

Will local ambition  
fast-track or  
frustrate the global  
energy transition?



The better the question. The better the answer. The better the world works.



# Contents



No one said the path to net zero would be a smooth one. Decarbonizing our world is, undoubtedly, the biggest challenge of the century. It will require all hands on deck; a plethora of hurdles will need to be overcome, and courageous decisions will have to be made.

Indeed, headwinds have emerged in the current macroeconomic environment, highlighted by rising interest rates, insecurity of supply chains and the increasing cost of renewables project development. The energy crisis, sparked by the war in Ukraine, also serves as a firm reminder of the limitations of interdependent power markets and the issues that can arise from a reliance on imported energy. Meanwhile, the commitment to energy security has never been stronger.

At the same time, we are seeing signs of a mid-year recession – and, given that such an environment typically facilitates spending and incentives for infrastructure projects, a generational opportunity has emerged for the renewables industry to turbocharge green energy demand more than subsidies have in the past. For larger economies, it could even drive growth through scaling up capacity in the push for energy independence.

Consequently, tailwinds have emerged in the form of innovative, game-changing policy, the most prominent of which is the US Inflation Reduction Act (the Act), which earmarks a combined US\$369b for investment in energy security and climate change.<sup>1</sup> In this edition of RECAI, we explore the impact and influence of the Act on renewables investment activity across global markets.

A broad range of renewable energy sources, vectors and applications – from wind and solar to newer innovations such as hydrogen and electric vehicles (EVs) – will get a major boost from tax credits, and new investment opportunities have been sparked throughout the supply chain. It's early days – the Act was passed in August 2022 – but, in its first six months, more than US\$90b<sup>2</sup> of capital investment has flooded into US clean energy development.<sup>3</sup> Given that, in 2022, a total of US\$50b<sup>4</sup> was invested, of which US\$40b came in the three months after the Act's passage, its colossal role in catalyzing investment in renewables cannot be overstated.

Equally important is that the legislation has sparked a race to the top among international markets eager to boost the competitiveness of their renewables industry. For instance, in response to the Act, the European Union announced its Green Deal Industrial Plan,<sup>5</sup> which offers support for the development of green technologies, with a target to manufacture 40% of the products and equipment it needs for net-zero technologies.

India has also stepped up investment and aggressively raised targets for its renewables industry. This edition of RECAI takes a deeper dive into developments there as the market aims to become a significant exporter of green ammonia and hydrogen.

Of course, it would be remiss not to acknowledge that the current path to net zero comes with risks. The Act intensifies competition for capital, and some markets could be left further behind. Domestic renewable energy supply chains could accelerate markets' broader economies, but the increased pressure on supply chains will require new partnerships to be developed, and this will take some time.

Increased competition will accelerate the energy transition, however, as exemplified by the fact that global investment in energy transition technologies rose 19% in 2022, to a record high.<sup>6</sup> This will speed up development of nascent green technologies that will benefit the world by combating climate change.

With policy support for renewables bolstered in numerous markets, a unique opportunity has emerged for the industry, worldwide, to double down on efforts to stimulate renewables supply and demand and accelerate economies.

There may be some twists and turns to navigate on the road to net zero, but the path is becoming clearer, and the speed of travel is increasing.

## Key takeaways

- ▶ The limitations of relying on imported energy have been highlighted by recent world events and markets' strengthened commitment to energy security.
- ▶ The current economic climate, with its inflationary pressures, could facilitate spending and incentives for infrastructure projects, enabling even greater opportunities for the renewables industry to turbocharge green energy demand.
- ▶ Innovative, game-changing policy – including the US Inflation Reduction Act – is set to boost a broad range of asset classes.
- ▶ The Act has accelerated investment into clean energy (and other decarbonization investments), but risks causing an imbalance in international capital allocation.
- ▶ Players looking to flourish in this new environment will need access to flexible capital and the full energy value chain, plus agility to operate in multiple jurisdictions.
- ▶ India is consolidating its leading position for solar and is on its way to becoming an exporter of green ammonia and hydrogen.



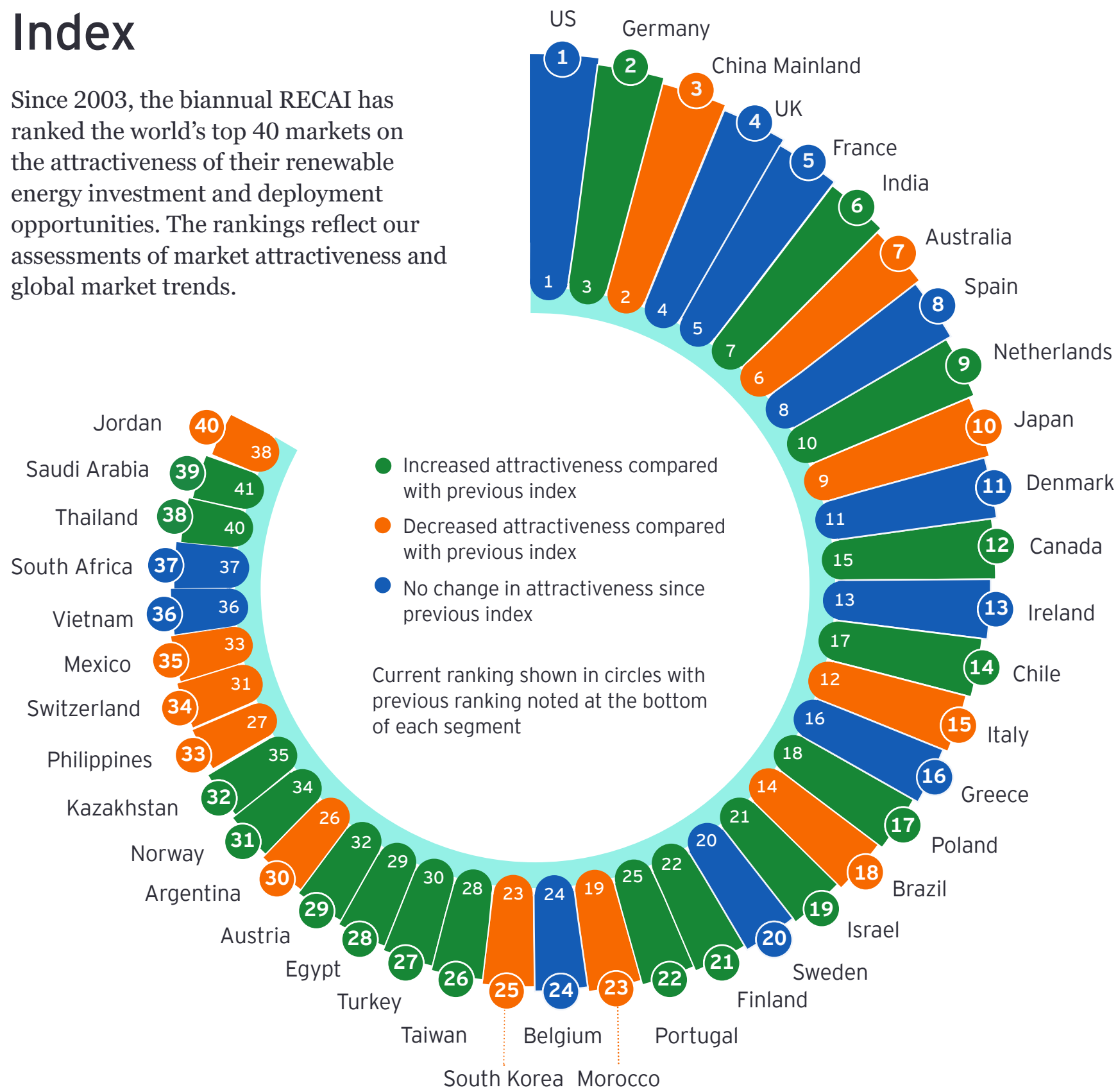
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# Index

Since 2003, the biannual RECAI has ranked the world's top 40 markets on the attractiveness of their renewable energy investment and deployment opportunities. The rankings reflect our assessments of market attractiveness and global market trends.



Recent global trends have had a significant and direct effect on renewable energy markets through both the gas crisis and supply chain concerns. To ensure a more relevant and appropriate reflection of the current investment climate the RECAI team has adjusted the model to be more reflective of the macroeconomic factors driving the attractiveness of individual markets. The model now has an increased weighting for the macro fundamentals pillar, which factors in the economic stability, ease of doing business and investment climate within markets.

## +1 Germany

The market is set to continue accelerating expansion of its solar photovoltaic (PV) sector as a core element of its decarbonization strategy, with the government setting targets of 11GW of ground-based and 11GW of rooftop installations per year from 2026. The energy minister has also announced plans to subsidize the decarbonization of energy-intensive industry.<sup>7</sup>

## +3 Portugal

The environment minister has stated that the energy industry can expect to see €60b (US\$66b) of investment by 2030, while increasing wind and solar capacity by 3.4GW and 6.4GW respectively. Portugal is also set to launch an auction covering the rights to sell hydrogen to the national grid.<sup>11</sup>

## +2 Saudi Arabia

The market has launched the development of the world's largest solar PV plant, at around 2GW by the end of 2025, as part of plans to install 27.5GW of new solar capacity by 2030. The Kingdom is also due to launch its greenhouse gas certificates market this year, while launching renewables capacity tenders backed by the Public Investment Fund.<sup>12</sup>

## +1 Netherlands

A new target of 3GW of offshore floating solar capacity has been announced as part of a €28b (US\$30.7b) package to achieve 2030 climate targets. The market has also reached its 6GW onshore wind target, with a further 800MW due to come online during 2023.<sup>8</sup>

## -4 Argentina

Argentina is committed to growing renewables, but its energy grid is thought to be insufficient to support a further significant rollout of renewables capacity, with recent investment in generating capacity not matched by infrastructure. Given the potential of solar in the north of the market and wind in the south, grid capacity in these areas is a key issue.<sup>13</sup>

## +3 Canada

Plans to lease plots for 5GW of offshore wind projects by 2026 have been set in motion in the province of Nova Scotia, with the projects targeted for operation by the end of the decade. The government has also introduced refundable tax credits for capital costs on new-build renewables projects.<sup>9</sup>

## -1 Australia

Despite 2022 being a record year for renewable energy project commitments, Australia is currently not on pace to reach the federal government target of 82% renewable generation by 2030, with deployment rates required to at least double to achieve this.<sup>14</sup>

## +3 Turkey

The government has issued new 10-year feed-in tariffs for renewable energy projects installed between 2021 and 2030, with an extra five years for solar projects using components produced in Turkey. This supports plans to decarbonize the energy mix to 65% renewable sources by 2030, requiring 53GW of solar PV by 2035.<sup>10</sup>

See page 23 for RECAI methodology.

## Normalized index

The RECAI uses various criteria to compare the attractiveness of renewables markets, such as the magnitude of the development pipeline, that reflect the absolute size of the renewable investment opportunity. Hence, the index naturally benefits large economies. However, by normalizing with the gross domestic product (GDP) we can see which markets are performing above expectations for their economic size.

In this way, the normalized index helps reveal ambitious plans for energy transition in smaller economies, creating some attractive alternatives for potential investors.

Normalized ranking	Market	Previous ranking	Movement vs. previous	RECAI ranking	Normalized ranking	Market	Previous ranking	Movement vs. previous	RECAI ranking
1	Greece	2	▲	16	21	Canada	36	▲	12
2	Morocco	1	▼	23	22	Belgium	20	▼	24
3	Denmark	3	●	11	23	Honduras	21	▼	60
4	Jordan	4	●	40	24	Philippines	19	▼	33
5	Chile	5	●	14	25	Norway	43	▲	31
6	Australia	7	▲	07	26	Austria	34	▲	29
7	Ireland	6	▼	13	27	Kenya	28	▲	46
8	Germany	10	▲	02	28	Taiwan	38	▲	26
9	Finland	9	●	21	29	Tunisia	23	▼	59
10	Portugal	8	▼	22	30	United States	31	▲	01
11	France	13	▲	05	31	Italy	24	▼	15
12	UK	12	●	04	32	South Africa	41	▲	37
13	Spain	14	▲	08	33	Argentina	25	▼	30
14	Netherlands	11	▼	09	34	China Mainland	29	▼	03
15	Israel	16	▲	19	35	Dominican Republic	26	▼	48
16	India	15	▼	06	36	Vietnam	39	▲	36
17	Poland	17	●	17	37	Japan	32	▼	10
18	Kazakhstan	22	▲	32	38	Brazil	30	▼	18
19	Sweden	18	▼	20	39	Panama	33	▼	56
20	Egypt	27	▲	28	40	Peru	49	▲	41

### +1 Greece

The government continues to implement policy to support the growth of renewable energy. With the announcement of its new solar-plus-storage scheme, residential and agricultural consumers will be able to claim subsidies to cover up to 65% of the installation cost of rooftop panels and batteries. Policy has also emerged to allow old operating wind turbines to be moved to isolated islands, to boost renewables production at these locations and extend the useful life of the turbines.<sup>15</sup>

### 0 Chile

Chile continues to establish itself as a leader in the renewable energy industry. Driven by strong government buy-in, natural resource and the use of global partnerships, it has become an attractive destination for foreign investment. Targets of 80% renewable energy by 2030 and carbon neutrality by 2050 are ambitious, and will require the market to build upon its existing infrastructure investment commitment to ensure the renewable energy produced can be distributed appropriately across the country.<sup>16</sup>

### 0 Finland

Finnish onshore wind capacity grew by 75% last year (2.4GW of new installed turbines), driven by domestic and foreign investment. Wind is now Finland's single largest driver of foreign investment, which will be core to the government's target of carbon neutrality by 2030. The market has also entered into a cross-border tender for renewable energy as part of the EU renewable energy financing mechanism, which will allow for up to 400MW of solar PV projects to be built in Finland.<sup>17</sup>

### +4 Kazakhstan

To create a more attractive environment for investors and install 6.5GW of renewables capacity by 2035, Kazakhstan has announced that it intends to improve its regulatory framework. Furthermore, it has identified the potential of green hydrogen and set its sights on becoming a net exporter of the fuel by the start of the 2030s. The government has signed an agreement to begin the development of a 20GW green hydrogen plant, which is expected to produce up to two million tonnes per year.<sup>18</sup>

See page 24 for normalized RECAI methodology.

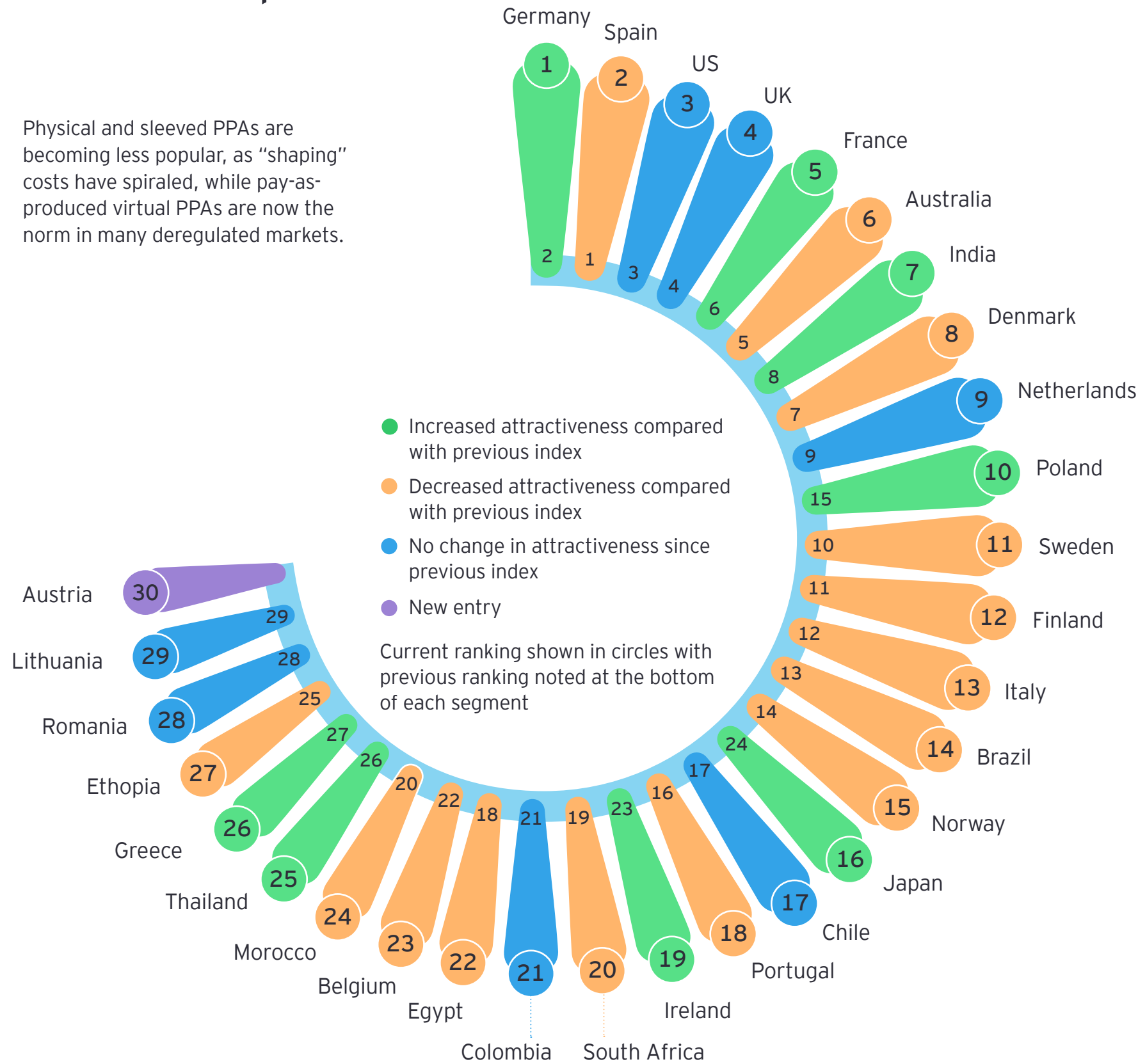
# Corporate PPA market rides out a bumpy year to come out on top in Europe

During 2022, corporate power purchase agreements (PPAs) significantly overtook utility PPAs in Europe, both in terms of capacity (7GW of 8.4GW) and deal count (129 of 161 deals).<sup>19</sup> This trend is expected to develop in other parts of the world.

It has not been an easy ride for corporates in the past year, however, with volatile, sky-high pricing – plus project scarcity – flipping the market in sellers’ favor. Inflation also affected PPA pricing structures, with few developers agreeing to no indexation – but this requirement has eased, with most now offering flat nominal pricing.

During early 2023, as global markets calmed, prices have eased considerably, and the PPA market is becoming more balanced again. With wholesale power price futures generally reducing compared with current prices in many markets, some countries being at risk of increased cannibalization of renewables’ capture prices, and developers needing long-term revenue security, the power of a long-term PPA is sending sellers back to corporates.

Physical and sleeved PPAs are becoming less popular, as “shaping” costs have spiraled, while pay-as-produced virtual PPAs are now the norm in many deregulated markets.



## Germany

For the first time since the EY PPA Index began, Spain has been knocked off the top spot by a rising PPA star. Since October 2021, Germany has steadily moved up the PPA Index, from fourth position, and PPAs are now enabling the market’s transition to renewables for energy security, as well as helping to reduce costs and decarbonize. Offshore wind deals play a key role in German PPAs, especially for large industrials. For smaller corporates, onshore wind and solar PV are the main technologies. Feed-in tariffs, and then government tenders, used to be the preferred choice of developers, but PPAs are now equally attractive.

## US

Static at No. 3 in our global PPA Index, the US was the origin of PPAs and has been their powerhouse for more than a decade now. The recent Inflation Reduction Act, which is spurring the US renewables investment market, is expected to drive growth of PPAs further. It was another record year in 2022, with 16.9GW of PPAs, of which at least half were via large technology companies.<sup>20</sup> An interesting development has been the rise of vPPAs for Scope 3 reduction of corporate suppliers’ emissions, as opposed to the typical Scope 2 corporate’s own operational emissions.

## Poland

Jumping five places into the top 10, Poland was the fourth-largest PPA market in Europe in 2022, behind Spain, Germany and the UK. With many companies having significant manufacturing operations in Poland, and with a carbon-heavy grid, there is a strong driver for renewable PPAs. But the future is not plain sailing. In late 2022, the government introduced a hard cap on power producers, including RES pricing to protect consumer costs, but this led to great uncertainty for PPAs, and a number of deals were paused. This cap is expected to be removed at the end of 2023, which should come as welcome news to pending deals.

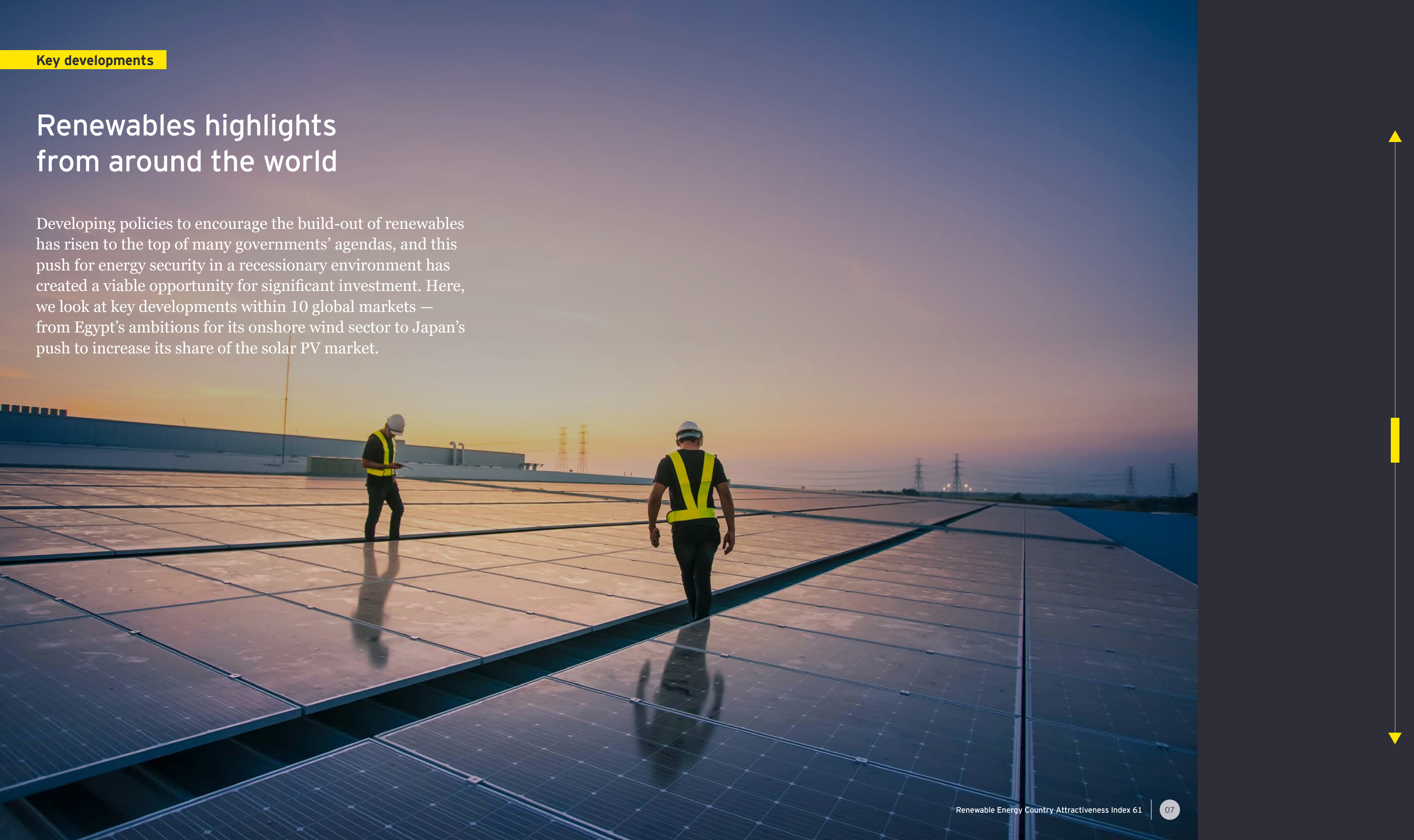
## Ireland

A relative newcomer to PPAs, Ireland is now seeing growing interest, especially among large data center and pharmaceutical companies with significant footprints in the market. Its four-rank rise in this edition of RECAI is based on several recent deals and the forthcoming pipeline. Ireland’s Climate Action Plan also aims for 15% of the market’s electricity to be delivered through PPAs by 2030. In 2022, there was 647MW of PPAs in Ireland,<sup>21</sup> competing with its Renewable Energy Support Scheme auction system.

See page 26 for PPA methodology.

## Renewables highlights from around the world

Developing policies to encourage the build-out of renewables has risen to the top of many governments' agendas, and this push for energy security in a recessionary environment has created a viable opportunity for significant investment. Here, we look at key developments within 10 global markets — from Egypt's ambitions for its onshore wind sector to Japan's push to increase its share of the solar PV market.



# 1

No change

RECAI ranking



## US: Connection and construction delays slow energy transition

The US's journey to net zero has not been helped by a gridlock of renewable energy projects waiting for connection to regional grids. Seven leading regional grids reported large interconnection queues, totaling 1TW, at the end of 2022. Solar was the technology with the most capacity in queues – almost 360GW – while standalone battery storage had 258GW.<sup>22</sup>

Despite significant growth of the market's offshore wind sector, the Biden administration's ambitious goal of having 30GW of offshore wind power operating by 2030 is likely to be missed by 10GW, according to current construction dates announced by developers. The target could still be met, however, if new lease areas are developed faster and there are additional investments in supporting infrastructure and supply chain.<sup>23</sup>

The US's EV sector has received a boost, meanwhile, with US\$2.5b of new funding announced in March to support EV charging and hydrogen infrastructure through the Charging and Fueling Infrastructure Discretionary Grant Program, established by the Bipartisan Infrastructure Law. Grants will be provided over five years to cities, counties, local governments and Tribes through a Community Program, while a Corridor Program will support development of hydrogen infrastructure along designated alternative fuel corridors.

The program will help boost the US's goal of adding 500,000 public EV charging stations by 2030.<sup>24</sup>

In this edition of RECAI, we explore the likely global impact and influence of the US Inflation Reduction Act policy: see page 13 of this report.

# 2

Up 1

RECAI ranking



## Germany: Offshore wind tender launched amid power market reforms

Germany climbs one place to second position for the first time in a decade, overtaking China Mainland in the index. The market has launched a tender for two offshore wind lots of 900MW each in the seabed areas off the Norderney shore. The bid deadline is 1 August 2023, with development rights expected to be granted in the first quarter of 2024 and the wind farms fully operational by 2028.<sup>25</sup> Germany boasts offshore wind power capacity of 7GW and has a target of reaching 30GW by 2030.<sup>26</sup>

Germany also continues to accelerate power market reform, transitioning away from fossil fuels as it pushes to achieve its goal of renewables comprising 80% of its power mix by 2030. Currently, renewable energy accounts for 46% of the market's power consumption, up from 41% at the start of 2022.<sup>27</sup>

In December 2022, the European Commission approved Germany's renewable energy act (EEG 2023), which includes a budget of €28b (US\$30.5b) and provides aid to support production of renewable energy through a market premium paid by the network operator to the producer, on top of the market price.<sup>28</sup>

In April 2023, Germany ceased operations at its last three remaining nuclear power plants.<sup>29</sup> While this is a major milestone in its progress to accelerated energy transition targets, there is likely to be an increase in the use of coal in the short term, to reduce the effects of intermittency in the power supply.<sup>30</sup>



4

No change

RECAI ranking



### UK: Green hydrogen certification planned for 2025

Seeking to increase investment in the growing green hydrogen market, the UK plans to develop a globally recognized certification scheme for green hydrogen production by 2025. The government will consult with industry on the scheme, which aims to build transparency and confidence in this nascent sector.<sup>31</sup>

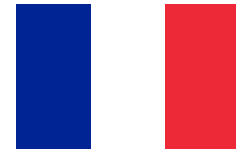
Meanwhile, in the market's fifth Contracts for Difference (CfD) scheme round, a budget of £205m (US\$255m) has been confirmed. It will include £170m (US\$211m) reserved for established technologies, which, for the first time, includes offshore wind. Additionally, £35m (US\$44m) will be set aside for emerging technologies. Results of the auction are expected to be revealed in late summer 2023.<sup>32</sup>

While the UK's offshore wind sector continues to grow, players in the market's onshore wind sector are calling for reforms to the planning system. Rules on community consent have severely limited development, particularly in England, where only two small turbines were installed in 2022.<sup>33</sup>

5

No change

RECAI ranking



### France: Progress on offshore wind, but still trailing on renewables targets

France has taken steps forward in its offshore wind development, with the selection, in March 2023, of EDF Renewables and Maple Power as the winning bid in the fourth offshore wind tender to build the market's biggest offshore wind farm. The Centre Manche 1 wind farm, off the coast of Normandy, will have a capacity of 1GW, enough to power 800,000 homes. The project was awarded at a tariff of €44.9/MWh (US\$49/MWh).<sup>34</sup>

Despite this, France still needs to ramp up its green energy sector. The share of renewables in the electricity mix rose by just 1% last year, from 25% in 2021 to 26% in 2022.<sup>35</sup> Onshore wind is one area that has been stalling. The market's last onshore wind auction was supposed to add nearly 1GW of capacity, but only four out of 60 projects were awarded, with a total capacity of 56MW. A convoluted and unclear instruction process was blamed for the massive undersubscription.<sup>36</sup>

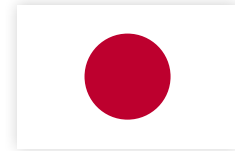
Solar has seen growth, with installed PV capacity rising to 15.8GW, but the current pace would achieve about 31GW by 2028, well short of France's goal of between 35GW and 44GW.<sup>37</sup>

Recognizing that lengthy permitting procedures have been a hindrance, France's National Assembly and Senate passed the Renewable Energy Acceleration Bill in February, simplifying applications and permitting, and limiting appeals. The legislation also gives local municipalities the authority to identify renewable acceleration zones, where permitting will be expedited to between one and three months.<sup>38</sup>

10

Down 1

RECAI ranking



### Japan: Solar PV and offshore wind primed for growth

Japan has long been a leader in solar PV innovation. In 2007, it was the first market in the world to build a floating solar installation, and it currently trails only China and the US in installed solar capacity, expecting to top 90GW before the end of 2023.<sup>39</sup>

Blessed with some of the most innovative companies in the sector, such as Panasonic and Mitsubishi, Japan has long possessed the technological know-how. Now, amid growing trade tensions between the US and China – the world’s biggest producer of solar panels – Japan is in a perfect position to take an increasing share of the market. It is seeking to import more silicon, to boost its production of solar technology.

Japan’s offshore wind market is also expected to experience significant growth. After the government’s recent revision of guidelines for the second round of offshore wind auctions, momentum has been picking up. The auction, which closes on 30 June, will select operators for four new areas capable of generating 1.8GW.<sup>40</sup> Current capacity sits at 190MW, with the market’s first commercial-scale offshore wind projects commissioned in December 2022 and January 2023.<sup>41</sup> Japan’s ambitious plans seek to add 10GW of offshore wind capacity by 2030, and between 35GW and 45GW by 2040.<sup>42</sup>

13

No change

RECAI ranking



### Ireland: Counting on offshore wind

Ireland has ambitious plans to install 7GW of offshore wind power by 2030 and 37GW by 2050, representing a bold vision for a market that currently has only 25MW of offshore wind capacity and 4.3GW of onshore wind farms.<sup>43</sup>

On 11 May, four projects totaling 3GW were announced as successful in Ireland’s first offshore wind auction. The average price of €86.05/MWh (US\$94.55/MWh) was viewed as hugely competitive and one of the lowest prices paid by an emerging offshore wind market. Altogether, the projects will produce more than 12TWh/year, which is more than one-third of Ireland’s electricity consumption. The auction had been open to six offshore wind projects, and the two unsuccessful ones are still eligible to secure a route to market through a corporate PPA or a future auction.<sup>44</sup>

In May, Ireland also announced plans to create the National Industrial Strategy for Offshore Wind, which is expected to be published in the first quarter of 2024. It will seek to develop supply chain opportunities and reduce risks from bottlenecks, while also introducing measures to develop local and export demand for offshore wind energy, and establish clusters of economic activity for the offshore wind sector.<sup>45</sup>

28

Up 1

RECAI ranking



### Egypt: Eyeing a leading position in wind energy

Egypt has high ambitions for onshore wind and has signed 10 memoranda of understanding (MoUs) for wind power projects since the start of 2022. By 2026, 4.3GW of new installations will have come online, followed by an additional 1GW of capacity annually after 2027, to bring Egypt's total installed wind capacity to 8GW by 2030. Considering its current installed capacity is 1.7GW, this is an enormous undertaking and will establish it as a leading wind energy market in the region.

While hosting COP27 in November 2022, Egypt signed framework agreements for nine green hydrogen and ammonia facilities, which could result in up to US\$83b being invested into these markets.<sup>46</sup> Egypt is now working to sign final agreements on these deals, one of which – with China Energy to build a US\$5.1b green hydrogen plant – has already been approved.<sup>47</sup>

Egypt is seeking to raise the proportion of renewables in the energy mix to 20% by the end of 2023, on the back of strong wind and solar growth. Amid this growth in renewables, the government is also expected to start decommissioning 5GW of gas-fired power plants this year, which is about 8% of the market's total generation capacity.<sup>48</sup>

30

Down 4

RECAI ranking



### Argentina: First public tender since 2019 launched

Argentina is holding its first public tender for renewable energy since 2019. The country's fourth round was delayed because of the COVID-19 pandemic, while a new process for tenders has now been established in an attempt to reignite the industry. The tender calls for 500MW focused on solar PV, wind and biomass, and 120MW focused on biogas and small-scale hydro power.<sup>49</sup> More than 2GW of potential capacity has been bid into the process, with winning bids set to be announced on 6 July 2023. They will secure 15-year supply contracts with CAMMESA, the operator of Argentina's wholesale electricity market.<sup>50</sup>

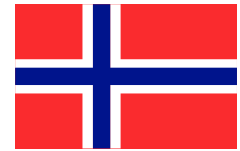
In 2019, in the third round, a minimum price of US\$54.22/MWh was achieved.<sup>51</sup> The announcement of a fourth round comes at a time when Argentina is on a trajectory for renewables to account for only 17.8% of total annual power generation by 2025, short of its target of 20%.<sup>52</sup> Industry experts hope the next auction round will be expedited to restore confidence among investors and stakeholders.

Despite possessing abundant land and ideal conditions for solar and wind power generation, these sources account for just 1.1GW<sup>53</sup> and 3.3GW respectively. They are dwarfed by thermoelectricity, which accounts for 25.3GW, and hydroelectricity, which provides 10.8GW.<sup>54</sup> As Argentina looks to accelerate renewable energy generation capacity, its transmission and distribution capacity will need to be increased so the industry can reach its full potential.

31

Up 3

RECAI ranking



### Norway: Seeking to harness emerging renewables technologies

Norway has revealed plans to develop its offshore wind sector with a goal of reaching 30GW of capacity by 2040. In March, the government formally launched its first offshore tenders, including a 1.5GW fixed foundation and three 500MW floating projects. The tender deadlines for the two projects are the beginning of August and September 2023 respectively.<sup>55</sup>

As Norway embraces offshore wind, it has signaled its intention to develop other emerging renewable energy technologies and green industry. In January 2023, Norway and Germany signed a joint declaration to increase the production of renewable energy through cooperation in hydrogen, battery technology, and carbon capture and storage.

Additionally, Norwegian state-owned Equinor will collaborate with German utility RWE to create an industrial supply chain for low-carbon hydrogen production. Plans also include the construction of a €3b (US\$3.3b) hydrogen pipeline to connect the two markets, which could begin delivering hydrogen as early as 2030.<sup>56</sup>

36

No change

RECAI ranking



### Vietnam: Offshore wind central to energy transition

Vietnam is turning its attention to untapped potential in offshore wind thanks to strong winds and relatively shallow waters near populated areas. The market is now developing a regulation framework for the sector, which the World Bank believes could generate up to 30% of Vietnam's electricity output by 2050.

A production target of 7GW from offshore wind by 2030 has been set, with the sector's growth expected to accelerate and reach generation capacity of 64.5GW by 2045.<sup>57</sup> Vietnam also hopes that the development of its offshore wind capability will spark growth in supporting industries and logistics services.

As part of its push to reach net zero by 2050, Vietnam has also joined the Just Energy Transition Partnership, which includes a financing package of US\$15.5b offered by high-income countries to assist the market in shifting away from coal.<sup>58</sup>

# How market actions are impacting the global journey toward net zero

Domestic clean energy production is now a priority for governments around the world, but will local ambition help or hinder the push for decarbonization?

The global drive for energy security and a recessionary environment mean the renewables industry has never had a better opportunity to accelerate both demand for its products and progress toward net zero. Governments are placing renewables, as well as traditional energy sources, at the center of their energy policies, and legislating for market interventions to address domestic concerns about energy supply and affordability.

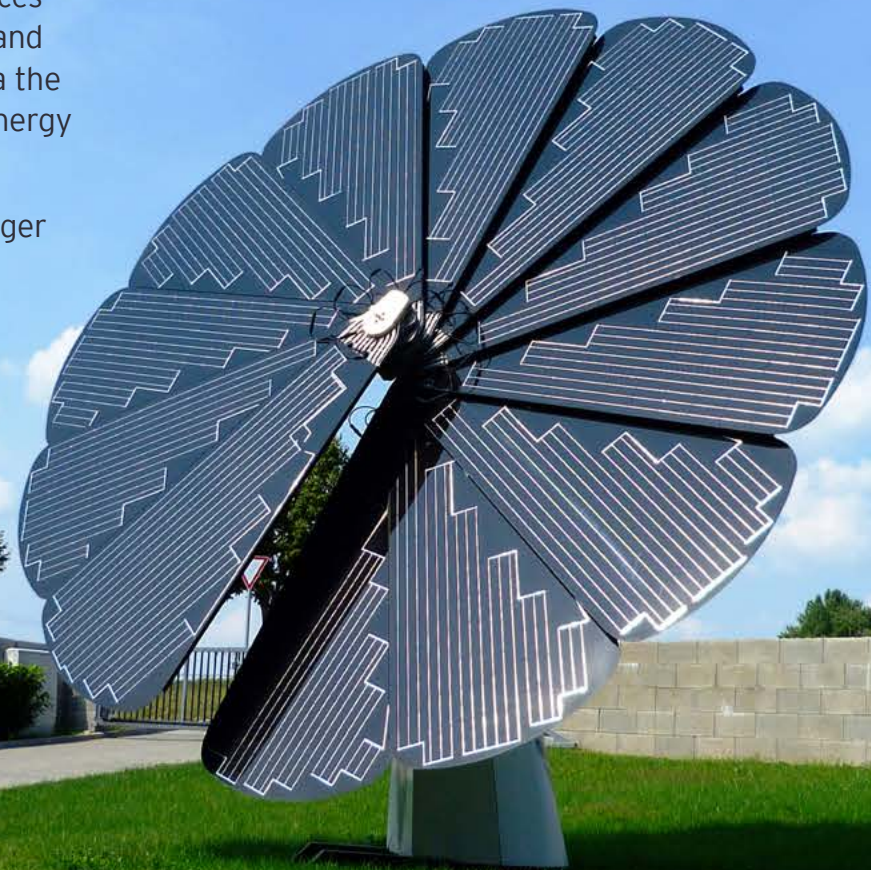
With geopolitical events such as the ongoing war in Ukraine sending energy costs to record highs, governments are keen to reduce their reliance on imported energy and find ways to remove links between natural gas and renewables pricing. The EU, for example, is exploring how to decouple gas and electricity prices as it works to accelerate the rollout of renewables and reduce its dependence on imported Russian gas via the REPowerEU initiative.<sup>59</sup> The UK is also looking at energy reforms to delink gas and electricity prices.<sup>60</sup>

Interdependent legacy market dynamics are no longer seen as sustainable, while domestically produced, low-cost, low-carbon and, in some cases, low-lead-time energy – using local technology – looks more attractive than ever.

The US, for example, is aiming to bolster its renewables industry with the Inflation Reduction Act, a game-changing piece of legislation that offers various incentives, credits and grants for the development and commercialization of green technologies. The Act risks causing an imbalance in international capital allocation, however – and localized supply chains will have to be rapidly built or strengthened to achieve net-zero targets. Expanding domestic supply chains could also be key to boosting markets' broader economies, helping create jobs, expand various industries and increase gross domestic product, as well as enhance people's welfare.<sup>61</sup>

## In brief

- ▶ Governments are eyeing domestically produced, low-cost, low-carbon energy in a bid to reduce their dependence on imports and enhance energy security.
- ▶ The US Inflation Reduction Act has accelerated investment into clean energy (and other decarbonization investments), but risks causing an imbalance in international capital allocation.
- ▶ Localized supply chains will have to be rapidly built or strengthened to meet net-zero targets.



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Such goals will take time to realize, however. Economic growth is forecast by the International Monetary Fund (IMF), in its baseline scenario, to fall from 3.4% in 2022 to 2.8% in 2023, before rebounding slightly to 3.0% in 2024.<sup>62</sup> Gregory Daco, EY-Parthenon Chief Economist, Strategy and Transactions, Ernst & Young LLP, commented: “Global growth continues to slow in the face of elevated inflation, higher interest rates, tighter financial conditions and the lingering impact of the war in Ukraine. The threat of global financial instability in the wake of the recent banking turmoil is an additional risk clouding the outlook.”<sup>63</sup>

Despite such a slow-growth outlook, the investment landscape for low-carbon technologies has continued to evolve in recent years, as economies recover from the impacts of the COVID-19 pandemic – and the resulting pressures on supply chains – while setting increasingly ambitious decarbonization targets. After an initial steady double-digit growth, energy transition deal volumes exploded over the last two years, with more growth expected as capital continues to flow into the space. In North America, deal volumes across all investor segments remained strong in 2022 following 2021’s record year, though with a modest reduction in overall volumes.<sup>64</sup>

Conditions, then, are ripe for turbocharging renewable energy demand and accelerating the transition to net zero – but will market interventions underpin or undermine such ambition?

## Inflation Reduction Act changes the game

Perhaps the most significant policy when it comes to renewables expansion is the US Inflation Reduction Act, which was signed into law by President Biden on 16 August 2022. The White House described the Act as “the most significant action Congress has taken on clean energy and climate change in the nation’s history”<sup>65</sup> – and while its full impact will

not be felt for some time yet, the Act can already be seen to be increasing renewable (and other decarbonization-related) investment opportunities in the US. It prioritizes energy security and climate change, which are due to get a combined investment of US\$369b.<sup>66</sup>

The Act is designed to drive “the development and commercialization of new green technologies” through three bespoke focus areas: accelerating the energy transition (including improving market competitiveness, efficiency and innovation); boosting domestic manufacturing; and increasing the number of US jobs.

It is complementary to the Infrastructure Investment and Jobs Act passed in 2021, which provides US\$1.2t in infrastructure funding over five years, with a focus on grid resilience, EV infrastructure development and the reduction of greenhouse gases. Some of the provisions in the Inflation Reduction Act include US\$30b worth of tax credits allocated to the manufacturing of solar panels, wind turbines, batteries and critical minerals processing.<sup>67</sup> Tax credits and grants worth US\$6b have also been allocated to emission-reduction efforts by heavy polluters in industrial manufacturing. A further US\$10b in tax credits is available for the development of EV manufacturing and renewable energy technologies, while US\$30b in grants and loans is being allocated to help utilities transition to clean energy. Additionally, the Greenhouse Gas Reduction Fund is being established, with US\$27b worth of funding to support clean energy projects.

A broad range of assets – including wind, solar, energy storage, carbon capture utilization and storage (CCS and CCUS), the production of clean hydrogen, renewable natural gas, nuclear and EVs – is set to benefit from the Act. Notably, the legislation stands to make the US the world leader in CCS and CCUS, while US-produced green hydrogen could become the cheapest in the world<sup>68</sup> under the updated tax credit regime. It will also be

possible for green hydrogen players to benefit from a combination of tax credits for renewable power generation and clean hydrogen production.<sup>69</sup>

Expansion of the green hydrogen industry is expected to have a knock-on effect on demand for the renewable energy that it requires for production. By 2030, US-based green hydrogen producers are projected to need around 500GW of electrolyzer capacity and roughly 750GW of solar and wind power capacity to meet green hydrogen demand.<sup>70</sup>

Further, the Act includes a number of additional mechanisms for developers of certain green energy or low-carbon technologies to monetize the US tax credits. In particular, the ability for a developer to “transfer” or “sell” certain US federal income tax credits for cash (the receipt of which is tax-free) is a game changer, and it is having an immediate impact on financing and project development. Additionally, some tax-exempt investors, government entities and certain other entities may be eligible for a newly established “direct pay” regime – an additional monetization valve that aims to enhance the capital attractiveness of certain green energy-related investments.<sup>71</sup>

Despite it being early days for the Act, investors are already coming forward to take advantage of the incentives it offers. In the first eight months since its passage in mid-August 2022, more than US\$150b of capital investment into utility-scale US clean energy was announced, surpassing the total investment estimated for all clean energy projects commissioned in the market over 2017-21.<sup>72</sup>

Over the same period, 46 new utility-scale clean energy manufacturing facilities were announced, with these estimated to create more than 18,000 domestic jobs. Of these 46 projects, 26 are solar manufacturing facilities. A further 10 projects are utility-scale battery storage manufacturing facilities or expansions, and 10 are wind power manufacturing facilities.

So far, the Act appears to be making progress on achieving its stated goals, and this looks set to continue as investors seek to take advantage of the tax credits, grants and other economic incentives. Certain technology-specific investment and production tax credits have been extended by the Act through 2024, but will then be replaced with technology-neutral clean energy tax investment and production tax credits.<sup>73</sup> With respect to the tax credit for the production of clean hydrogen, or the tax credit available for the capture and sequestration or use of qualified carbon oxides, such projects may qualify for the updated incentives as long as the construction of the applicable facilities began before 1 January 2033 (in addition to meeting other requirements).<sup>74</sup>

“Global growth continues to slow in the face of elevated inflation, higher interest rates, tighter financial conditions and the lingering impact of the war in Ukraine. The threat of global financial instability in the wake of the recent banking turmoil is an additional risk clouding the outlook.”

### Gregory Daco

EY-Parthenon Chief Economist, Strategy and Transactions, Ernst & Young LLP

Significantly, the Act is expected to result in new investment opportunities throughout the energy and manufacturing supply chain, not just in specific renewables projects and technologies, as it seeks to promote domestic manufacturing of the components required for clean energy production.

The Act is expected to drastically increase the demand for components needed for clean energy technologies. But some of the incentives hinge on a certain amount of raw materials being sourced in the US, the final product being constructed in the US, or meeting apprenticeship and prevailing wage standards.

To accommodate the increased participation by investors – and to develop the supply chains needed for newer technologies, new technology-specific economies and increased domestic energy production – new commercial structures and joint ventures are being created. Although an ambitious undertaking, the Act's inclusion of additional monetization options, and the credits, incentives and grants available, is driving US development. What is left to be seen, however, is what the Act's impact will be on international markets.

### Implications for global markets

The Act has implications on a global level, as it is likely to result in at least some distortion of global markets. The concern among European politicians and policymakers, for example, is that it will incentivize developers and manufacturers to locate investments in the US and away from Europe.

Similar concerns have emerged elsewhere in the world, and governments are examining the impact and formulating their responses at the policy level.

In 2022, the US accounted for 13% of global renewables capacity, excluding hydro, whereas China and the EU held shares of 38% and 21% respectively.<sup>75</sup> As other economies push to expand their own renewables industries, the Act looks set to more than double installed capacity in the US. The total US renewable energy capacity, excluding pumped hydro facilities, is 385GW. The American Clean Power Association estimates that investments driven by the Act could deliver an additional 525GW to 550GW of clean power for the US by 2030, generating US\$550 to US\$600b of capital investment.<sup>76</sup>

While renewables investment continues to increase worldwide, it still falls short of what is needed. The International Renewable Energy Agency (IRENA) has estimated that US\$35t of investment is needed by 2030 to keep global temperature rises to within 1.5°C of pre-industrial levels.<sup>77</sup> The US, China and the EU accounted for two-thirds of all renewable capacity additions in 2022,<sup>78</sup> and the Act's passage into law intensifies the competition for capital, as well as highlighting the need to incentivize green energy to attract capital in developing markets.

Aside from India and China, clean energy spending in emerging and developing markets remains stuck at 2015 levels. These markets account for one-fifth of all global energy investment, and, within many of these economies, public funding

accounts for around 50% of energy investment. With the high cost of capital and rising borrowing costs threatening to undercut the economic attractiveness of capital-intensive clean energy technologies, increased competition from leading renewables markets could make it more challenging still for emerging and developing economies to attract investment from the private sector.

Of significance, the US Inflation Reduction Act is expected to result in new investment opportunities throughout the energy and manufacturing supply chain, not just in specific renewables projects and technologies, as it seeks to promote domestic manufacturing of the components required for clean energy production.

# US\$35t

worldwide investment IRENA says is needed by 2030 to keep global temperature rises within 1.5°C of pre-industrial levels

Indeed, there is already significant interest among investors based elsewhere in the deployment of future capital expenditures in the US, as illustrated by the presence of foreign companies among those announcing new US clean energy investments in the first eight months following the passage of the Act. These include Italy's Enel, which is investing in a facility for the manufacturing of solar panels and cells.<sup>79</sup> Meanwhile, Germany's RWE has announced and completed the acquisition of Con Edison Clean Energy Businesses, which it said makes it the number four renewable energy company in the US.<sup>80</sup> And EE North America, a subsidiary of Denmark's European Energy, unveiled plans to develop 10GW of renewable energy in the US by 2026.<sup>81</sup> Others, including automakers Volkswagen,<sup>82</sup> BMW<sup>83</sup> and the Mercedes-Benz Group,<sup>84</sup> battery producer Northvolt<sup>85</sup> and industrial gas player Linde,<sup>86</sup> have indicated in recent months that they are focusing more on their North American businesses.

The EU's response – both to date and planned – is important, as recent market interventions can make Europe less attractive for investors. Analysis by the European Parliament estimates that revenue from the temporary windfall tax on energy companies' profits, applied in 2022 by setting a cap on market revenues for renewable generators, so far amounts to €30.9b (US\$34.1b) from onshore wind, €16.7b (US\$18.4b) from biomass and €7.9b (US\$8.7b) from offshore wind.<sup>87</sup> As the bloc unwinds decades of Russian gas dependency by expanding renewables, hydrogen and biomethane,<sup>88</sup> its market design proposals must ensure that the ability to continue to attract investment isn't undermined.

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**My view is that, today, the reactions to the US Inflation Reduction Act are more country-led, rather than European Commission-led.**

**Bruno Bousquié**

Strategy and Transactions Leader France, Ernst & Young Advisory

The EU is under pressure from the private sector and Member States to do even more. Indeed, companies, including steelmaker ArcelorMittal, are calling on the EU to simplify its approvals process for green investments and provide more incentives to keep the region competitive with the US.<sup>89</sup> Given the challenges involved in achieving consensus across the bloc, however – and the amount of time this can take – individual markets are also having to pursue their own initiatives to bolster their attractiveness to renewables investors.

“My view is that, today, the reactions to the US Inflation Reduction Act are more country-led, rather than European Commission-led,” said Bruno Bousquié, Strategy and Transactions Leader France, Ernst & Young Advisory. He cites Germany as one of the European economies leading the way. The German Federal Ministry for Economic Affairs and Climate Action has prioritized investment and innovation support measures to strengthen its renewable energy and power grid production capacity. This includes enabling access to finance, offering hedging instruments and promoting innovations.<sup>90</sup>

Globally, Germany and France are third and fourth respectively in terms of annual investment into the energy transition.<sup>91</sup> In February 2023, France adopted a new renewable energy bill aimed at helping it achieve a tenfold expansion in solar energy output to exceed 100GW by 2050 and to roll out 50 new offshore windfarms to reach a capacity of 40GW.<sup>92</sup>

Nonetheless, the EU continues to pursue bloc-wide initiatives. In February 2023, the European Commission proposed its Green Deal Industrial Plan, with the aim of “enhancing the competitiveness of Europe's net-

zero industry.”<sup>93</sup> The proposals included the relaxation of state rules to drive funding, the Net-Zero Industry Act, the enhancement of skills, and open trade aimed at ensuring resilient supply chains. Then, in March 2023, the European Commission approved a significant relaxation of state aid rules<sup>94</sup> under the Temporary Crisis and Transition Framework, amid concern that companies would favor investment in the US because of the Act. The European Commission amended the EU's state aid rules to simplify the approval of subsidies in six key areas – batteries, solar panels, wind turbines, heat pumps, electrolyzers and carbon capture technology – as well as for the production of the components and raw materials needed to manufacture them.<sup>95</sup> The move is aimed at giving EU Member States more flexibility to inject public money into clean energy and, thereby, provide additional incentives to private sector players.

However, there have also been warnings that the EU should not rush to replicate the Act, as this could serve to distort the market further still and undermine the bloc's existing mechanisms for incentivizing the build-out of renewables. There has been debate among EU Member States on how to respond to the Act in such a manner that it does not negatively affect local markets, suggesting that a more carefully thought-out approach is needed. For example, while France, Germany, Italy and Spain have been among those advocating for more flexible and quicker procedures to grant state aid, Nordic countries, the Netherlands and several Central and Eastern EU Member States are wary that relaxing state aid rules would only benefit a few EU Member States with deeper pockets while damaging competition within the 27-nation bloc.<sup>96</sup>



Outside the EU, as it pursues its own energy transition, the UK is also looking at how to remain competitive with the US in the wake of the Act. In March 2023, for example, the UK unveiled a package of measures aimed at spurring investment in CCUS, offshore wind, green hydrogen, and other clean energy industries and initiatives.<sup>97</sup>

Beyond Europe, major players, including India and China, are pursuing the aggressive growth of their own renewables industries. For example, India is expanding via a combination of government targets and private sector actions, although Indian firms will also be open to the new US investment opportunities provided by the Act. (See page 18, regional focus article.)

China's response will be significant, given its current dominance across a wide range of clean energy supply chains, including wind and solar components, batteries and critical minerals. A major goal of the Act is to improve US competitiveness with China across those supply chains.

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China is taking measures to retain its competitive advantage — for example, in technologies where it is really leading the market.

Alex Lu

Associate Partner, Ernst &amp; Young Hua Ming LLP

At the same time, China is focused on aggressively expanding its renewables industry as it seeks to rebound from almost three years of pandemic-related lockdowns and the impact they have had on the economy. Chinese growth is forecast by the IMF to rebound to 5.2% this year,<sup>98</sup> and this comes as the market steps up its pursuit of energy transition targets. Beijing is aiming for carbon neutrality by 2060, and this target will help drive domestic demand for renewables and clean energy. Further, China appears set to continue dominating the solar components industry for some time. Chinese players are also targeting export markets globally, and their efforts to be competitive could drive costs lower.

“China is taking measures to retain its competitive advantage — for example, in technologies where it is really leading the market,” said Alex Lu, Associate Partner, Ernst & Young Hua Ming LLP. He added that China's competitive advantage has previously been cost-led rather than technology-led.

Elsewhere in Asia, markets such as Malaysia, which has a solar manufacturing industry and exports to the US, stand to be affected by the introduction of the Act. Others in the region, including Indonesia, want to establish a new solar manufacturing industry and will need to consider how to do so in the face of competition from significantly larger economies, including the US and China — the latter of which supplies solar panels to much of Southeast Asia.

In Australia, federal and state governments recognize that the Act is likely to have an impact on their investment landscape, though the extent of this remains uncertain. Indeed, companies that were considering Australia for investments in green hydrogen are rethinking their plans in light of the Act's ability to bring down the costs of production in the US. In comparison, Australia's competitiveness in the nascent green hydrogen space now looks reduced.

Nonetheless, federal and state governments in Australia are keen to demonstrate that their markets remain open for business, and that further support for renewables is likely to materialize in the future. This is especially the case as Australia has an aggressive target for 82% of its power generation coming from renewables by 2030.<sup>99</sup>

Indeed, the Australian government recently introduced the Capacity Investment Scheme, which is initially focused on providing capacity incentives to energy storage projects. “There is still, I think, a potential revenue gap for storage projects, because of the range of revenue streams. So that is the first lever, and there is also a question mark over whether a broader capacity investments scheme could be brought in to help renewable energy from a global attractiveness perspective,” said Michael Newman, EY Oceania Renewables Leader.

### A win for the energy transition

Increased competition represents a win for the energy transition, while also benefiting those markets that turn to renewables to drive their economies out of the recessionary environment with which they are currently dealing.

The US wants to accelerate growth and has set the stage for a major expansion of its renewables

industry. Other major economies, faced with increased competition from the US, will seek to double down on their own renewables investments and take steps to enhance their competitiveness. Increased competition can help speed up technological advances and bring down costs, which should benefit the energy transition across the board and help spur the investment required to decarbonize and keep global temperature rises in check. The considerable acceleration of the learning curve for nascent green technologies, thanks to the Act, stands to be to everyone's benefit globally.

On the other hand, market leaders will have to navigate carefully if they are to avoid significant setbacks. The Act has been the subject of international criticism for its protectionist measures, and it could run into further pushback if it does not evolve to become less disadvantageous to foreign companies and components. Similarly, renewables supply chains span markets and continents, so any attempt to shift them significantly will be costly and time-consuming. And markets that currently dominate supply chains, such as China, will be focused on remaining competitive and retaining their dominance.

Unless potential issues with localized supply chains are addressed correctly, net-zero targets could be missed, and the global energy transition delayed.

The path forward will not be without risks and pressures, and policies and incentives will need to evolve further still to adapt to new market distortions. Over time, some of the Act's current provisions stand to be phased out, and unless these are extended, or new ones brought in, this could help level the playing field in the longer term, improving the comparative attractiveness of other markets again. Governments can help set the stage for this by taking carefully considered steps now.

# India: working round the clock to cement investible position in renewable energy

India's renewables industry is growing rapidly. According to the International Energy Agency (IEA), India has the fastest rate of renewable electricity growth of any major economy, with new capacity additions on track to double between the start of 2022 and 2026.<sup>100</sup> It also doubled between 2015 and 2022, to reach 163GW.<sup>101</sup> As of February 2023, renewables accounted for around 42.5% of India's installed power generation capacity.<sup>102</sup>

India's renewable energy industry is expanding via a combination of government targets and private sector actions. Solar, in particular, has continued to take significant strides forward. In 2022, it accounted for 63GW of the market's total renewables capacity, followed by renewable hydropower, at 47GW, and wind power, at 42GW.<sup>103</sup>

The private sector – and C&I companies in particular – is increasingly turning to renewable PPAs as it seeks lower-cost electricity while simultaneously pursuing lower emissions. However, the growing share of renewable power generation means that supply intermittency is also becoming a bigger concern. Solar – which is expected to continue to play a dominant role in India's energy mix – and wind are closely associated with intermittency issues, which, unless properly managed, can strain power grids. As a result, ensuring round-the-clock (RTC) supply is becoming more of a priority. Pumped hydro is expected to play a significant role in this. According to IRENA, India's pure pumped

storage capacity of 4.8GW has remained unchanged since 2013.<sup>104</sup> This is likely to increase in the coming years, however, with major new projects under development.

“With increasing adoption of renewable electricity across private sector and commercial and industrial consumers, intermittency and nonavailability of RTC power is a growing concern,” says Somesh Kumar, EY India Power & Utilities Leader. “Pumped hydro storage can play a significant role in ensuring RTC power to consumers.”

In addition, new and upcoming technologies, such as green hydrogen, are making their way into the domestic renewable energy mix, to the extent that they can boost India's export advantage. This reinforces the importance of RTC supply of usable clean energy for potential offtakers. Policies to boost market participation are gradually taking center stage, and the renewables market has attracted large pension funds lately.

## In brief

- ▶ India has the fastest rate of renewable electricity growth of any major economy, with solar leading the transition.
- ▶ Commercial and industrial companies are turning to renewable power purchase agreements to lower their electricity costs and emissions.
- ▶ Ensuring round-the-clock supply is a priority as India seeks to become a major producer and exporter of green hydrogen.

# 108GW

India's total amount of pumped storage potential, according to the government



**Somesh Kumar**

EY India Power & Utilities Leader

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These priorities are leading to clear policy actions designed to boost storage and hydrogen and unlock barriers for corporate players. Interest in investing in India's energy market – and its renewables industry in particular – is already rising and expected to grow further still. In addition to large pension funds, investments have flowed in via a mix of deals, including acquisitions, bonds, debts, equity investment and mezzanine funding.<sup>105</sup>

### Government incentives and targets

In the fourth quarter of 2022, India released its long-term low-carbon development strategies through its latest draft National Electricity Plan (NEP). The NEP sets out decarbonization targets for the power sector up to 2031-32. It also sets out plans to expand the transmission infrastructure network by 300GW by 2030, to allow for effective power transmission from areas of high renewable energy generation. The market is aiming to have 500GW of renewables capacity by 2030<sup>106</sup> and net-zero greenhouse gas emissions by 2070. Meanwhile, under its recently launched National

Green Hydrogen Mission – which has an initial outlay of INR197b (US\$2.4b) – India is targeting production of five million metric tonnes of green hydrogen by 2030.<sup>107</sup>

The government has allocated INR350b (US\$4.3b) to “priority capital investments toward energy transition and net-zero objectives, and energy security” in its 2023-24 budget.<sup>108</sup>

To date, India has had considerable success in driving growth in certain areas. It is a major hub for the manufacturing of components required for wind power generation – indeed, it is one of only five markets that can currently produce all six major wind turbine components.<sup>109</sup> It is also promoting the domestic manufacturing of components required for solar generation. Under the Production Linked Incentive Scheme for High Efficiency Solar PV Modules, for example, the government had allocated 48.3GW of domestic solar PV module manufacturing capacity by the end of March 2023, with cumulative support of INR185b (US\$2.3b).<sup>110</sup> This capacity is due to come online by April 2026. However, increases in domestic manufacturing capacity need to be accelerated to meet the market's renewable energy goals, especially in light of the taxes imposed

on imported solar modules and cells in 2022.<sup>111</sup> As of early 2023, cell and module manufacturing capacity in India was around 44GW per year,<sup>112</sup> while the market is targeting 280GW of installed solar power capacity by 2030.<sup>113</sup> In addition, emphasis on research and development through the Advanced Chemistry Cell scheme has been pivotal in exploring indigenized, higher-efficiency solar cells.

“India is making significant efforts to establish itself as an attractive and investible market for renewable energy,” says Kumar. “The Indian government has been implementing various policies and initiatives to promote renewable energy development and attract both domestic and foreign investments.”

### C&I segment pursues PPAs

The emergence of C&I PPAs means the industry will, to some extent, rely on the government to allow it to advance with its plans, because these customers would otherwise be supplied by state-owned utilities and require approvals to obtain power from alternative sources.

The PPAs in question are typically for RTC supply, so it is up to the suppliers of the power sold under these deals to complement renewable sources of energy with storage capacity.

These C&I customers have their own net-zero emissions targets and, in pursuit of these, are seeking to sign PPAs under India's open-access mechanism. Another key reason for the growth of PPAs is the high grid tariffs associated with coal-derived energy and the fact that renewable energy is now widely available in India.<sup>114</sup>

From the other side, capital is also chasing these agreements, with competition in utility-scale tenders and increased interest by private equity players because of better returns and sovereign guarantees. Indeed, the market has evolved from a

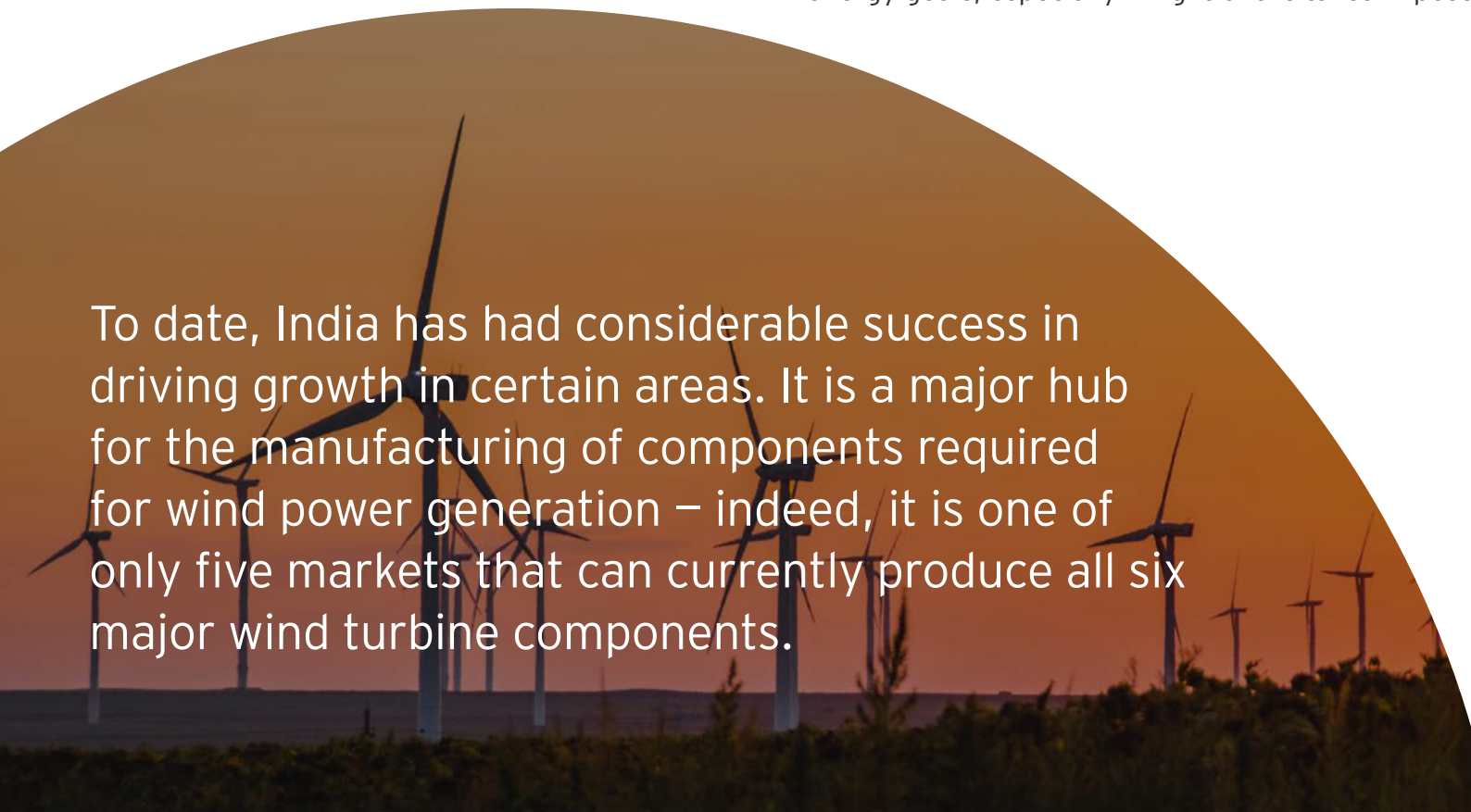
capital standpoint, and the emergence of C&I PPAs – especially involving solar power – has helped bring down the costs for power in some cases, compared with what customers would be able to buy from the grid. This has not been the case everywhere, however, with only some states viable for open access. In most, open-access power remains more expensive than power supplied by state distribution companies.

The open-access market for renewable energy grew to around 10GW by the 2022 fiscal year, from 300MW in 2009.<sup>115</sup> It currently accounts for a minority of consumers, but India is one of the fastest-growing PPA markets in the world, and it could increase faster still if policies across different states became more standardized.

The only thing that can slow the momentum is the government's reluctance to provide approvals for C&I PPAs to proceed. Overall, momentum remains strong, but, in some states, approvals have been slow. Nonetheless, government enablement, the pull from customers to shift to renewables and the fact that capital is increasingly chasing C&I platforms mean renewable capacity continues to expand.

### Growing storage needs

To keep pace with the growth in renewable generation and transmission capacity, and help ensure RTC supply, energy storage systems need to be put in place. Recently, India appears to have been moving away from battery-based storage and toward pumped storage, given the potential scale of projects, their environmental credentials and the availability of the necessary technology. The Ministry of Power published draft guidelines on promoting pumped storage in February 2023<sup>116</sup> – but this preference could change if the economics shift, as battery storage costs are expected to fall over time.



To date, India has had considerable success in driving growth in certain areas. It is a major hub for the manufacturing of components required for wind power generation – indeed, it is one of only five markets that can currently produce all six major wind turbine components.

Several large-scale pumped hydro projects have been announced by private sector developers, though these have long lead times and the potential to run into delays because of their scale and complexity.

The government will be keen for these to move forward, however, given that it recently estimated the market will require 18.8GW of pumped hydro storage and 51.5GW of five-hour battery storage to integrate the 500GW of renewable capacity it is targeting to bring online by 2032.<sup>117</sup> India has 108GW of pumped storage potential in total, according to the government. As of February 2023, only eight projects were in operation, with a combined capacity of 4.7GW. A further 24 projects, with a combined capacity of 26.6GW, are under development.<sup>118</sup>

### Hydrogen export potential

India is aiming to become a low-cost renewables production center, with a view to targeting export markets as well as domestic consumption. With cheap renewable power generation, it will also aim to provide RTC renewable power supply to facilitate green hydrogen and ammonia exports. Currently, hydrogen incentives in India are not sizable, especially compared with the US and its Act, but India is banking on the US prioritizing domestic hydrogen consumption, while it can target export markets such as Europe.

Indeed, India is aiming to become a global hub in this space,<sup>119</sup> citing in its National Green Hydrogen Mission<sup>120</sup> both a need to achieve self-reliance for energy and its desire to contribute to the energy transition globally. If India achieves its goals, it will reduce its dependence on fossil fuel imports, and help it become a technology and market leader in green hydrogen. However, India is currently the third-largest consumer and net importer of crude oil and petroleum products in the world,<sup>121</sup> and its energy demand is expected to keep growing, putting

the market under pressure to displace more of its demand for fossil fuels with renewables. It is also the world's fourth-largest buyer of liquefied natural gas (LNG),<sup>122</sup> importing an estimated 212.4 million metric tonnes of crude and 30.8b cubic meters of LNG over the 2021-22 fiscal year.<sup>123</sup>

The Green Hydrogen Mission proposes to expand India's nascent green hydrogen industry in a phased manner, first focusing on deploying it across sectors that use less clean forms of hydrogen and developing an ecosystem for research and development, regulations and pilot projects. IRENA estimates that India currently consumes six million metric tonnes per year of hydrogen, most of it grey hydrogen, which is produced using fossil fuels.<sup>124</sup> Ramping up domestic electrolyzer manufacturing capacity will also be an early priority.

Progress is also being made on plans for green ammonia exports. In February 2023, Greenko signed an MoU, paving the way for negotiating a first-of-its-kind deal to supply green ammonia to Germany's Uniper. The integration of a pumped storage plant to help ensure reliable and competitive supply was highlighted at the time as a key differentiator for that project.

### Next steps to boost renewables growth

The Indian government's policy push on renewables is in line with the global trend of customers demanding procurement from renewable developers. There are push and pull factors involved, and new investors are emerging to take advantage of the opportunities available.

The market will have to consider when it should provide more subsidies to renewables as industry players increase their operations. Between 2014 and 2022, subsidies for coal, fossil gas and oil fell by 76% in real terms, but they remain more than four times the subsidies for renewables and

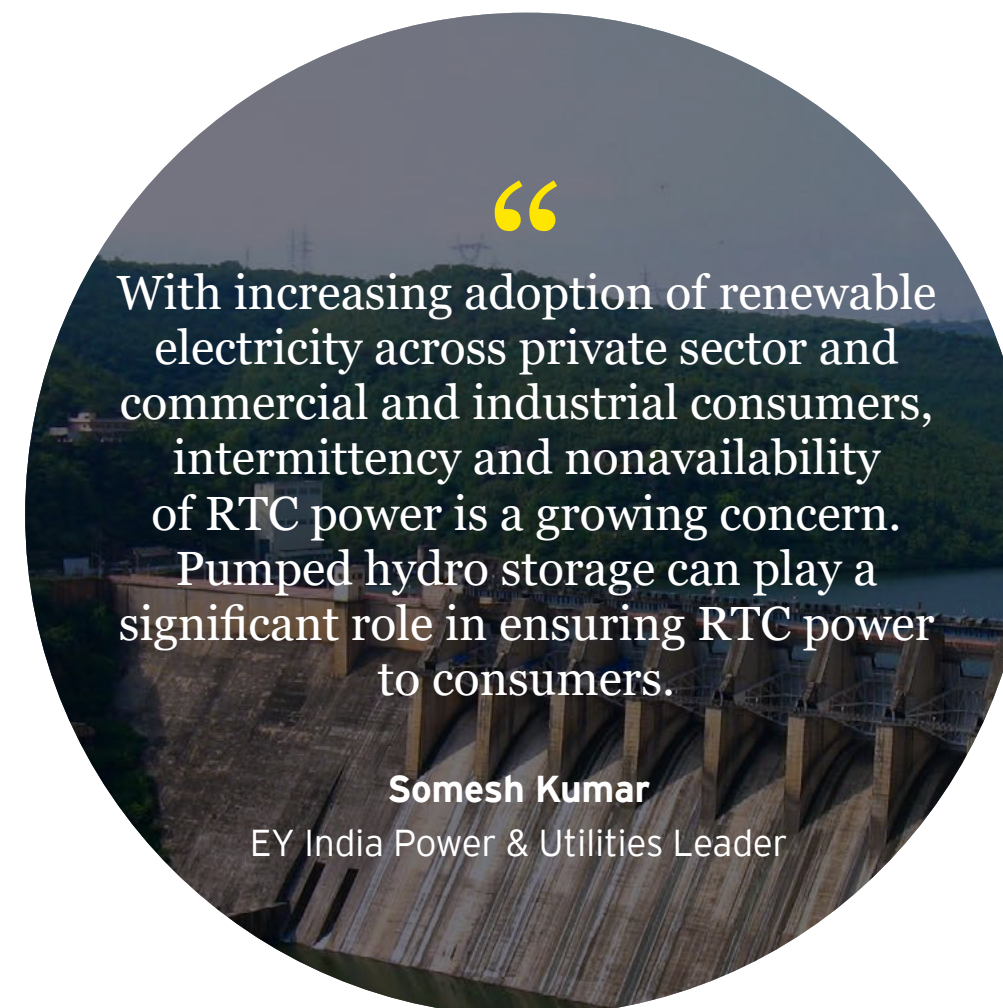
EVs, at INR138.87b (US\$1.9b).<sup>126</sup> Such continued support for fossil fuels is out of step with India's energy access, energy security and climate change objectives. If the government is to achieve its commitment of 500GW of renewable capacity by 2030, it is estimated that a doubling of investment – to INR2.44t (US\$28b) per year – will be required between 2022 and 2029.<sup>127</sup>

Maintaining the growth momentum of renewables will also come down to private sector interest, and financial incentives could help boost this. Additionally, a balance will need to be struck between broader efforts to keep the renewables build-out going and the push to expand domestic manufacturing capacity, should it not keep pace with overall renewables growth.

Meanwhile, further standardization of processes for open access across India's states would be required to help the C&I sector specifically to grow more quickly.

The green hydrogen industry is still nascent, with considerable uncertainty ahead. However, substantial opportunities are presenting themselves as a growing number of markets look ahead to importing green hydrogen over the longer term.

With energy demand growing, the pressure will be on to keep fossil fuel consumption in check. Renewables, storage and an eventual role in the green hydrogen supply chain are integral and complementary components in achieving this, and the Indian government is stepping up support for all three.



## RECAI 61 scores

Ranking	Market	Previous ranking	Movement vs. previous	Score	Technology-specific scores							
					Onshore wind	Offshore wind	Solar PV	Solar CSP	Biomass	Geothermal	Hydro	Marine
1	United States	1	●	72.9	58.3	50.7	58.5	46.5	40.4	46.8	39.5	20.6
2	Germany	3	▲	72.3	56.4	43.2	57.2	32.3	50.4	37.1	41.6	21.1
3	China Mainland	2	▼	70.7	53.3	45.2	61.6	55.2	49.6	24.3	50.9	17.9
4	United Kingdom	4	●	69.8	58.3	52.5	49.8	15.7	54.9	36.3	39.9	35.4
5	France	5	●	69.6	55.4	44.1	54.9	24.0	46.4	39.0	42.1	38.6
6	India	7	▲	69.1	53.9	24.5	62.9	34.5	43.4	22.0	48.1	20.1
7	Australia	6	▼	68.7	53.5	33.4	56.9	46.7	41.1	15.5	26.9	25.4
8	Spain	8	●	66.0	52.8	27.1	53.6	29.4	40.0	15.7	23.4	23.3
9	Netherlands	10	▲	64.0	53.6	38.8	46.9	15.8	51.1	24.7	27.6	16.6
10	Japan	9	▼	63.9	50.0	42.0	48.8	19.3	56.0	44.8	38.0	23.3
11	Denmark	11	●	63.8	53.5	42.0	46.3	16.8	44.3	15.8	21.7	21.5
12	Canada	15	▲	63.8	56.8	38.5	46.8	19.3	35.5	25.8	47.4	26.4
13	Ireland	13	●	62.7	50.1	35.9	46.2	19.9	36.2	18.1	22.1	24.9
14	Chile	17	▲	62.4	51.9	22.6	48.3	55.0	42.4	46.1	45.2	28.1
15	Italy	12	▼	62.3	47.2	34.0	50.8	31.1	41.8	32.3	45.7	18.4
16	Greece	16	●	62.2	49.5	33.3	49.1	35.8	43.4	25.5	41.6	15.1
17	Poland	18	▲	62.0	48.9	41.6	49.2	13.7	45.7	19.9	36.2	14.5
18	Brazil	14	▼	60.7	51.3	31.8	52.0	24.6	49.6	12.7	47.6	18.4
19	Israel	21	▲	60.6	40.1	15.8	55.3	36.9	29.2	15.3	18.3	15.5
20	Sweden	20	●	59.5	49.1	31.9	42.4	15.9	43.5	18.4	36.2	27.4

## RECAI 61 scores

Ranking	Market	Previous ranking	Movement vs. previous	Score	Technology-specific scores							
					Onshore wind	Offshore wind	Solar PV	Solar CSP	Biomass	Geothermal	Hydro	Marine
21	Finland	22	▲	59.0	59.8	28.0	36.1	15.7	45.0	15.7	23.0	15.7
22	Portugal	25	▲	58.6	43.6	19.6	47.7	25.4	40.4	23.3	37.0	24.0
23	Morocco	19	▼	58.6	46.2	17.2	50.6	50.2	25.0	13.8	33.9	13.8
24	Belgium	24	●	58.5	51.1	29.1	41.9	18.4	41.1	22.7	25.6	18.0
25	South Korea	23	▼	58.0	39.3	32.7	49.0	18.7	48.6	17.1	29.8	32.9
26	Taiwan	28	▲	57.8	42.6	38.7	45.7	18.7	29.6	23.9	33.4	27.7
27	Turkey	30	▲	57.3	49.3	21.3	48.8	23.9	41.3	41.9	45.6	19.8
28	Egypt	29	▲	56.7	45.7	15.3	54.2	35.2	24.9	11.9	23.4	11.9
29	Austria	32	▲	56.6	46.0	21.0	43.4	14.1	41.9	17.5	39.8	21.2
30	Argentina	26	▼	56.5	50.8	22.1	48.5	31.5	36.0	18.0	34.4	17.6
31	Norway	34	▲	56.5	48.9	33.5	39.0	14.9	32.8	17.4	46.0	32.8
32	Kazakhstan	35	▲	56.2	48.5	16.4	45.6	18.1	34.8	16.3	41.5	13.8
33	Philippines	27	▼	56.1	41.9	20.8	47.4	20.0	40.0	43.1	41.8	20.2
34	Switzerland	31	▼	55.7	41.3	17.9	44.3	18.4	35.9	22.8	38.8	15.3
35	Mexico	33	▼	55.3	42.2	21.4	47.6	24.5	34.5	39.7	35.1	19.1
36	Vietnam	36	●	54.4	44.6	34.1	43.4	17.5	38.8	13.0	46.5	18.6
37	South Africa	37	●	54.4	47.2	18.3	44.9	47.1	31.4	12.6	19.8	20.7
38	Thailand	40	▲	52.9	38.9	15.4	44.3	21.6	41.3	16.6	31.7	18.6
39	Saudi Arabia	41	▲	52.9	45.3	16.1	44.8	28.1	25.9	15.8	12.1	11.8
40	Jordan	38	▼	52.9	43.6	16.3	44.2	30.3	23.2	13.2	15.4	13.2

# RECAI 61 methodology

The index rankings reflect our assessment of the factors driving market attractiveness in a world where renewable energy has gone beyond decarbonization and reliance on subsidies.

We have defined the questions being asked, based on what we see as global market trends affecting investment and deployment priorities, and the challenges and success factors impacting EY clients:

- ▶ Is there a long-term need for additional or replacement energy supply? If so, is there a strong case for energy from renewable resources in particular?
- ▶ Is policy hindering or helping the ability to exploit renewables opportunities?
- ▶ Are essential components in place to ensure project delivery, such as long-term contracts, grid infrastructure (including storage) and availability of finance?
- ▶ What does the strength of natural resource, track record and project pipeline reveal about the outlook for particular renewable technologies?
- ▶ Even if all other elements are in place, does the macro stability and investment climate enable or impede the ease of doing business?

These index pillars therefore put emphasis on fundamentals such as energy imperative, policy stability, project delivery (including capital availability) and diversity of natural resource – factors that will increasingly become key market differentiators as markets move toward grid parity, and “artificial” motivations, such as government targets or the ring-fencing of technologies, become less critical.

## Determining the rankings

Each parameter within the five pillars comprises a series of data sets that are converted into a score, from one to five, and weighted to generate parameter scores. These are weighted again to produce pillar scores, then an overall RECAI score and ranking. Weightings are based on the EY assessment of the relative importance of each data set, parameter and pillar in driving investment and deployment decisions. Each technology is also allocated a weighting based on its share of historical and projected investment levels.

Separate from the main index, EY technology-specific indices rankings reflect a weighted average score across the technology-specific parameters, and a combined score covering our other macro and energy market parameters. This is because some markets may be highly attractive for specific technologies but face other major barriers to entry.

Data sets are based on publicly available or purchased data, EY analysis or adjustments to third-party data. We are unable to publicly disclose the underlying data sets or weightings used to produce the indices.

If you would like to discuss how EY RECAI analysis could help your business decisions or transactions, please contact the RECAI advisor [Lavaanya Rekhi](#).

## Normalized RECAI methodology

With the largest global markets tending to top the core RECAI, there are many smaller markets where renewable energy is growing rapidly and becoming highly attractive. By dividing a market's RECAI score by logarithm of GDP to produce a "normalized score," the index identifies those smaller renewable energy markets that perform best on the core RECAI pillars of energy mix, government support, project delivery and natural resource. Removing a market's economic size showcases those that are efficient in terms of their size and the most attractive for investors. The normalized index also highlights larger markets that score well in the core RECAI but could be doing more to support the green transition.

See the normalized index ranking on [page 5](#).





# PPA Index scores

Ranking	Market	Previous ranking	Movement vs. previous	Normalized score (0-100)	PPA Index score	PPA market maturity	PPA future market score	PPA policy score	RECAI score
1	Germany	2	▲	100.0	24,718,483	71.3	88.3	54.3	72.3
2	Spain	1	▼	98.9	24,435,816	80.9	89.7	51.0	66.0
3	United States	3	●	92.8	22,948,409	100.0	55.5	56.7	72.9
4	United Kingdom	4	●	85.5	21,132,502	68.9	82.1	53.4	69.8
5	France	6	▲	71.3	17,622,052	62.0	81.0	50.4	69.6
6	Australia	5	▼	69.6	17,194,182	79.3	54.2	58.2	68.7
7	India	8	▲	69.2	17,097,777	72.1	51.0	67.4	69.1
8	Denmark	7	▼	64.6	15,961,744	59.8	82.0	51.0	63.8
9	Netherlands	9	●	59.3	14,650,800	59.1	75.9	51.0	64.0
10	Poland	15	▲	57.4	14,195,090	63.0	65.3	55.6	62.0
11	Sweden	10	▼	56.6	13,994,285	63.3	76.1	48.8	59.5
12	Finland	11	▼	56.1	13,867,500	64.4	68.8	53.0	59.0
13	Italy	12	▼	53.4	13,198,559	51.2	82.2	50.4	62.3
14	Brazil	13	▼	44.2	10,929,447	78.5	54.0	42.4	60.7
15	Norway	14	▼	43.0	10,632,699	60.0	63.4	49.5	56.5
16	Japan	24	▲	35.2	8,691,937	54.2	48.0	52.3	63.9
17	Chile	17	●	31.3	7,727,267	60.4	39.1	52.5	62.4
18	Portugal	16	▼	27.5	6,801,790	34.4	65.6	51.5	58.6
19	Ireland	23	▲	26.4	6,529,299	50.6	35.9	57.4	62.7
20	South Africa	19	▼	26.2	6,479,559	60.8	36.5	53.7	54.4
21	Colombia	21	●	23.1	5,720,006	59.4	40.0	49.2	49.0
22	Egypt	18	▼	22.9	5,649,491	46.9	38.8	54.7	56.7
23	Belgium	22	▼	20.7	5,104,547	54.9	31.8	49.9	58.5
24	Morocco	20	▼	20.5	5,070,665	39.3	37.4	58.8	58.6
25	Thailand	26	▲	14.4	3,569,552	47.0	23.3	61.5	52.9
26	Greece	27	▲	14.4	3,554,512	32.6	35.1	49.9	62.2
27	Ethiopia	25	▼	12.7	3,151,254	36.0	35.0	58.9	42.4
28	Romania	28	●	10.3	2,553,006	26.7	34.9	53.2	51.5
29	Lithuania	29	●	8.0	1,982,618	32.2	33.7	50.5	36.1
30	Austria			7.8	1,940,366	19.9	34.3	50.3	56.6

# PPA Index methodology

By analyzing the same 100 markets as in the full RECAI database, the goal is to create a new ranking that focuses on the attractiveness of renewable power procurement — via offsite corporate PPAs — rather than the attractiveness of renewable project investment.

The final score for the top 30 markets is calculated from a weighted combination of 12 key parameters, which act as a proxy for corporate PPA potential. The PPA Index focuses on four pillars (three PPA-specific pillars together with a RECAI score pillar):

- ▶ **PPA market maturity** – this focuses on activities carried out within each market in the past decade. It concentrates on market maturity, looking at past PPA deal frequency and volume, as well as a quantitative analysis of more recent PPA deal growth.
- ▶ **PPA future market** – this forward-looking score assesses the forecast activity of each market. Forecast power capacity is a key driver of the magnitude of a market, so this has a significant weighting on the score as well as the wholesale power price relative to the levelized cost of energy (LCOE) or PPA price in each market. Forecast capacity installations and a weighted project pipeline score from RECAI are used. The index has focused on wind and solar PPAs (together weighted at 93%) as these represent the vast majority of offsite corporate PPAs.
- ▶ **PPA policy score** – this focuses on the ease of operation in a given market. If a market is to have potential for corporate PPA growth, supporting government policy must be in place for efficient and large-scale expansion. This is considered in the core RECAI, but is also examined here, with a more nuanced focus on PPA supportive policy.
- ▶ **RECAI score** – the overall score yielded by RECAI is also factored in as one of the fundamental pillars, because it provides a strong overview of the existing and potential strength of a market's renewable energy landscape.

The PPA Index uses a multiplicative formula to prioritize well-rounded markets with strengths in all aspects of corporate PPA development and integration. For example, this will mean that markets with zero PPA deals to date will score zero overall and will not yet be included.

However, with strong weighting on forward-looking parameters, even markets with just a few deals to date could score highly if significant growth is expected in the corporate PPA market within the next five years – the horizon of RECAI.

The RECAI PPA Index score (which can be very large) has been normalized into a score from 0 to 100, to create a more manageable reference value. The leading market will score 100 – but this does not mean that the market is perfect for corporate PPAs. It means that, relatively speaking, it is the most attractive market for corporate PPAs across the coming five years.

Data sets are based on publicly available or purchased data, EY analysis or adjustments to third-party data. We are unable to publicly disclose the exact data sets or weightings used to produce the indices.

For more information on the services that EY teams provide to corporates around renewable energy strategies and PPAs, please refer to our website: [www.ey.com/uk/ppa](http://www.ey.com/uk/ppa).

## PPA market maturity

(Sources: Pexapark, DLA Piper and EY analysis)

1. Number of PPAs signed in the past five years
2. Total PPA volume in the past five years
3. Number of PPAs signed in the past year
4. Total PPA volume in the past year

## PPA future market

(Sources: Wood Mackenzie, GlobalData, IRENA, IEA, Pexapark and EY analysis)

1. Pipeline of projects:
  - a. Forecast power capacity
  - b. Forecast installation growth
  - c. Project pipeline
2. Wholesale power pricing:
  - a. Wholesale power price relative to the historic LCOE
  - b. Wholesale power price relative to the PPA price

## PPA policy score

(Sources: World Bank, GlobalData, IEA and EY analysis)

1. Ease of doing business index (World Bank)
2. Renewable energy imperative:
  - ▶ Renewable energy percentage of total generation
  - ▶ Percentage of population with access to electricity
  - ▶ Forecast energy consumption growth
  - ▶ CO<sub>2</sub> emissions

## RECAI score

(Source: EY analysis)

1. Macro fundamentals
2. Energy imperative
3. Policy
4. Project delivery
5. Technology

Special thanks to Pexapark for providing access to their data.

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