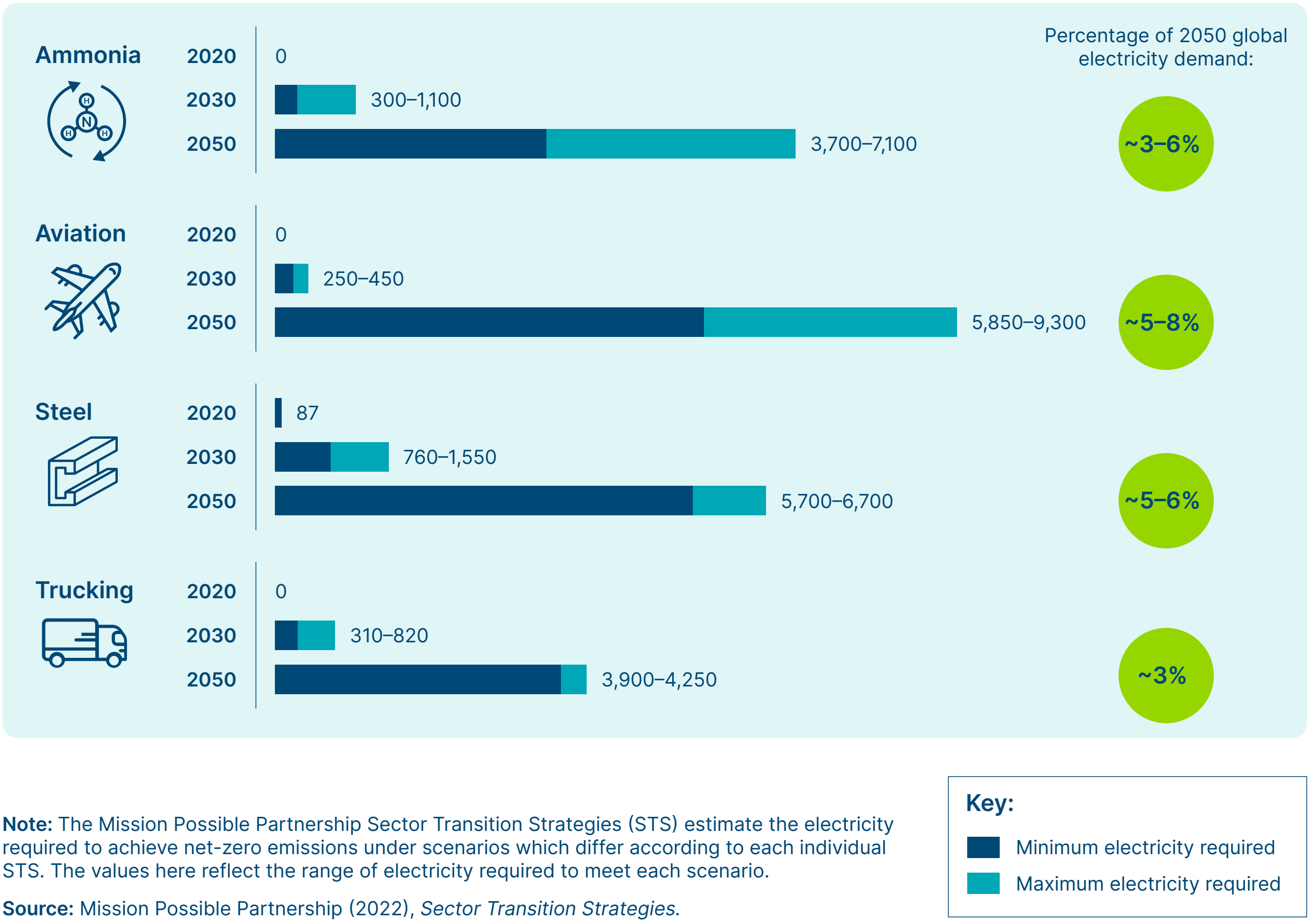
This Insights Briefing will be accompanied by a set of Solution Toolkits. These Toolkits provide a series of recommendations, targeted specifically at a core group of key actors/stakeholders in a stand-alone format. Three Toolkits accompany this briefing:

1. Actions for national/regional governments and policymakers
2. Actions for wind and solar developers
3. Actions for local authorities and civil society

Decarbonising harder-to-abate sectors requires massive scale up in clean electricity supply, including for green hydrogen production

Exhibit 0.2

Sectoral electricity demand across net-zero-consistent scenario pathways
TWh/year



Note: The Mission Possible Partnership Sector Transition Strategies (STS) estimate the electricity required to achieve net-zero emissions under scenarios which differ according to each individual STS. The values here reflect the range of electricity required to meet each scenario.

Source: Mission Possible Partnership (2022), *Sector Transition Strategies.*

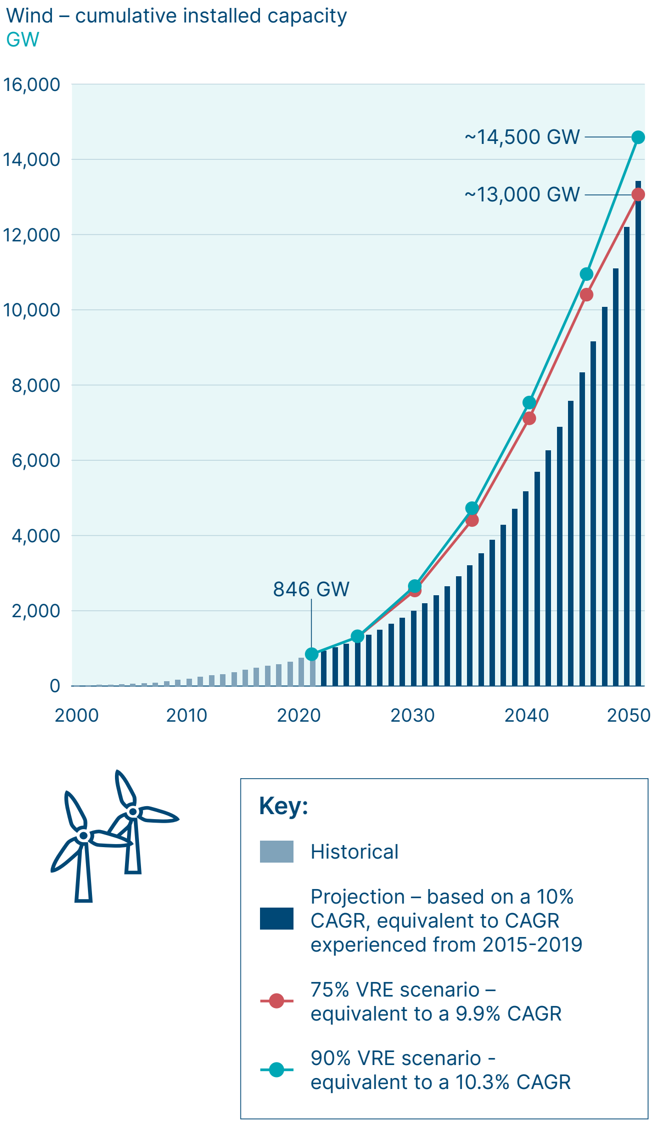
Wind and solar deployment is increasing but needs to accelerate to hit net-zero targets

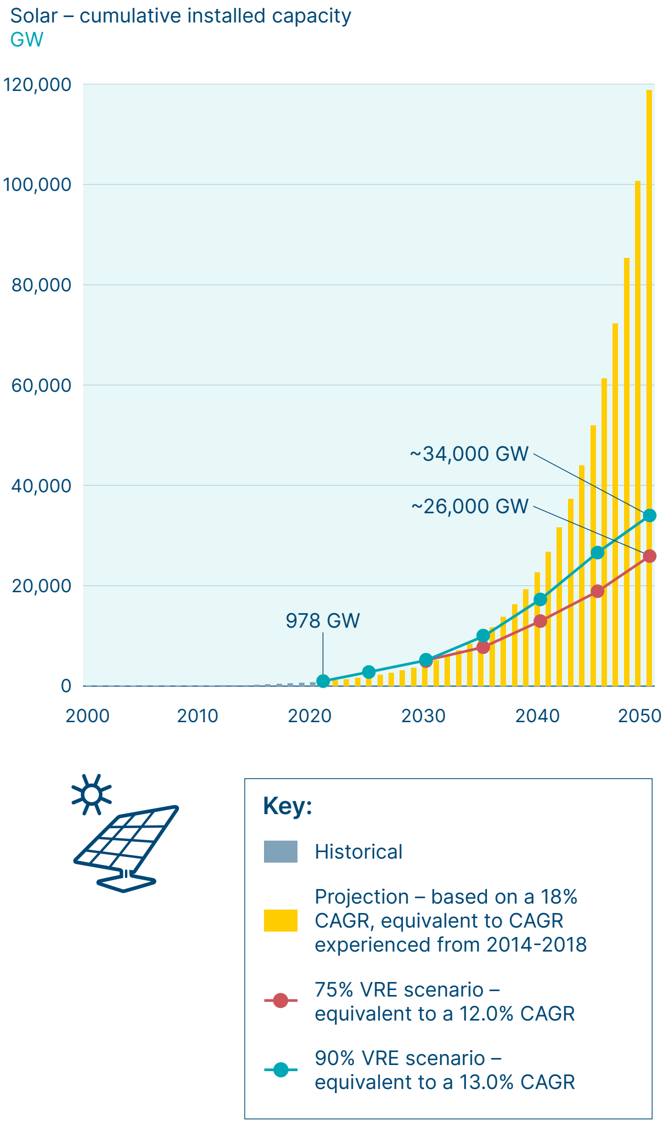
1

A global energy system based on clean electrification will require dramatic growth of wind and solar capacity. The ETC's report *Making Clean Electrification Possible* sets out that, under a net-zero trajectory, installed wind capacity needs to increase from around 850 GW in 2021 to ~2,600 GW in 2030; and solar must increase from around 1,000 GW in 2021 to ~4,900 GW in 2030, to enable a power system built on 75% – 90% renewables by 2050 [Exhibit 1.1].

Wind and solar installed capacity must grow dramatically

Exhibit 1.1





Note: CAGR = Compound Annual Growth Rate; VRE = Variable Renewable Electricity (i.e. wind and solar).

Source: BNEF (Accessed October 2022), *Global Installed Capacity*; Systemiq analysis for the Energy Transitions Commission (2022).

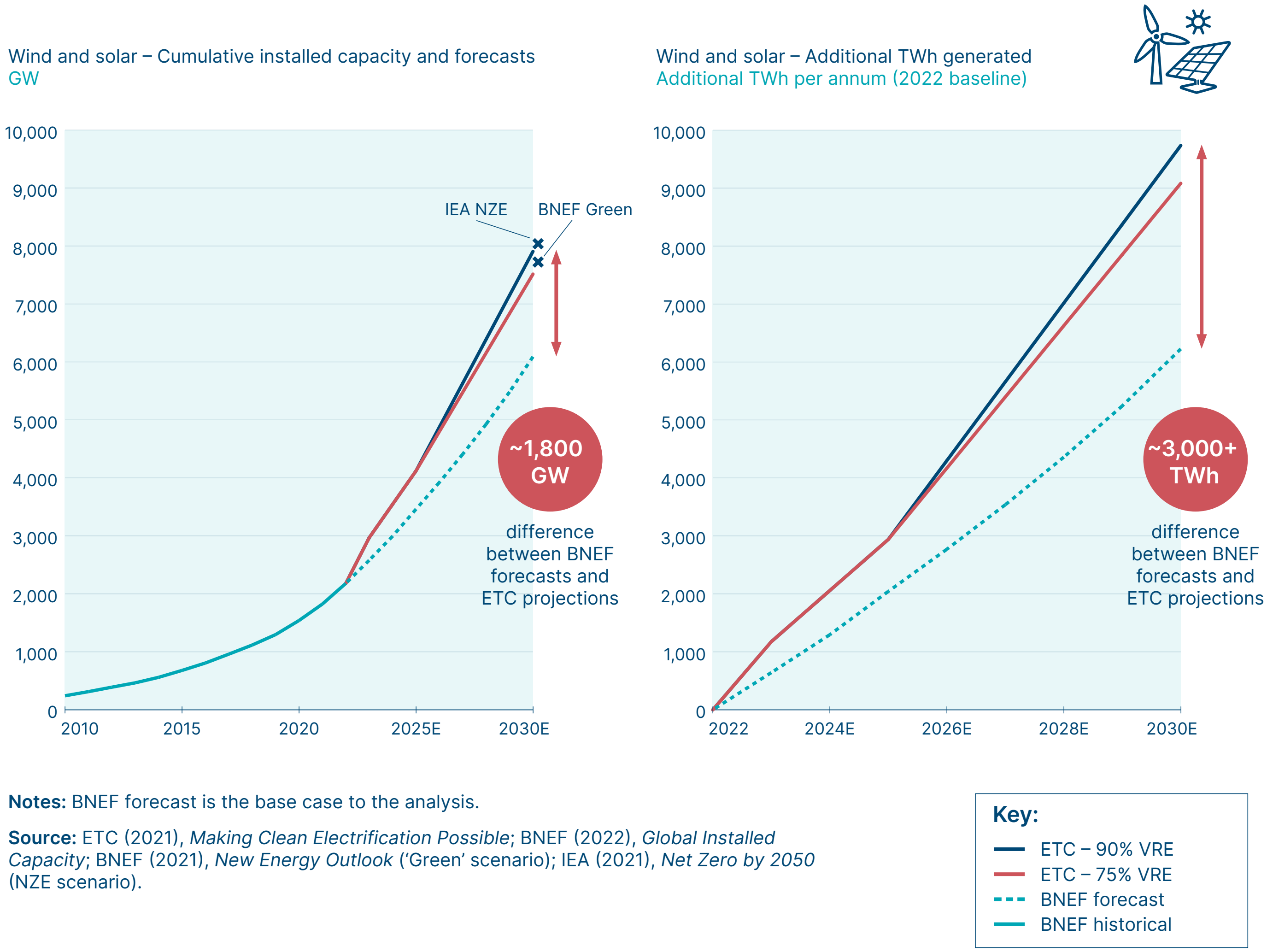
Renewables capacity has been accelerating; annual renewable capacity additions are expected to break a new record, increasing 25% compared to 2021 installations (280 GW) to reach over 350 GW in 2022. In particular, solar installations are soaring. Solar PV installations are expected to be 250 GW in 2022, a 39% gain from last year.[4]

Despite significant progress, current forecasts for installed capacity in 2030 suggest that deployment rates for both wind and solar are off track to meet net-zero-aligned trajectories.

- The annual rate of deployment in 2021 was 180 GW per year for solar and 100 GW per year for wind; these would need to increase to an annual average of 440 GW and 190 GW respectively, and for the rest of the decade to be in line with the ETC's vision.
- Projections from BloombergNEF suggest that renewables deployment by 2030 may be around ~1.8 TW (or 25%) below the ETC's vision [Exhibit 1.2].[5] A 1.8 TW "gap" by 2030 would be equivalent to the total installed renewable capacity today. This trajectory would leave a gap of up to 3,500 TWh of clean electricity generation in 2030 compared with the ramp-up outlined in the ETC's net-zero trajectory, leading to lost emissions savings of around 2.2 $GtCO_2$ per annum in 2030 (a cumulative 9.5 $GtCO_2$ from 2023–2030).[6]

Current forecasts see wind and solar capacity and generation lagging behind ETC's vision for 2030

Exhibit 1.2



Notes: BNEF forecast is the base case to the analysis.

Source: ETC (2021), *Making Clean Electrification Possible*; BNEF (2022), *Global Installed Capacity*; BNEF (2021), *New Energy Outlook* ('Green' scenario); IEA (2021), *Net Zero by 2050* (NZE scenario).

4 BNEF (2022), *Global Installed Capacity*.

5 As part of a pathway towards a 90% share of power generation from wind and solar in 2050.

6 Using BNEF forecast deployments as a base case compared with ETC 90% VRE scenario. Assumes new wind and solar deployments directly replace electricity generated through gas and coal from power generation in equal measure, at emissions factors of 0.40 $kgCO_2/kWh$, and 0.85 $kgCO_2/kWh$ respectively.

Though the global picture is below the target, the regional picture is somewhat more mixed [Exhibit 1.3]. While many countries are currently forecast to miss 2030 capacity levels consistent with net-zero based on present trajectories, several governments have taken important steps by setting more ambitious renewables targets.[7] In some markets – such as China and Spain – renewables deployment is already projected to be above net-zero compatible targets for deployment in 2030. In other key markets such as the US and the EU, deployment is also expected to accelerate.

- **The Chinese government** set 2030 wind and solar targets of 1,200 GW in 2020.[8] In 2021, the ETC, in collaboration with RMI, suggested a trajectory towards 1,725 GW by 2030 could be possible.[9] At current build rates, China is forecast to well surpass both, with some forecasting deployment of 2,200 GW by 2030.[10] Factors supporting renewables deployment include non-burdensome regulatory and administrative processes, the use of guaranteed renewable purchasing obligations for grid operators, and strong local supply chains which have been resilient despite global shipping issues caused by the pandemic. Fast deployment of solar is underpinning China's deployment push, with total capacity set to increase from 430 GW in 2022 to 1,285 GW in 2030, whilst wind capacity increases to a lesser extent from 400 GW in 2022 to 900 GW in 2030.
- **The Spanish government** set 2030 wind and solar targets of ~90 GW in 2020,[11] as part of their target for renewable energy sources to account for 74% of the energy mix by 2030, and carbon neutrality by 2050.[12] BNEF forecasts expect that Spain will exceed this target, with 125 GW capacity in 2030, with the most growth in solar (from 20 GW in 2021 to 85 GW in 2030), supported by recently launched policies to streamline renewables project development.[13,14]
- **The US, UK and Germany** have all recently committed to full power sector decarbonisation by 2035. Whilst BloombergNEF forecasts do not currently have these countries on track by 2030, policy packages such as the US Inflation Reduction Act,[15] REPowerEU, and the German Easter Package[16] take significant steps to support the growth and funding for clean power supply (including by freeing up new land for green power production and speeding up permitting procedures). These significant policy interventions have the potential to increase deployment levels to be much closer to their target.

[7] This assessment refers to the BNEF October 2022 base case forecast. Country-level targets for this analysis refer to individual country pathways developed independently to ETC pathways, and/or government targets. Although individual country pathways are ambitious, they are not as ambitious as the ramp-up implied by the ETC's scenarios, implying a gap between the sum of these targets and the ETC's vision for 2030.

[8] Carbon Brief (2020), *Analysis: China's new 2030 targets promise more low-carbon power than meets the eye*.

[9] ETC/RMI (2021), *China Zero Carbon Electricity Growth in the 2020s: A Vital Step Toward Carbon Neutrality*.

[10] BNEF (2022), *Global Installed Capacity*.

[11] Climate-laws.org (Accessed November 2022), *Spain's integrated National Energy and Climate Plan for 2021-2030*.

[12] Global Data (2022), *Spain Power Market Outlook to 2035, Update 2022 – Market Trends, Regulations, and Competitive Landscape*.

[13] For example PV projects smaller than 150 MW can bypass the country's lengthy Environmental Impact Assessment procedure, provided that projects are in low or moderate environmentally sensitive areas, and that their aerial grid connection lines do not exceed 15 km in length and 220 kV in voltage.

[14] BNEF (2022), *Global Installed Capacity*.

[15] Forbes (2022), *Inflation Reduction Act Benefits: Clean Energy Tax Credits Could Double Deployment*.

[16] NS Energy (2022), *Easter Package: Germany's biggest energy policy reform in decades*.

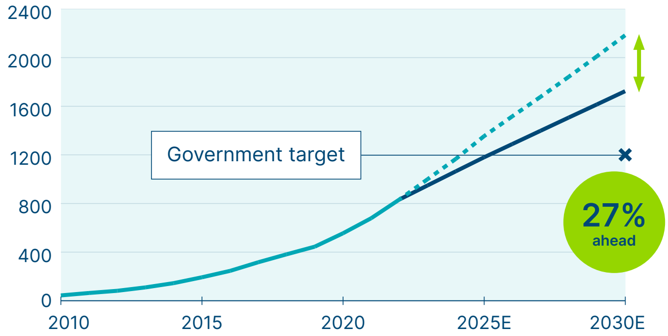
Whilst deployment in China and Spain is forecast to exceed expectations, other countries are falling behind

Cumulative installed capacity and forecasts for wind and solar.
GW

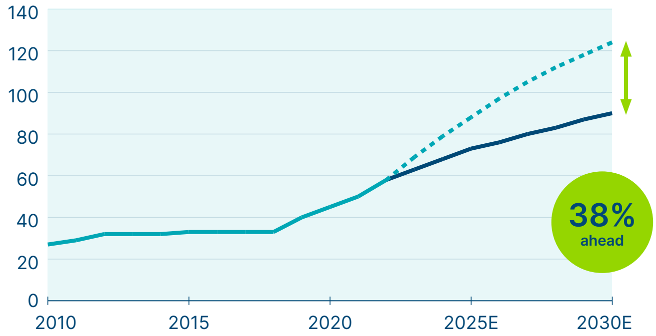
Key:
- Pathway to net zero
- BNEF forecast
- BNEF historical

Exhibit 1.3

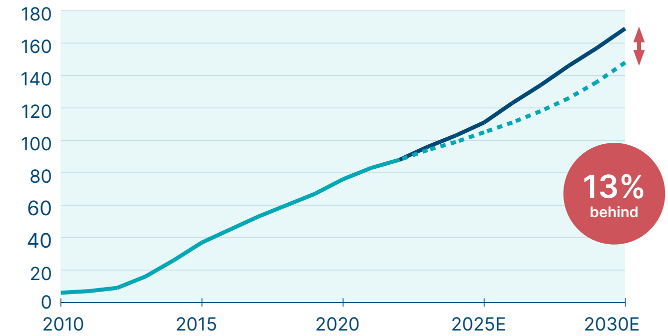
China



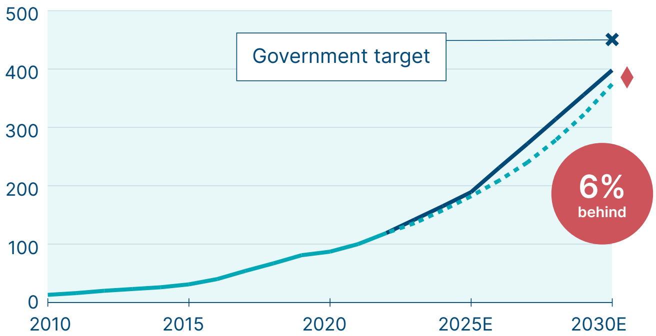
Spain



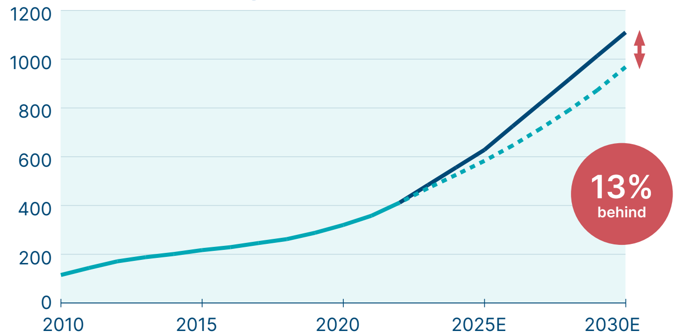
Japan



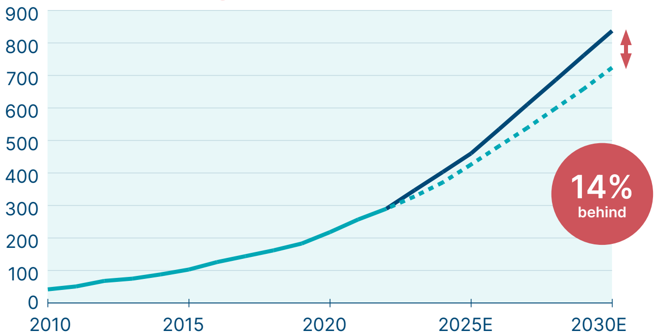
India



European Union



United States



Sources:

All countries – historical and forecast data: BNEF (October 2022), *Global Installed Capacity.*

China – 2030 Zero-Carbon Investment Scenario targets: ETC RMI (January 2021), *China Zero Carbon Electricity Growth in the 2020s: A Vital Step Toward Carbon Neutrality*;
Government targets: Bloomberg (March 2022), *China Could Hit 2030 Renewable Target by 2025 on Local Ambitions.*

Spain – Government wind and solar targets consistent with 74% renewable energy by 2030 and carbon neutrality by 2050: Power Technology (July 2022), *Strong policies and investments are key for Spain's 2030 renewable targets.*

Japan – Wind and solar required by 2030 for 2050 climate-neutrality and energy autarky: Agora Energiewende (March 2021), *Renewable pathways to climate-neutral Japan.*

India – High Renewable Energy Scenario 2030 targets: TERI (July 2020), *Renewable power pathways: Modelling the integration of wind and solar by 2030 in India*;
Government targets: Mongabay (July 2022), *What does India need to meet its 2030 renewable energy targets?*

European Union – REPowerEU targets consistent with fast forwarding the energy transition: European Commission (May 2022), *REPowerEU: A plan to rapidly reduce dependence on Russian fossil fuels and fast forward the green transition*;
Wind Europe (June 2022), *EU Energy Ministers endorse faster permitting of renewables.*

Unites States – E+ targets, assuming aggressive end-use electrification, but energy-supply options are relatively unconstrained for minimising total energy-system cost to meet the goal of net-zero emissions in 2050: Princeton (October 2021), *Net Zero America, Potential Pathways, Infrastructure and Impacts.*

Challenges to wind and solar scale-up in the 2020s

Overall, there are strong foundations in place globally for the power sector transition. However, several barriers are slowing down the pace of wind and solar deployment. It is critical to understand and address these barriers if clean electrification is to progress at pace in the 2020s.

Around the world, there is a very strong economic case for renewables in power generation. Wind and solar are now cheaper than new fossil in countries representing over 90% of electricity generation, and cheaper than existing fossil in countries representing two thirds of electricity generation.[17] Technology progress and economies of scale have led to rapidly declining costs. As investors have become more familiar with the technology, renewables investments have also been significantly de-risked with lower costs of capital, leading to lower levelised costs of electricity (LCOEs).[18] The gap between renewables and fossil has continued from 2021 into 2022 as coal and gas-fired power has become more expensive.[19] In some limited geographies where fossil remains cheaper than renewables, the economics have slowed renewable deployment rates. For example, this is the case in Japan, which has some of the most expensive renewables in the world due to higher labour costs, environmental permit costs, land constraints, and lower availability of renewable resources. However, by the mid-2020s, renewables are expected to be cheaper than fossil fuels even in Japan.[20]

Furthermore, many countries have acted on favourable economic fundamentals to set increased deployment targets supported by frequent auctions and contracts that offer revenue stabilisation. As noted in the ETC's 2021 report *Making Clean Electrification Possible* these mechanisms are critical to de-risking and scaling renewable deployment.[21]

These trends have led to a robust renewable energy project pipeline in many countries around the world. However, key challenges are occurring in the project execution phase. There are three major sets of barriers:

- **Planning and permitting** barriers, addressed in this report, are some of the most severe. Across the world, projects are consistently held back by planning and permitting challenges, which lead to delays at various project stages. For offshore wind projects, for example, out of 245 GW of projects announced between 2000–2017, by August 2022 only 90 GW had been financed, and 55 GW (22%) had been commissioned – highlighting significant project development hurdles.[22,23] These barriers have also fed back into the project pipeline stage; some auctions have been undersubscribed largely due to poor planning and permitting processes, most recently in Italy[24] and Germany.[25]
- **Supply chain issues**, such as the disruption faced in 2021–2022 around polysilicon manufacturing capacity and shipping delays, have held up some solar and wind projects. Many of these issues are however forecast to be resolved in the medium term:

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17 BNEF (2022), *1H 2022 LCOE Update*.

18 LCOE is a measure of the average net present cost of electricity generation for a generating plant over its lifetime. The LCOE is calculated as the ratio between all the discounted costs over the lifetime of an electricity-generating plant divided by a discounted sum of the actual energy amounts delivered.

19 BNEF (2022), *1H 2022 LCOE Update*.

20 BNEF (2022), *1H 2022 LCOE Update*.

21 ETC (2021), *Making Clean Electrification Possible*.

22 BNEF (data accessed 16/08/2022), *Renewable Energy Projects database*.

23 In some cases, the burden on developers has been increasing over time, with the UK offshore wind project Hornsea 4 (planning consent applied for in 2021) requiring an Environmental Impact Assessment (EIA) of 10,209 pages; which is slightly longer than Hornsea 2's (planning consent granted in 2016) 10,179 pages, despite Hornsea four being around two thirds of the size of Hornsea Two, see: Sam Dumitriu (2022), *Why Britain struggles to build infrastructure*.

24 Wind Europe (2022), *Messy permitting leads to yet another undersubscribed wind auction in Italy*.

25 Clean Energy Wire (2022), *Return of undersubscribed wind power auctions a setback for Germany's expansion push*.

- **For solar**, the global manufacturing capacity of polysilicon (which had been a bottleneck for solar in 2021), is planned to increase to enough for 1 TW of solar panels per year by 2025, far surpassing forecast demand. Manufacturing capacity of all other key components (such as ingots, wafers and modules) is also set to far surpass demand over the next few years.[26]
- **For wind**, the supply chain may continue to be affected in the shorter term, as steel, neodymium and copper have all seen recent price inflation which will lead to near-term turbine price increases as raw material costs are eventually passed on to customers. However, in the longer term, prices are set to decrease as the availability of these key components increases. The shipping sector has seen instability and disruption of supply chains, resulting in delayed component/material deliveries, and turbine transportation to project sites. Some turbine manufacturers expect disruptions to start to ease from 2023 onwards when prices are expected to decrease.[27]

- **Network availability**, such as long grid connection queues, leads to a backlog of projects in the pipeline. Network availability is a key constraining factor which has been limiting the amount of wind and solar that can be added to power grids all over the world. In recent years, the United States has been particularly affected, with connection queues reaching record levels [Box 1.1]. Future consideration of this barrier in ETC work will focus on key tools to overcoming grid connection challenges, such as developing a "strategic vision" for the grid, with appropriate coordination between national, regional, and local levels of government and stakeholders; defining the importance of overhead vs underground vs undersea wires, where the additional cost of undergrounding may have to be borne as a "social cost"; promoting international collaboration for quicker interconnection projects; limited global suppliers of HVDC cables; addressing workforce skills and capability shortages such as with "linesmen" and power system engineers; and firmly linking policy to implementation.

The focus of this Insights Briefing is planning and permitting barriers; future ETC *Barriers to Clean Electrification* work will focus on the other critical areas noted above.

Increasing length of grid connection queues in the US[28,29]

Box 1.1

The United States currently have 1.4 TW of wind, solar and battery projects waiting for a connection to the power grid, roughly the same as the amount needed to hit the US target of 80% of electricity from low-carbon sources by 2030. This poses a challenge to the country's 2035 power sector decarbonisation goals.

- The amount of time projects spend in the queue has been increasing, **from 2.1 years on average in 2010**, to **3.7 years in 2021**.
- Transmission infrastructure needs to be built **to three times total 2022 capacity** to decarbonise the power system by 2035.
- **Environmental review** of long-distance electric transmission lines **and related permitting severely restricts grid buildout**, as this normally takes **between 5 and 10 years**, sometimes even longer.
- Over **80% of potential emissions reductions in 2030** delivered by the **Inflation Reduction Act are expected to be lost** if grid expansion is constrained to **1% p.a.** (current pace). **~2.3% expansion p.a. is required**.

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26 Bloomberg (2022), *The Supply Chain to Beat Climate Change Is Already Being Built*.

27 BNEF (2022), *1H 2022 Wind Turbine Price Index (WTPI): Turbulence Stays*.

28 Berkeley Lab (2022), *Queued Up: Characteristics of Power Plants Seeking Transmission Interconnection as of the End of 2021*.

29 Not all projects which have applied for grid connection will ultimately be developed, as some developers adopt a "portfolio" strategy by which they ensure a number of projects are fully permitted and authorised (including obtaining grid connection), but only a subset will reach financial close.

Planning and permitting barriers add significant delays to wind and solar development across project stages

2

Stages of project development Exhibit 2.1

* Stages focused on in this report

Slow planning, permitting, and land acquisition represent one of the most critical barriers to accelerating wind and solar deployment. This section of the report provides an assessment of these barriers, covering:

- An overview of the key stages of utility-scale renewable project development.
- Key types of barriers, including regulatory, administrative, and societal support.
- Impact of planning and permitting barriers on renewable project development stages and timescales.

What are the stages of renewables project development?

Wind and solar projects must progress through various hurdles and stages of project development in order to move from pre-development to operation. Exhibit 2.1 provides an overview of the critical stages that most democratic countries must proceed through to develop a renewable energy project, whilst also respecting biodiversity, social effects, and system planning for efficient deployment. Some key stages have the most potential to be condensed:

- **Mapping and selection of the site** involves plotting out the land (or seabed space) required for renewables development and purchasing or leasing this land (for larger sites, this is sometimes done via auction). It can take from 4 months to 2 years.
- An **Environmental Impact Assessment (EIA)**, which is based on a number of environmental surveys, assesses the potential impact of the proposed development on the physical, biological and human environment during the construction, operation and decommissioning of the wind or solar farm.[30] This can take from 1 to up to 3 years in some cases, though this may be longer if significant environmental issues are discovered that need to be mitigated.
- A **stakeholder consultation process** occurs throughout the project development, as developers are obliged to seek the views of a number of statutory consultees. These include a wide range of government-appointed consultees and authorities, affected local authorities, and those that have an interest in the land. Non-statutory consultees with specific interests in the development are also likely

[30] A full suite of environmental surveys must be undertaken to determine the impacts, before mitigation measures are defined and applied in order to mitigate the residual effects associated with the development.

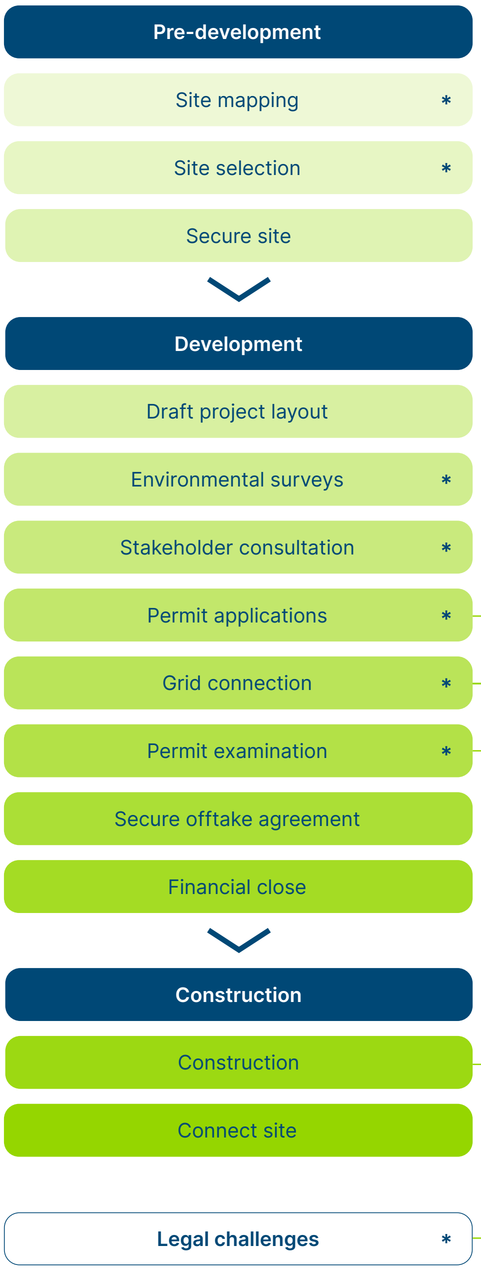
to be consulted (such as environmental NGOs). Developers often also seek the views of local communities and indigenous peoples as part of this process and hold a series of public information and consultation events. This can take around 9 months or more, often done via multiple rounds of stakeholder consultation.

- **Application and examination of permits** requires successfully completing all necessary permits (in some extreme cases this may be up to 10 for a solar farm or up to 20 for an offshore wind farm) and having these approved by permitting authorities (in some cases there may be multiple permitting authorities across local, regional and central government). This can take up to 4 years.
- The **grid connection phase** involves applying to the network operator for connection to the power grid and is generally constrained by the total network system capacity and ease of connecting to existing or future grid connection points. If grid upgrades are required, once a connection is negotiated, the relevant transmission or distribution lines must be constructed in tandem with the construction of the project. Can take from 1.5 to up to 4 years to negotiate, potentially even longer if there are severe grid constraints.
- Finally, the **construction phase** involves physically assembling the wind or solar farm and the necessary grid connection infrastructure to transfer renewable energy to the grid. This varies from 6 months for a utility-scale solar project to up to 2 years for an onshore wind farm, and 3 years for an offshore wind farm.
- **Legal challenges** must be tackled throughout the process, as most permits can be challenged in a court of law (generally multiple times). On some occasions, legal challenges are made in the pre-development stage, before sites have even been made available for lease/purchase and continue to be made well into the construction phases of projects.[31] The legal window for challenges could amount to multiple years of project development time (in some cases even up to 10 years for offshore wind), with additional delays possible through successful and unsuccessful legal challenges. Generally, the window for legal challenges lies between the first permit application and acceptance of the final permit, which for offshore wind could be around 4 years.

In certain other countries – particularly centrally-led countries such as China – many of these stages of project development may be shortened or skipped. In countries with a much lower likelihood of facing legal challenges, there could be no or limited obligation to conduct comprehensive environmental surveys and thorough stakeholder engagement. The grid connection phase can also be shortened through the use of renewable purchase obligations which ensure grid connection to any new renewable project coming online.

Stages of project development

Exhibit 2.1



* Stages focused on in this report

[31] Some offshore wind projects may face legal challenges at the site mapping stage e.g., during identification of sea space for offshore wind leasing, prior to the permitting process.

In most countries, developers lead the project development process from securing the site onwards, applying to government departments for the relevant permits. There may be some benefits for governments leading permitting stages, as outlined for offshore wind in the Netherlands in Box 2.1.

Centralised offshore wind development: the Dutch model — Box 2.1

The Netherlands has enacted a streamlined centralised process for offshore wind development, designed in close consultation with the wind energy sector. The government takes on the site mapping and selection in agreement with other users of the sea, conducts environmental surveys and site investigations, undertakes the consenting process and grants the permits, guarantees a timely grid connection (through the national Transmission System Operator) and arranges the tender. This process is run by a dedicated governmental body, functioning as a one-stop shop.

Through this proactive approach, the government helps reduce pre-bid investment risks, financing and societal costs. The approach has been seen to play a role in reducing levelised costs of energy, making subsidy-free bidding possible,[32] and is often seen as successful and innovative in the international context.[33] While this approach provides clarity and efficiency, it puts a substantial burden on government agencies. This brings the risk of slow progress due to lack of capacity, political recess or bureaucratic challenges, predominantly during the tender phase.

What are the barriers associated with planning and permitting?

Overall, we have identified three major categories of planning and permitting barriers: regulatory, administrative and societal support; with network availability as an external constraining factor [Exhibit 2.2].

- **Regulatory barriers** arise through governments not setting adequate direction, with a build-up of adverse and complex rules and laws associated with permitting and land acquisition, and is typically the responsibility of national governments.
  These barriers:
  - Fail to provide adequate direction to stakeholders and developers due to a lack of a clear strategic vision with well-designed medium-term targets.[34]
  - Limit the land available for renewable deployment (including limits on who can own the project), such as high setback distances for onshore wind turbines.[35]
  - Increase the complexity of permitting processes, place limits on developers installing the most efficient pieces of technology and enable excessive legal challenges throughout the project development process.

What are the groups of barriers slowing down deployment of technologies?

Exhibit 2.2

Regulatory	Administrative	Societal support	Network availability
Lack of strategic vision	Multiple authorities in charge of permitting	Understanding scale up challenge	Network system capacity
Lack of dedicated land	Lack of capability and resources	Protecting biodiversity	Queues to connect to grid
Complex regulation	Lack of digital permitting infrastructure	Local socio-economic concerns	Lack of strategic infrastructure planning
Inflexible permits	Lack of data aggregation		(Network availability will be the focus of a forthcoming briefing)
Adverse legal system			
Land ownership issues			

32 Although contracts are awarded there is no net payment to generators in excess of the wholesale electricity price.

33 Netherlands Enterprise Agency (2022), *Dutch Offshore Wind Guide*.

34 Including due to a lack of cross-party political support for renewable initiatives in some regions.

35 According to analysis from Instrat, since its introduction in 2016, the "10H" regulation to increase the setback distance for onshore wind turbines in Poland (which imposes a minimum distance of over 2000 metres between wind turbines and settlements – 4 times more an average of 500 metres in most European countries) has blocked 99.7% of the country from onshore wind development. See: https://ember-climate.org/press-releases/failure-to-remove-barriers-to-polands-onshore-wind-risks-blackouts-and-higher-bills/

- **Administrative barriers** result from inadequate permitting frameworks and bureaucratic structures, which can stem from a lack of resources, communication and assigned responsibilities between local, regional, and national governments. These barriers:
  - Slow permit applications, examination and monitoring through a lack of capability and resourcing in permitting departments, a reliance on archaic permitting infrastructure, and conflict between levels of government.[36]
  - Slow site mapping and selection through a lack of central collection and aggregation of environmental and energy productivity data.
- **Societal support** barriers stem from public resistance to the deployment of new infrastructure projects, which may come from stakeholders perceiving that developers are not taking adequate action to protect biodiversity and manage impacts, not conducting appropriate stakeholder engagement, delivering relevant local socio-economic benefits, or a general lack of public awareness/acceptance of the benefits associated with the transition to clean power systems. These barriers:
  - Lead to extended approvals periods.
  - Lead to increased numbers and significance of legal challenges.
  - Restrict sites available for selection by developers.
- **Network availability** constraints lead to delays and deferrals in projects obtaining connection to the grid, resulting generally from a lack of strategic vision and anticipatory investment from central government authorities in augmenting existing and developing new national and local power lines. This is a significant barrier which will be addressed in a subsequent ETC Insights Briefing.

How do planning and permitting barriers stretch project development timelines?

As presented in the selected case studies below, planning and permitting barriers can have negative effects on almost all stages of project development, stretching out development timelines longer than required, even under strong environmental and social safeguards. Wind projects have longer timelines compared to solar, and while planning and permitting barriers affect both technologies, it leads to more severe delays for wind given the longer overall timelines.

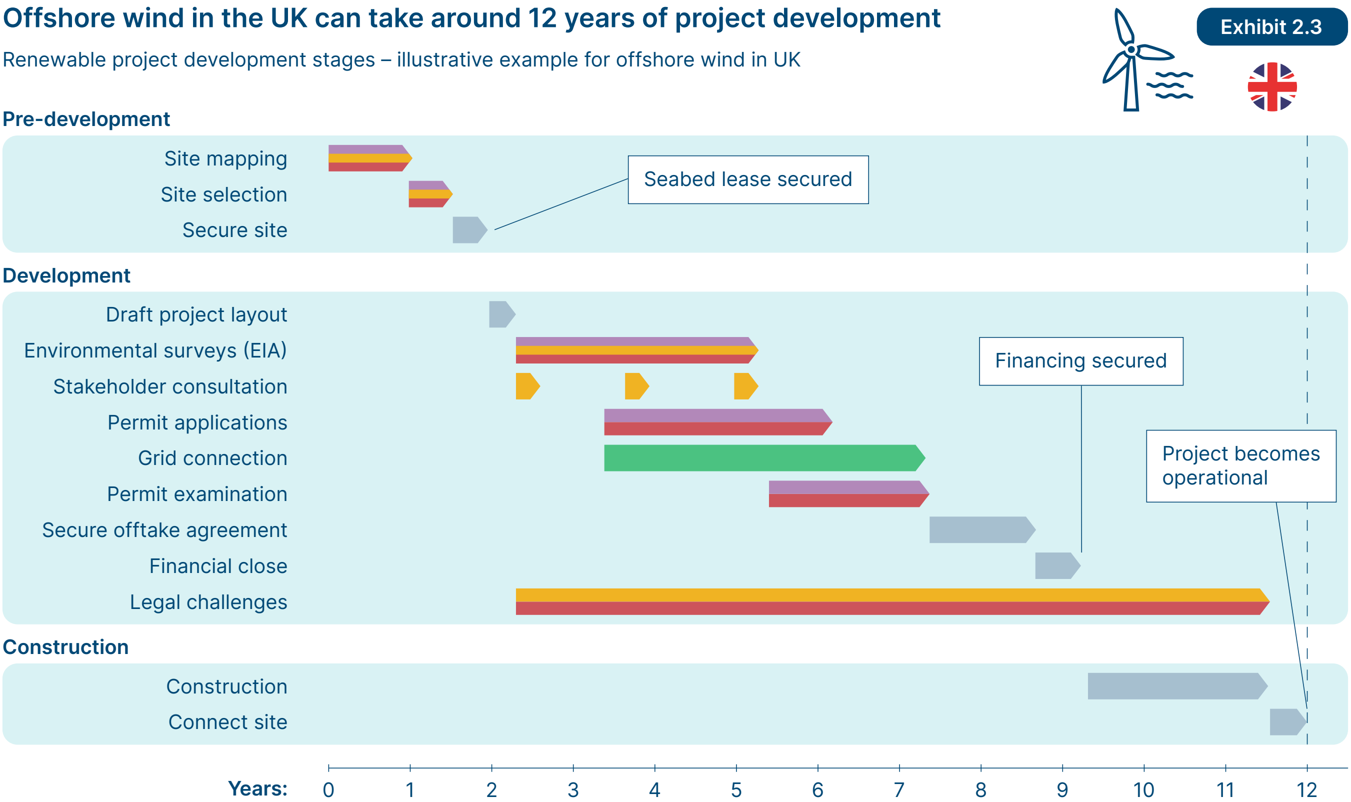
- **Legal challenges** are a common issue across technologies, including not aligning with local planning schemes, noise and amenity impacts, and impacts to current industries in the area including tourism, fishing, and farming.
- **Environmental surveys** to support Environmental Impact Assessments analysis for offshore wind farms can be extensive and may include: bird, fish, marine mammal and habitat surveys as well as marine navigation studies, socio-economic surveys, commercial fishing, archaeology, noise analysis, landscape and visual assessment, and aviation impact assessments.
- Environmental Impact Assessments can be slightly less intensive for onshore wind, as marine factors do not need to be considered. However, extra consideration must be paid to ecology and the natural environment, including other flying wildlife such as bats.
- Environmental Impact Assessments are generally less intensive for solar, where there is less scope for damage to wildlife when the solar farm is operational. However, these can be more time consuming if there are known to be nesting birds in the area.
- Obtaining a **grid connection** is a common bottleneck across technologies.
- **Permit applications and examination** also have common issues across technologies, largely due to administrative issues associated with processing permit examinations.

[36] Conflicts can be both between levels of government (e.g., national vs. regional) and between different "branches" of government at the same level. This issue has been becoming more common in offshore wind globally – where a lead energy authority is aiming to take forward permitting of sites, but surrounding legislation governing other activities and designations at sea, including biodiversity protection, shipping, and fishing, is not "pulling in the same direction" and so this complex mix of priorities ends up at a pinch point within a consultative permitting process.

Offshore wind in the UK can take around 12 years of project development

Exhibit 2.3

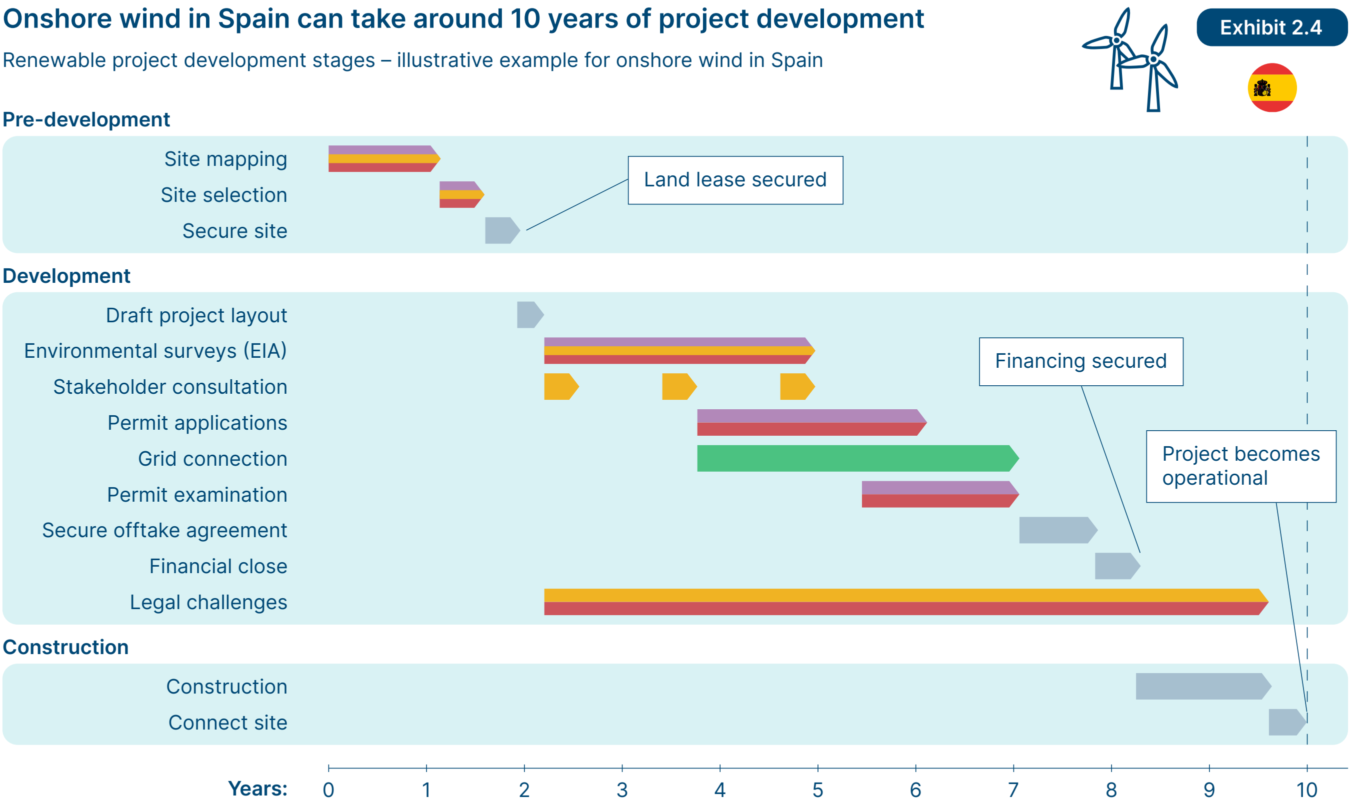
Renewable project development stages – illustrative example for offshore wind in UK



Onshore wind in Spain can take around 10 years of project development

Exhibit 2.4

Renewable project development stages – illustrative example for onshore wind in Spain



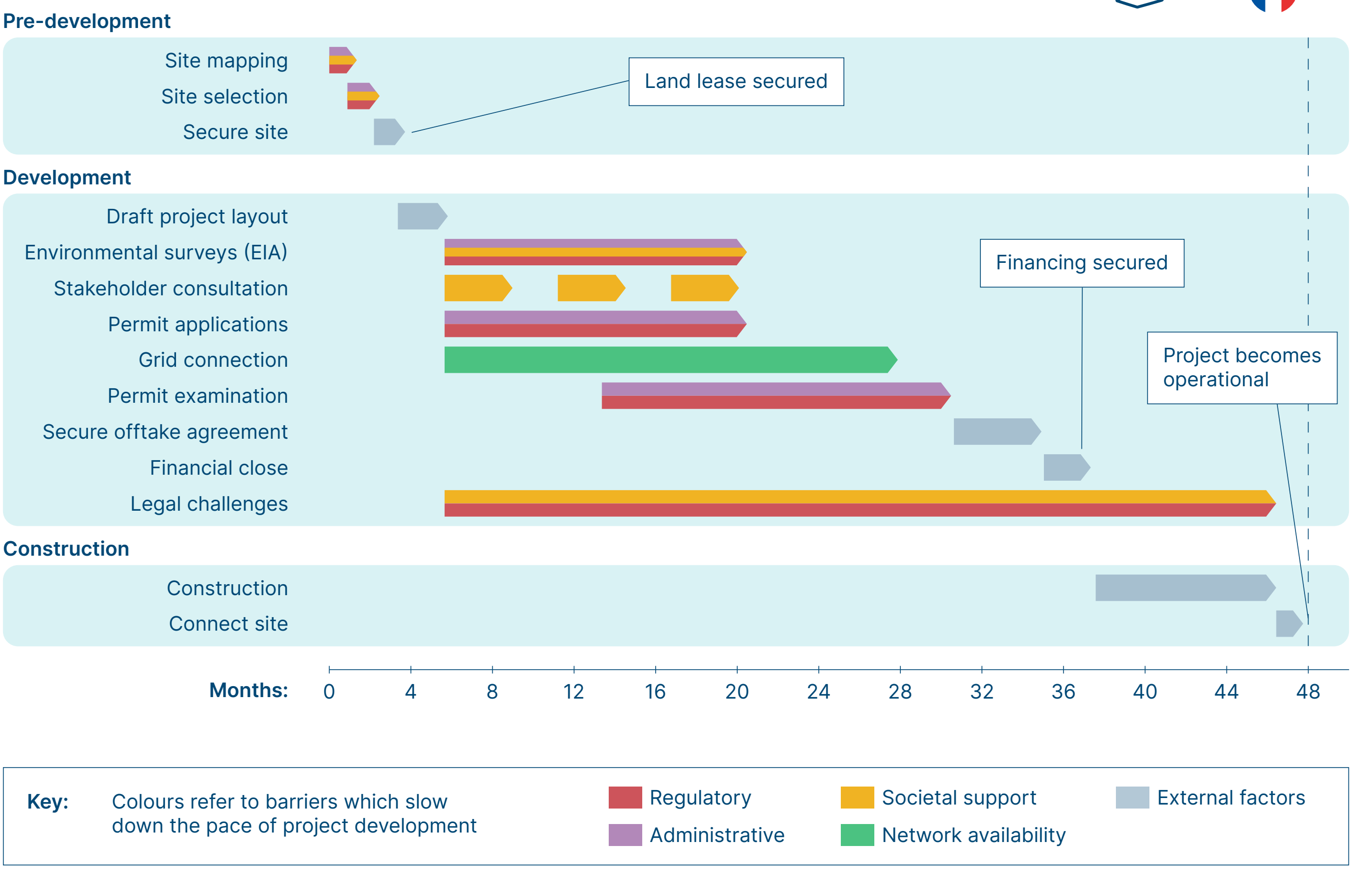
Key: Colours refer to barriers which slow down the pace of project development

Regulatory · Administrative · Societal support · Network availability · External factors

Utility-scale solar in France commonly has around 4 years of project development

Exhibit 2.5

Renewable project development stages – illustrative example for 5 MW utility-scale solar in France



Regulatory, administrative, and societal support solutions are critical to deploying renewables at speed and scale

3

To address key planning and permitting barriers, there are multiple measures that can be taken across government, industry, and other stakeholders to minimise delays, accelerate these processes, and increase overall deployment while safeguarding environmental and social rights. This section sets out an overview of the key solutions that can be deployed and their impact at various project stages. The accompanying Solution Toolkits will provide an in-depth view of these solutions, targeted to specific actors. This section covers:

- **Solutions to regulatory barriers**, such as dedicating sufficient land to renewables projects and enforcing permitting targets.
- **Solutions to administrative barriers**, such as digitalising the permitting process and creating digital spatial mapping tools to aid deployment planning.
- **Increasing societal support**, including actions such as ensuring appropriate stakeholder engagement and managing socioeconomic and environmental impacts for local communities.

What are the key solutions?

Solutions to regulatory barriers

The key set of solutions to mitigating regulatory barriers is shown in Exhibit 3.1 alongside an indication of how they could speed up multiple project stages. These involve setting a clear strategic vision for the power system and then creating an optimal regulatory and legal environment for the development of renewable energy projects.

Key considerations of the actions required to improve regulatory systems associated with wind and solar development are below. More information on the key solutions including direct actions and case studies can be found in the national/regional governments and policymakers Solutions Toolkit.

1. **Strategic vision for the power system**. It is critical for governments to outline a clear strategic vision for the power system with ambitious medium-term GW targets for renewables deployment. This will provide political leadership and clarity to renewables developers and other stakeholders.
2. **Ensure renewables are appropriately prioritised in law and land use**, by:
   a) **Assigning priority development status to renewable energy projects**, whilst respecting important caveats. For example, the EU's "overriding public interest" status, a designation introduced for renewable energy in 2022[37,38], has experienced pushback from some developers and environmental NGOs, who believe "overriding" is too strong a wording and will result in adverse biodiversity effects. These risks should be mitigated by designating a preferential legal status except where there is clear evidence that projects have major adverse effects on the environment and society which cannot be mitigated or managed, maintaining a high priority for biodiversity effects.

   b) **Dedicating sufficient land to renewable energy projects**, such as designating specific renewable energy zones as well as ensuring there are no overwhelming restrictions to renewables development (e.g., restrictive setback distances between onshore wind turbines and residential developments). Where possible land should be allocated in areas which have no or limited effect on the natural environment and wildlife, and limited impacts on communities and existing industries.
3. **Reduce the time taken in permitting stages**. Actions taken to streamline processes through setting and enforcing more ambitious permitting targets should be made alongside improvements to administrative processes, such as ensuring there are sufficient staff in permitting departments and other relevant authorities, to ensure that there is capability to progress applications using the new accelerated processes.
4. **Increase the flexibility of permits**. Where possible, permitting should be made more flexible. In the case of repowering existing assets, these should go through an expedited process and not be subject to applying for an entirely new permit. General permit applications should also be more flexible and move

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[37] Whilst this is the first time that the EU has designated renewable energy as being of overriding public interest across the board, the term "imperative reasons of overriding public interest" (IROPI) was introduced as part of the "Habitats Directive" in January 2007 to ensure that member states take all compensatory measures necessary to ensure that the overall coherence of the Natura 2000 network of nature protection areas is protected. See: https://ec.europa.eu/environment/nature/natura2000/management/docs/art6/guidance_art6_4_en.pdf

[38] European Commission (2022), *Amending Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources*.

towards a "box model"[39] of permitting where appropriate, which gives developers the flexibility to alter the positioning of their turbines and increase/decrease hub heights and rotor speeds within a given range without having to apply for an entirely new permit.

5. **Streamline and clarify the legal process.** Countries must ensure that legal processes are fit for purpose for a world needing a massive scale-up in renewable energy, that a sufficient screening process is in place for legal challenges, that the maximum number of legal appeals is limited, and the window for legal challenges has boundaries. These regulatory backstops can provide a clear endpoint in negotiations of conflicts of interest between consultees or differing areas of policy.

6. **Establish legal ownership**. In politically unstable countries where property rights have not been fully assigned, legal ownership of land must first be established before renewable energy projects can be built on this land.

As well as this set of regulatory solutions, general regulation can also be used on a more interventionist basis to accelerate deployment in instances where the pros far outweigh the cons. For example, governments could mandate that solar should be installed on "no regrets" areas, such as on rooftops, car parking sites, above rail and road lines, and on old industrial sites. The potential increase in energy generation from these sites can be substantial, as outlined for rooftop solar in the US in Box 3.1.

Solutions to regulatory barriers

Exhibit 3.1

▶ = Potential to accelerate

			Site mapping and selection	Environmental surveys	Stakeholder consultation	Permitting	Grid connection	Legal challenges
1	Strategic vision	Create a strategic vision of the power system with medium-term targets	▶▶			▶▶	▶▶	▶▶
2	Ensure renewables are appropriately prioritised in law and land use	Assign priority status to renewable energy projects	▶▶	▶		▶▶	▶▶	▶▶▶
		Dedicate sufficient land to renewable projects	▶▶▶	▶		▶▶		▶▶▶
3	Reduce the time taken in permitting stages	Set streamlined permitting targets		▶▶		▶▶▶		
		Enforce permitting targets				▶▶▶		▶▶
4	Increase the flexibility of permits	Streamline repowering processes	▶	▶		▶▶		
		Utilise flexible 'box permits'		▶		▶▶		
5	Streamline and clarify legal process	Limit the number and extent of legal challenges						▶▶▶
6	Establish legal ownership	Assign property rights where these are limited	▶▶					

The EU has proposed assigning legal status of 'overriding public interest' to renewable projects

Texas created Renewable Energy Zones (REZs) to enable fast permitting of grid and wind infrastructure, to build wind in the west and use in the east

In Spain certain projects can bypass EIA procedures as long as authorities do not object within 2 months

Sweden's 'box permits' provide developers the flexibility to optimise turbine features during development

Note: Permitting includes both permit applications and permit examination.

Sources: European Commission (2022), *REPowerEU: Commission steps up green transition away from Russian gas by accelerating renewables permitting*; National Renewable Energy Laboratory (2016), *Renewable energy zones: delivering clean power to meet demand*; BloombergNEF (2022), *Fast Permitting and Floating Solar in Iberia*; Eclareon (2020), *Technical support for RES policy development and implementation – Sweden.*

[39] In offshore wind this is referred to as the "design envelope" or the "Rochdale envelope" in the UK. Developers advocate for this strongly given that EIAs or permits have to be defined before they have complete certainty on final design or installation methods.

The potential for rooftop solar in the US

Box 3.1

According to analysis by the US National Renewable Energy Laboratory (NREL), in 2016 there were over 8 billion square metres of rooftops suitable for solar panel installation in the US (out of a total rooftop area of 33.5 billion square metres), representing over 1,100 GW of potential capacity and over 1,400 TWh of annual energy generation.[40] This 1,100 GW potential could fulfil most of the Department for Energy's zero-carbon grid targets of 1,600 GW of solar capacity by 2050.[41]

Whereas retrofitting solar on existing rooves may be best done through incentivisation, it is easier to mandate that new building stock and roof replacements are designed in such a way that rooftop solar can be installed. NREL estimate that an average of 3.3 million US homes per year will be built or require roof replacements in the coming decade – representing a potential of approximately 30 GW of "no regrets" solar capacity per year that could be tapped into through firmer regulation.[42] If even a small fraction of these new rooves had solar installations, it could have a significant impact on US power generation.[43]

Solutions to administrative barriers

The key solutions to mitigating administrative barriers involve making the permit application and examination process more efficient and streamlined and creating better data sharing, such as via improved environmental data banks and digital mapping tools. These are outlined in Exhibit 3.2.

Key considerations of the actions required to improve administrative systems associated with renewable development are outlined below. More information on the key solutions including direct actions and case studies can be found in the national/regional governments and policymakers Solutions Toolkit.

1. **Speed permitting applications and examination.** This set of solutions should ensure developers can have a single point of contact for applications, in departments that are adequately staffed and trained, with clear digital permitting processes, which should all significantly speed permit application and examination. In tandem with these recommendations, permitting processes must be clearly defined and include a sequential description of the application

Solutions to administrative barriers

Exhibit 3.2

▶ = Potential to accelerate

		Site mapping and selection	Environmental surveys	Stakeholder consultation	Permitting	Grid connection	Legal challenges
1 Speed permitting applications and examination	Create one-stop-shops for permitting				▶▶▶		
	Sufficiently staff permit roles				▶▶▶		
	Digitise the application and permitting process				▶▶▶		
2 Create better environmental mapping tools	Better government environmental data banks	▶▶	▶▶▶				
	Digital mapping tools to aid deployment planning	▶▶▶	▶▶▶				

The Danish Energy Agency serves as a one-stop-shop for offshore wind procedures, requiring only 3 permits

In Spain digital mapping of wildlife in Natura 2000 zones provides an overview of detail required in environmental assessments

Note: Permitting includes both permit applications and permit examination.

Sources: Eclareon (2021), *Technical support for RES policy development and implementation – Denmark*; Energy Cities (2022), *Human capacity in local governments: the bottleneck of the building stock transition*; RESMonitor (Accessed November 2022), *Environmental zoning tool for PV and Wind projects in Spain.*

40 NREL (2019), *Rooftop Photovoltaic Technical Potential in the United States.*

41 Energy.Gov (2021), *DOE Releases Solar Futures Study Providing the Blueprint for a Zero-Carbon Grid.*

42 NREL (2018), *Cost-Reduction Roadmap for Residential Solar Photovoltaics (PV), 2017-2030.*

43 The potential for rooftop solar across the world today stands at around 7,500TWh (or one-third of global electricity demand) and is projected to increase up to 25,000 TWh by 2050. See: Schneider Electric (2022), *The unexpected disruption: Distributed generation.*

process, individual responsibilities, an overview of required documentation, and outlined deadlines for each stage of the process.[44] Furthermore, resourcing departments sufficiently to process multiple applications at the same time would speed up overall deployment.

2. **Create better environmental mapping tools.** Governments can take a lead in environmental mapping processes, conducting initial environmental assessments and displaying the results of these using digital tools. This can provide developers with an initial understanding of the landscape and ensure they do not have to start the process from scratch with every Environmental Impact Assessment. While these tools will be helpful across the industry, they should not preclude a project from being able to start if the developer can collect the data themselves.

Increasing societal support

Key to society welcoming renewable energy infrastructure is ensuring that local stakeholders: have a clear understanding of the overall societal benefits of a transition to clean power as well as some of the local impacts that will entail (e.g., contribution of wind and solar to overall climate goals; improved local air quality; energy security and local control over energy sources; local financial benefits and jobs; landscape changes); are inclusively engaged early and appropriately throughout the process, are not unduly undermined or economically hurt by renewables projects. As part of this process, developers should work to employ biodiversity-positive strategies,[45] and government auctions should recognise biodiversity and social effects in the auction tender process. Key actions to increase societal support are outlined in Exhibit 3.3:

Actions to increase societal support

Exhibit 3.3

▶ = Potential to accelerate

		Site mapping and selection	Environmental surveys	Stakeholder consultation	Permitting	Grid connection	Legal challenges
1 Stakeholder engagement	Ensure effective stakeholder engagement		▶	▶▶			▶▶▶
2 Responding to local concerns and benefits-sharing	Ensure benefits sharing with local communities	▶▶▶		▶▶			▶▶▶
	Improve aesthetic design of renewable technology	▶		▶			▶
3 Biodiversity conscious development	Implement biodiversity-conscious approaches to siting and construction	▶▶	▶	▶	▶▶		▶▶▶
	Implement company-level biodiversity positive strategies	▶▶▶	▶	▶▶	▶▶		▶▶▶
4 Community awareness	Maximise community-readiness for the energy transition	▶▶		▶▶			▶▶
5 Tender processes which recognise non-price factors	Recognising biodiversity and social effects in auction tender processes	▶▶		▶▶			▶▶

In Germany developers have the option to pay local communities 2 €/MWh, which could equal 2000 EUR per hectare, per year

In Brazil Iberdrola are creating a biodiversity corridor connecting forest and permanent conservation areas as part of their net positive impact on biodiversity by 2030 goal

Strong opposition to solar in UK Conservative leadership election, despite solar farms taking up less than 0.1% of land space

Note: Permitting includes both permit applications and permit examination.

Sources: RESMonitor (Accessed November 2022), *Financial incentive to communities in Germany*; Iberdrola (Accessed November 2022), *How do we protect and preserve biodiversity on some of our more flagship projects?*; Carbon Brief (2022), *Factcheck: Is solar power a 'threat' to UK farmland?*

[44] Where projects cross multiple jurisdictions or require permits from multiple entities a permitting roadmap specific to a particular technology can help streamline permitting by determining permit sequencing, establishing how authorities will conduct reviews and work together, and specifying review and approval timelines. In the US, the FAST-41 process is a mechanism for improving consultation and coordination between federal agencies and is applied to certain utility-scale infrastructure projects. See: https://www.energy.gov/oe/mission/transmission-permitting-and-technical-assistance-division/fast-41

[45] Biodiversity positive strategies to development, land and marine management aim to leave biodiversity in a better state than before the development took place.

Key considerations of the actions required to improve societal support of renewables are outlined below. More information on the key solutions including direct actions and case studies can be found in the three supporting solution toolkits.

1. **Stakeholder mapping and engagement**. There are a variety of stakeholders relevant to new environmental developments (e.g., environmental campaign groups, trade groups, landholders, indigenous communities, etc.). Stakeholders should be mapped out to understand what is important to each actor, and an engagement plan should then be developed. Every community may have different priorities. Some may be concerned about visual appeal, others about biodiversity impacts such as potential bird collision rates, or economic benefits and jobs, or land rights, and others still may push for complementary environmental benefits, such as new beehives installed alongside solar farms. Whilst this is generally part of the permitting process, mapping and engaging stakeholders early and appropriately (e.g., understanding the potential for conflicting areas and community concerns) can ease project development by guiding developers towards a range of project-specific solutions.
2. **Responding to local concerns and benefits-sharing**. Societal support can be enhanced by ensuring that local communities are not damaged economically by new renewable energy plants. Key tools to achieve this include working to ensure that projects can complement local economic activity where possible, providing local jobs, a direct financial benefit from the project to the community, or assisting in the development of other local infrastructure. Income from renewable project sources for the community could be bound to specific public policy measures that benefit citizens like social services (e.g., nurseries, health services) or infrastructure (e.g., roads or public transportation). It is important that the benefits-sharing strategy reflects the local community's/region's needs and aspirations. While large-scale renewables deployment will be necessary to meet climate goals, in some cases community-owned smaller scale projects could play a significant role in ensuring buy-in.[46]
3. **Biodiversity positive strategies** will be essential to both ensuring biodiversity is sufficiently protected, and minimising legal challenges as the pace of renewables deployment scales to hit decarbonisation targets. This should be conducted at project level, where developers manage impacts on biodiversity through avoidance, reduction and mitigation of key impacts, such as avoiding protected areas, selecting appropriate installation methods, and considering how design can affect bird migration routes.

   There are also benefits associated with developers setting targets to be net-biodiversity-positive (i.e. to provide an overall benefit to biodiversity on the land and sea in which their projects are located). Both Orsted and Iberdrola, two large renewables developers, have signed targets to be net-biodiversity-positive by 2030, which includes both best-practice siting and construction at a project level, but also biodiversity-positive actions for overall deployment and restoration at a developer level (e.g., through reintroduction of native species and rewilding of affected areas).[47] In theory, developers committed to having a positive influence on biodiversity may be subject to less legal challenges on nature grounds than those who take no mitigating action.[48]
4. **Increase community awareness of scale up challenges**. Even in areas where public support for the energy transition is generally/consistently high, some local regulations can be at odds with climate objectives.[49] Increasing awareness of the scale up challenges and trade-offs that come with scaling renewable energy systems should help mitigate concerns that renewables will end up taking over entire countrysides, or about 'finite resource' concerns with other land/sea users. For example, for the UK to scale up its current solar capacity by up to five times existing capacity (an additional 38 GW, enough to be on track for net-zero targets), analysis has shown this would take up less than 0.3% of UK land.[50] In other geographies where the transition is not as well supported, continued communication efforts around the importance of the energy transition are required.
5. **Tender processes which recognise non-price factors**. To ensure developers take steps towards positive biodiversity and social effects in their deployment plans, these factors should receive weighting in the auction tender processes for site lease awards and offtake agreements. The January 2022 EU State Aid Guidelines for climate, environmental protection and energy (CEEAG) for offshore wind, allow for member states to use non-price criteria (including social and biodiversity effects) to make up 30% of the weighting by which tenders are decided.[51]

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[46] More information on community ownership can be found in *Making Clean Electrification Possible* (2021), and the solution toolkits.

[47] Some centralised government coordination may be required, as developers may have multiple wind or solar plants at scale in certain markets, and limited locations where biodiversity positive actions can be deployed.

[48] Some geographies, such as England, are in process of introducing strict biodiversity net gain requirements, where developers will have to deliver at least a 10% net gain in biodiversity to be granted planning permission. See: https://www.local.gov.uk/pas/topics/environment/biodiversity-net-gain-local-authorities

[49] In the UK over 80% of the public is happy with increased levels of solar in their local area, see: Solar Power Portal (2022), *Over 80% of public happy with solar in their local areas in 'ringing endorsement' of technology*.

[50] Carbon Brief (2022), *Factcheck: Is solar power a 'threat' to UK farmland?*

[51] Examples of using non-price criteria can be found at - WWF (2022), *Accelerating offshore wind deployment in a nature friendly way*.

What are the biodiversity concerns related to wind and solar power generation?

What is biodiversity and how does renewable development affect it?

Biodiversity plays a crucial role in the composition and functioning of every ecosystem and their cycles: the water cycle, the food chain, the soil cycle. Keeping a good biological balance also helps to stabilise the climate and ensures humans have access to food, raw materials and clean water. Some currently challenge the development of renewable energy projects on the grounds of adverse impacts on biodiversity. Although renewable developments can impact biodiversity, negative impacts are either often misperceived or partly balanced by offsetting positive impacts.

Many environmental NGOs recognise this and tend to agree that the massive scale up of wind and solar to substitute away from fossil fuels is a positive ambition and can be delivered without major negative biodiversity impacts.[52]

Key considerations for wind turbines

Wind farms largely do not harm the utility of the land they are placed on; they are commonly located on farmland that continues to have other uses (e.g., as cropland, or grazing land); and when deployed offshore, turbines are generally spaced far enough apart so as not to prevent boats and ships from sailing through.

Impact on birdlife: The most commonly cited opposition to wind turbines on biodiversity grounds is bird deaths due to collisions with the rotor blades.[53] However, though bird deaths do occur they are often lower than other common causes of avian fatalities such as cars, windows or cats. For example the US Fish and Wildlife Service has found that as of 2017, on average 234,000 birds per year die from collisions with turbines, but this is less than 0.01% of the estimated 3.3 billion birds that perish each year in the US – and significantly less than the 215 million killed by vehicles, and the 2.4 billion killed by cats.[54]

Although overall bird deaths are not likely to be substantially increased compared to the status quo, a more significant issue is where rare or protected birds and bats may be at increased risk. In these cases, migration zones for protected species can be mapped and ideally avoided, and developers of onshore wind could use adaptive management techniques such as painting turbine blades black as a contrast colour – which in some cases has been found to result in 70% less collisions – and using sensors to pause turbine operations when rare birds are flying past, which has previously resulted in 80% less collisions.[55]

Impact on marine life: Impact on marine life is often cited as an impact of offshore wind development, however the overall net impact of offshore wind development has both positive and negative impacts. Whilst certainly disturbing to marine life during the installation phase, scientists have found some positive effects of offshore wind on marine life over project lifetimes, with some scientists noting that wind turbine areas are like artificial reefs, creating sanctuaries for marine life. An example of this is off the coast of Virginia Beach in the US, where algae and mussels have attached themselves to the structures while schools of fish – including mahi, sea bass and bait fish – now circle the foundations.[56] However others note there can be a negative effect of some displacement and reduction in fish and shellfish numbers.[57] In either case, collaborative, biodiversity-aware planning of projects will be a key mitigating factor as offshore wind expands to meet net-zero targets.

To balance and mitigate the significant impacts to marine and avian life, governments can take a lead in the environmental mapping process, conducting initial environmental surveys of their land and seabed space as part of the spatial planning process and displaying these results using digital mapping tools. They should require developers to share results of environmental studies to create a publicly available robust ecological evidence base to inform environmentally conscious siting of new wind farms.

52 WWF, for example, has a vision for a rapid transition towards net zero which is underpinned by a 'massive expansion in renewable energy technologies such as wind and solar' WWF (2022), *'Go-to-areas' for renewables: making the puzzle fit.*

53 Other concerns with birdlife in addition to collisions are present, e.g., that birdlife flight patterns will have to change to avoid wind turbines.

54 US Fish & Wildlife Service (2017), *Threats to Birds.*

55 Power Technology (2021), *The Power Environment: making wind turbines work for birds and bats.*

56 World Economic Forum (2021), *This is how offshore wind farms can become havens for marine life.*

57 European MSP Platform (2021), *Offshore wind and fisheries.*

Key considerations for solar farms

Compared to wind energy developments, there is currently limited scientific evidence of the impacts of solar developments on biodiversity. However, whilst some consider solar farms dangerous to biodiversity, some research has shown that they can actually benefit wildlife, especially when comparing best-practice solar developments to non-organic farms.

Recent studies have found that compared to land previously used for agriculture:

- Solar farms have been found to have a greater diversity of flora and birds when managed through grazing.[58]
- The patterns of shading created by the panels offers a wider range of habitats for plants, with those in the shade often flowering later. Pollinators generally need flowers into October, so a range of flowering times helps to extend the time they can spend foraging, benefiting populations of pollinators, including bumblebees and honeybees.[59]
- Below ground biodiversity may also benefit from solar farm installations, as the switch from intensive agriculture to permanent grassland means less fertiliser, insecticide and herbicide, and less disturbance from ploughing, though more evidence is needed to quantify this effect.[60]
- Solar farms last for 25 to 40 years and these sites, on which human disturbance is minimal, could offer shelter to wildlife and help to regenerate the soil.

Despite the potential positive effects, in some instances there can be negative effects from installing new solar farms, including habitat loss through clearance or displacement, which can lead to a reduction in species richness and density;[61] there is also potential for bird collisions with solar panels, particularly if panels are vertically orientated or reflecting light, though this is generally at much lower levels than wind turbines.[62]

Solar farms do not need to be installed instead of traditional grazing fields, as solar panels can be built on top of traditional farmland in a process known as 'agrisolar'. Farmers who would like extra income from leasing their land for solar, will see larger gains if that land also stays in production. If solar panels are sufficiently raised and spaced there can be plenty of space for livestock (including cattle, goats and sheep) to graze and thrive underneath rows of solar panels.[63] SolarPower Europe have created guidelines on best-practice agrisolar which details how to make this work in practice.[64]

58 Montag et al. (2016), *The effects of solar farms on local biodiversity: a comparative study.*

59 Renewable and Sustainable Energy Reviews (2021), *Opportunities to enhance pollinator biodiversity in solar parks.*

60 The Conversation (2022), *Solar farms a 'blight on the landscape'? Research shows they can benefit wildlife.*

61 As demonstrated by a study on birds Visser et al. (2009), *Assessing the impacts of a utility-scale photovoltaic solar energy facility on birds in the Northern Cape, South Africa.*

62 Kosciuch et al. (2020), *A summary of bird mortality at photovoltaic utility scale solar facilities in the Southwestern U.S.*

63 Greenpeace (2022), *Farming and solar panels can work together – here's the proof.*

64 SolarPower Europe (2021), *Agrisolar best practice guidelines.*

What impact can solutions have on project timelines?

The regulatory, administrative, and societal support solutions described in this report have the potential to significantly accelerate multiple project stages. Accelerating each project development stage will expedite overall timelines for wind and solar, significantly reducing overall time of development by as much as over 50% for wind and 75% for solar[65] (though reaching these levels would likely require the entire set of solutions to be implemented where these are not currently sufficiently utilised in respective countries, and more stages to be conducted in parallel, see exhibits 3.5, 3.6, and 3.7) [Exhibit 5.1].

Whilst each stage of project development can be expedited, there are limits to the speed that each stage can be completed without compromising on overall project quality, such as ensuring that habitats are respected, communities are protected, and deployment does not lead to significant increases in curtailment and system inefficiencies. The view of expedited times illustrated in Exhibits 3.4–3.7 has been arrived at through consultation with developers, industry bodies and environmental NGOs, and reflects a view of achievable accelerated timelines without compromising overall project quality.

Project development stages can generally be significantly expedited, with largest gains in permitting, legal challenges and grid connection

Exhibit 3.4

Development stage	Technology	Indicative time	Expedited time	Time savings
Site mapping and selection	Onshore	2 years	1 year	– 1 year
	Offshore	2 years	1 year	– 1 year
	Solar	4 months	2 months	– 2 months
Environmental surveys	Onshore	3 years	1.5 years	– 1.5 years
	Offshore	3.5 years	2 years	– 1.5 years
	Solar	1.33 years	4 months	– 1 year
Stakeholder consultation	Onshore	9 months	9 months	None recommended
	Offshore	9 months	9 months	None recommended
	Solar	9 months	4 months	– 5 months
Permit applications and examination	Onshore	3 years	1 year	– 2 years
	Offshore	4 years	1.5 years	– 2.5 years
	Solar	2 years	3 months	– 1.75 years
Obtaining grid connection	Onshore	3 years	9 months	– 2.25 years
	Offshore	4 years	1 year	– 3 years
	Solar	1.66 years	1 month	– 1.5 years
Legal challenges	Onshore	7 years	1 year	– 6 years
	Offshore	9 years	1.5 years	– 7.5 years
	Solar	3.33 years	4 months	– 3 years

Offshore wind ÷2
From a 12 year indicative timeline to a 5.5 year expedited timeline.

Onshore wind ÷2
From a 10 year indicative timeline to a 4.5 year expedited timeline.

Solar ÷4
From a 4 year indicative timeline to a 1 year expedited timeline.

[65] This analysis is based upon an assessment of indicative timelines across wind and solar technologies worldwide, and as specified in detail in Exhibits 2.3, 2.4 and 2.5. The assessment of potential to streamline and condense timelines across stages is based on a standardised view across markets.

Though precise savings will vary by project and geography, we identify the key opportunities and minimum timelines to be as follows:

- **Site mapping and selection could be reduced by 2 months to 1 year**
  - For onshore and offshore wind farms this time is limited by the physical speed at which governments can conduct the mapping of the land and complete the auction process to lease the seabed/land space.[66]
  - Solar sites can be mapped and sold much quicker, as long as regulations do not prohibit the sale of certain land to be used for solar generation.
- **Environmental surveys could be reduced by 1 to 1.5 years**
  - For onshore wind, although some time could be reduced, time savings are limited as extensive surveys must be undertaken, for example to understand flight paths and migration habits of birds and bats.
  - For offshore wind, in addition to surveying bird life, marine life must be considered, and surveys have to take place over water, which further limits time savings.
  - Solar surveys can be much shorter as there is a much lower likelihood of bird collisions. However in Europe, if there are known to be nesting birds, this stage is generally limited to at least 12 months.[67]
- **Stakeholder consultation could be conducted more in parallel with other stages**
  - For onshore and offshore wind each consultation round typically lasts ~3 months. Although shortening the time dedicated to stakeholder consultation is unlikely to be advisable, consulting stakeholders earlier, with fewer breaks in between rounds could deliver time savings.
  - Solar stakeholder consultation should start as soon as the site is secured (or even before this to inform the siting of the project), and developers should attempt to engage all relevant stakeholders early to achieve quick resolutions if needed, which is necessary to have project times of 1 year in best-case scenarios.
- **Permit applications and examination could be reduced by 1 year and 8 months to 2.5 years**
  - For onshore and offshore wind there is sufficient scope to cut permitting times by more than half by implementing best practices, with offshore permits taking longer due to the complex nature of projects.
  - Solar farms in most current forms are inherently less challenging to construct and permit, so the permitting process can be significantly expedited.
- **Obtaining grid connection could be reduced by 1 year and 3 months to 3 years**
  - For all technologies, grid connection times could be significantly expedited if the grid was built to have excess capacity and transparent connection points. Wind connection negotiations can take longer due to the overall longer project development times, whilst solar negotiations should happen faster due to the general tendency of smaller solar projects, and ease of curtailment when necessary.
- **Legal challenge window could be shortened by 3 to 7.5 years**
  - For all technologies the window to be legally challenged should start when permit applications begin, be open at least 4 months after submission of an EIA and should be closed before projects get to financial close to limit disruption.

Finally, it is important to note that these barriers and opportunities refer to grid-scale generation technologies, which represent the bulk of capacity required for the clean power scale-up. As discussed previously, maximising the deployment of small-scale generation which is inherently subject to less onerous planning and permitting requirements (e.g., rooftop solar) is a significant avenue to accelerate the deployment of clean energy generation.[68]

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66 For offshore wind, national authorities typically assume responsibility for analysing and selecting relevant site location tenders and then afterwards conduct preliminary site investigations (geotechnical and geophysical site characterization) to create a high level of project-specific transparency ahead of the bid auction. This assessment of timelines is based on this approach. However, there could be an opportunity to further reduce timelines if developers were able and willing to bid under uncertainty of site conditions, and then conduct geotechnical and geophysical site characterization in parallel to the EIA. The trade-off would be between faster deployment vs higher bids and lower probability of realisation.

67 It is worth noting that these stages have the potential to be significantly further expedited across all technologies if governments managed better environmental data banks and made these available to developers.

68 Current proposals for amendments to REPowerEU legislation indicate an obligation to ensure that permits to install solar energy equipment on buildings are delivered within three months. For smaller installations below 50kW, a simple notification procedure would be enough. Installing solar equipment would be exempt from the requirement to conduct an environmental impact assessment. See https://www.europarl.europa.eu/news/en/press-room/20221114IPR53911/energy-crisis-meps-back-plans-to-boost-the-deployment-of-renewables

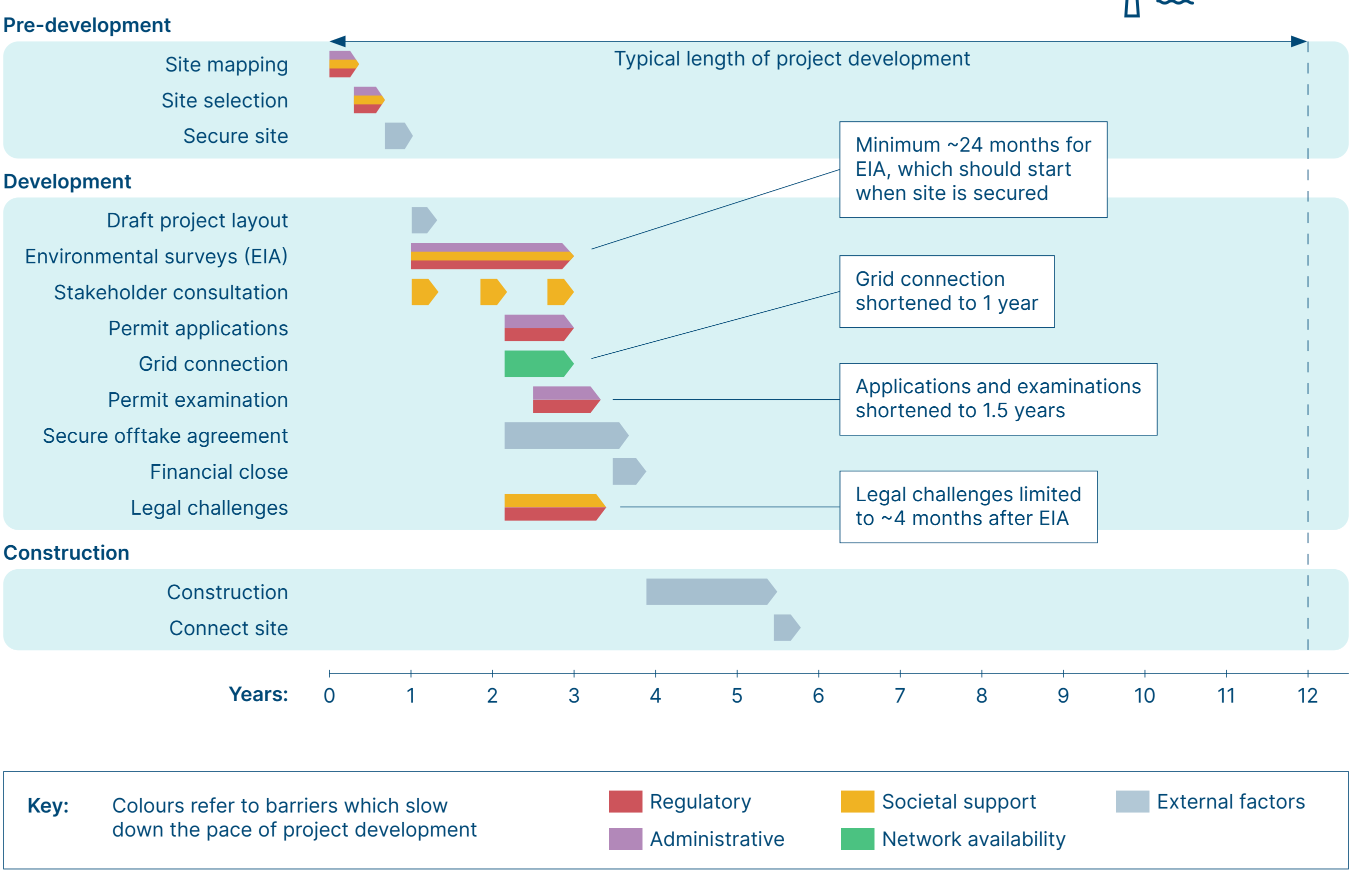
How do solutions impact each technology?

Planning and permitting solutions can have positive effects on almost all stages of project development, condensing development timelines to optimal levels.

Mitigating key barriers can save over 6 years for offshore wind

Exhibit 3.5

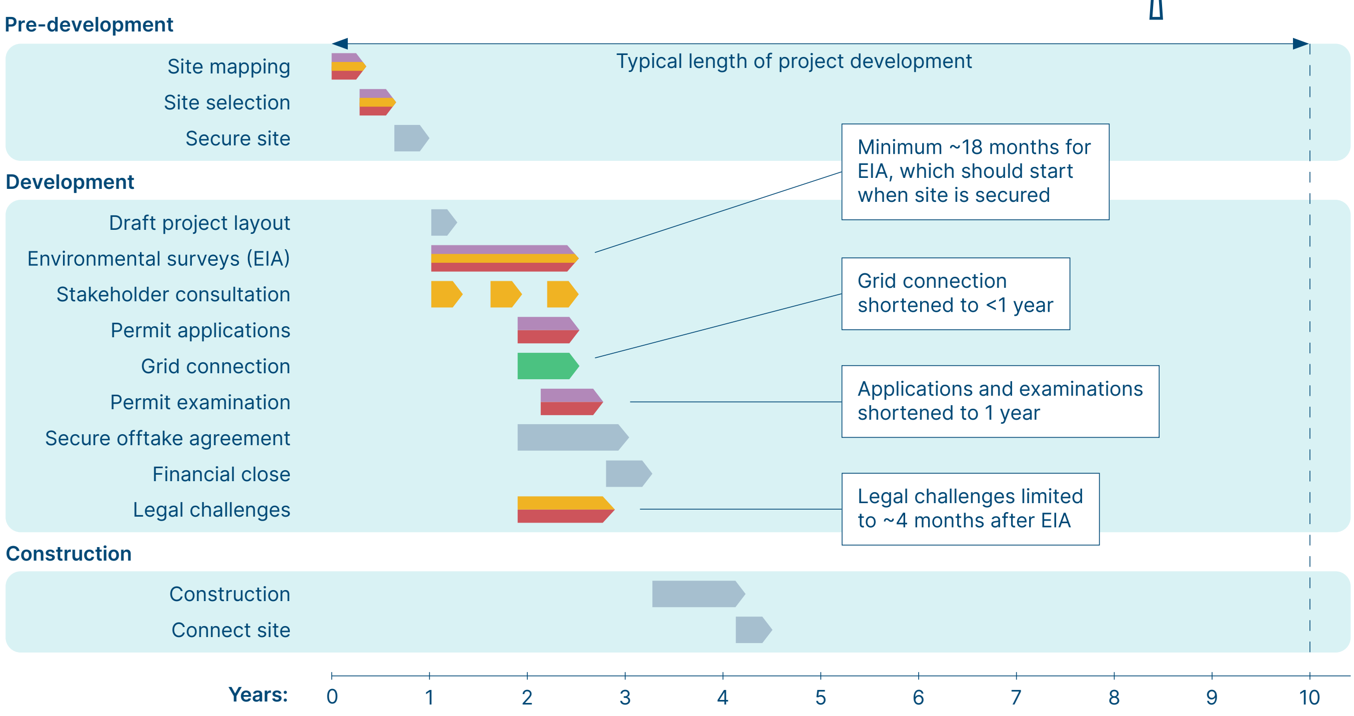
Renewable project development stages – illustrative example for expedited offshore wind farm deployment



Mitigating key barriers could save 5 years for onshore wind

Exhibit 3.6

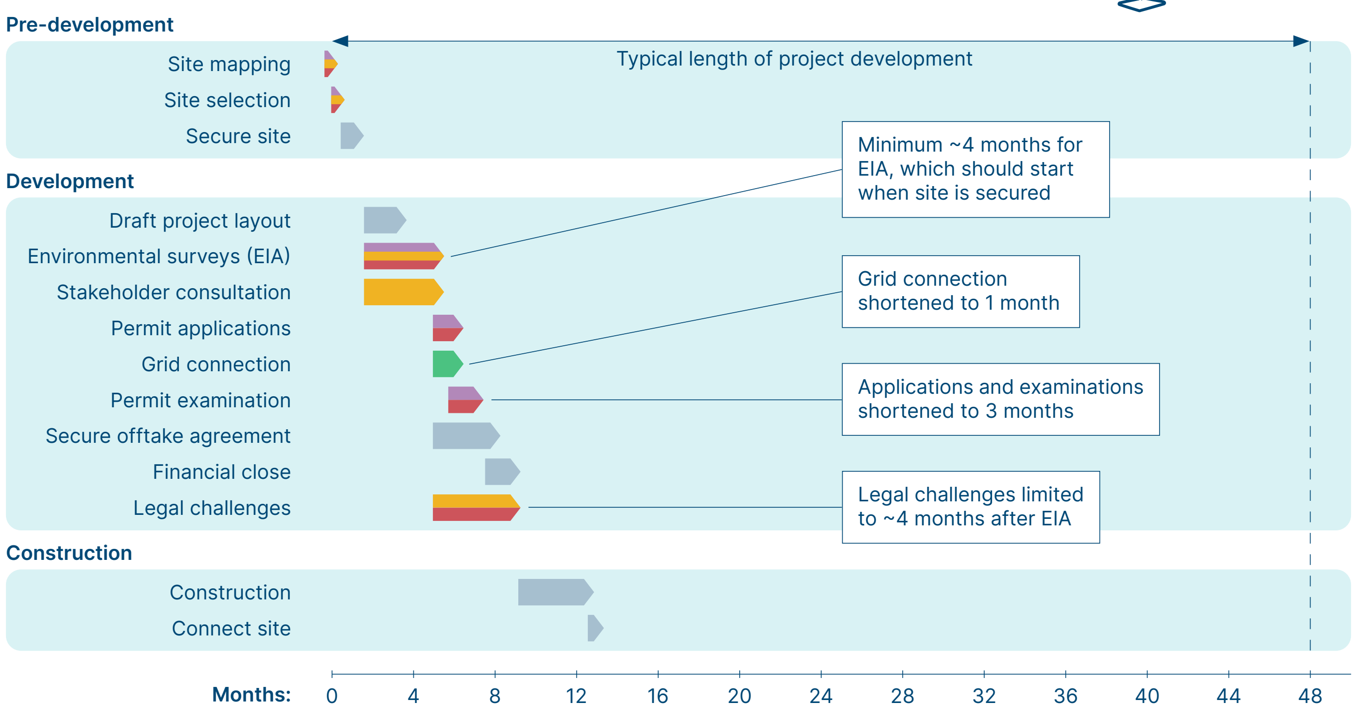
Renewable project development stages – illustrative example for expedited onshore wind farm deployment



Mitigating key solar barriers can reduce deployment time by three quarters

Exhibit 3.7

Renewable project development stages – illustrative example for expedited 5 MW utility-scale solar deployment



Key: Colours refer to barriers which slow down the pace of project development

Regulatory
Administrative
Societal support
Network availability
External factors

Regional considerations

4

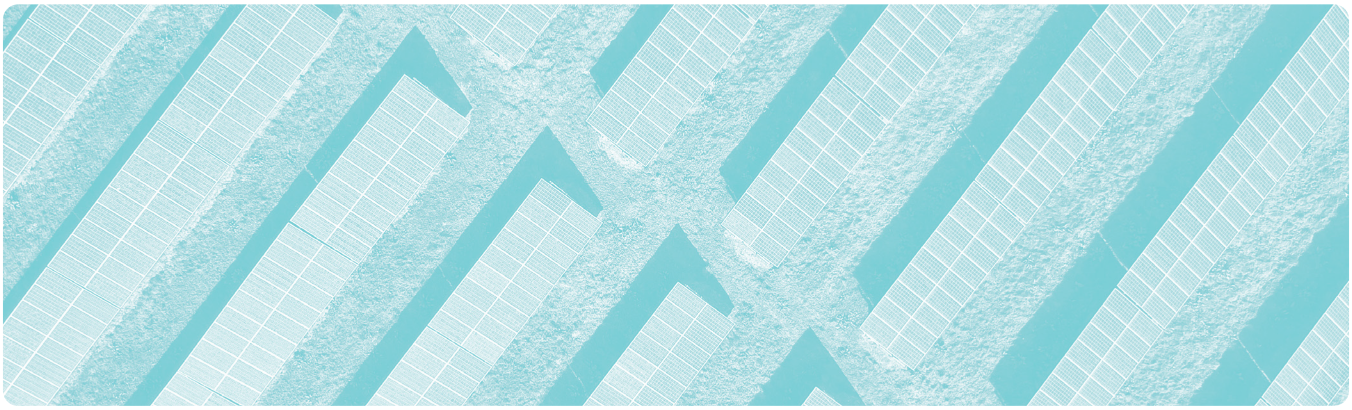
Planning and permitting processes and issues differ vastly depending on the local political context. In countries with strong democratic processes, regulatory, administrative and societal support considerations tend to make processes more lengthy than in some centrally-led countries. Land-constrained countries also face a much more challenging planning and permitting environment than areas with low population density.

- In centrally-led countries like China and Vietnam, there is generally less scope for legal challenges, meaning that there is less of an obligation to conduct extensive stakeholder consultation and environmental surveys, resulting in less severe societal support barriers and fewer regulatory and administrative barriers.
- In countries with strong democratic processes such as the US and EU nations, planning and permitting creates challenges through regulatory and administrative barriers, with long drawn-out processes often delaying deployment by many years. There can also be organised local opposition to projects, and legal systems which respect these challenges. Grids could be better developed across the board, particularly in the US, which has an interconnection queue of renewables at over 1.4 TW.
- Severely land-constrained countries such as Japan and Korea can accumulate disadvantages when they also have long regulatory processes, this has led to Korea having one of the longest project development times for offshore wind in the world, at up to 15 years.[69] These regions may have to take more severe actions to allocate sufficient land and sea space and take even earlier action to develop their grids.
- Infrastructure-constrained countries – a few examples being the Democratic Republic of Congo, Burundi and Niger – generally have bigger issues than planning and permitting when it comes to deployment of renewables. If there is not a sufficient grid in place, and land ownership is disputed, then it makes it much harder to deploy renewables at scale in the first place. Furthermore, there are significant real economy and financial barriers that stymie the deployment of renewables in these geographies.[70]

Whilst centrally-led countries can deploy renewables faster than anywhere else in the world, there are some drawbacks to bypassing sections of the planning and permitting process, outlined in Exhibit 4.1.

More democratic countries tend to feel planning and permitting barriers much more severely, as outlined in Exhibit 4.2.

Given that democratic countries are most severely affected by planning and permitting barriers, they also have the most to gain. However it should be noted that whilst expediting planning and permitting processes is necessary for the world to stay in touch with climate goals, there may be some trade-offs with individual freedoms that have led to these barriers in the first place, our Solution Toolkits outline actions that aim to strike the right balance between respect for biodiversity, social impacts, and accelerating deployment.



[69] BNEF (2022), *South Korea: A Burgeoning Offshore Wind Market?*

[70] One of the largest barriers to deploying renewables in these countries is the high cost of capital they face. This issue will be explored in detail in the upcoming ETC finance report: ETC (forthcoming early 2023), *Financing the Transition.*

Centrally-led countries have a permissive environment where some barriers can be bypassed, but this can have consequences

Exhibit 4.1

Regulatory

Do adverse regulations hinder renewable projects?

Key factor:
Land acquisition can be mandated, permitting rules sped up where needed.

Case study:
Vietnam offered generous Feed-in-tariff payments and softened regulations in 2017 enabling wind farms to be built in 1 year, sparking a construction frenzy.

Drawback:
Generators are forced to stop generating for 12 days a month due to grid buildout not keeping up with generation.

Barrier significance:

Administrative

Is permitting infrastructure a blocker?

Key factor:
Generally less paperwork and bureaucracy in state-owned companies.

Case study:
China's largest energy and construction companies are state-owned so permits can be directly granted, and companies can start construction immediately.

Drawback:
Lack of due process can lead to inefficient planning of resources.

Barrier significance:

Societal support

Is public resistance responsible for slowing projects?

Key factor:
Less weight given to public opposition to infrastructure projects.

Case study:
Very limited local opposition in Gulf Cooperation Council states, leading to limited legal challenges and enabling fast deployment.

Drawback:
People's rights can be infringed upon, and significant biodiversity harm can be inflicted.

Barrier significance:

Network availability

Can projects obtain connection to grid infrastructure in good time?

Key factor:
Renewable developers can be guaranteed an immediate grid connection.

Case study:
China have used renewable purchasing obligations since early 2006, requiring grid companies to purchase all possible renewable energy.

Drawback:
Lack of strategic planning has led to inefficient deployment, and contributed to large curtailment and rolling blackouts in China.

Barrier significance:

Sources: Al Jazeera (2022), *After renewables frenzy, Vietnam's solar energy goes to waste*; ClydeCo (2022), *Saudi Arabia: Changes in the construction liability regime and the introduction of a mandatory inherent defects insurance scheme*; IEA (2021), *Renewable Energy Law of the People's Republic of China*.

In countries with strong democratic processes constraining factors limit the pace of deployment

Exhibit 4.2

Regulatory

Do adverse regulations hinder renewable projects?

Key factor:
Lack of land and sea space, and strict regulations for new developments.

Case study:
In South Korea the permitting process for an offshore wind farm can take up to 15 years.

Largely due to lengthy environmental impact assessments, and obtaining community acceptance from the local fishing industry.

Barrier significance:

Administrative

Is permitting infrastructure a blocker?

Key factor:
Poorly designed systems and staff shortages lead to insufficient monitoring and target enforcement.

Case study:
The EU has a 24 month permitting deadline for onshore wind permitting, but limited means of tracking/enforcing targets.

All EU countries overshoot the target, ranging from 30 months in Romania to 120 months in Croatia.

Barrier significance:

Societal support

Is public resistance responsible for slowing projects?

Key factor:
Significant weight is given to public opposition.

Case study:
German public opposition to new overhead transmission lines has led to the average planning, permitting and consulting process for transmission investments being more than 10 years.

Barrier significance:

Network availability

Can projects obtain connection to grid infrastructure in good time?

Key factor:
Lack of anticipatory investment in grids means projects spend longer waiting for a grid connection.

Case study:
The average time utility scale power projects in the US spend in interconnection queues has increased from 2.1 years in 2010 to 3.7 years in 2021. This has led to 1.4 TW of renewable projects in grid queues that may not be built unless processes are expedited.

Barrier significance:

Sources: BNEF (2022), *South Korea: A Burgeoning Offshore Wind Market?*; EMBER (2022), *Ready, Set, Go: Europe's race for wind and solar*; RECHARGE (2018), *Public opposition to power lines threatens the energy transition*; Berkeley Lab (2022), *Queued Up: Characteristics of Power Plants Seeking Transmission Interconnection as of the End of 2021*.

Conclusion: action required in the short-term, with a critical role for governments

5

There is a lot to gain from mitigating the barriers to slow planning, permitting and land acquisition, and actions need to be taken to improve regulation, administrative and societal support if that is to happen. Addressing these barriers will be critical to ensure the deployment of renewables at the speed and scale required to support climate objectives.

Three key stakeholders are responsible for driving action in this space: national/regional governments and policymakers, wind and solar developers, and civil society and local governments. National/regional governments and policymakers bear the largest responsibility for driving progress, particularly to address restrictive regulation and administrative factors.[71] Developers can use best-practice to deliver projects that minimise environmental and social impacts and work for local communities. Local governments and civil society can also play a role [Exhibit 5.1]. All key actions across stakeholder groups are explained comprehensively in our Solution Toolkits, which can be used as a guide to developing better systems associated with clean power development.

Whilst the full suite of actions will be critical to reduce planning and permitting times over the medium and long-term, some of these actions will take longer to implement than others. To accelerate deployment in the short-term, governments will need to act urgently and take bold decisions to ensure renewables are sufficiently prioritised, without delaying medium and longer-term action. In particular, for the short-term, permissive actions can help to rapidly accelerate deployment. For example, applying the rule of positive silence, so that certain permit applications not responded to within a certain amount of time will be granted automatically, as in Spain,[72] or encouraging solar panels to be installed on all suitable buildings (e.g., car parks, as in France,[73] or new-build public buildings and factories, as in China).[74] Another immediate priority for governments should be to ensure an increase in staff within permitting departments, to ensure that the increased number of permit applications can be managed.

Links to solution toolkits:

1. Actions for national/regional governments and policymakers
2. Actions for wind and solar developers
3. Actions for civil society and local authorities

[71] The national/regional governments stakeholder group refers to the authorities who are responsible for major regulation and/or house the administrative bodies. This may be at the supranational level (e.g., EU), national level (e.g., UK), or at regional/federal level, (e.g., US or Germany).

[72] Only for PV projects smaller than 150 MW and wind farms under 75 MW to enable then to bypass the country's lengthy Environmental Impact Assessment Procedure, provided projects are in low or moderate environmentally sensitive areas. BNEF (2022), *Fast Permitting and Floating Solar in Iberia*.

[73] Electrek (2022), *In France, all large parking lots now have to be covered by solar panels*.

[74] Climate Change News (2022), *China's ambitious rooftop solar pilot helps drive 'blistering' capacity growth*.

Key actions to speed deployment this decade

Exhibit 5.1

National/regional governments and policymakers

- Create and communicate a strategic vision of the power system
- Assign priority development status to renewables
- Dedicate sufficient land
- Set and enforce permitting targets
- Streamline and clarify legal process
- Create one-stop-shops for permitting
- Sufficiently staff and train permitting departments
- Digitalise permitting process
- Streamline repowering processes
- Utilise 'box-model' permits where possible
- Create digital mapping tools to aid deployment planning
- Keep better environmental data banks and mandate developers to share study results
- Recognise biodiversity and social effects in auction tender processes

Wind and solar developers

- Ensure effective stakeholder engagement
- Implement biodiversity-conscious approaches to siting and construction
- Implement company-level biodiversity positive strategies
- Improve aesthetic design of renewable technology
- Ensure benefits sharing with local communities

Local authorities and civil society

- Maximise community-readiness for the energy transition
- Establish and support multi-stakeholder engagement processes
- Ensure local planning processes are comprehensive and departments are appropriately staffed

Key:
- Regulatory
- Administrative
- Societal support

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