Fit for the future, not Fit-for-55

Clean energy technologies are set to outpace expectations for the 40% renewable energy target and put the EU on track to reach 45% by 2030.

Published date: 28th February 2023

Lead author: Elisabeth Cremona

Other authors: Chris Rosslow, Ali Candlin

Contents

About

This briefing compares the Fit-for-55 2030 renewables target of 40% to recent market outlooks for clean technologies, with analysis suggesting that the EU is on course to reach 45% renewable energy share by 2030 under current conditions, rising to 50% with more support.

Europe's energy landscape has unquestionably and fundamentally shifted in recent years, but policy discussions may lag behind that new reality. Final negotiations on the EU's renewable energy target for 2030 are officially scheduled to take place at the trilogue discussions in March 2023. The European Commission and Parliament stand in favour of upping the ambition from 40% to 45% but a blocking minority of Council members are digging in their heels. Will the EU take the opportunity to bring targets in line with Europe's new energy landscape?

Highlights

45-50%

EU renewable energy share in 2030 based on forecasts for key clean technologies

x2

Solar capacity expected to reach almost double that required for the 40% renewables target

+20mn

Heat pumps expected to exceed Fit-for-55 and REPowerEU targets by 20 million

Executive Summary

40% target for renewables is not only unambitious - it is also outdated

Sticking with a low target risks killing the momentum of Europe's energy transition.

In response to Russia's invasion of Ukraine, the European Commission's REPowerEU plan proposed raising the bloc's 2030 renewable energy target from 40% to 45%, a move overwhelmingly supported by the European Parliament. However, certain Member States are resisting this shift towards higher ambition. The final EU renewable target is not only lower than levels required to phase out Russian gas, but also entirely out of touch with the new energy reality.

01 Solar to reach double EU policy forecasts, with other clean technologies surging

Recent market outlooks foresee deployment of key clean technologies that far exceeds the current Fit-for-55 pathway. Leading this is a surge in solar power, with capacity in 2030 at least twice that originally forecast. The number of heat pumps is expected to reach at least 60 million (+50%) and the EV fleet to expand to a minimum of 40 million (+30%).

02 EU is on course to reach at least 45% renewables by 2030

This acceleration of clean technologies renders the EU's 2030 target for 40% renewable energy not only unambitious but outdated. Taking into account reasonable industry forecasts, our calculations demonstrate that the EU is on course to achieve 45% renewables by 2030. With strengthened policy and financial support, more optimistic outlooks boost the renewable share to 50%.

03 Outdated EU policy must align with market trends

Discussions on the renewable energy target coincide with the publication of the Net Zero Industrial Plan. Climate ambitions shaping EU policy should reflect emerging technology trends to better enable European industry to capitalise on exponential market growth of clean technologies in the EU, helping the EU to safeguard competitiveness.

Investment trends in clean technologies foreseen by industry bodies reflect a very different future than that set out in the Fit-for-55 package. EU countries should be working to realise forecasts of what can be reasonably delivered by 2030 in order to maximise the benefits of renewable energy for the climate, consumers and the economy.

An EU commitment to 45% renewable energy is the minimum required to realign policy with current market outlooks through to 2030.

A new energy reality has unfolded across Europe since the Fit-for-55 package was presented eighteen months ago, with record breaking clean energy investments reflecting the security and economic imperatives for increasing renewables. Clean technologies are forecast to outpace Fit-for-55 expectations, putting the EU on course for at least 45% renewables by 2030. As 40% renewables no longer reflects where we are heading, sticking with the lower target means aiming for failure.

Elisabeth Cremona
Energy and Climate Data Analyst, Ember

A new energy outlook

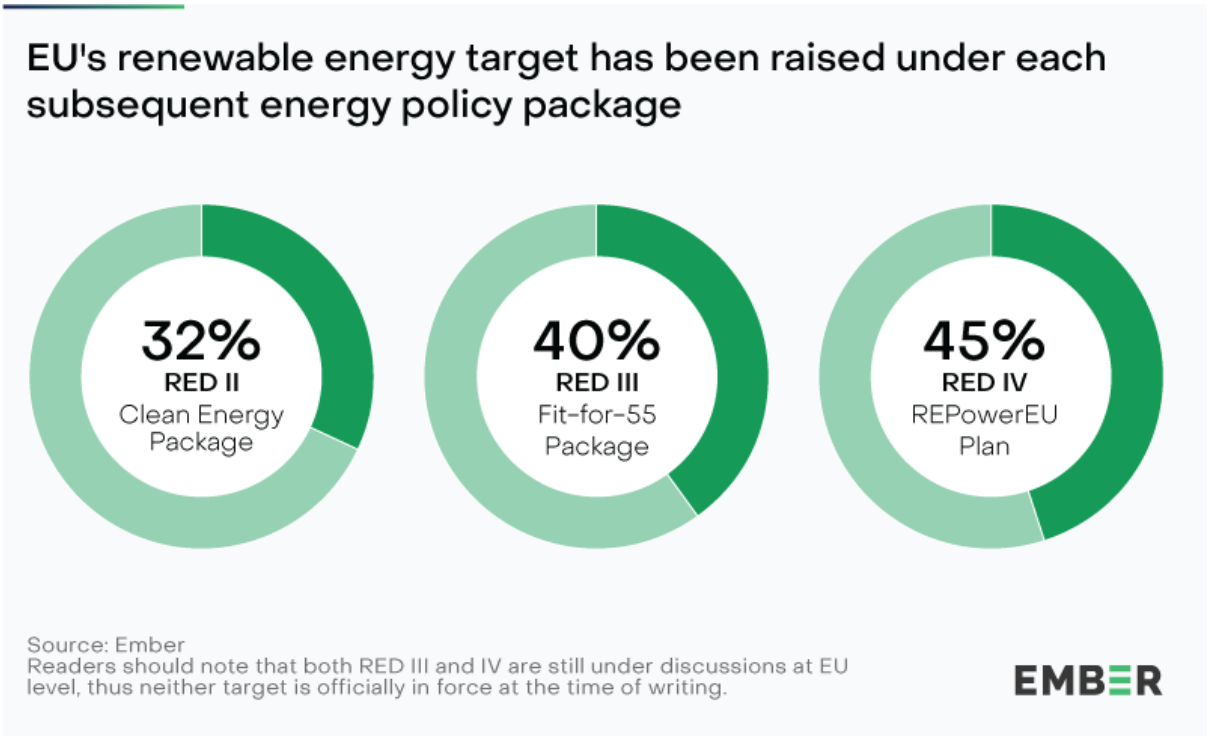
Market trends reveal a new energy outlook for Europe

Since the presentation of the Fit-for-55 package in July 2021, a new energy reality has unfolded across Europe. The EU's response to the energy crisis, fuelled by the Russian invasion of Ukraine, has turbocharged the green transition with deployment of key clean technologies taking off at previously unprecedented levels.

EU debates: From targets to national plans

At the centre of the EU's climate plan is its target for renewable energy sources. Since the start of discussions on the EU's 2030 target, the proposed level of ambition has been successively raised through new policy packages (see fig. 1). This reflects the EU's drive for accelerated climate action, as well as catching up with a pace of renewables deployment that has exceeded previous expectations.

In the wake of Russia's invasion of Ukraine, the importance of renewables has taken on an additional dimension of providing energy security, weaning Europe off Russian gas and increasing its energy independence. This saw the proposed 2030 renewable energy target raised to 45% under the REPowerEU plan.



But while all three branches of the EU executive have agreed on the 40% target, raising the official ambition level to 45% is proving more difficult. The European Parliament overwhelmingly voted in favour of the higher RES target, but a blocking minority of EU governments has so far limited the political commitment to "at least 40%" renewable energy. The culmination of this debate and a final political decision on the renewables target is expected to be discussed at the trilogues in March 2023.

This has important implications for national energy policy, which will set out concrete plans to reach the overall EU targets. The national energy and climate plans (NECPs) of EU member states currently reflect the official 2030 renewable energy target of 32%, but these are due to be revised by June 2024 with drafts submitted by June this year. At the time of writing, it remains unclear whether these updated national policies will be driven by a target of 40% or 45%.

A new energy reality

Just eighteen months on from the launch of the Fit-for-55 package and its renewable energy target of 40%, a new energy reality has taken shape in Europe. With energy security an urgent

priority, accelerating clean solutions has taken on a new dimension—both at the political level and on the ground.

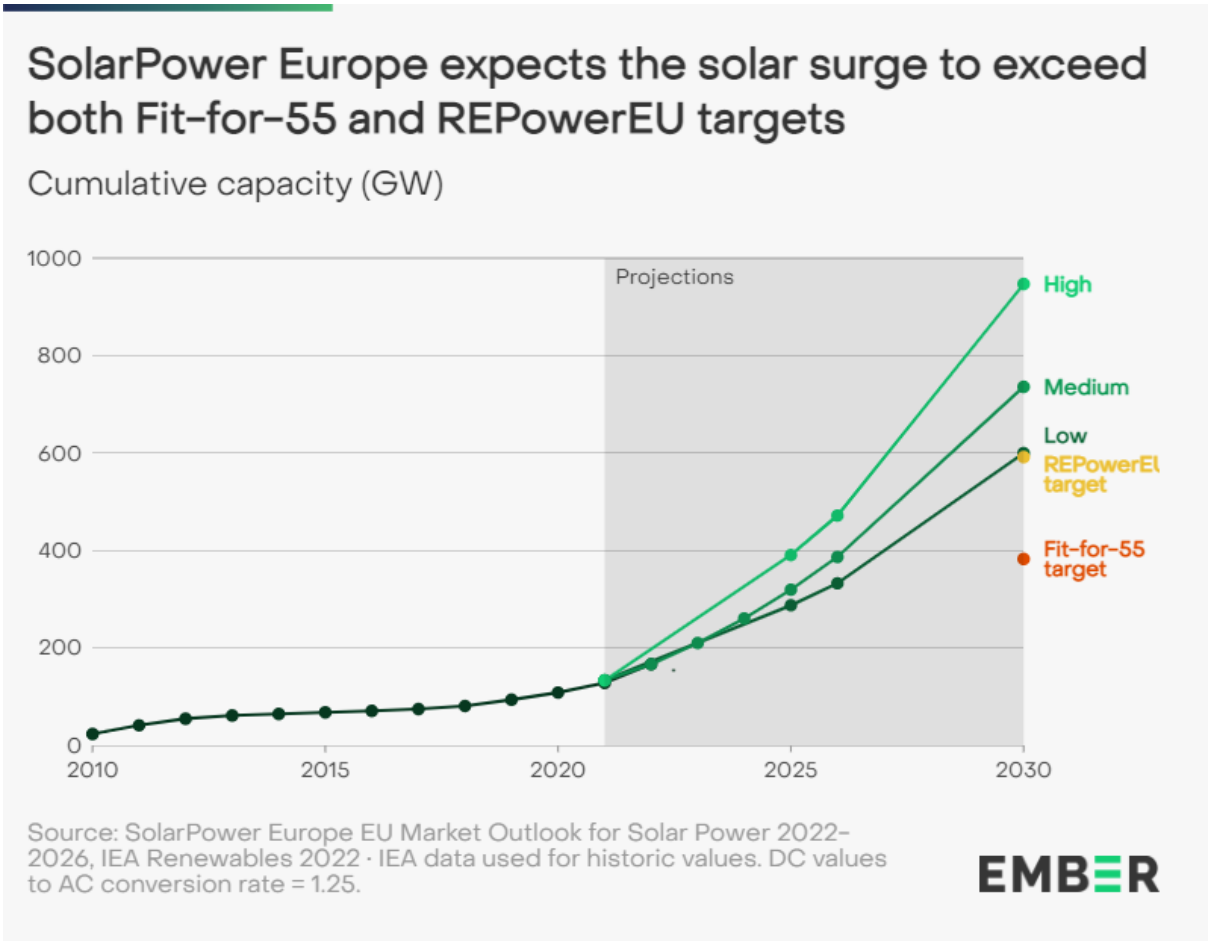
The energy crisis has "turbocharged" the energy transition in Europe, prompting many countries to significantly step up their renewables ambition. Investment in clean technologies reached record highs in 2022, jumping by 31% over the previous year despite concerns around global supply chains and macroeconomic headwinds. The rate of clean energy deployment has not only exceeded previous expectations, but appears to be far outpacing the capacity growth originally foreseen by the Fit-for-55 package. Recent market outlooks confirm that clean technology industries expect continued acceleration and that the high demand for technology deployment can be met.

Consequently, the Fit-for-55 renewable energy outlook not only lacks ambition, but is also out of step with the rapid shift in Europe's energy landscape that has produced a new reality.

Solar champions the clean power surge

2022 was a record year for solar deployment in the EU. More than 40 GW of new solar capacity was added, an increase of 47% compared to 2021. This was driven by enhanced cost competitiveness due to high energy prices and significant improvements in supply chain and COVID-19 related restrictions. SolarPower Europe is confident that deployment will exceed 50 GW in 2023. Notable growth is taking place in the rooftop segment, due in part to improved investment conditions as well as the potential for rapid deployment of this small-scale technology.

The latest market outlook from SolarPower Europe (December 2022) reveals that this exponential growth in solar is expected to continue throughout this decade, exceeding the Fit-for-55 target for installed solar capacity by 2026, four years early. Its medium scenario outlook—considered the most likely—forecasts capacity in the EU to reach 736 GW by 2030, more than 90% higher than originally foreseen under the Fit-for-55 scenario (383 GW) and 25% higher than REPowerEU (592 GW). The largest power additions are expected in Germany and Spain, followed by Poland, Italy, the Netherlands and France.



Onshore wind struggles, but offshore picks up

These positive trends in solar assume additional importance as the wind industry struggles with supply chain issues and inflationary impacts on prices. This is certainly the case for onshore wind capacity, with projected installed capacity between 311-353 GW in 2030, lower than the Fit-for-55 target of 361 GW. While 2022 saw annual installations increase by 40% over the previous year to 15 GW, this remains below the rate required to meet the 2030 capacity target according to WindEurope.

Recent developments in the offshore segment are more positive. Earlier this year, EU member states agreed to ambitious long-term goals for offshore renewable energy, with an interim target of 111 GW offshore capacity by the end of this decade. Such political commitments imply a certain level of optimism and certainty that this capacity can be delivered. Indeed the projects under development (70.5 GW) already surpass the capacity required for the Fit-for-55 40% renewables target (66 GW).

While wind power is not defying expectations to the same extent as solar, market outlooks expect deployment levels still aligned with the requirements for Fit-for-55, with a ratio that tips in favour of offshore wind.

Electrification of heating and transport continues to set records

In 2022, growth in the stock of both heat pumps and electric vehicles (EVs) continued to defy expectations.

Another record year for heat pumps
According to early estimates from the European Heat Pump Association (EHPA), 2022 was a record year for heat pumps with around 3 million units sold, boosted by soaring fossil fuel prices and subsidies in some countries for household purchases. Italy, France and Germany saw the largest sales in terms of heat pump additions. This brings the total stock to approximately 20 million heat pumps. The EHPA estimates that the REPowerEU targets require around 20 million heat pumps to be installed by 2026, meaning that the EU has already reached its interim objective four years ahead of schedule.

As a highly efficient low-carbon technology, heat pumps play a vital role in offsetting fossil consumption for heating and reducing import dependencies, particularly for natural gas which is currently the most used heating fuel in Europe. Indeed, it is estimated that 30 to 40% of Russian gas imported into the EU in 2021 (46.5-62 bcm) was used to heat buildings. The units sold in 2022 alone replaced roughly 4 bcm of natural gas.

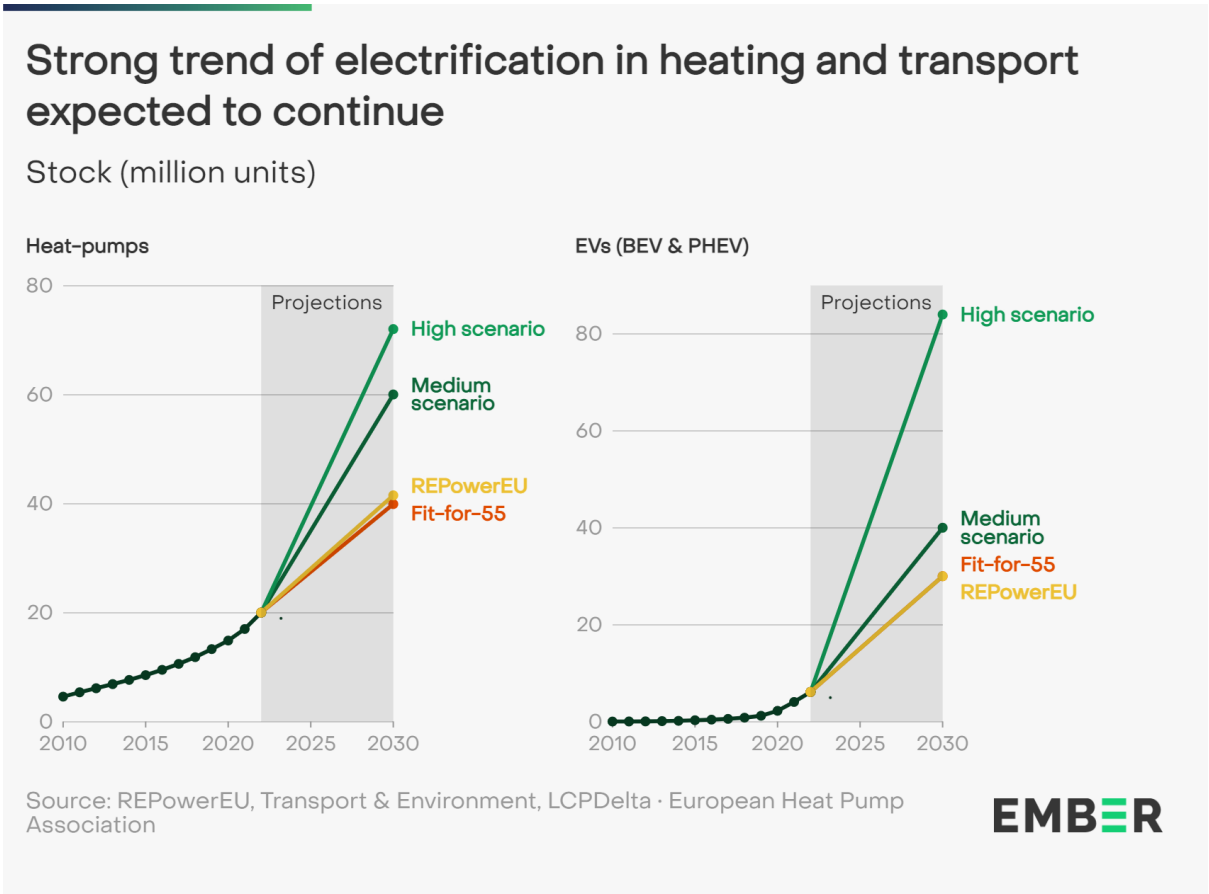
Multiple sources agree that heat pump growth can be expected to accelerate in Europe, with the EHPA forecasting a total stock between 60-72 million units by 2030. This is a huge step up in electrification of heating, more than 50% higher than the 40 million heat pumps assumed in modelling for the Fit-for-55 package.

A wide range of outlooks for EVs

2022 was also a record year for sales of EVs in the EU, bringing the total fleet to approximately 6.1 million. While it was a challenging year for car sales in general due to the dragging impact of COVID-19, rising inflation and high fuel costs, sales of electric cars were virtually unaffected. Battery electric vehicles (BEVs) sales climbed to a record 12.1% of total market share and that of plug-in hybrid electric vehicles (PHEVs) increased to 9.4%. Although relatively modest, these market shares tell a story of rapid change in the automotive industry; BEV sales only accounted for 1.9% in 2019.

The EV fleet must see a fivefold increase between now and 2030 to reach the 30 million EVs required under both the Fit-for-55 package and REPowerEU plan (differences in transport investments between the two are minimal). Outlooks from the automotive industry demonstrate a clear level of certainty that this level of road transport electrification will be achieved, placing the 2030 EV fleet between 40 million and 84 million.

Recent developments in regulation provide additional support for these higher forecasts. In October 2022, the EU reached an agreement to end sales of new combustion engine cars and vans by 2035, and set an interim 2030 target for carmarkets to reduce the CO2 emission of new cars and vans by 50% in 2030. This is expected to increase the market share of EVs to a minimum of 50-60% by 2030, a trend that would take the total EV fleet to at least 40 million.



Implications for electricity demand

Clean technology outlooks expect higher rates of electrification of heating and transport than those assumed in the modelling for Fit-for-55 and REPowerEU. Electricity consumption for heat pumps and EVs will therefore also be higher than current EU policy assumes, as will the offset consumption of fossil fuels.

Ember estimates that the resulting increase in final power demand will be between 120 TWh and 247 TWh by 2030, based on current market and optimistic outlooks, respectively. This represents an increase of 52-108% over the foreseen power demand from heat pumps and EVs under the Fit-for-55/REPowerEU scenarios. However, we estimate this additional electricity demand will be more than covered by higher than expected growth in renewable electricity supply.

Preparations should be made in anticipation of expected exponential deployment rates of these technologies to ensure sustained grid stability as electricity demand grows. Plans should also ensure that potential impacts on peak demand are kept low. The smart control

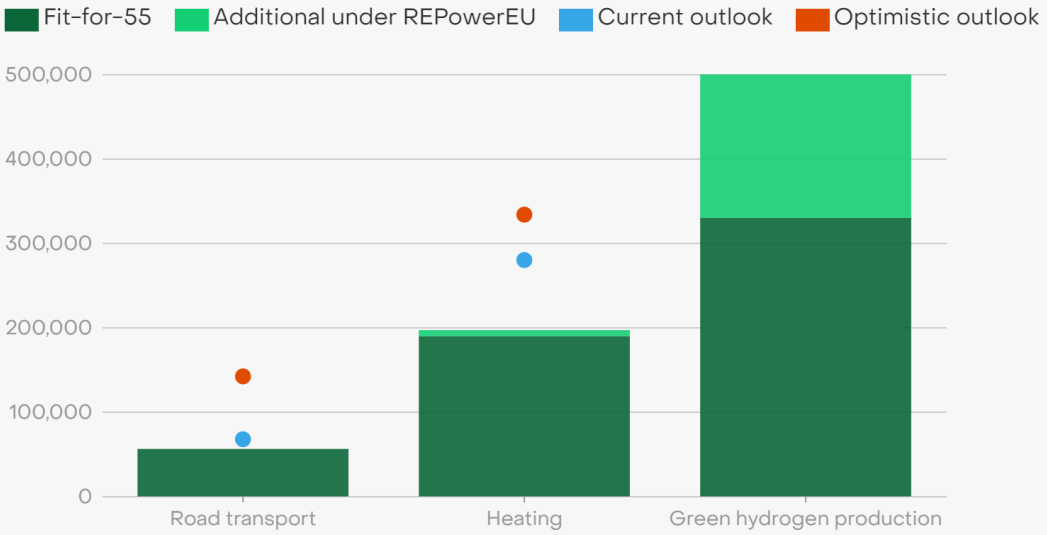
functions of heat pumps and EVs, as well as the storage possibilities offered by vehicle-to-grid services, present an opportunity for grid operators to achieve this by enhancing demand- and supply-side flexibilities, and optimising the integration of variable renewable generators.

While demand increases from electrification seemingly add to the challenge of power sector transition on rapid timelines, this is the most efficient and cost-effective route for decarbonising heating and light road transport and reducing gas dependencies. Policy efforts should therefore support expanding cross-sector electrification.

Clean hydrogen and hydrogen-derived fuels also offer the potential to decarbonise end-uses. However, given the highly electricity intensive nature of electrolysis, the process to produce green hydrogen from electricity, it is essential for the energy transition that hydrogen use is prioritised for those hard-to-abate sectors such as heavy industry, as opposed to being promoted for end-uses where more efficient electric options exist. This would risk placing undue pressure on renewable electricity generation and grid infrastructures. Indeed, it is notable that the total power demand for heat pumps and EVs in 2030, even under the most optimistic industry forecasts, is less than that required for the production of 10 Mt of green hydrogen as planned under REPowerEU.

Green hydrogen production dominates projected rise in EU electricity demand

Projected electricity demand in the EU in 2030, by end-use (GWh)



Source: REPowerEU · Ember calculations

On track for 45%

The EU on course for 45%

With clean technologies outpacing existing policy targets, the EU is already heading towards a renewable energy share of 45% in 2030.

This section analyses the impact of key technology trends, discussed in the previous section, on the three components which determine the EU's overall renewable energy share: electricity, heating and transport. Two scenarios are defined from the most recent market outlooks: the Current market outlook, considered to represent a realistic 2030 outlook under current market conditions, and the Optimistic market outlook, considered to represent a potential increased 2030 outlook that can be achieved through additional policy and financial support. In both cases, all variables other than those listed in the table below are kept fixed in line with the modelled Fit-for-55 scenario (including its 2030 energy efficiency target).

2030 capacities of clean technologies according to industry outlooks, REPowerEU and Fit-for-55

Solar Onshore wind Offshore wind Wind

	Solar and wind (GW)	Heat pump stock	EV fleet
Fit-for-55		39.9 mn	30 mn
REPowerEU		41.5 mn	30 mn
Current outlook		60 mn	40 mn
Optimistic outlook		72 mn	65 mn

Source: See methodology for individual sources

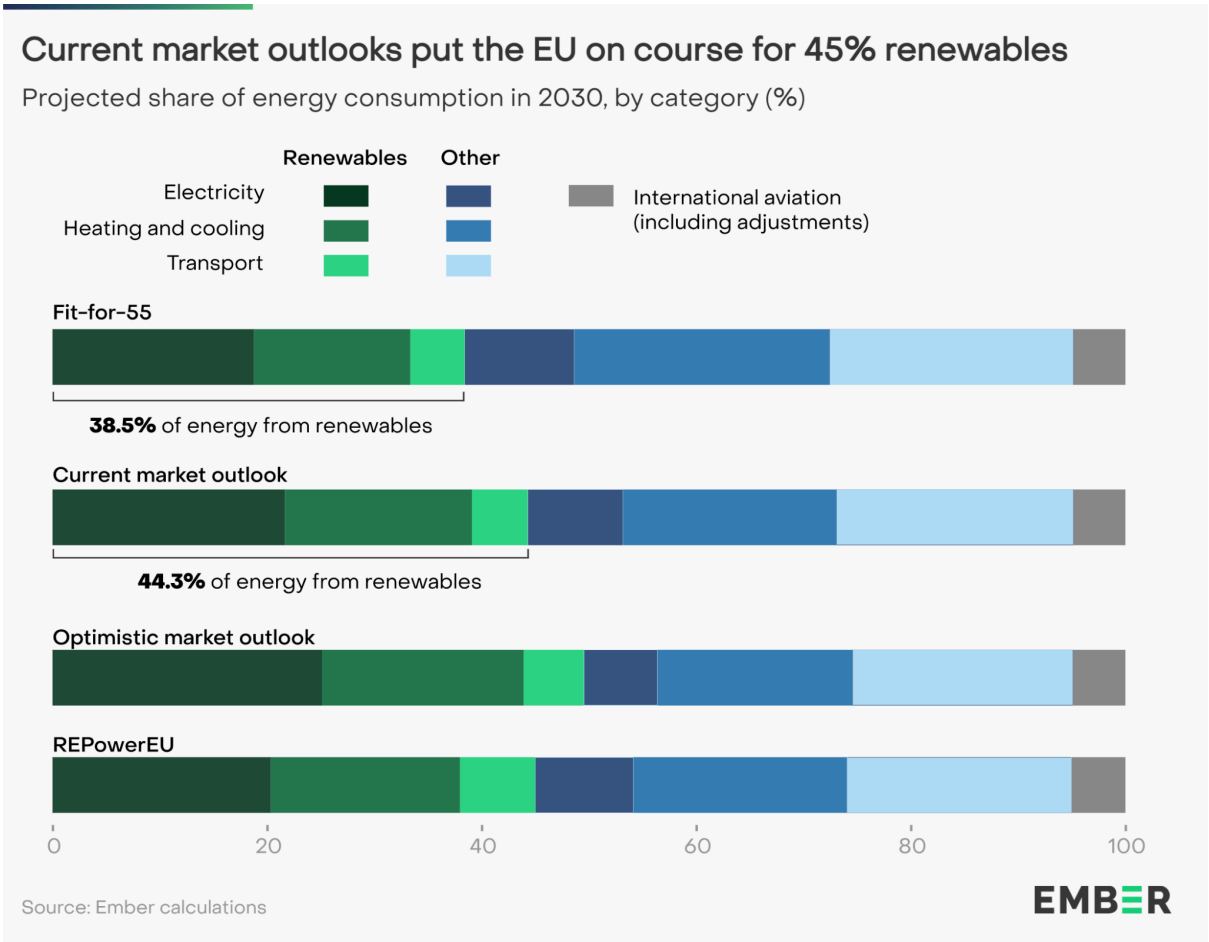
EMBER

Current market trends put the EU on course for 45%

When overlayed on the Fit-for-55 modelling of the 40% renewable target, the combined impact of the forecast clean technology deployment increases the 2030 renewable energy share to 44.3% under the Current outlook scenario and 49.5% under the Optimistic outlook.

The higher share is largely a result of an increase in renewable energy supply (4225 TWh in the Current outlook, 4672 TWh in the Optimistic outlook, compared to 3671 TWh in the Fit-for-55 scenario). There is also a reduction in total energy consumption (-15 TWh and -120 TWh for the Current and Optimistic outlooks, respectively) resulting from efficiency gains due to electrification.

Bioenergy consumption remains at Fit-for-55 levels in Ember's calculations for this briefing. This further demonstrates that the EU can reach its higher target of 45% renewables without the increase in bioenergy envisaged in REPowerEU.



The power system gets cleaner and bigger

Capacity forecasts from the solar industry reach new heights in each subsequent edition of market outlooks. When combined with the modest expectations from the wind industry, Ember calculates that renewable power generation will be 22% higher under the Current market outlook scenario than that modelled for the 40% target under the Fit-for-55 package (2502 TWh compared to 2050 TWh, respectively). This increases to 38.5% higher under the Optimistic market outlook scenario (2839 TWh).

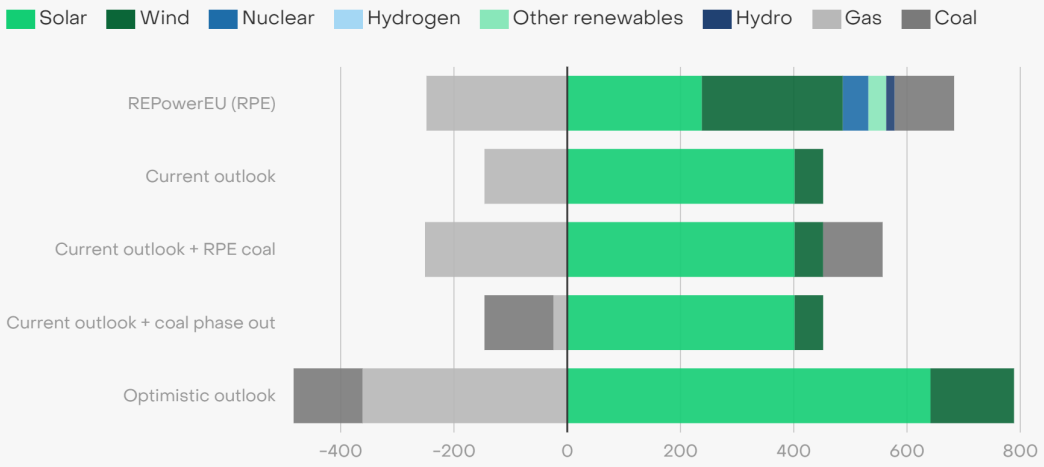
The larger renewable supply - more than double current levels - is able to meet the increased electricity demand in 2030 and also reduce fossil generation. In the Current outlook scenario, fossil power is 25% lower than Fit-for-55 levels, decreasing between now and 2030 to a total of 441 TWh, while renewable generation reaches 72% of the electricity mix. The change is more dramatic in the Optimistic scenario where total fossil generation drops to just under 6% or 214 TWh as renewable electricity soars to 82% of the power mix.

The forecast combined growth of wind and solar under the Current outlook (1158 GW) compares similarly to that proposed in REPowerEU (1102 GW) for 2030. This increases to 1300 GW under the Optimistic scenario. But outlooks from the wind and solar industries indicate that solar will constitute a much larger share of new installations, compared to the relatively equal shares expected by REPowerEU. Renewable electricity supply in 2030, under the Current market outlook, is still similar to that of REPowerEU due to the higher solar capacity and larger proportion of offshore wind in total wind capacity, which typically has a higher capacity factor.

Boosting investments in grid infrastructure and other key enabling technologies will be essential to cost-effectively integrate the forecasted capacities and enable this rapid expansion of the wind and solar fleet. Roll-out of flexibility solutions which are able to provide flexibility at short temporal scales will be particularly important in view of the high ratio of solar capacity that can be expected.

At least 450 TWh more renewable power expected by 2030, and less gas

Difference in 2030 power generation – per energy source – for each scenario, compared to Fit-for-55 (TWh)



Source: Ember calculations, REPowerEU

Electrification reduces fossil consumption, adds renewables

Continued acceleration of electrification of heating and transport, combined with increased electricity consumption for electrolytic production of hydrogen, drives gross power generation levels up by 10% to 13% (306 to 415 TWh) in 2030 under the Current and Optimistic market outlook scenarios respectively.

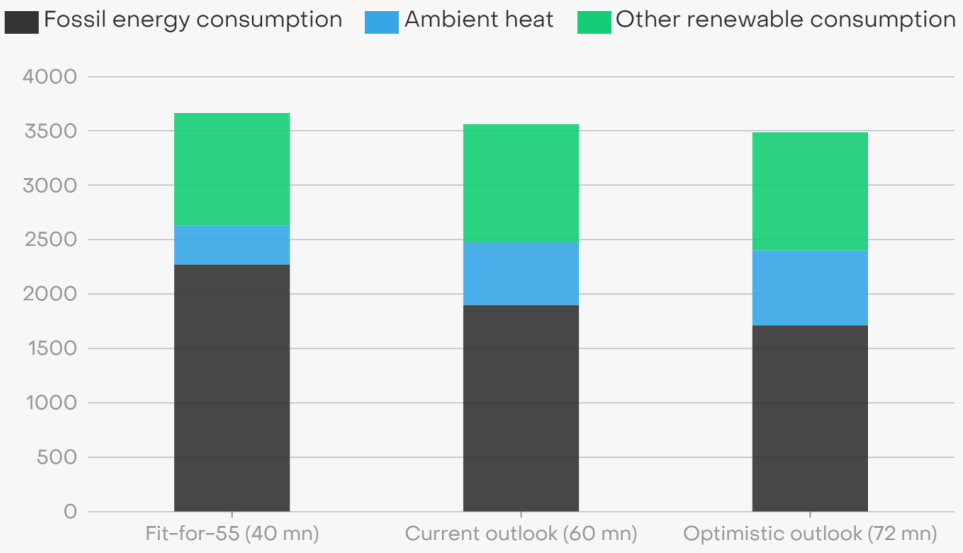
Electrification reduces fossil fuel consumption and introduces more renewables into the system. In this regard, it plays a vital role in realising the sub-targets of the Renewable Energy Directive, particularly that for renewable heating and cooling (this category includes energy consumption for heating and cooling in households and the tertiary sector, and industrial processes).

The additional deployment of 20 million heat pumps in the Current outlook scenario - over and above the 40 million assumed in the Fit-for-55 modelling - decreases fossil fuel consumption in this category by 14% (-325 TWh) and replaces it with 222 TWh renewable heat. This increases to 333 TWh renewable heat in the Optimistic outlook, reducing fossil fuel consumption by 22.5% (-511 TWh).

This positive net change results in a higher share of renewables in the heating and cooling category. In combination with the additional green hydrogen consumption in industry planned under REPowerEU (assumed to be about 12 Mt or 48 TWh in 2030), the EU reaches a renewable energy share in heating and cooling of 46.7% and 50.8% under the Current and Optimistic outlooks. This compares similarly to the 47% expected under REPowerEU.

Heat pumps add to renewable consumption and reduce fossil fuels

2030 energy consumption (TWh)



Source: European Heat Pump Association, Ember calculations

A renewables target that supports European industry

The energy transition will require significant scale-up of clean technologies and investment in infrastructure. Recent market outlooks foresee exponential growth in these markets over the decade and beyond. The question now is how much of this value will be captured by European industry.

The global race to lead the production of clean technology, as well as supplying their raw materials base, has been unfolding over the last few years. This race appears to be intensifying, driven by heightened concerns over economic competitiveness and supply chain disruptions. Many countries are gearing up to drive investment in industry and scale up domestic manufacturing power, the US Inflation Reduction Act being a notable example of such momentous efforts.

Responding to this pressure, the European Commission presented its proposal for a Green Deal Industrial Plan for the Net Zero Age at the start of February 2023, designed to support expansion of the EU's net zero manufacturing capacities while strengthening competitiveness. It will shape strategic investment decisions of the private sector in line with the EU's green transition ambitions, and drive the clean energy economy forward.

In this manner, the Net Zero Industrial Plan creates an implicit link between the EU's goals for climate action and industrial growth. The EU is already a global leader in wind and heat pump technologies, and is set to become the world's second largest battery cell manufacturer by the end of the decade. Raising the 2030 renewables target to at least 45% is necessary to square Europe's climate ambition with its industrial policy, and creating the conditions for European industry to deliver on the exponential demand for clean technologies.

Conclusion

40% is not just unambitious, it is outdated

Forecasted deployment of key clean energy technologies is outstripping expectations of the Fit-for-55 package. An EU commitment to at least 45% would unlock more opportunities for energy security, climate, consumers and industry in this new energy reality.

The political prioritisation of energy security for economic resilience and consumer protection has accelerated deployment rates of solar, heat pumps and EVs. Clean energy industry bodies now expect investments to far outpace those originally required for the Fit-for 55 40% renewables target. However, the momentum of clean technology acceleration is at risk of being derailed by a blocking minority of EU governments resisting increasing the ambition to 45%, as proposed by REPowerEU.

Emerging trends indicate that the EU stands at the precipice of an accelerated energy transition. Strengthened and coordinated action, stemming from an EU ambition aligned with market expectations, will be key to successfully unlocking this significant potential. It will enable energy system planners to prepare the infrastructure necessary to support the new energy reality expected in 2030. It will also create the conditions for European industry to better deliver and capitalise on the exponential clean technology demand, helping to safeguard EU competitiveness. Consequently, this improved 2030 outlook should not be considered an easy way out by national governments but rather an opportunity to leverage the advantages of the energy transition for consumers and economic competitiveness.

An EU commitment to 45% renewable energy share is the minimum required to align climate ambition with emerging trends in clean energy technologies. Anything less risks stymying the momentum of the energy transition in Europe.

Supporting Materials

Methodology

The EU's renewable energy share under different scenarios was calculated based on the methodology set out in Article 7 of the Renewable Energy Directive (RED II). The Fit-for-55 scenario data was sourced from the policy scenarios produced for the impact assessment of the European Green Deal policy package. The MIX scenario was selected as this appears to be most closely aligned to the energy and climate targets of the Fit-for-55 package (-55% greenhouse gas emissions). The impact of selected technology trends on the renewable energy target was calculated by adding/removing energy from the numerator and denominator of the Fit-for-55 scenario.

General notes:

- All values for solar capacity are in AC - a factor of 1.25 is used for conversion to DC
- 2030 figures for wind were extrapolated from Wind Europe's 2023 market outlook and the IEA's 2022 renewables outlook.
- 2030 figures for EVs (BEVs and PHEVs) were based on T&E and Consultancy which estimate 40 million, EY/Eurelectric which estimate 65 million and LCPDelta which estimate 84 million. The T&E calculation is based on the total number of sales currently forecasted in LMC Automotive's Global Hybrid & Electric Vehicle Forecast (Q2 2022 update with commercial vehicles excluded).

REPowerEU scenario

The full scenario data for REPowerEU was not published at the time of writing. For the purposes of this briefing, it was constructed using data reported in three sources - REPowerEU Plan and two non-papers on complementary modelling of higher energy efficiency and renewable energy targets - as described below.

Gross final consumption of energy (RES share):

- Final energy consumption is reported to be 751 Mtoe (8,734 TWh). The equivalent figure for Fit-for-55 of 787 Mtoe (9,093 TWh) is the same as that reported in the MIX scenario, and is noted to exclude international aviation. As the renewable energy share is calculated on gross final consumption of energy including aviation (with adjustments), assumptions had to be made to complete the figure. As REPowerEU

does not mention expected changes in aviation (apart from the integration of sustainable fuels), consumption of international aviation is assumed to be the same as in the Fit-for-55 scenario (465 TWh). The aviation adjustment is calculated using the ratio between total energy including aviation and total energy after aviation adjustment as reported in the SHARES tool for 2021, resulting in 9,195 TWh.

- Final consumption of energy from renewable sources is reported as 45%, resulting in 4,138 TWh.

Power sector data (RES-E):

- Net electricity generation reported as 3,450,049 GWh. This was converted to gross electricity generation assuming self-consumption levels of approximately 4%, the EU average for the previous 5 years, resulting in 3,588,051 GWh.
- The reported shares of renewables in gross electricity generation were converted to GWh. Total RES 72% (2,583 TWh), hydro 10.5% (376 TWh), wind 37% (1,328 TWh). Solar share was reported with other renewables; solar generation was therefore calculated based on the solar capacity reported, using the same capacity factor assumed in the MIX scenario. The remaining portion of renewable energy was allocated to the category “other renewables”.
  It should be noted that the share of renewables in gross electricity generation (72%) is not the same as the share in gross final consumption of electricity (69%). The latter excludes renewable electricity used in transport and green hydrogen production.
- Nuclear generation is reported to be 45 TWh higher than in the Fit-for-55 (515 TWh), resulting in a total of 560 TWh.
- Coal generation is reported to be 105 TWh higher than in the Fit-for-55 (139 TWh), resulting in a total of 244 TWh.
- Hydrogen generation in power was calculated to be 0.255 TWh, based on the 0.105 Mt reported for the power sector and assuming combustion in a CCGT engine with 60% efficiency.
- Gas generation could not be calculated from the source documents as qualitative descriptions resulted in varied values. It was therefore calculated as the remaining gross electricity generation once all other sources are accounted for. Generation from “other fossil” was assumed to be the same as that in the Fit-for-55 scenario (8 TWh). This resulted in 192 TWh.

Heating and cooling data (RES-H&C):

- Final energy consumption for heating and cooling was calculated as the remaining energy once final energy consumption in electricity and transport were accounted for (3,453 TWh).
- Renewable energy share in heating and cooling reported as 47%, resulting in 1623 TWh.

Transport data (RES-T):

- Total energy in transport was reported to be 221 Mtoe (or 220 Mtoe), resulting in 2,570 TWh.
- Renewable energy in transport was calculated as the remaining renewable energy once that in heating and cooling, and electricity was accounted for, resulting in 644 TWh.

Current market outlook and Optimistic market outlook scenarios

Power sector data:

- Generation figures from the Fit-for-55 scenario were maintained for hydro, other renewables, other fossil fuels, and nuclear. Generation from coal was kept at Fit-for-55 levels, unless otherwise stated in the briefing. Power generation from hydrogen was assumed to be the same as that under REPowerEU (255 GWh).
- Wind and solar generation was calculated based on forecasted capacity figures, using the same capacity factor as that assumed in the Fit-for-55 modelling.
- Gas generation is calculated as the remaining electricity once all other sources are accounted for.
- Gross power generation is calculated based on the Fit-for-55 figure, plus the additional electricity demand for green hydrogen production, increased stock of heat pumps and larger EV fleet. Transmission losses for electricity consumption by electrolysers are not factored in as these are assumed to be negligible, with the majority of planned electrolysers in the EU expected to be off-grid installations. Final electricity demand for heating and transport is converted into gross electricity generation (which includes transmission losses and self-consumption) using the Fit-for-55 ratio of gross electricity generation to final electricity consumption (1=0.88).

Heating data (RES-H&C):

- Given the focus of the briefing on heat pumps, renewable heating was split into “ambient heat” and “all other RES-H&C”. The former increased, based on the assumed number of heat pumps installed in 2030.
- The ambient heat provided by the stock of heat pumps was estimated based on a strong linear relationship between historical stock figures and ambient heat reported in the SHARES tool since 2005. This constitutes a conservative approach to calculating ambient heat contribution as it does not take into account the improved average efficiency (COP) of the heat pump stock which can be expected by 2030. The additional ambient heat is added to the Fit-for-55 renewable energy consumption and the total energy consumption for heating and cooling (both the numerator and denominator).
- The electricity demand of the heat pump stock is calculated assuming a COP of 3.06, the current stock average reported in a 2022 JRC report. This is not included in the final energy consumption for heating and cooling as it accounted for under power generation.
- Heat provided by heat pumps is assumed to offset that from fossil fuel consumption. The latter is calculated based on the estimated useful heat demand met by heat pumps and assuming an EU average conversion efficiency of heating of 88.5%. The resulting figure is removed from the Fit-for-55 total energy consumption for heating and cooling.
- An additional 11.9 Mt of green hydrogen is assumed to be consumed in industry, thus falling under RES-H&C. This is converted to energy terms using the conversion factor provided in the REPowerEU plan (1 ktoe = 2.87 kT H2). For simplicity, it is assumed that the average conversion efficiencies in industry for hydrogen and fossil fuels are the same. Increased hydrogen consumption therefore does not change the total energy consumption for heating and cooling, but adds to the renewable energy consumption (numerator change only).
- Renewable cooling, although covered by EU legislation on renewables since entry into force of RED II, is not included in this briefing for simplicity and due to uncertainties in member state accounting methodologies (renewable cooling has been reported for the first time in SHARES 2021).

Transport data (RES-T):

- Total electricity in road was calculated based on the number of EVs, their assumed annual mileage and average electricity consumption per kilometre.

- 14,700 kilometres per year is assumed for battery electric vehicles (BEVs). The share of electric kilometres for plug-in hybrid electric vehicles (PHEVs) is assumed to be around 42%, or 6,125 kilometres per year.
- The average electricity consumption per kilometre was calculated as the weighted average of energy consumption per vehicle type of small, medium and large passenger vehicles and light commercial vehicles. Consumption figures per vehicle type were sourced from the technology assumptions used in the Fit-for-55 modelling. The resulting figure of 0.16 Kwh/km was crossed checked with that estimated based on the Fit-for-55 scenario and found to be consistent.
- The average consumption of EVs in the Fit-for-55 scenario was estimated by dividing the electricity in road (reported as a percentage of road transport consumption in the Fit-for-55 modelling) by estimated total kilometres of EVs in 2030. The latter was calculated assuming a stock of 30 million EVs in 2030, split between BEV and PHEV based on the distribution of the 2021 stock, and the annual average mileage described above. The resulting figure was 0.17 kWh/km. It is noted that the ratio between BEV and PHEV may be different in 2030, with the former prioritised due to its lower lifecycle emissions.

Acknowledgements

Reviewers

The Regulatory Assistance Project and Transport & Environment for their kind review of the market outlook figures and methodologies used in this analysis.

Image credit

Dutch housing with solar photovoltaic cells on the roofs in Stad van de Zon: **Martin Bond** / Alamy Stock Photo