EUROPE'S ENERGY FUTURE

Accelerate renewables to tackle energy costs and increase energy independence

Switching off the lights won't work in the dark – Europe can halve power sector gas consumption for electricity and save EUR 323 billion with renewable energy.

Summary: With energy prices at record highs, policy makers face a decisive moment in the energy transition. This report examines the potential to turn the current energy crisis into an opportunity to accelerate the share of renewable energy in European energy systems, coupled with balancing technologies, to ensure consumers can keep the lights on.

Wärtsilä has modelled the potential to radically increase the share of renewable energy in electricity generation by 2030, from 33% today to more than 60% by 2030. The modelling shows a clear positive impact on reducing Europe's exposure to the gas market, its carbon emissions and the cost of electricity - leading to lower bills for consumers.

CONTENT

EUROPE NEEDS TO ACCELERATE RENEWABLES TO TACKLE ENERGY COSTS AND INCREASE ENERGY INDEPENDENCE

Europe is in the midst of a once-in-a-generation energy crisis, as gas prices rocket and energy bills soar for households and businesses across the continent.

There are multiple reasons for this volatility and the tragedy in Ukraine has compounded the economic pain for consumers, who are already reeling from the last six months of price rises and fearful of even higher inflation this year. It has also dramatically raised the stakes on energy security, bringing geopolitics into the energy sector in a way that was thought long past.

As costs bite and the conflict continues, some have called for the brakes to be put on the energy transition. In response, our message is clear: now is not the time to change what you're doing, it is the time to do it faster.

We stand on the precipice of an opportunity to transition quickly and definitively to renewables, cutting emissions and harnessing the potential of unlimited clean power. Following this path can bring economic relief and secure that most valuable of assets that we currently lack: energy independence. Renewables, coupled with balancing technologies, can go a long way to creating a fairer power system for all.

We need to tackle the energy crisis today to ensure that people can afford to switch their lights on in future. The only way to do that is to end our reliance on fossil fuels and realise the potential of clean, cheap renewable power.

So, while it is easy to be reactionary, now is the time to invest to accelerate the switch to renewable systems this decade. Doing so can tackle energy prices, increase energy independence and enable rapid decarbonisation.

Sushil Purohit
President Wärtsilä Energy and EVP Wärtsilä

Considering Europe's energy future

Meeting the short-term mismatches in gas supply and demand is a complicated challenge. One thing is clear, however - it is counter-intuitive for governments to rely on more fossil fuels to solve the medium and long-term problem.

The price crisis, compounded by the war in Ukraine, has provided the clearest signal that countries need to accelerate away from baseload gas to mainstream renewable power, backed by balancing technologies, at breath-taking speed. It is vital that countries avoid stranding investment in new inflexible fossil fuel power plants, such as coal, that are incompatible with energy security and the net zero targets that now encompass 90% of global GDP.[1)]

The current situation has hit just as the antidote to volatile fossil fuel markets – limitless renewable energy – is becoming mainstream. Wind and solar have to be at the vanguard of our response to the immediate price and security challenge, but it is essential that they are backed up with flexible balancing capacity.

This includes the significant deployment of energy storage for short term balancing and flexibility, as well as the rollout of future-proof balancing engines, required only for short periods to manage the longer-term fluctuations in renewable generation, and which can run on sustainable fuels generated from excess renewables from the 2030s onwards. It is vital that we also invest heavily into sustainable fuels, including green hydrogen and synthetic fuels based on Power-to-X technology, in order to create 100% renewable energy systems.

This is the only way to meet our long-term goals for secure, affordable, clean power.

Raise European renewable targets to increase energy independence

This briefing shows what an accelerated shift to renewables could look like by 2030. We have applied our power system modelling capabilities to show the lowest cost path for Europe to increase energy independence and clean power, by maximising the use of renewables.

We modelled two scenarios to show the energy costs, gas use and carbon emissions of building renewable capacity across Europe:

1. The baseline scenario is an estimate of anticipated renewables growth based on current trends across Europe to 2030, as shown by the International Energy Agency (IEA) Renewables 2021 analysis[2)], to achieve 50% renewable electricity, underpinned by necessary balancing technologies.

2. The second more ambitious scenario shows a more urgent and striking renewable energy pathway, doubling the deployment of renewables to 80GW per year to achieve almost two thirds (61%) renewable electricity.

"The price crisis has provided the clearest signal that countries need to accelerate away from baseload gas to mainstream renewable power, backed by balancing technologies."

[1)] https://www.zerotracker.net/analysis/pr-post-cop26-snapshot/
[2)] https://www.iea.org/reports/renewables-2021/renewable-electricity?mode=market&region=Europe&publication=2021&product=Total

Our modelling shows that the more ambitious goal is achievable with the technologies available today and would significantly reduce the cost of energy for the power sector and consumer energy bills. The result would be cheaper, more secure power, with countries well on track to meeting their net zero ambitions.

Energy independence costs less with a 61% share of renewables

Increasing energy independence does not need to cost more for power companies or energy consumers. Accelerating the transition to a clean energy system could save European countries 323 billion EUR by 2030, compared to our baseline scenario.

This would have seemed unthinkable a decade ago. Yet the combination of plummeting technology costs, the imperative to shift away from fossil fuels and the climate crisis have made it politically acceptable and economically sensible.

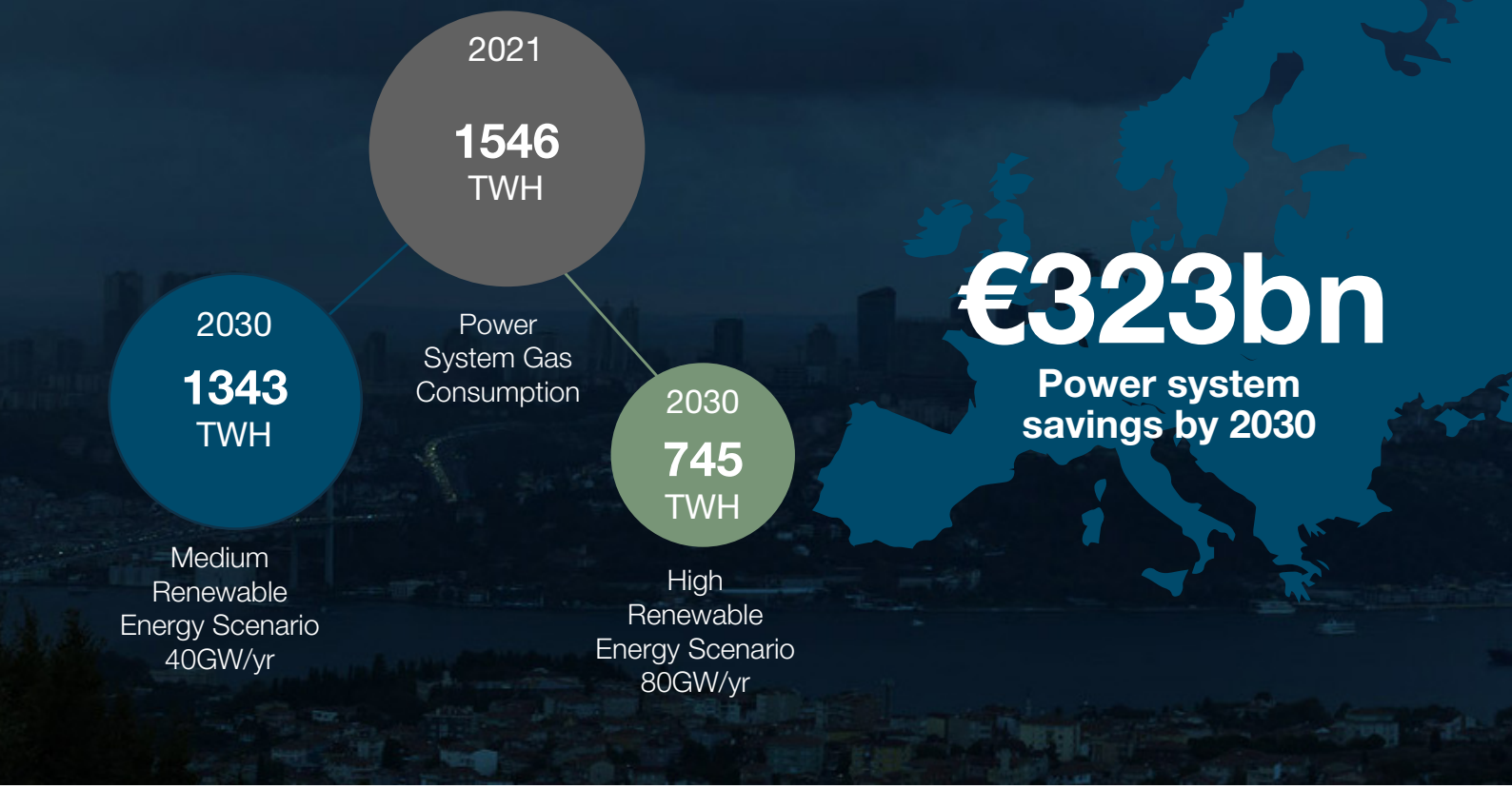
The key bottleneck has been persistently high demand for fossil fuels. Now, for the first time, that demand is curtailed as the acute volatility of a fossil fuel future is clear.

Against this backdrop, calls to reverse decarbonisation and double down on fossil fuels appear illogical. This is not a debate for the future – the cost benefits of accelerating renewables can be seen in the short term as well, with a cumulative saving of 98 billion EUR possible by 2025.

We have all of the technologies and expertise we need for a rapid transition. All we need now is the political will.

www.wartsila.com/energy/towards-100-renewable-energy/europes-energy-future

We have modelled the potential to accelerate the roll-out of renewable energy across Europe by comparing two different progression scenarios - medium and high scenarios. The modelling aims to show how more ambitious renewable targets will affect gas use, carbon emissions and cost.



DATA ANALYSIS OF ENERGY SYSTEM MODELLING

We have modelled the potential to accelerate the roll-out of renewable energy across Europe by comparing two different progression scenarios - Baseline and Ambitious. The modelling aims to show how more ambitious renewable targets will affect gas use, carbon emissions and cost.

The model accounts for the current mix of installed power sector technologies across 33 European countries, including the European Union, UK, Switzerland, Norway and the Balkans.[3)] Renewable generation is backed up by the required balancing technologies, such as energy storage and balancing engines capable of running on sustainable fuels, to meet demand up to 2030.

Existing power plants in each country are included in the model, including wind and solar photovoltaic with hourly generation profiles based on forecast weather conditions. The model accounts for the operational costs (fuel, maintenance and carbon) of existing generation assets, as well as the investment and operational costs of new renewable generation and balancing technologies to 'level up' renewables.

Baseline scenario	Ambitious scenario
Renewable energy provides 50% of power by 2030, with 40GW new renewables capacity added every year to 2030.	Renewable energy reaches 61% by 2030, with 80GW of new capacity per year to 2030.

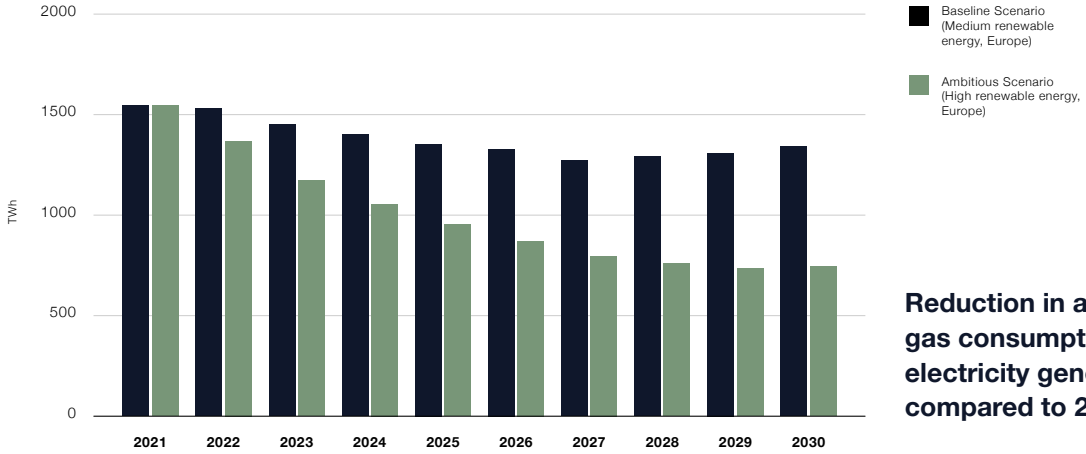
Under the Ambitious scenario, the cost of Europe's energy at source can be cut by 323bn EUR by 2030, compared to the Baseline scenario, with savings of more than 50bn EUR per year by 2030, which could be passed to consumers to reduce the cost of energy.

	Baseline scenario	Ambitious scenario
New renewable energy capacity by 2030	360GW	720GW
Total renewable energy added per year	40GW/yr	80GW/yr
Renewables as a proportion of total power capacity by 2030	50%	61%
Europe level net-zero target	2050	2040
Annual power sector gas use by 2030	1,343TWh/yr	745TWh/yr
Reduction in annual gas consumption for electricity generation compared to 2021	13%	48%

Both scenarios use initial conditions from 2021 data. Annual gas use: 1546TWh/yr. Annual CO2 emissions: 878 million tonnes per year.

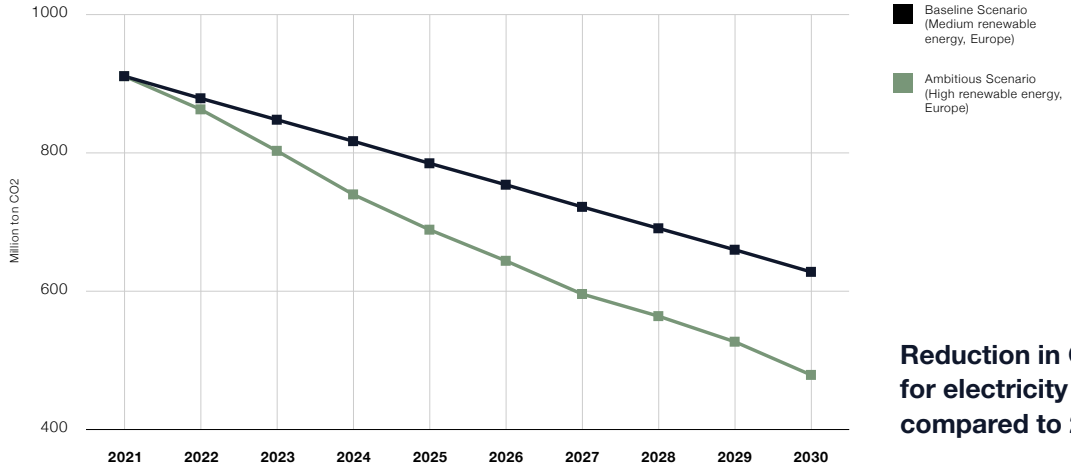
[3)] Full list of countries on page 10

GAS CONSUMPTION



Reduction in annual gas consumption for electricity generation compared to 2021

CO2 EMISSIONS



Reduction in CO_2 emissions for electricity generation compared to 2021

A 61% renewable power system by 2030 achieves low-cost, clean and secure energy

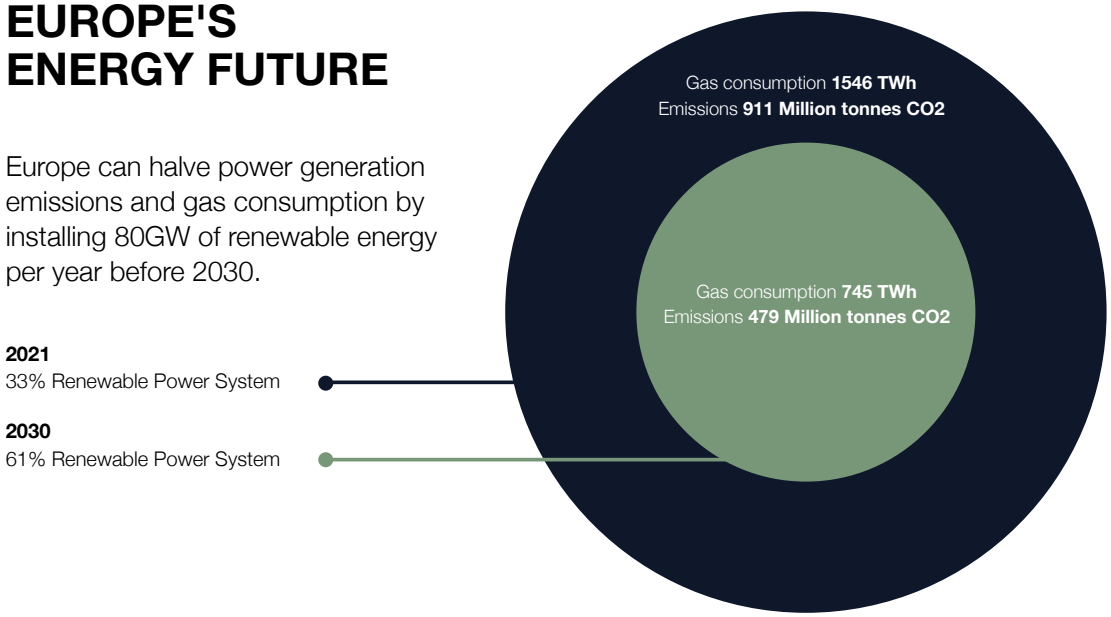
Europe can cut total system costs by 323bn EUR over the next eight years, compared to the current anticipated trajectory for renewables growth, through building 80GW of renewable energy per year to achieve a 61% renewable system. In addition, annual gas consumption can be cut in half by 2030, significantly reducing carbon emissions and reliance on imported gas supplies.

In contrast, under the Baseline Scenario, annual gas consumption would only be reduced by approximately 13% to 1,343TWh/yr. This shows how effective building renewable energy can be for reducing gas consumption across Europe. The Baseline Scenario relies more on gas than renewables in order to meet carbon emission reduction targets.

We need to see a step change in ambition and action to achieve this, front loading renewables growth this decade to bring down costs, increase energy independence and significantly cut our carbon emissions.

EUROPE'S ENERGY FUTURE

Europe can halve power generation emissions and gas consumption by installing 80GW of renewable energy per year before 2030.



50% renewable electricity by 2025 provides rapid benefits

The next three years are critical in reducing Europe's exposure to the intense volatility we see in fossil fuel markets today. Targeting the addition of 80GW of renewables per year by 2025 would significantly address the triple challenges of energy security, cost, and carbon emissions.

Under the Ambitious scenario, by 2025 Europe could:

- Achieve 50% renewable electricity.
- Avoid 1,635TWh of gas consumption.
- Reduce overall energy system costs by 98bn EUR from 2022-2025.
- Stem the dramatic increases in retail electricity prices and even put them into reverse.[4)]

80GW per year: transformational, but conceivable, possible and necessary

To put 80GW per year into context, the EU alone installed 37GW of wind and solar in 2021. A dramatic acceleration is necessary, but it is possible. For example, China installed more than double the amount of offshore wind in 2021 than the previous year (17GW in total).

Such dramatic scaling of low carbon technologies is the norm internationally, not an exception. Over the last 20 years, models have consistently underestimated the speed that emerging renewable technologies can scale in global economies.

In just six years, solar shifted its reputation as "the most expensive way to reduce carbon emissions" (The Economist, 2014) to "…the cheapest electricity in history" (IEA, 2020). Similarly, offshore wind costs have fallen by 70% within a decade – and the IEA's projections for wind energy by 2030 were exceeded in 2010 (WEO 2002).

Over the past year, and particularly in response to the energy crisis, we have seen bold new ambition shown across Europe, including the EU Fit for 55 plan outlining approximately 60GW of renewable deployment per year and more recent REpowerEU, which proposes even faster growth. Our modelling shows European energy leaders can be even bolder.

Given the urgency to find sustainable solutions to the energy price crises, the need for long-term European energy security, and the combined capital of European economies, 80GW per year is conceivable, possible and necessary.

[4)] From an EU average 2021 energy tariff 231€/MWh in 2021 to an average 2025 tariff of between 211 (based on an average gas price of €14.7/GJ) and 235 (average gas price of €27.3/GJ), including network costs, tax and levies.

These savings are calculated by comparing the average EU household energy price tariffs during 2021 to the levelised cost of electricity under each scenario. While it is impossible to fully cost all variables, the data shows a clear trend that greater renewable energy, balanced by flexibility, can reduce the cost of energy for consumers.

RECOMMENDED ACTIONS

Adding the necessary renewables capacity to achieve such a clean, secure and lower cost system demands a level of cross-country coordination and investment akin to the Marshall Plan which helped Europe to recover following World War II. It requires clear strategic policy action, built on detailed data modelling, that address technology, finance and planning permission. Decision makers across Europe should act together to:

1. Coordinate actions that can accelerate the scalability of innovation, increase economies of scale, plus provide the incentives for investment.
2. Enable additions of renewable electricity as quickly as possible, for example establishing permitting frameworks that give renewable energy projects priority status and fast-tracked approval, to accelerate deployment.
3. Create market frameworks that encourage investments in flexible energy storage and balancing engines, to enable renewable energy to provide baseload power.
4. Leverage public investment to secure private sector capital, through incentive measures, such as tax credits, which according to IRENA, the International Renewable Energy Agency, can raise investment by a factor of 3-4.[5)]
5. Encourage cross-border infrastructure projects linking the energy systems of EU countries to promote energy security, streamline costs and promote efficiency.
6. Plan and prepare the right conditions to balance high renewable systems using Power-to-X capacity for sustainable hydrogen-based fuel production and convert balancing power plants to run that fuel from the 2030s onwards.
7. Use the shift to high renewable energy systems in the power sector to begin electrifying related sectors, such as transport, industry and heating and cooling. This will drive significant efficiencies, as well as deep decarbonisation needed to realise net zero.

The next three years are critical in reducing Europe's exposure to the intense volatility we see in fossil fuel markets today.

[5)] https://www.irena.org/newsroom/pressreleases/2020/Jun/IRENA-Puts-Energy-Transformation-at-Heart-of-Sustainable-Recovery-Agenda

MARKET VIEWS

GERMANY – Jan Andersson, General Manager, Market Development Africa & Europe

The German government has committed to developing a 100% renewable system by 2035 by building up to 20GW of renewable energy sources per year. Our modelling shows that this step is critical to reduce the country's hunger for gas. However, as approximately 60% of the German gas consumption originates from Russia the country will have a hard time to completely cutting supply. Policy to lower demand for gas may lead Germany to use more coal, a huge step backwards, this makes it even more important that gas powered generation is flexible and works to integrate renewables.

UK – Tony Meski, Senior Analyst, Market Development

The UK has a huge opportunity to capitalise on its renewable energy resources, especially wind. The country has set a clear and achievable target of having net zero emissions from the power sector by 2035, on the path to decarbonise the country's economy by 2050. This can be achieved with the technologies available today. Adding unprecedented amounts of renewable power generation capacity will decrease the dependency on fossil fuels and drive down the cost of electricity. The UK needs to simultaneously shift from a system reliant on baseload gas generation to a system capable of providing renewable balancing. This balancing capacity will eventually shift to sustainable fuels to reach net zero in 2035.

ITALY – Marco Golinelli, Senior Business Development Manager, Europe Sales

These latest European modelling results are aligned with Italy's Climate and Energy plan, which shows the country can make some of the biggest gains of any country in Europe by front-loading renewable energy capacity before 2030. By rapidly building renewable energy capacity, underpinned by flexible capacity, Italy can meet most of its electricity demand with low cost, clean energy, dramatically cutting reliance on baseload gas. Funds are increasingly being diverted from the public purse to shield consumers from immediate energy price rises. However, leaders now have an opportunity to rescue consumers from ongoing medium-term and long-term price volatility, by rapidly accelerating the transition to renewable energy - ensuring Italy meets its target to reduce greenhouse gas emissions by 60% by 2030.

FINLAND – Anja Frada, Vice President, Strategy And Business Development

Finland's current government targets for a carbon neutral society by 2035. In the power sector, this transition aims to phase out coal this decade and deploy more wind generation. The expansion of wind power generation is crucial, but this needs balancing. Currently, hydro generation and import lines have important role in the balancing. However, as Europe phases out coal and reduces gas consumption, less reliable power is available through interconnections. Finland cannot depend only on its neighbours to build reliable and low carbon power systems. Instead, it needs to actively deploy demand response, energy storage and balancing power generation to achieve energy security.

METHODOLOGY

The modelling is based on techno-economic optimisation of Europe's power system.

The countries included in the modelling are:

- Albania
- Austria
- Belgium
- Bosnia & Herzegovina
- Bulgaria
- Croatia
- Czech Republic
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hungary
- Ireland
- Italy
- Latvia
- Lithuania
- Luxembourg
- Macedonia
- Montenegro
- Netherlands
- Norway
- Poland
- Portugal
- Romania
- Serbia
- Slovakia
- Slovenia
- Spain
- Sweden
- Switzerland
- United Kingdom

Existing power plants are included with their technical properties and fuels to model their carbon emissions and ability to balance variable renewable generation. Wind and solar PV are modelled with their hourly generation profiles based on the weather conditions in the studied area.

The detailed PLEXOS optimisation modelling uses a chronological approach, i.e., the variability and seasonality of renewable generation and load need to be balanced hour-by-hour in the model. Thus, the modelling accurately dimensions the required flexibility and storage capacity in the studied power system.

To cost optimally meet the future demand and political targets, the modelling adds required technologies to the system. The available options include different renewable sources, such as wind, solar PV and geothermal, thermal technologies from gas engines and turbine power plants - to nuclear power, storage technologies, such as battery and pump storage, and technologies to produce sustainable fuels.

ABOUT WÄRTSILÄ

Wärtsilä Energy leads the transition towards a 100% renewable energy future. We help our customers to decarbonise by developing market-leading technologies. These cover future-fuel enabled balancing power plants, hybrid solutions, and energy storage and optimisation technology, including the GEMS energy management platform. Wärtsilä Energy's lifecycle services are designed to increase efficiency, promote reliability and guarantee operational performance. Our portfolio comprises 76GW of power plant capacity and more than 110 energy storage systems delivered to 180 countries around the world.

Wärtsilä has developed this report to use our energy modelling expertise to present a clear pathway for Europe to maximise its use of renewable energy and cut costs for consumers. We believe data-based policy decisions are essential for creating a future energy system that is secure, sustainable, and low cost.

https://www.wartsila.com/energy