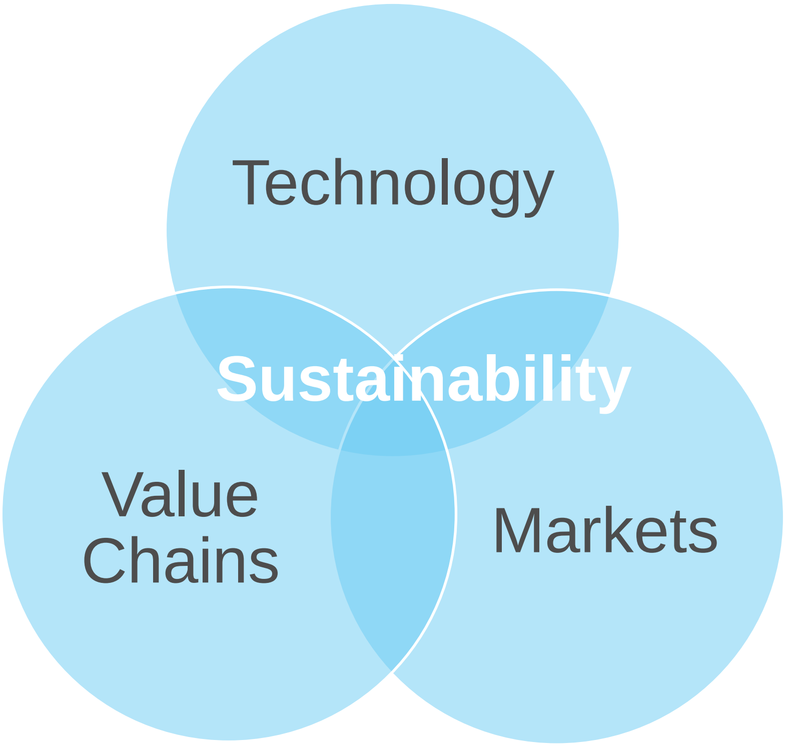
# Clean Energy Technology Observatory

European Commission Joint Research Centre

June 2025

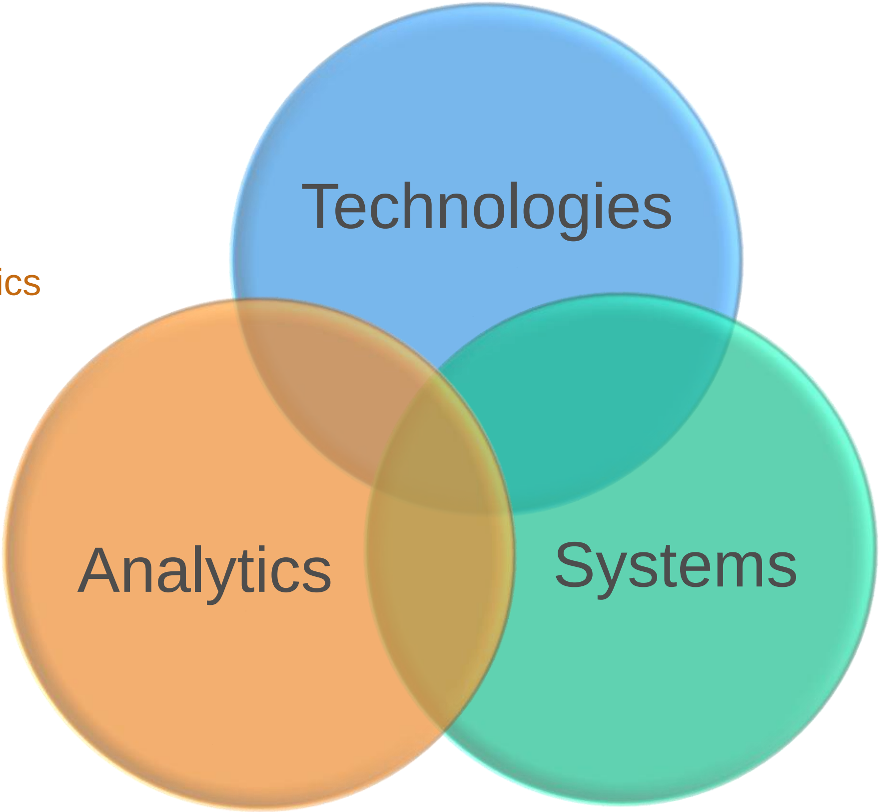
# Clean Energy Technology Observatory (CETO)

- Commission **in-house project** to
  - monitor EU research and innovation activities on clean energy technologies needed for the delivery of the European Green Deal
  - assess the competitiveness of the EU clean energy sector and its positioning in the global energy market
- JRC runs CETO under an administrative agreement with DG Research & Innovation and DG Energy



# CETO Scope

**Analytics**
- Technology readiness metrics
- Energy system models
- Foresight techniques
- Patent analysis
- R&D investment analysis
- Bibliometrics, text mining
- Manufacturing capacities
- Cleantech Trade Analysis
- Sustainability metrics




**Technologies**
- Batteries (Li-ion and non-Li)
- Bioenergy (biomass and biofuels)
- Carbon Capture Utilisation and Storage
- Solar thermal power and heat
- Direct Solar Fuels
- Geothermal heat and power
- Fuel Cells
- Heat Pumps
- Hydrogen Production by Electrolysis
- Hydropower & Pumped Storage
- Ocean energy
- Photovoltaics
- Novel Electricity and Heat Storage technologies
- RFNBOs
- Wind (offshore and onshore)

**Systems/applications**
- Building-related RES technologies
- Digital infrastructure
- Industrial and district heat & cold management
- Standalone systems, including islands
- Transmission and distribution technologies
- Smart cities
- Innovative energy supply for transport

# CETO Indicator Framework

| Technology analysis | Value Chain Analysis | Market analysis |
|---|---|---|
| Technology readiness level | Turnover and Gross Value Added | Global trends & EU market leaders |
| Capacity & production | Sustainability | EU Trade |
| Costs | Role of EU companies | EU manufacturing |
| Public R&I funding | Employment and Skills | Resource efficiency and dependencies |
| Private R&I funding | Energy intensity | |
| Patenting trends | Labour productivity | |
| Scientific publications | EU production | |
| Impact and trends for EU-funded R&I | | |

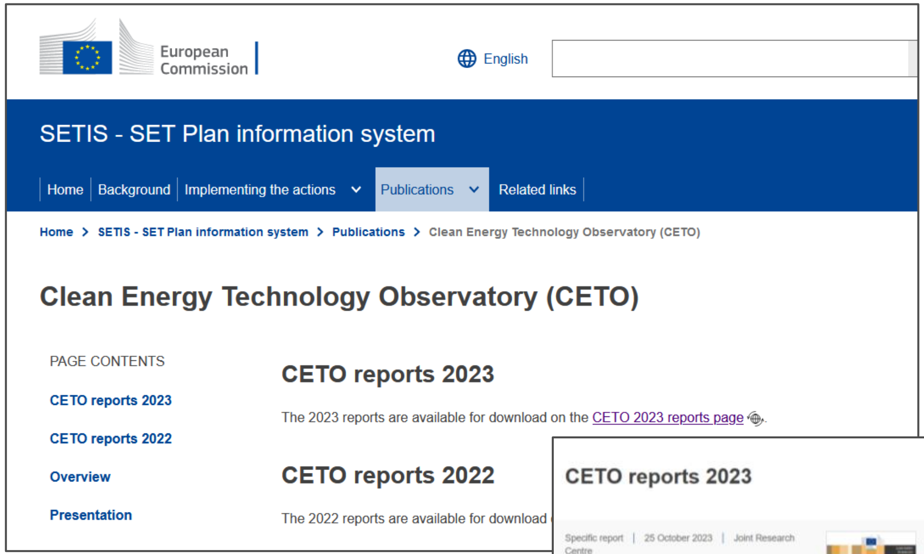
# CETO Reports 2024

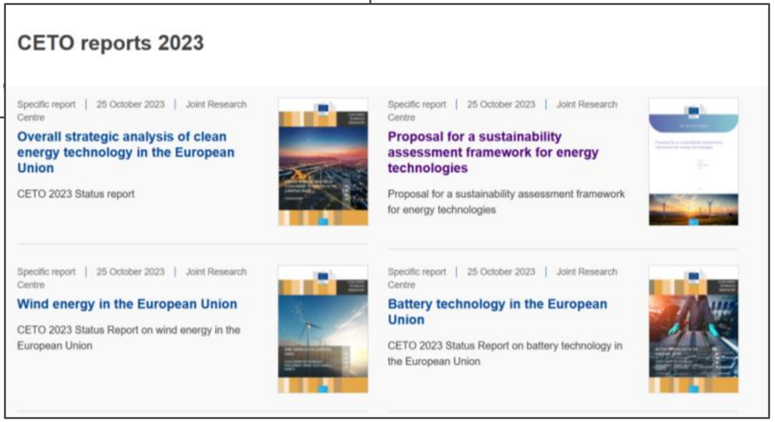
**Series 1: Status on Technology Development, Trends, Value Chains and Markets**

- Advanced Biofuels
- Batteries for Energy Storage (pending)
- Bioenergy
- Carbon Capture Utilisation and Storage
- Concentrated Solar Power and Heat
- Geothermal heat and power
- Heat Pumps
- Hydropower & Pumped Hydropower Storage
- Novel thermal energy storage
- Ocean energy
- Photovoltaics
- Renewable Fuels of non-biological origin
- Hydrogen electrolysis
- Solar Fuels (direct)
- Wind

**Series 2: System Integration Aspects**

- Smart grids
- Smart Thermal Networks




https://setis.ec.europa.eu/publications/clean-energy-technology-observatory-ceto/ceto-reports-2023_en

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# Early-Stage Energy Technologies

- 77 emerging technologies related to energy have been detected using a hybrid approach combining text mining and expert knowledge.
- Analysis of the involvement of public and private entities, patenting activity, and the relative performance of major economies in these emerging technologies.
- See: JRC Publications Repository - Early stage technologies in the field of Energy, Eulaerts, O.D., Grabowska, M. and Bergamini, M.,, Publications Office of the European Union, Luxembourg, 2024, doi:10.2760/711, JRC135619.



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# Energy System Modelling

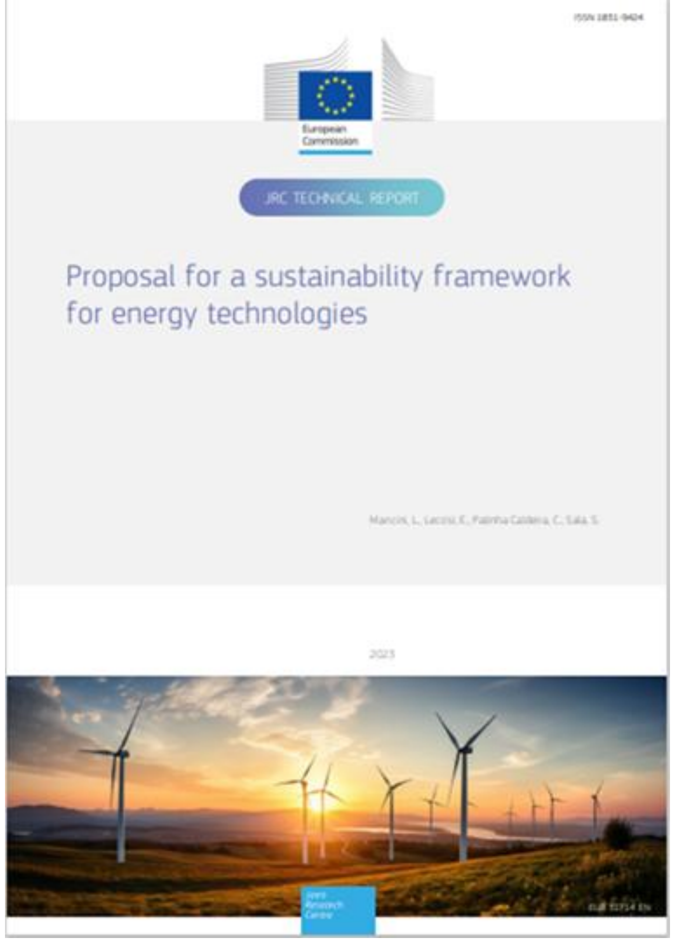
- Global: POLES
  - 2050 and 2100 timeframes
  - Impact of R&I investments via learning-by-doing
  - Performance indicators: $CO_2$ reduction, savings in investments of deployed capacities, etc.
  - Socio-economic analysis (GEM-E3)
- EU: POTEnCIA
  - Dedicated POTEnCIA-CETO scenarios
  - technology-rich
  - disaggregation for all EU countries

JRC Publications Repository - Clean Energy Technology Observatory - Impacts of enhanced learning rates for clean energy technologies on global energy system scenarios - Energy system modelling for clean energy technology scenarios

JRC Publications Repository - Clean Energy Technology Observatory: POTEnCIA CETO 2024 Scenario

# Sustainability Assessment Framework

- Aim is to collect key sustainability performance data and/or references for state-of-the-art information in a common structure
- Three dimensions reflecting EU policy priorities: security – environmental – social sustainability
- Structure based on the Driver – Pressure – State – Impact – Response (DPSIR) framework
- Life cycle-based methodologies used when available



# Annual strategic analysis report for the clean energy tech sector

a) Consolidated data on

- Energy and Resources Trends (including energy intensity, share of renewables, trade balance, electricity, carbon and fuel prices, and turnover)
- Human Capital and Skills
- Research and Innovation Trends (investments, patents)

b) Strategic analysis, addressing:

- Critical industrial value chain relationships
- Sustainability
- SWOT analysis for EU technology competitiveness


https://setis.ec.europa.eu/overall-strategic-analysis-clean-energy-technology-european-union-0_en



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# CETO Impact

Technology Development

Value chains

Markets & Deployment

CETO reports (annual)


Horizon Europe R&I programme priorities

EU Climate Law implementation

Clean Industry Deal
Net Zero Industry Act

***Reports link: https://setis.ec.europa.eu/publications-and-documents/clean-energy-technology-observatory_en***



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