Committee on Energy

WORLD ENERGY COUNCIL | CONSEIL FRANÇAIS DE L'ÉNERGIE

World Energy Bridges

Sharing energy expertise across the globe

International Webinar Series

Facing the energy trilemma in turbulent times

Perspectives from France and Europe

8 April 2026 | 1:00-2:00 pm CEST

World Federation of Engineering Organizations
Fédération Mondiale des Organisations d'Ingénieurs

unesco

WFEO: an international, non-governmental organization representing the engineering profession worldwide.

Founded in 1968 by a group of regional engineering organizations, under the auspices of the United Nations Educational, Scientific and Cultural Organizations (UNESCO), WFEO brings together national engineering organizations from 100 nations and represents more than 30 million engineers from around the world.

The international organization for the engineering profession

Cooperates with United Nations bodies and other international organizations

Acts through thirteen Committees and Working Groups addressing key engineering issues

ENERGY

Committee on Energy

WFEO / FMOI

Program

- **Task groups**
- **Sharing international knowledge and experiences :**
  - **technological solutions and innovations for energy transition**.
  - **effective energy policies** on how to speed up the implementation of these solutions while managing the dimension of acceptability and affordability
  - **how to guarantee resilience of global energy systems**

Task groups

- **Hydrogen** – Prof. Massimiliano Capezzali, Switzerland
- **Energy Efficiency** – Dr. Ruomei Li, China
- **Solar PV –** Dr. Carsten Ahrens, Germany
- **Electrification** – Prof. Abubakar Sambo, Nigeria

Committee on Energy - Organization

Chair: Marie-Line Vaiani

Vice-Chair:

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- **Asia/Pacific** – Prof. Sun Hongbin, China
- **Europe/Russia** – Dr. Daniel Favrat, Switzerland
- **Latin America** – Mag. Ing. Miguel Fierro, Uruguay
- **Middle East/South Central Asia** – Mr. Pradeep Chaturvedi, India

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Institution of Engineers Rwanda	Nigerian Society of Engineers
Order of Engineers of Angola	Myanmar Engineering Society
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Institution of Engineers, India	Ordem dos Engenheiros Tecnicos
Institution of Engineers, Mauritius	China Association for Science and Technology
Asociación de Ingenieros del Uruguay	Ethiopian Association of Civil Engineer
Macau Institute Of Engineers	Ingénieurs et Scientifiques de France
Union National des Ingénieurs du Maroc	China Association for Science and Technology
Engineering Council of Zimbabwe	HK Institution of Engineers
Institution of Engineers of Keny	

World Energy Bridges

World Energy Bridges: initiative launched by WFEO Committee on Energy and World Energy Council France.

It **connects energy professionals, engineers and policymakers across the world** to share expertise and real-world experience on energy policy, technology and innovation.

WFEO / FMOI

World Energy Bridges

Sharing energy expertise across the globe

International Webinar Series

WORLD ENERGY COUNCIL | CONSEIL FRANÇAIS DE L'ÉNERGIE

Facing the energy trilemma in turbulent times: perspectives from France and Europe

8 April 2026 | 1:00-2:00 pm CEST

Sandra WINKLER
Senior Director, Insights,
World Energy Council

Laurent KUENY
Director of Energy,
Ministry of Energy, France

Marie-Line VAIANI
Chair, WFEO Committee on Energy
Member, UN Council of Engineers
for the Energy Transition

Rebalancing World Energy System Leadership

Navigating trade-offs and tensions in a more turbulent world

Sandra Winkler, Senior Director, Insights – World Energy Council

WORLD ENERGY COUNCIL 100 YEARS OF IMPACT

Energy is not a sector.

It remains the operating system of civilization.

Where energy flows, prosperity follows.

For over a century, energy systems have evolved through distinct eras

WORLD ENERGY COUNCIL 100 YEARS OF IMPACT

Each phase added complexity.
Each required a different kind of leadership.

Emerging horizon

Energy for Peace
Stable systems

Energy for Prosperity
Growth and access

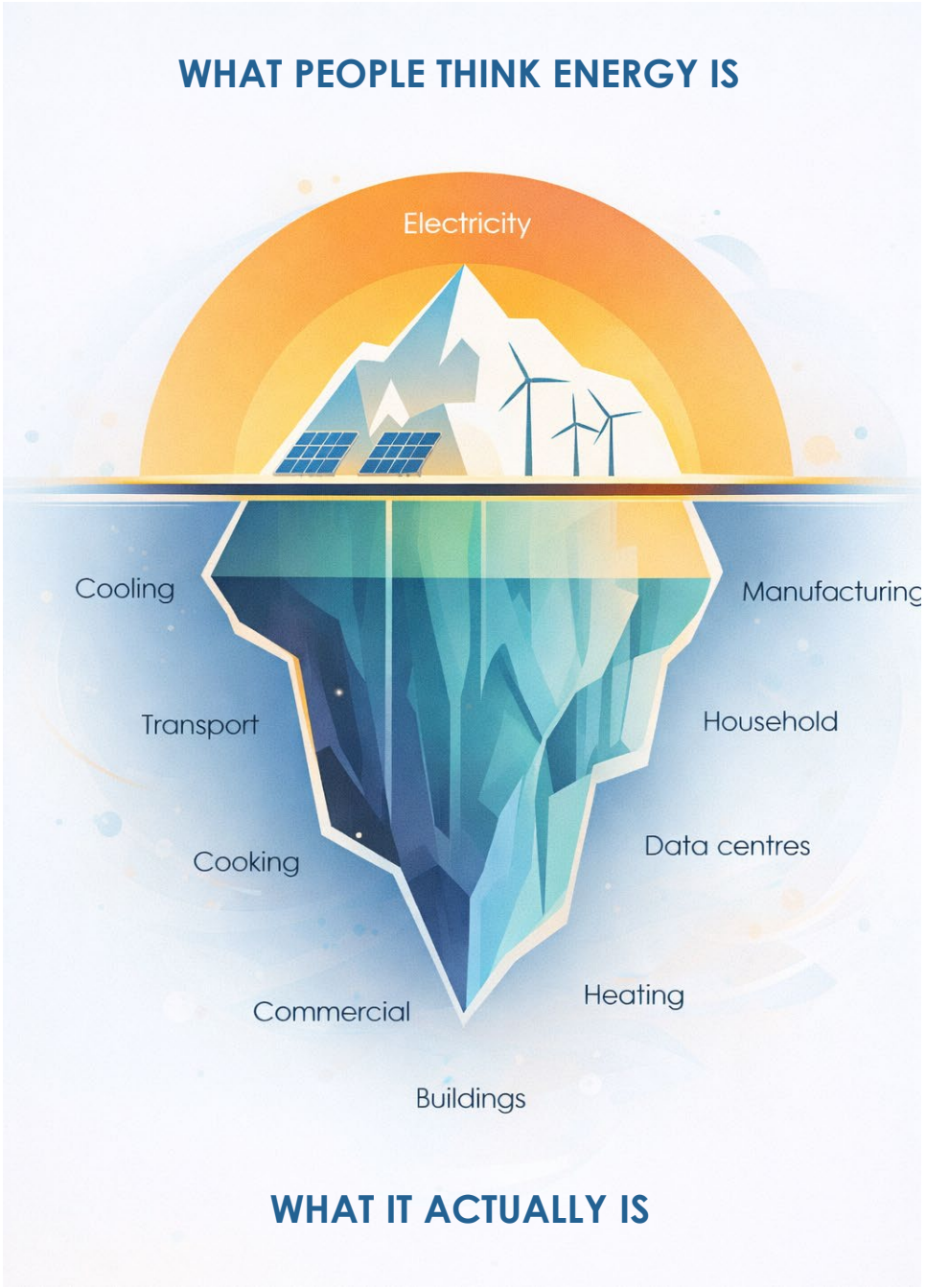
Energy for Sustainability
Balanced systems

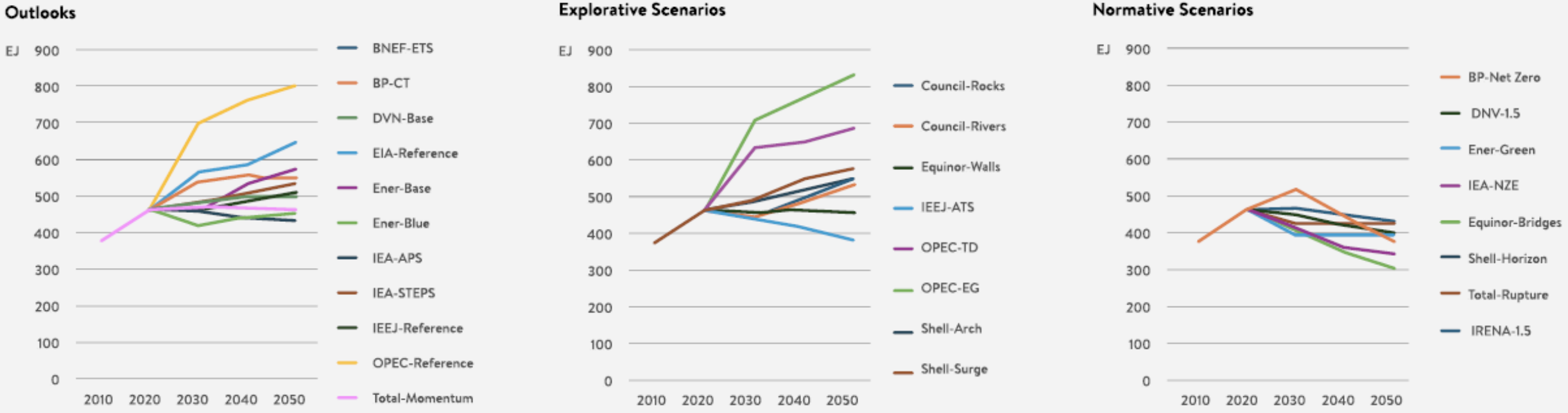
Energy for Flourishing
New safe operating space

Energy is getting bigger.

The system is expanding (and more complex than it looks)

- Energy directly intersects with security, industry, finance, digital infrastructure and cities
- Systems are expanding across geographies and technologies
- Supply alone no longer defines the system
- Demand is emerging as a major — and poorly understood — source of uncertainty





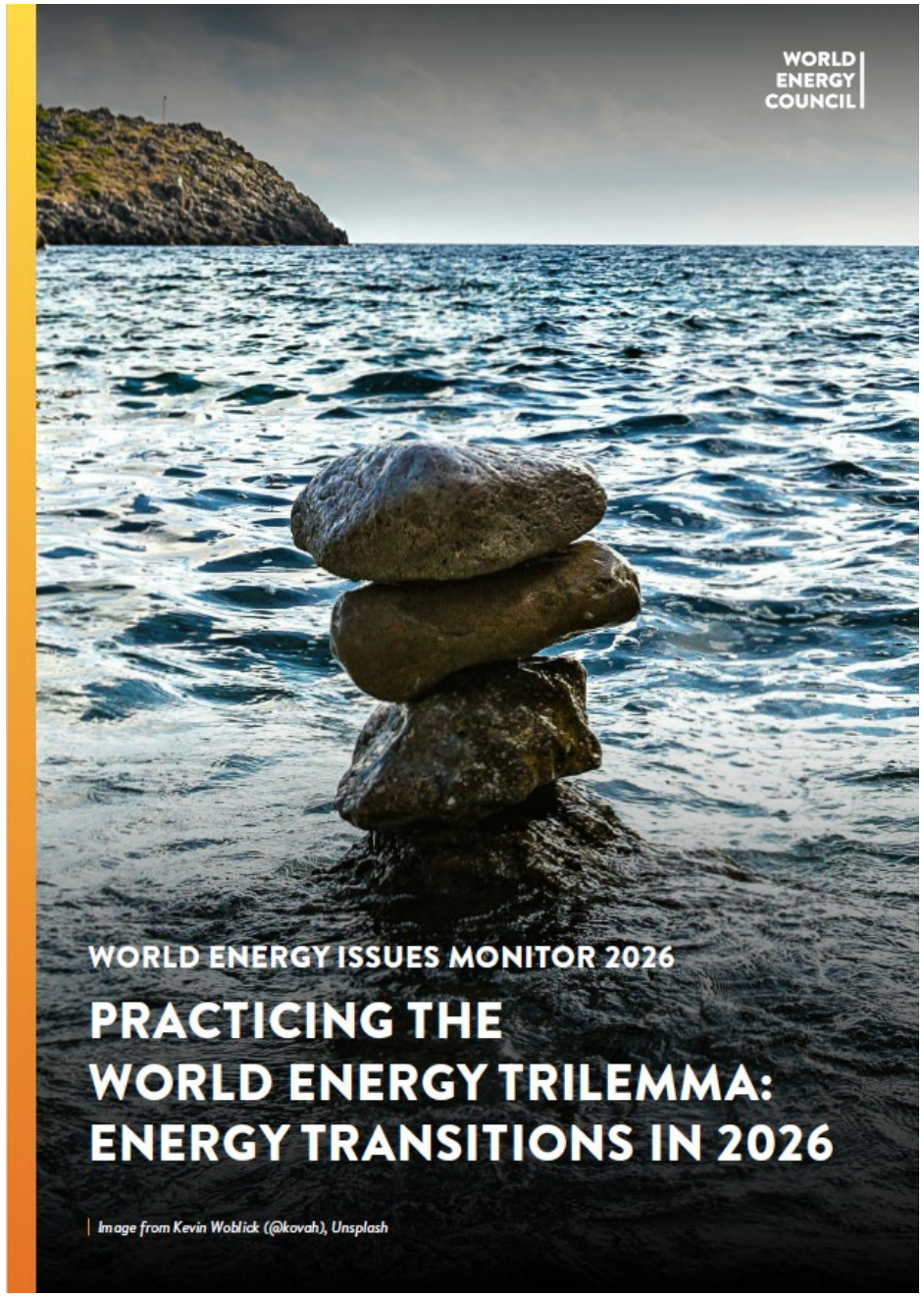
2025 World Energy Scenario Comparison, World Energy Council

Demand is not just growing – it is compounding

Multiple forces are now acting at once – and reinforcing each other

- AI and data centres
- Electrification surges
- Urbanisation and industrial growth

Where and when demand shows up is shifting – and harder to predict



WORLD ENERGY COUNCIL 100 YEARS OF IMPACT

The system is under pressure

- Grid congestion and delays
- Permitting bottlenecks
- Investment uncertainty
- Supply chain constraints

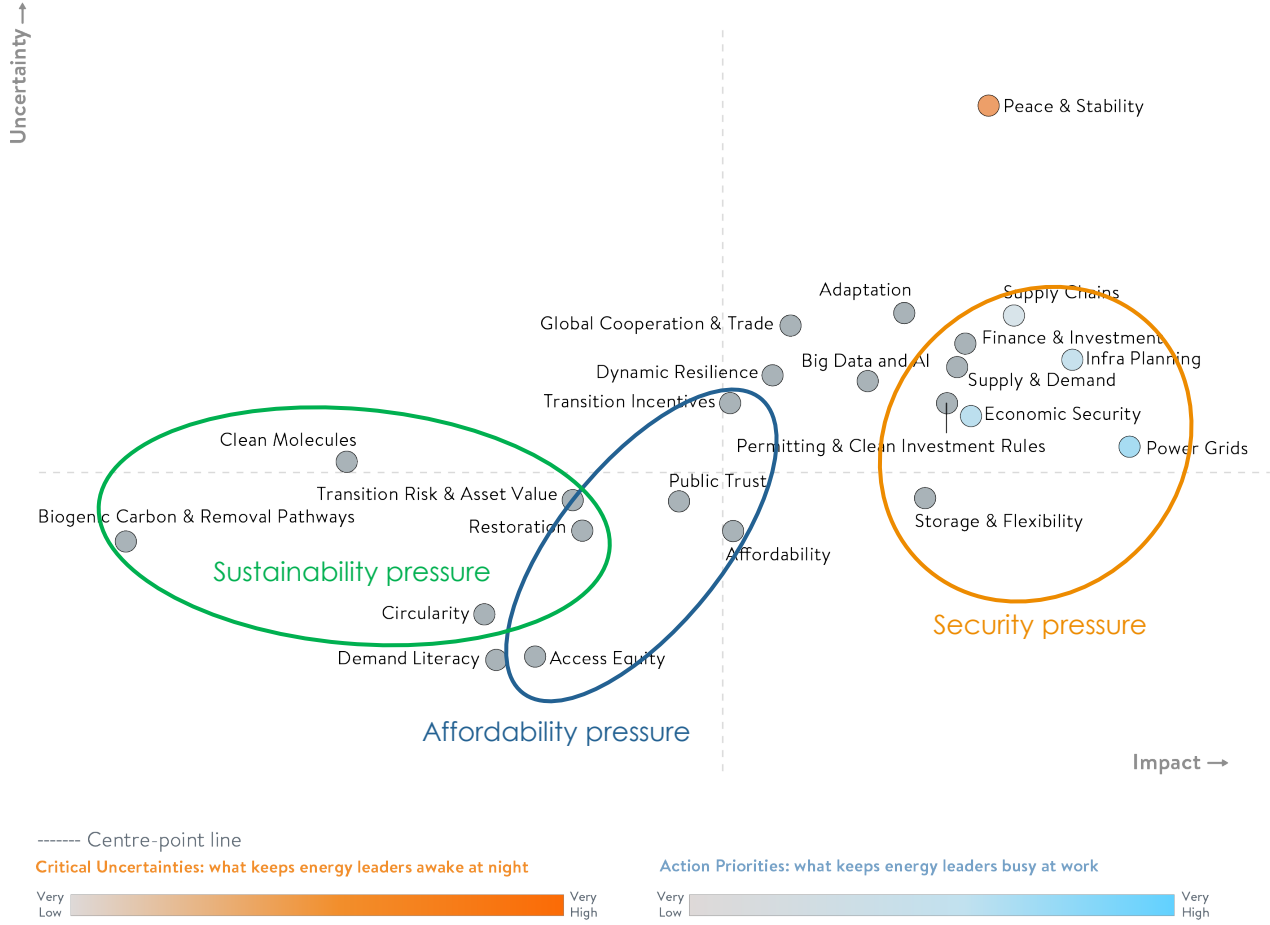
This is where system pressures turn into trade-offs

Global Highlights

WORLD ENERGY ISSUES MONITOR | MARCH 2026

1. **Peace & Stability** is the dominant uncertainty influencing decisions across regions.
2. **Power delivery constraints** – grids, permitting, supply chains, skills – set the pace of transitions.
3. **Power demand drivers** extend well beyond the AI narrative. Multiple structural forces are compounding – electricity expansion will persist even if hydrocarbon demand plateaus.
4. **Power system stress** is visible in congestion, curtailment, negative pricing and interconnection limits.
5. **Trust** functions as invisible infrastructure – and in many places it is thinning, particularly where affordability pressures and uneven cost burdens intensify.

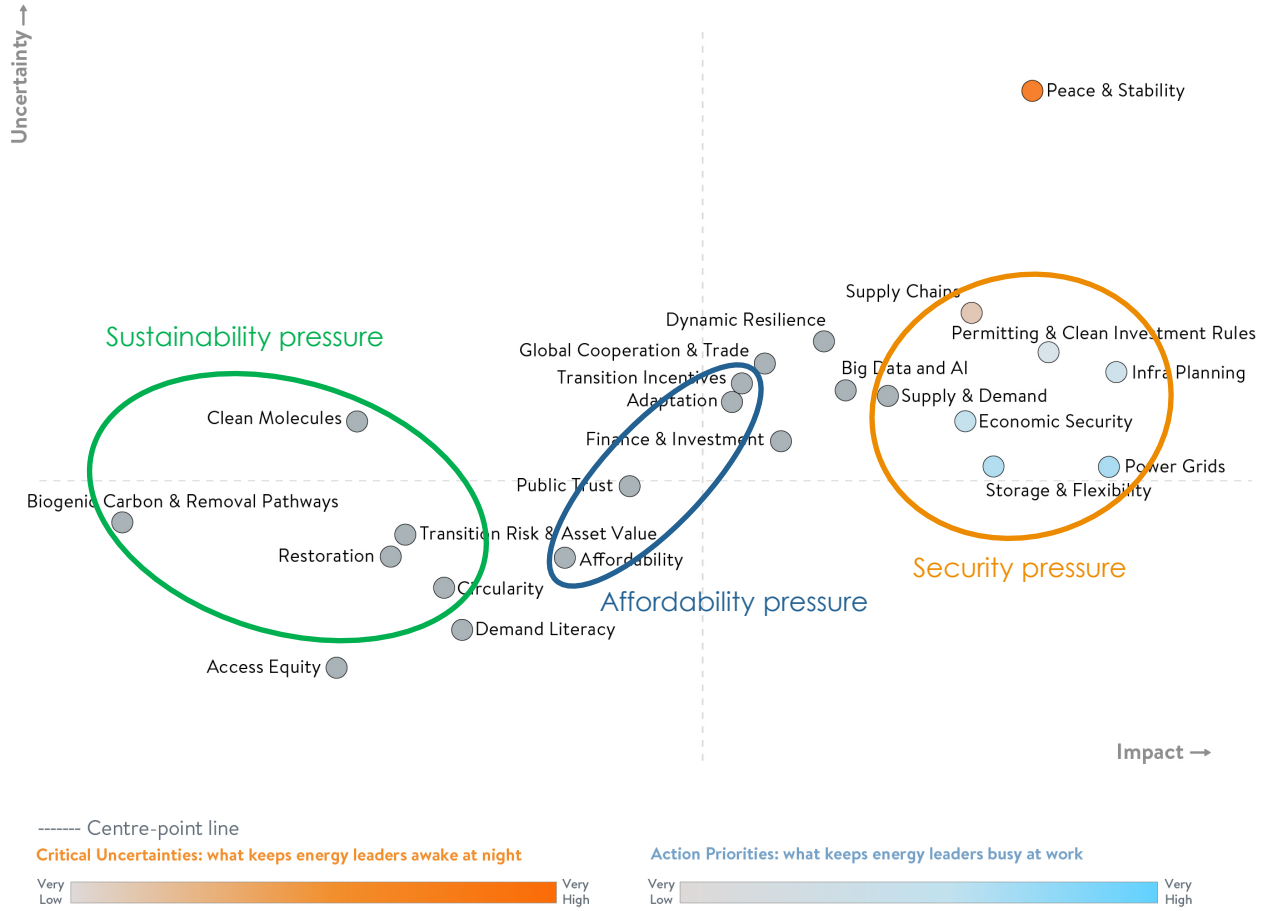
2026 World Energy Issues Monitor (Global)

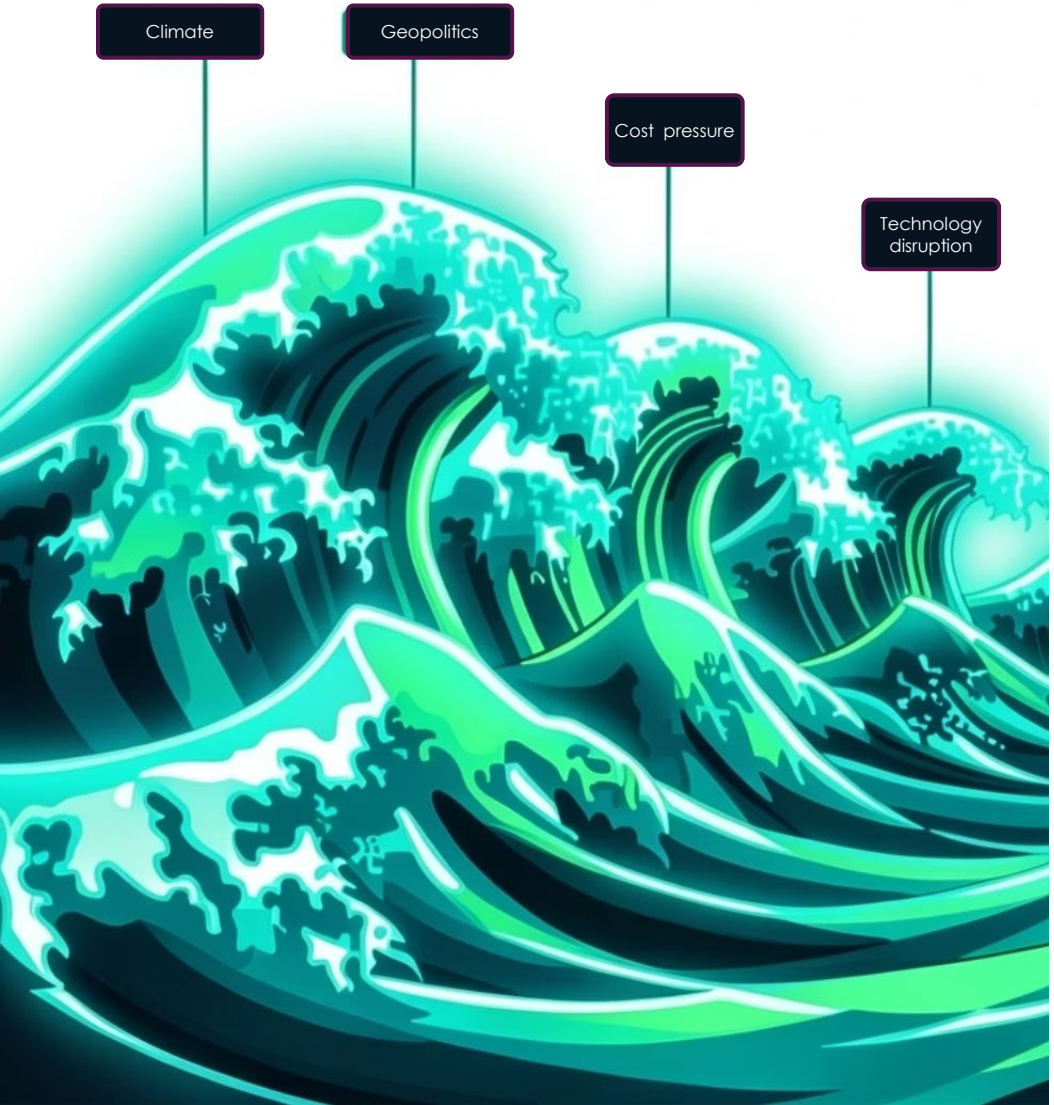


Trade-offs are becoming unavoidable.

- Security vs affordability
- Affordability vs sustainability
- Sustainability vs system stability

2026 World Energy Issues Monitor (Europe)





Today, energy systems are under constant strain

Under strain, systems are becoming:

More volatile

Harder to predict

Expanding beyond traditional boundaries

Trade-offs intensify

WORLD ENERGY COUNCIL 100 YEARS OF IMPACT

The World Energy Trilemma

A leadership discipline

The discipline of balancing **security, affordability, and sustainability** — simultaneously, under real-world constraints.

You cannot maximise all three at once.

Energy Trilemma history

From early framing to global benchmarking and now to practical leadership. The Trilemma continues to grow in relevance as energy systems become more interconnected.

2000s – The 3 As

- Access, Availability, Acceptability
- Early conceptualisation of evolving energy challenges

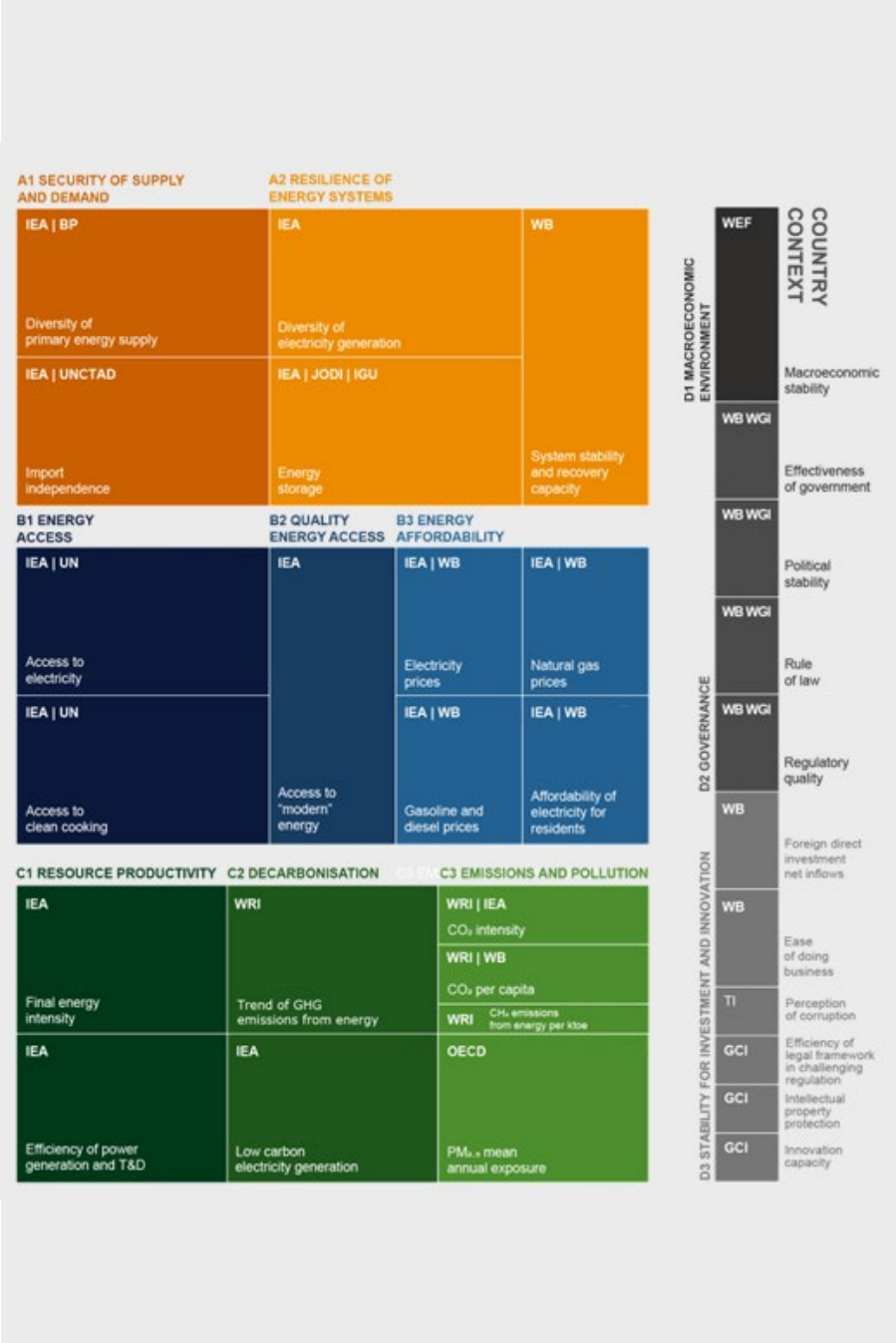
2009 – The first global Index

- Formalized measurement framework
- Tracking performance across countries

2013 – 120+ countries

- Expanded global coverage and deepened comparative analysis
- Growing adoption of framework

Today – From measurement to leadership practice



How are countries assessed?

Security → security of supply, resilience

Affordability → prices, access

Sustainability → emissions, productivity, decarbonisation

Context factors → stability, governance

Methodology to date

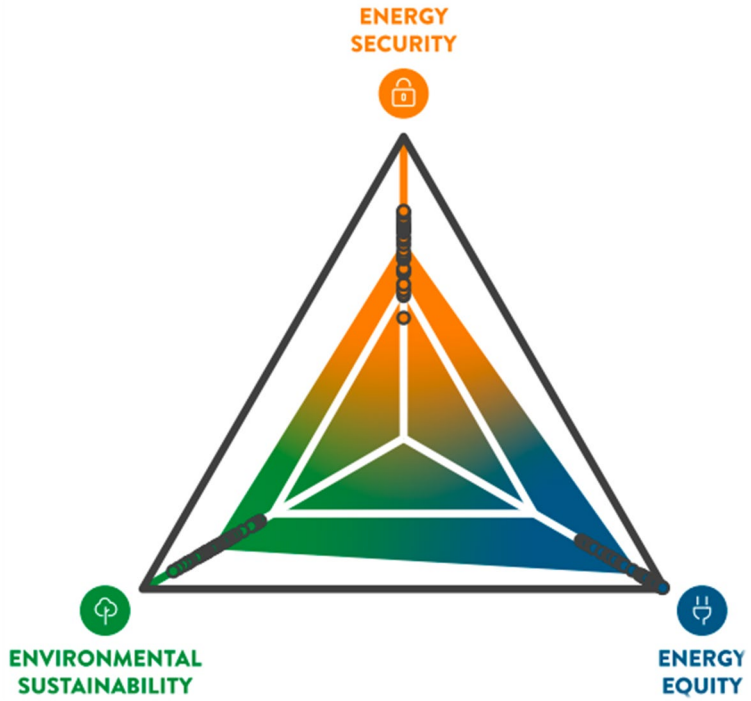
Europe

Progress in one area creates pressure in others

Security → up in importance

Affordability → under pressure

Sustainability → commitment remains



Navigating Dimensional Tensions

France

Security Pressures	Affordability Pressures	Sustainability Pressures
• Future adequacy depends on **nuclear life extensions and new build** amid delays and rising costs • Limited gas generation and battery storage increases reliance on **nuclear and interconnections** • France acts as a **European electricity hub**, increasing reliance on cross-border flows • Rising electricity demand will test the balance between **nuclear, renewables and system flexibility**	• Retail electricity prices becoming **politically sensitive** as crisis protections fade • Major **grid and system investment** needed for electrification and resilience • Nuclear new-build delays highlight **cost and financing risks** • Transition equipment and electrification investments shift costs **towards households and industry**	• **Public resistance to onshore wind** slowing renewable expansion • Expanding offshore wind raises **marine, biodiversity and visual impacts** • Climate policy debate increasingly includes **land use, water and biodiversity trade-offs** • **Decarbonisation beyond power** (transport, industry, building etc.) remains a major structural challenge

Better energy leadership begins by making trade-offs explicit — and using the Trilemma as a discipline for structured rebalancing.

Trilemma is Deepening

The Trilemma is more relevant than ever.

Security

- Fuel and Hydrocarbon Supply
- Power System Operation
- System Resilience and Strategic Dependence

Affordability

- Household Energy Costs
- Business and Industry Costs
- Taxpayer Costs
- Energy Access

Environmental Sustainability

- Atmosphere and Climate
- Sea and Fresh Water
- Biodiversity
- Land
- Human and Materials

From measurement to leadership practice

From Measurement

- Measures system performance
- Provides a static snapshot in time
- Simplifies complexity into scores
- Supports benchmarking and tracking progress

To Leadership Practice

- Surfaces trade-offs explicitly
- Explores tensions between dimensions
- Supports decision-making in context
- Enables continues learning across systems

The Pivot: Trilemma as Leadership Practice

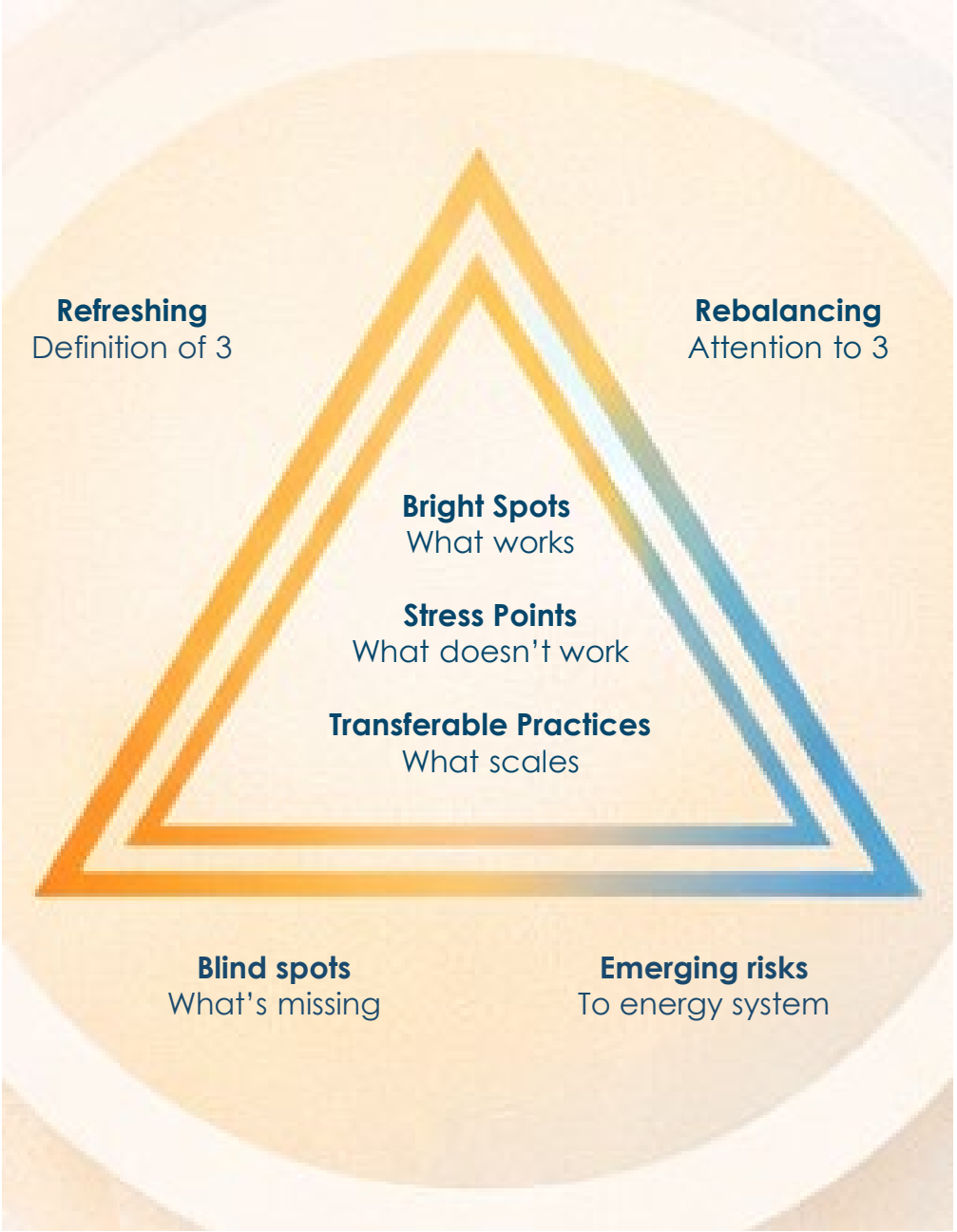
Make trade-offs explicit

Explore tensions

Test decisions

Learn across systems

This moment requires a different way of leading and learning



www.worldenergy.org | @WECouncil

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3rd MULTI-YEAR ENERGY PLANNING (PPE 3)

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Planning a low-carbon France

At a time when the world is engaged in an existential race against time in the face of the climate emergency, **the French Government is taking action to accelerate its ecological transition.**

Since 2021, the Government is preparing or had adopted :

- **The 3rd low-carbon strategy (SNBC)**: France's roadmap for implemting its GHG emissions reduction policy
- **The 3rd multiannual energy plan (PPE)** : a tool for steering France's energy policy
- **The 3rd national climate change adaptation plan (PNACC)**

These documents form the basis for **coherent, integrated and ambitious action in this area.**

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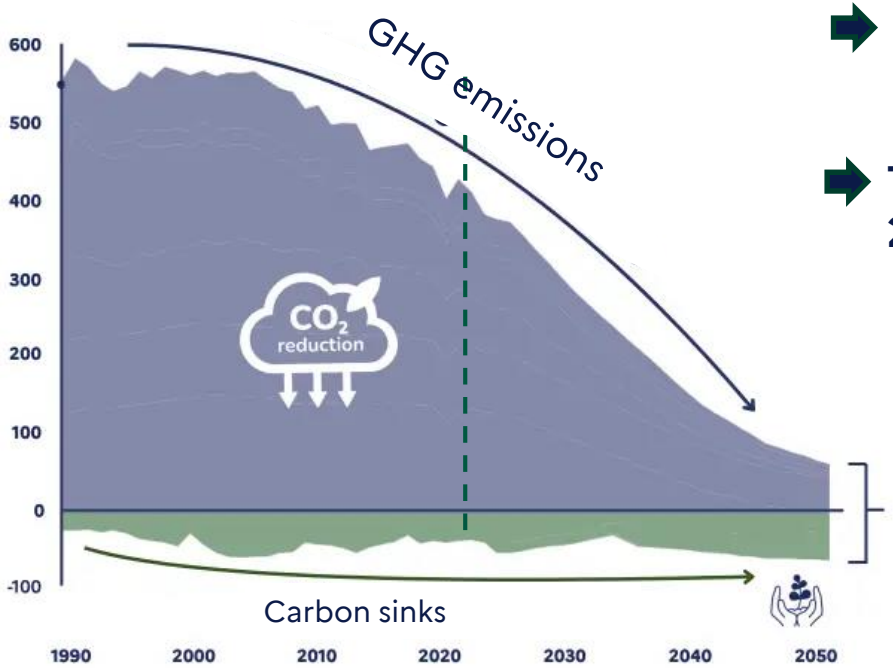
PPE 3 supports our mid- and long term climate objective…



Carbon neutrality

- **To cut our emissions by a half in 2030 compared to 1990**
- **To reach carbon neutrality by 2050**

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European Union has implemented ambitious policy packages and targets

In 2024, fossil fuels accounted for 59% of energy consumption in the EU

	European Climate Law	Fit for 55 package	RepowerEU
1	GHG emissions to be reduced by at least : **55% by 2030**	Sectoral legislations and regulations to make the economy fit the climate target (effort sharing, carbon adjustment mechanism, RES and energy efficiency directive,…)	Increased ambitions of FF55 to mitigate the impact of the 2022 crisis ,and diversification of supply sources
2	**(new) 90% by 2040**	To be defined…	

Supported by other initatives (eg the Green deal industrial plan): Electricity market reform, Net Zero Industrial Act, Critical Raw Material Act, Clean Energy Investment Strategy,…

PPE 3

TWO KEY FINDINGS: OVERSUPPLY AND FALLING PRICES

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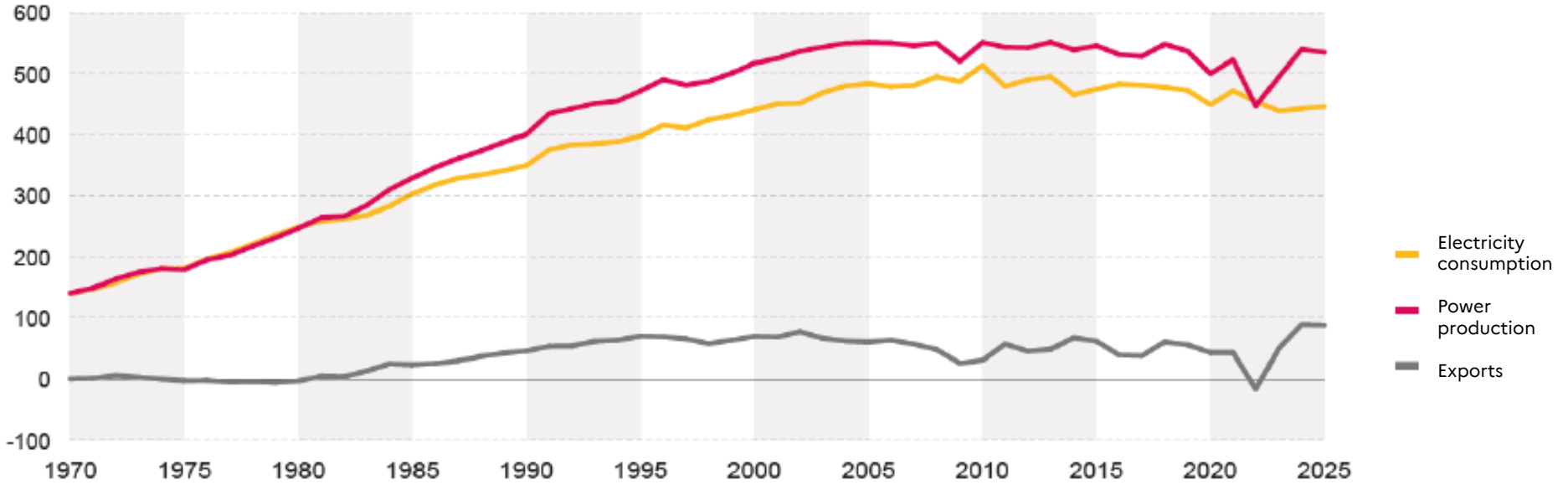
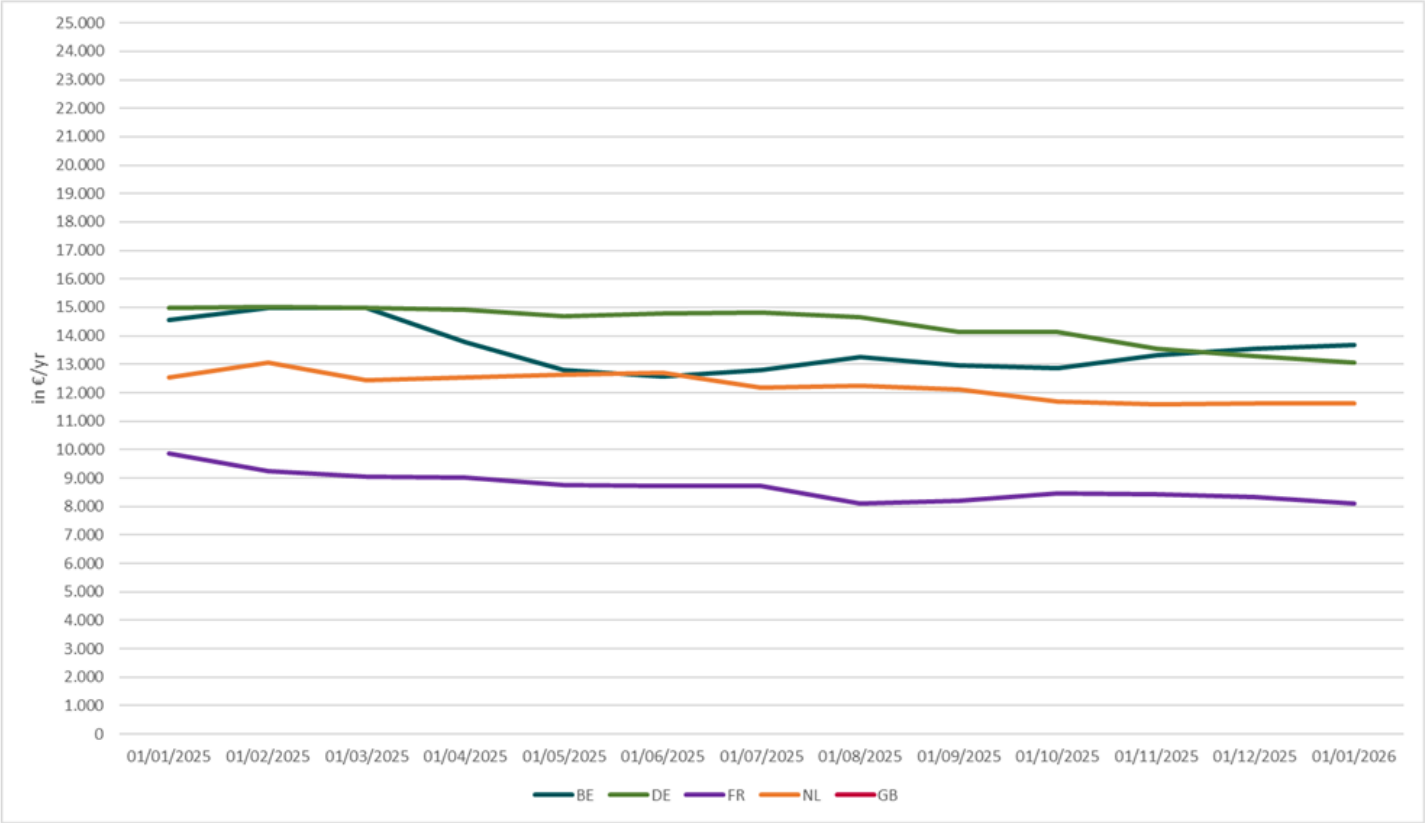
Observation



Electricity prices evolution (excl. VAT), for a professional use

CREG



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PPE 3

AN INDUSTRIAL POLICY PROJECT

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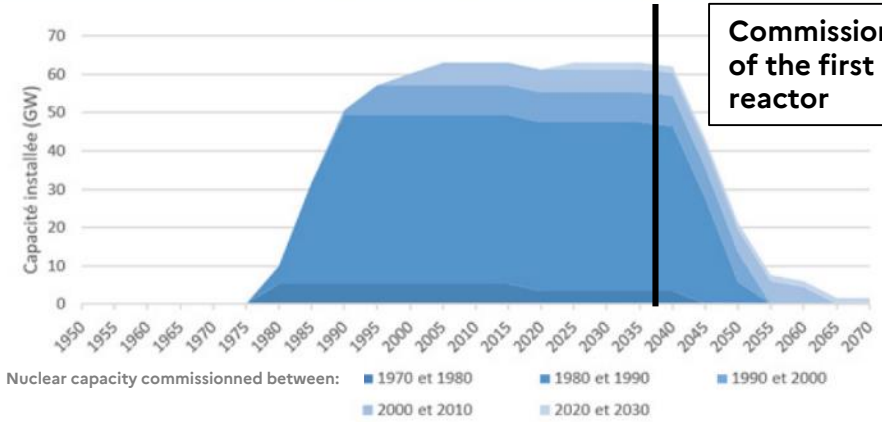
Timescale issues and nuclear

Previous PPE (PPE 2) :

- **Closure** of 4 to 6 nuclear reactors by 2028
- **Closure** of 14 nuclear reactors by 2035
- **50% nuclear electricity in the electricity mix by 2035**

« CLIFF EFFECT » IN CASE OF SIMULTANEOUS SHUTDOWN OF NUCLEAR REACTORS AFTER 60 YEARS OF OPERATION



Commissioning of the first EPR2 reactor

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With PPE 3, France confirms three industrial ventures: Nuclear, Offshore Wind, and Hydropower Revival

DGEC

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PPE3 strengthens the industrial basis

Siemens Gamesa (76)
Wind turbine blades

Elogen (91)
Electrolysers

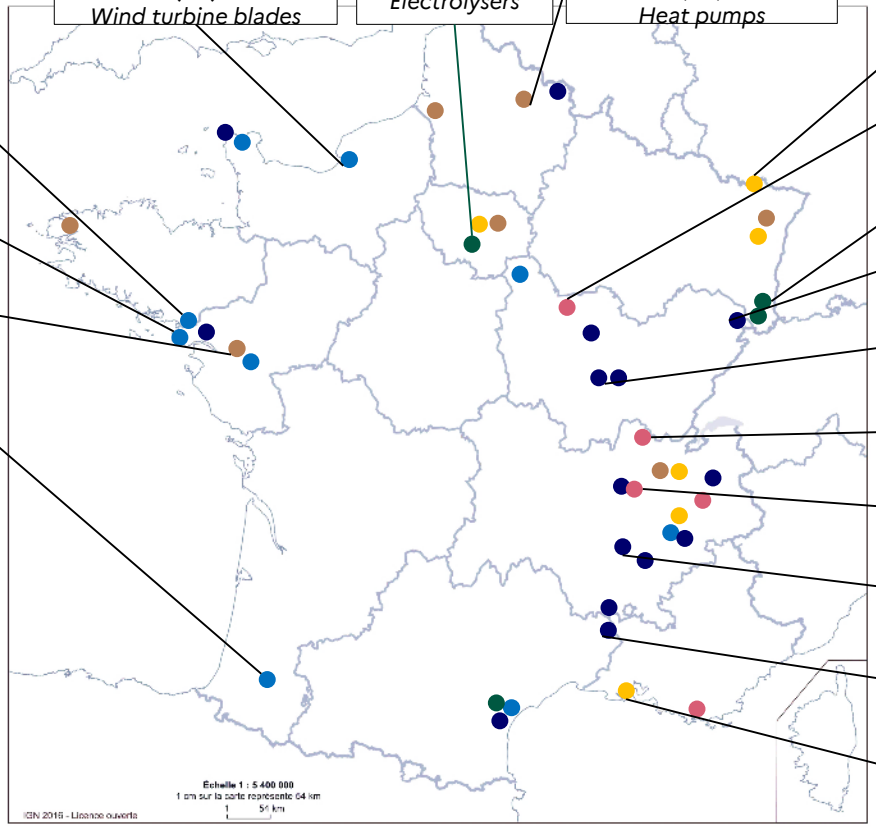
Groupe Atlantic (62)
Heat pumps

GE Vernova (44)
Wind turbine nacelles

Chantiers de l'Atlantique (44)
Power substations

Saunier Duval (44)
Heat pumps

Carester (64)
Rare earths



Key industrial sites (including projects

- Nuclear
- PV
- Wind power
- Hydrogen
- Heat pumps
- Electrical grids

Holosolis (57)
PV cells and modules

Prysmian (89)
Transmission network cables

John Cockerill (68)
Electrolysers

Arabelle Solutions (90)
Turbo generators sets

Framatome (71)
Tanks, steam generators, pressurisers

Nexans (01)
Distribution network cables

JST Transformateurs (69)
Power stations

Vanatome (26)
Nuclear valves and taps

Orano (30)
Mox nuclear fuel

Carbon (13)
PV cells and modules

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PPE 3

DEMAND SCENARIOS & A MAJOR ELECTRIFICATION PLAN

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PPE & demand scenarios

Many industrial projects have already secured their network access for the coming years

~30 GW

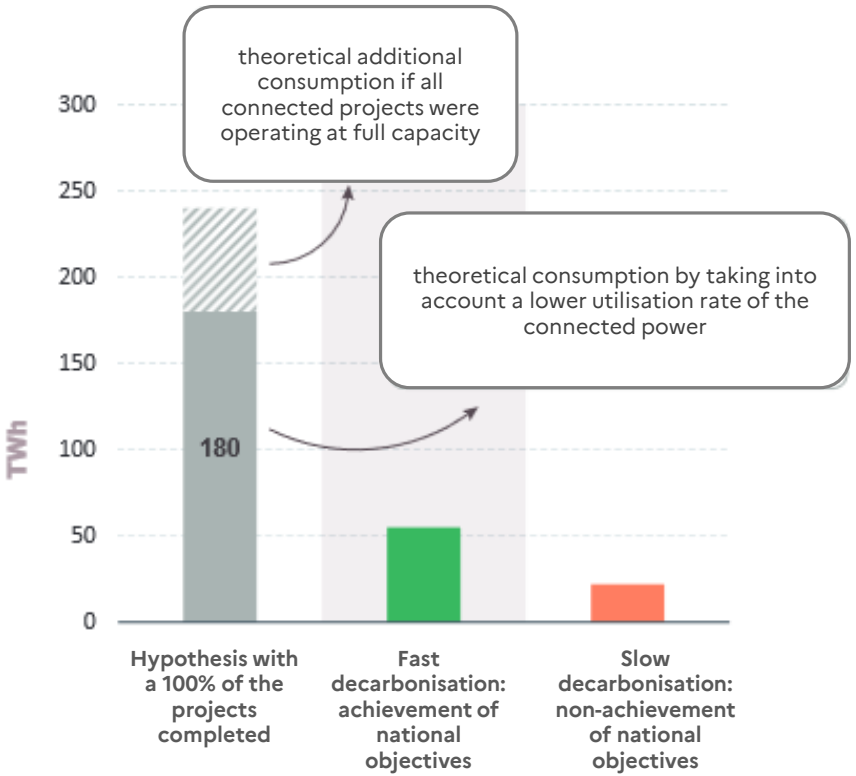
Of transmission network access capacities already booked

Manufacturing industry
~7 GW

Hydrogen and derivatives
~10 GW

Digital and datacenters
~14 GW

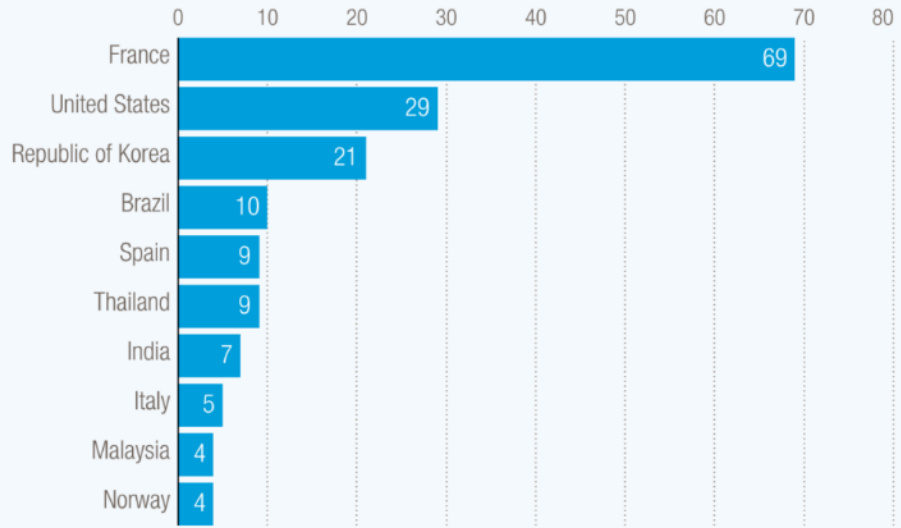
→ If all projects materialize, consumption will significantly exceed projected scenarios (RTE central scenario).



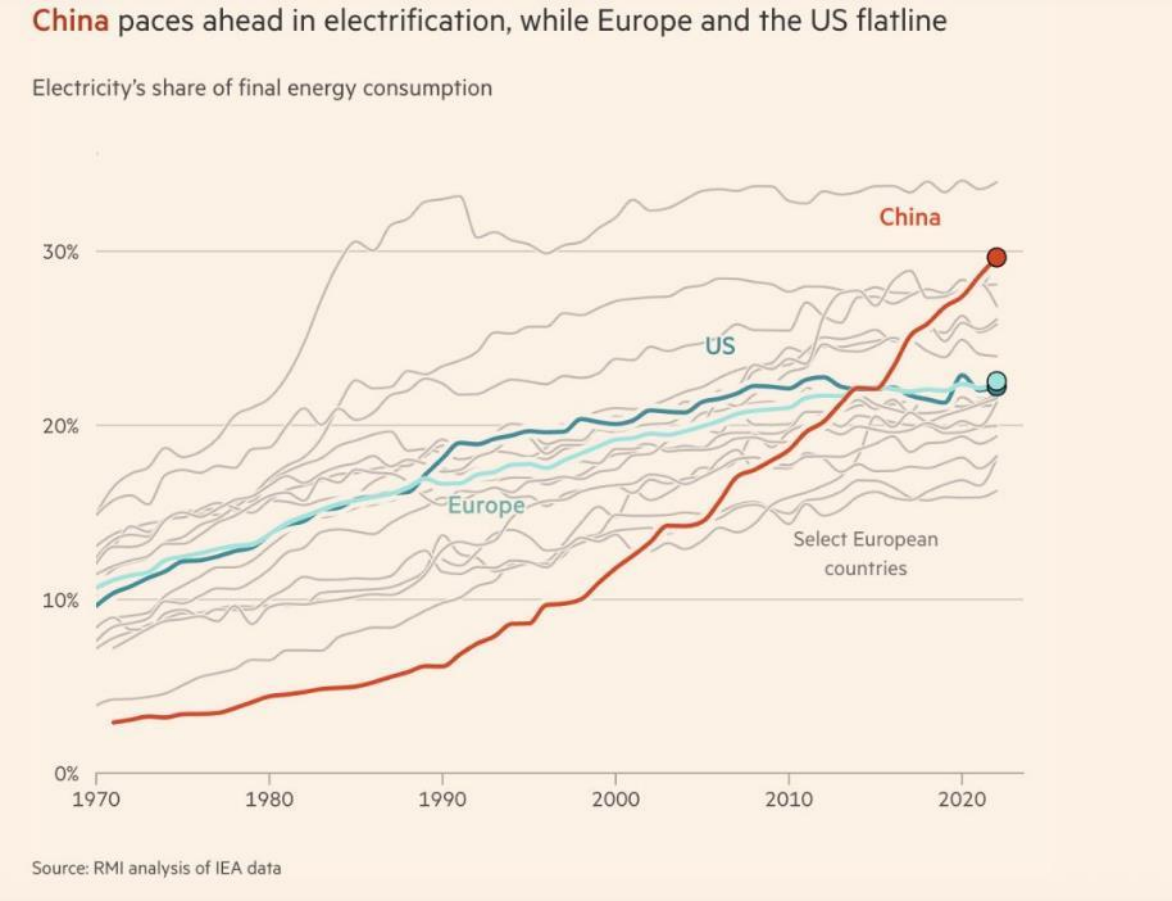
Normand'Hy – 200MW

Foreign investment in data centres is concentrated in a handful of countries

Major recipients of data center investments, 2025, billions of dollars



Source: UN Trade and Development (UNCTAD), information from The Financial Times Ltd, fi Markets (www.fDimarkets.com).
Note: The data covers the first three quarters of 2025


China paces ahead in electrification, while Europe and the US flatline
Electricity's share of final energy consumption
China
US
Europe
Select European countries
30%
20%
10%
0%
1970
1980
1990
2000
2010
2020
Source: RMI analysis of IEA data

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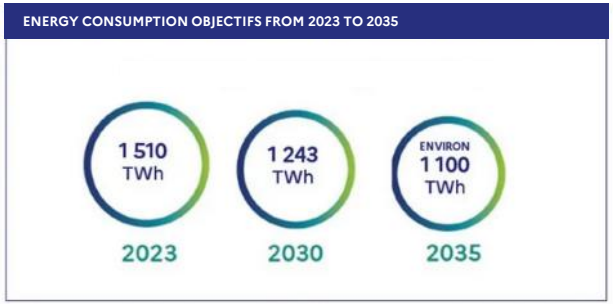
The electrification path for end uses is key in the PPE 3

	2025	2030	2035
Electricy consumption:	**499 TWh**	**566 TWh**	**618 TWh**

60% of fossil fuel in final energy consumption

40% of fossil fuel in final energy consumption



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France is pushing forward to accelerate electrification

Three benefits of electrification:

- **Reducing our reliance on imported fossil fuels**
- **Securing our energy supply**
- **Keeping costs down for consumers**

The middle east crisis is a stark reminder of our dependance on fossil fuel.

In this context, France seeks to accelerate the implementation of the PPE 3 electrification plan.

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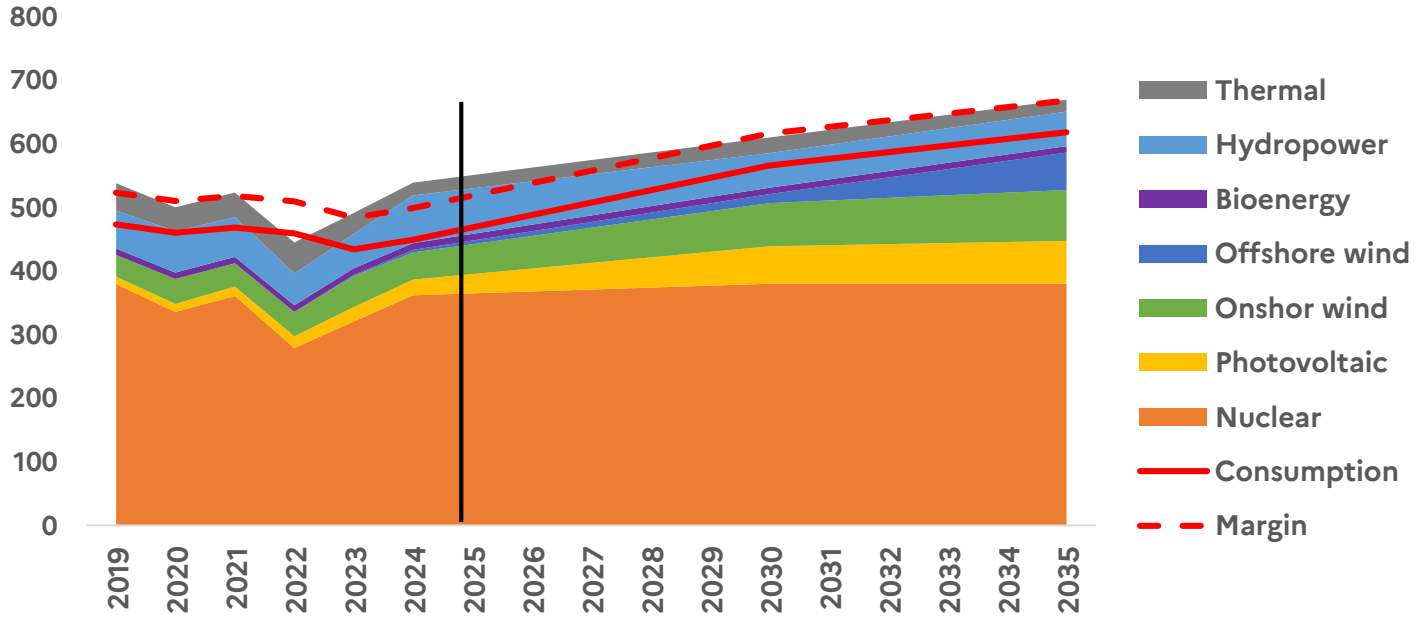
PPE 3

A SUPPLY POLICY ANTICIPATING DEMAND

Growth in Decarbonized Electricity Production to Support Electrification

Annual production by energy source vs. projected consumption in TWh



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2035 VS 2023

ELECTRICITY SECTOR

- NUCLEAR — 380 TWH/AN
- OFFSHORE WIND — 15 GW
- ONSHORE WIND — +1,3 GW/AN
- PHOTOVOLTAIC — X3
- HYDROPOWER — +2,8 GW

FILIÈRES NON ÉLECTRIQUES

- HYDROGEN — 8 GW
- BIOMETHANE — X6
- BIOFUELS — X2
- RENEWABLE AND WASTE HEAT — X2
- HEATING NETWORKS — X3

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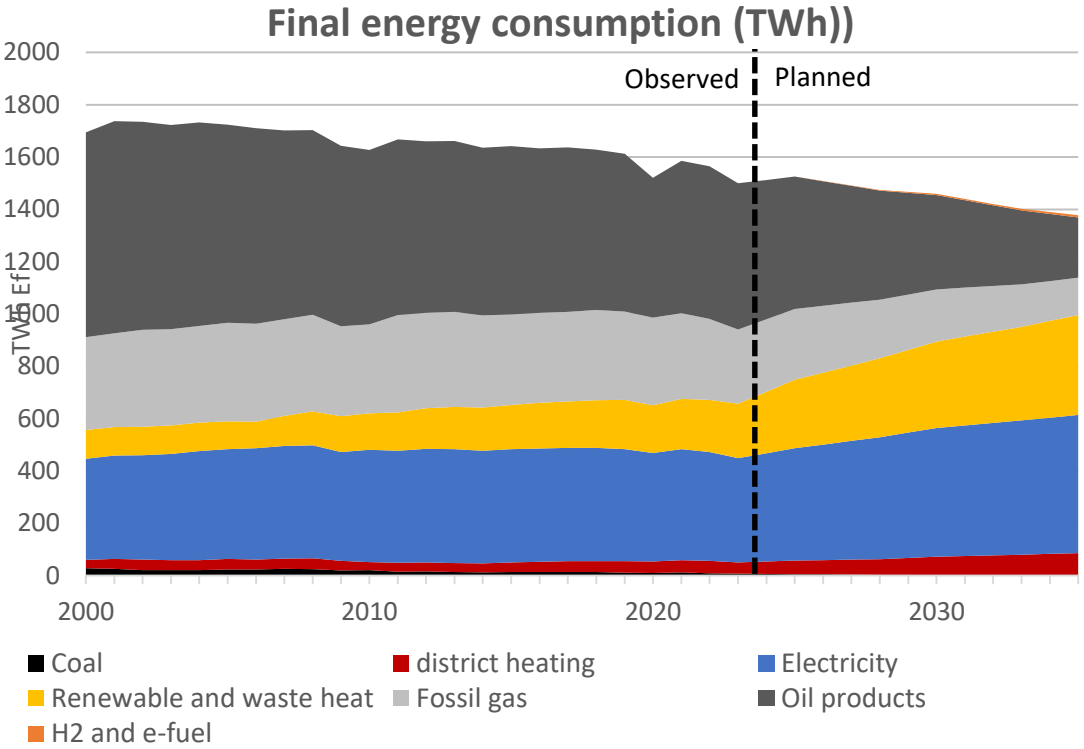
MULTI-YEAR ENERGY PLAN

France's Energy Sovereignty & Heat Decarbonization Strategy



2025
60% fossil - 40% low-carbon

2030
40% fossil - 60% low carbon

2035
30% fossil - 70% low carbon

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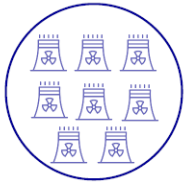
PPE 3 revives nuclear energy

Previous PPE (PPE 2) :

- **Closure** of 4 to 6 nuclear reactors by 2028
- **Closure** of 14 nuclear reactors by 2035
- **50% nuclear electricity in the energy mix by 2035**

PPE3 – Production 2023 : 320 TWh

2023	**320,4 TWh** 56 reactors	**6 new EPR 2 from 2038**
2030 **2035**	**380TWh** 57 reactors target: 420 TWh	 And 8 others to be confirmed

Extend reactor lifetimes to 50+ years, then 60+ years

6 new EPR2 reactors by 2038

Continue fuel reprocessing & cycle optimization

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PPE3 Supports Hydropower Investments

PPE 3 allows for:

- **Revitalising investment in the hydropower sector**
- **Developing and ensuring the long-term sustainability of France's dam infrastructure**

2023	25,9 GW
2030	26,3 GW
2035	28,7 GW

+ 11 % of power capacity production

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PPE3 confirms offshore wind ambitions

2023	0,8 GW
2025 (T3)	2 GW
2030	3,6 GW
2035	15 GW
2037	*18 GW*

Deployment on all the french coatlines

Lauch of multi-GW tenders

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PPE3 maintains onshore renewable ambitions with adjusted early-year pace

2023	21,9 GW
2025 (T3)	23,8 GW
2030	31 GW
2035	35 - 40 GW

Priority will be given to repowering

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PPE3 maintains onshore renewable ambitions with adjusted early-year pace

2023	19,3 GW
2025 (T3)	29,7 GW
2030	48 GW
2035	55 - 80 GW

Until 2028, cannot exceed PPE 2 targets

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PPE3 sets high ambitions for heat decarbonization

	2023	2030	2035
Renewable/waste Heat & Cold	172 TWh heat 1 TWh cold	297 TWh heat 2 TWh cold	328 – 421 TWh heat 2,5 – 3 TWh cold
Biomethane in Gas Networks	9 TWh	44 TWh	47 – 82 TWh
Biofuels in transports	38 TWh	55 TWh	70 – 90 TWh
Hydrogen	0 GW	4,5 GW	8 GW

From 220 TWh in 2023 to at least 460 TWh in 2035

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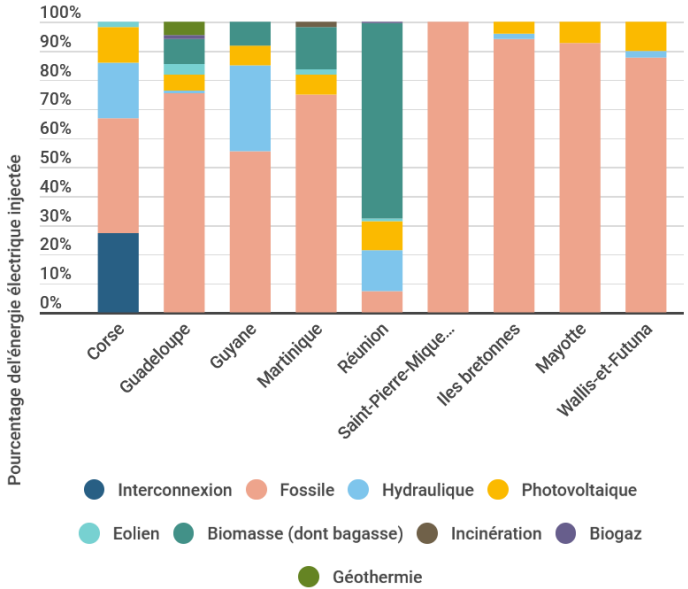
Overseas territories: toward 100% decarbonized electricity

Electricity mixes mainly based on fossil fuels (2023)



Goal: 100% decarbonized electricity mix

- **By 2935 for** Réunion, Guyane, Martinique, Guadeloupe
- **In the years following,** for Mayotte and Wallis-et-Futuna

GOUVERNEMENT
Liberté
Égalité
Fraternité

PPE3 maintains onshore renewable energies ambitions, but with adjusted early-year pace