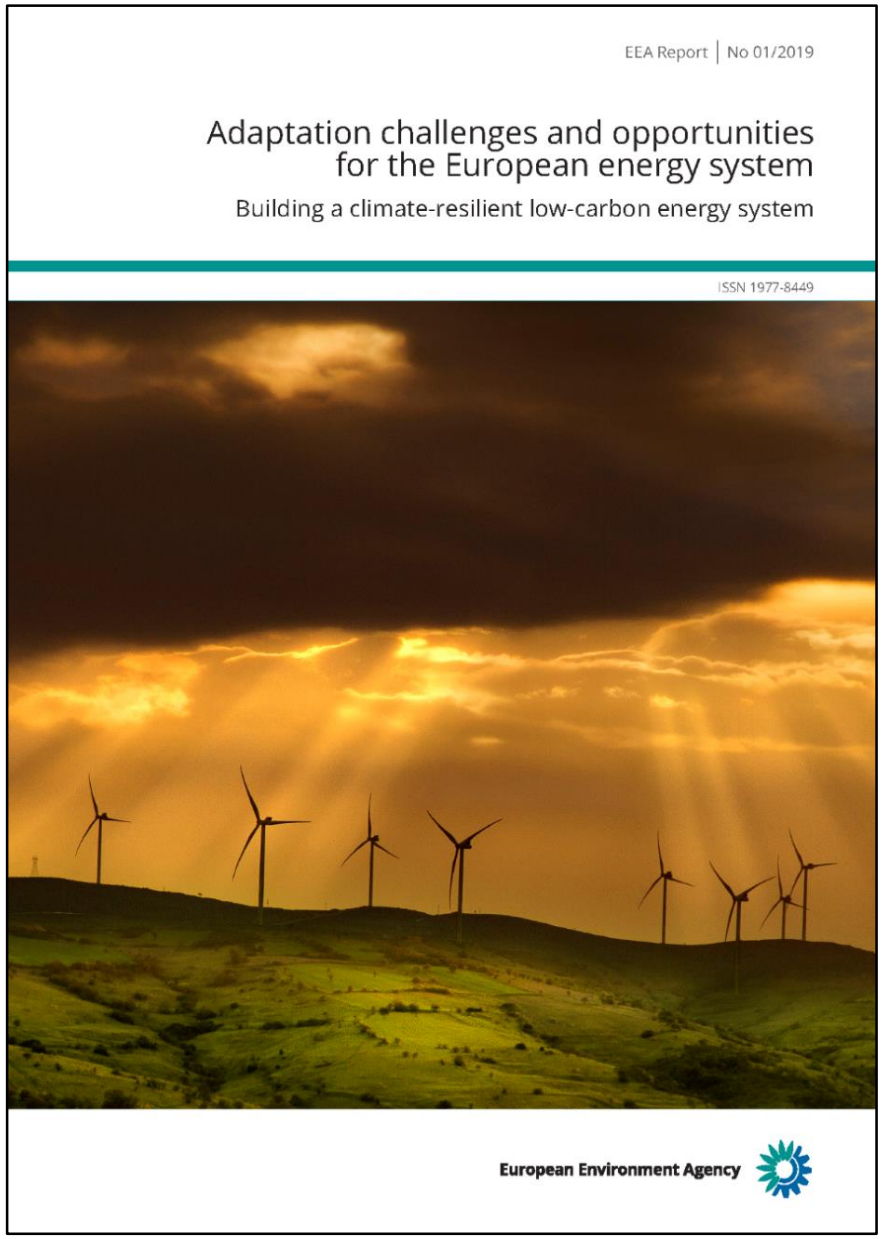
Climate adaptation challenges and opportunities for the European energy system

Key information source: recent EEA Report



- Published on 18 June 2019: eea.europa.eu/publications/adaptation-in-energy-system
- Launch at EUSEW Policy Conference: Session INT40: Preparing the European energy system for the impacts of climate change (with web streaming)
- First European-level overview of information on
  - climate impacts on the energy system,
  - the rapidly evolving policy framework,
  - activities of the most relevant stakeholders,
  - opportunities for further action
- Aims to help that the massive investments made in the clean energy transition are viable also in a changing climate

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Climatic drivers and impact chains for the energy system

Changes in ambient temperature

· Total and peak energy demand for heating and cooling

· Efficiency of electricity generation and transmission

· Fossil fuel extraction and transport

Changes in water availability

· Cooling water availability for thermal power plants

· Hydropower potential

· River-borne fuel transport

· Energy demand for water provision

Changes in extreme climate-related events

· Inland flooding

· Wind, hail, ice and snow storms

· Heat waves and forest fires

· Combined and cascading effects

Changes in coastal and marine hazards

· Impacts on coastal infrastructure

· Impacts on maritime infrastructure

Further impacts on renewable energy potential

· Wind power

· Solar power

· Bioenergy

· Supply security from renewable energy sources

Key climate drivers

- Temperature increase
- Water availability
- Extreme climate-related events
- Coastal and marine hazards

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Projected change in relevant climate variables across Europe

		Northern Europe	British Isles	Central Western Europe	Central Eastern Europe	Iberian Peninsula	Apennine Peninsula	South Eastern Europe
Ambient temperature	Air temperature	⇧	⇧	⇧	⇧	⇧	⇧	⇧
	River temperature	⇧	⇧	⇧	⇧	⇧	⇧	⇧
Water availability	Annual precipitation	⇧	⇧	⇗	⇗	⇩	⇘	⇘
	Annual river flow	⇧	⇧	⇗	⇗	⇩	⇘	⇘
	Low river flow*	⇗	⇩	⇘	⇔	⇩	⇩	⇩
	Summer soil moisture**	⇗	⇘	⇘	⇔	⇩	⇩	⇩
Extreme climate-related events	Heat waves	⇧	⇧	⇧	⇧	⇧	⇧	⇧
	Inland floods	⇔	⇧	⇧	⇧	⇔	⇗	⇗
	Wind storms	⇗	⇗	⇗	⇗	⇘	⇘	⇘
	Forest fire danger	⇔	⇧	⇗	⇔	⇧	⇧	⇧
Coastal and marine hazards	Relative sea level	⇔	⇧	⇧	⇧	⇧	⇧	⇧
	Storm surges and wave length	⇗	⇗	⇗	⇗	⇔	⇔	⇔

⇧ Increase throughout the region ⇩ Decrease throughout the region ⇔ Inconsistent or limited changes

⇗ Increase in most of the region ⇘ Decrease in most of the region

* A downward arrow indicates a lower streamflow during low flow events, i.e. more severe river flow droughts

** A downward arrow indicates lower soil moisture (in summer), i.e. more soil water stress

- Some climate variables show uniform changes across Europe (e.g. heat waves, temperature)
- Other climate variables show divergent trends (e.g. river flow)
- Most extreme weather events are projected to increase in most regions

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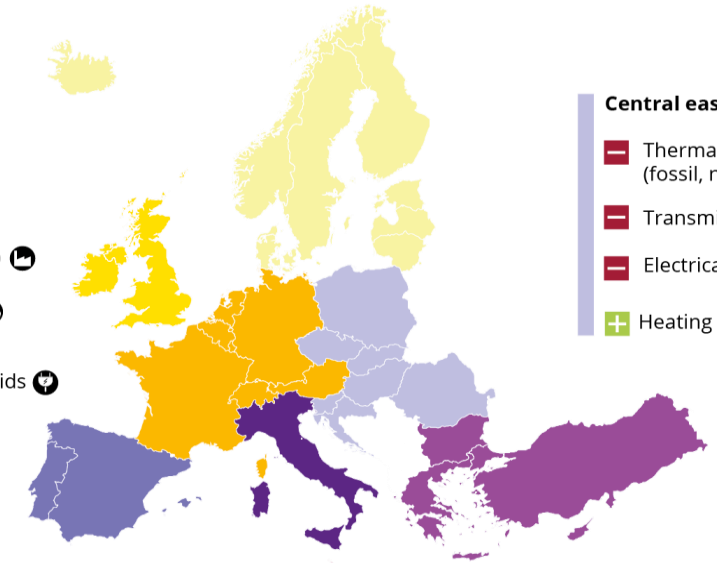
Overview of climate change impacts on the energy system

British Isles

- Offshore energy production infrastructure (wind, oil, gas)
- Coastal energy infrastructure (power plants and refineries)
- Transmission and distribution grids
- Electrical susbtations
- Heating and cooling demand

Northern Europe

- Hydropower
- Offshore wind power
- Biomass energy
- Oil and gas extraction
- Offshore energy production infrastructure (wind, oil, gas)
- Coastal energy infrastructure (power plants and refineries)
- Oil and gas transport
- Transmission and distribution grids
- Heating and cooling demand



Central western Europe

- Offshore energy production infrastructure (wind, oil, gas)
- Thermal power plants (fossil, nuclear and biomass)
- Transmission and distribution grids
- Electrical susbtations
- Heating and cooling demand

Central eastern Europe

- Thermal power plants (fossil, nuclear and biomass)
- Transmission and distribution grids
- Electrical susbtations
- Heating and cooling demand

Iberian Peninsula, Apennine Peninsula and South-eastern Europe

- Hydropower
- Concentrated solar power
- Biomass energy
- Thermal power plants (fossil, nuclear and biomass)
- Transmission and distribution grids
- Pumped hydro storage
- Peak electricity demand
- Energy demand for desalination

- All components of the energy system are vulnerable to climate change and/or extreme weather events
- Impacts differ across regions and energy sector components
- Southern European regions are most adversely affected

- Predominantly beneficial impacts
- Predominantly adverse impacts
- Impacts not classifiable as beneficial or adverse due to complex economic and environmental effects
- Renewable energy sources
- Fossil energy sources
- Other energy sources and carriers (nuclear, electricity, heating and cooling)

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Three reasons why climate change adaptation in the energy system is becoming increasingly important

1. **Climate change:** Changes in average climate as well as climate and weather extremes
2. **Energy system change:** Rapid growth of renewable energy sources, most of which are climate-sensitive
3. **Societal change:** Increasing dependence of modern economies and societies on a reliable energy supply

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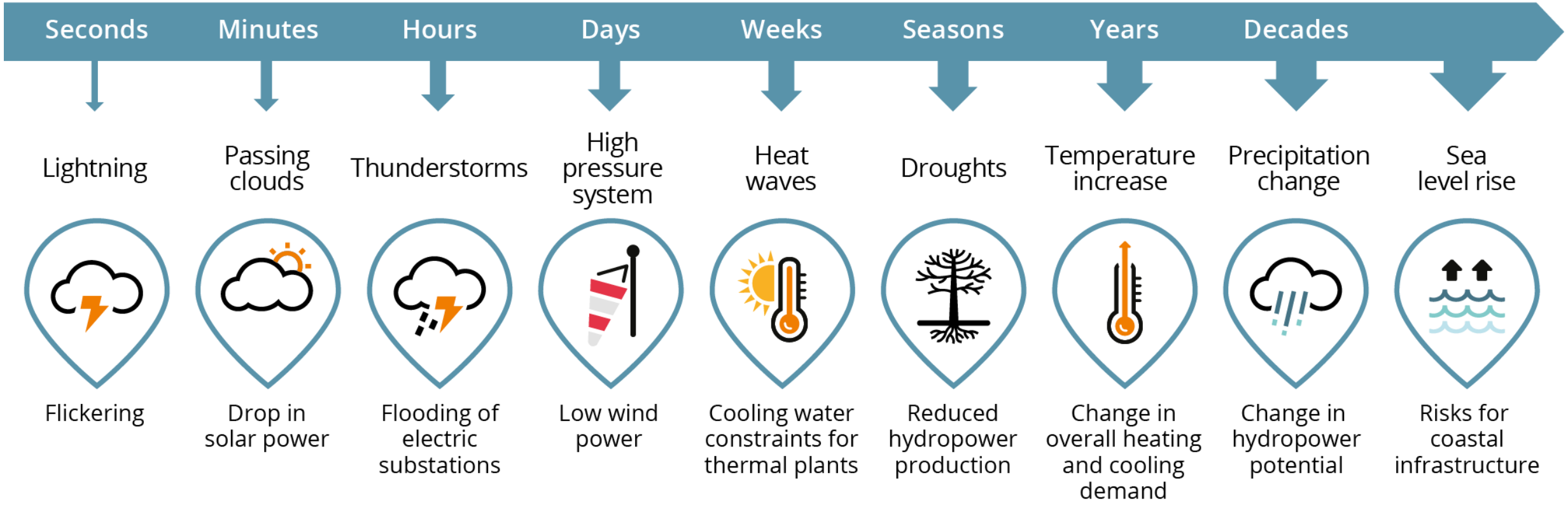
A climate-resilient energy system needs to address weather and climate events at many time scales



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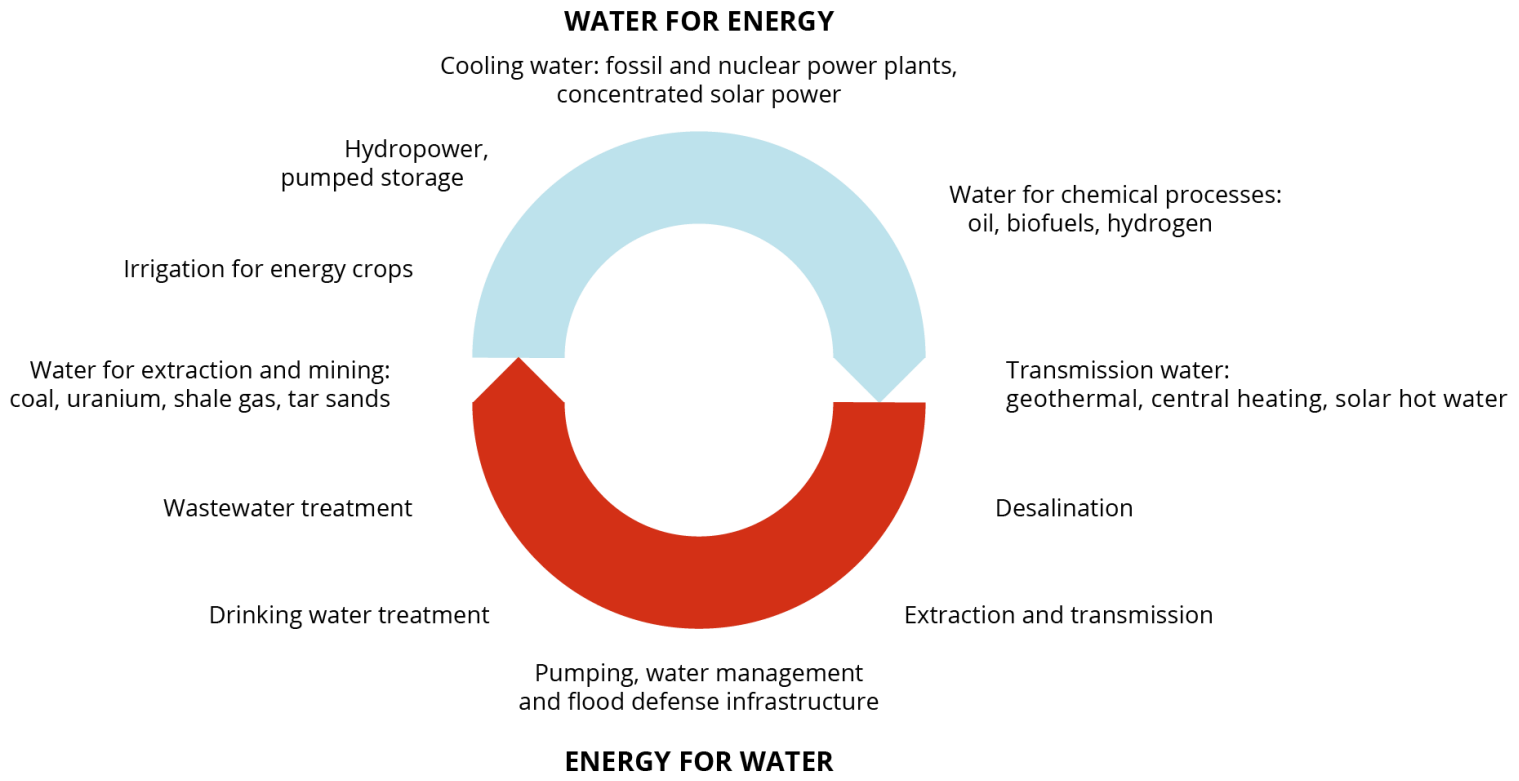
Adaptation is linked to other sustainability concerns

- **Mitigation and adaptation:**
  There can be both synergies and trade-offs between mitigation and adaptation
- **Energy-water-land nexus:**
  Different low-carbon energy technologies have different needs for water and land
- **Integrated policy approach:**
  Integrated consideration of different policy goals allows to maximize synergies and to limit adverse side effects



Adaptation occurs in a rapidly decarbonizing energy system

LTS scenarios agree in:

- Rapid growth in the share of renewable energy sources
- Electrification of most energy uses
- Expansion of electricity grids and energy storage
- Increasing energy efficiency

LTS scenarios differ in:

- Role of hydrogen and ‚Power-to-X‘
- Role of CCS and bioenergy

➢ **Different clean energy scenarios are associated with different adaptation challenges**

EU policies increasingly support enhancing climate resilience in the energy system

- **EU adaptation strategy** (recently evaluated)
- Mandatory climate proofing of major EU-funded infrastructure
- European standardization organisations revise infrastructure standards
- **EU Regulation on the governance of the Energy Union and climate action** (including NECPs and European/national long-term strategies)
- **EU Regulation on risk preparedness in the electricity sector**
- Improving the knowledge base for adaptation (including **Copernicus Climate Change Service**)

Many governments in Europe are already facilitating adaptation in the energy system

Examples for national actions

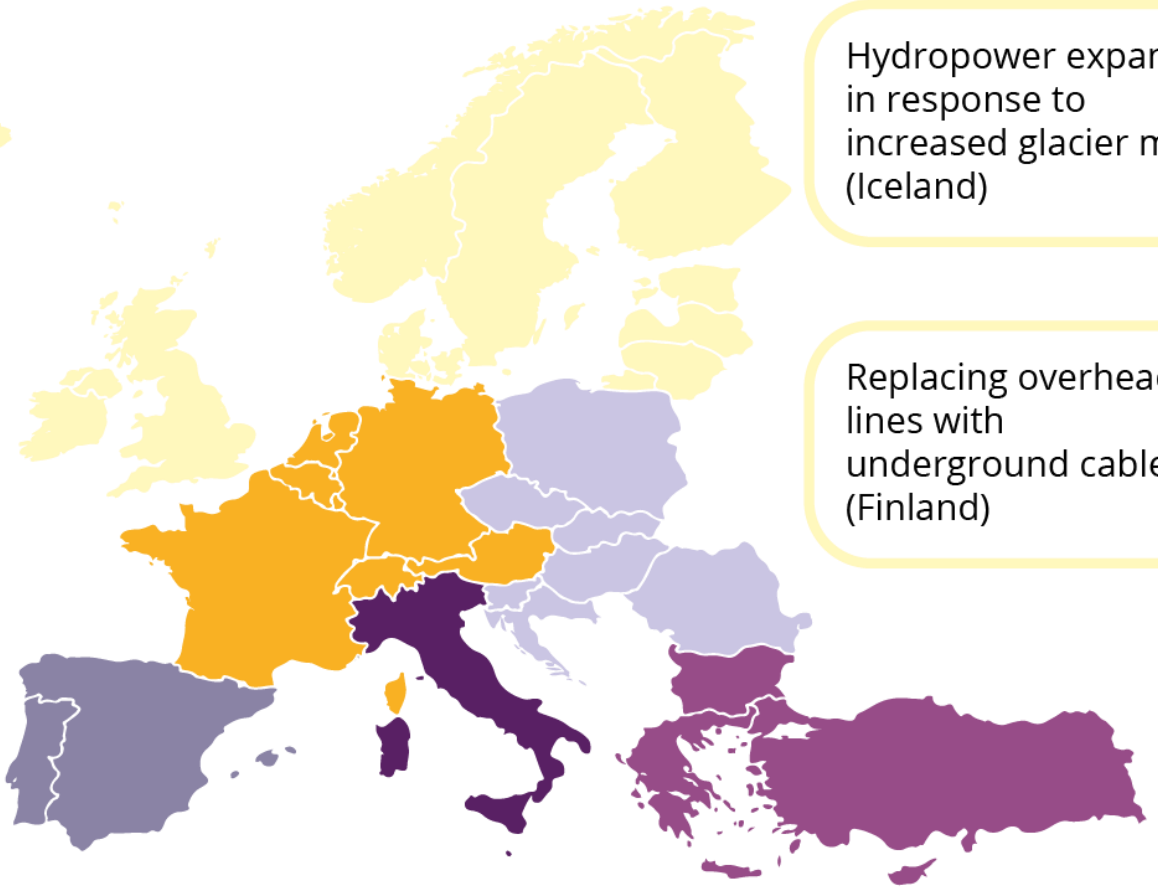
- (Multi-)sectoral climate change risk assessments
- Sectoral adaptation plans
- Reporting obligations for infrastructure providers
- Guidance material for climate change risk assessments and resilience planning
- Weather and climate services

Adaptation case studies by European energy companies

Adapting overhead lines to increasing temperatures (United Kingdom)

Improved resilience of biomass fuel supply chain (United Kingdom)

Flood risk management for hydropower plants (France)



Hydropower expansion in response to increased glacier melt (Iceland)

Replacing overhead lines with underground cables (Finland)

Further information is available on Climate-ADAPT:

climate-adapt.eea.europa.eu/knowledge/tools/case-studies-climate-adapt

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Conclusions and outlook

1. There is an **increasing need for climate change adaptation** and strengthening climate resilience in the European energy system
2. **Climate change impacts** on the European energy system differ across regions and energy system components.
3. There are **synergies and trade-offs** between climate change adaptation, mitigation and other sustainability concerns
4. Many policymakers and stakeholders are already addressing adaptation needs in the energy system, but **there is scope for further action**
5. The **development of the Energy Union** and the EU long-term strategy provide **important opportunities** for mainstreaming adaptation concerns in the planning and implementation of a decarbonised energy system