

# Resiliency Measures and Cost&Benefits: RGI's and ENTSO-E's workstream on the CBA methodology

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*European Climate Resilient Energy System  
Integrating Climate Adaptation into Planning and Implementation*

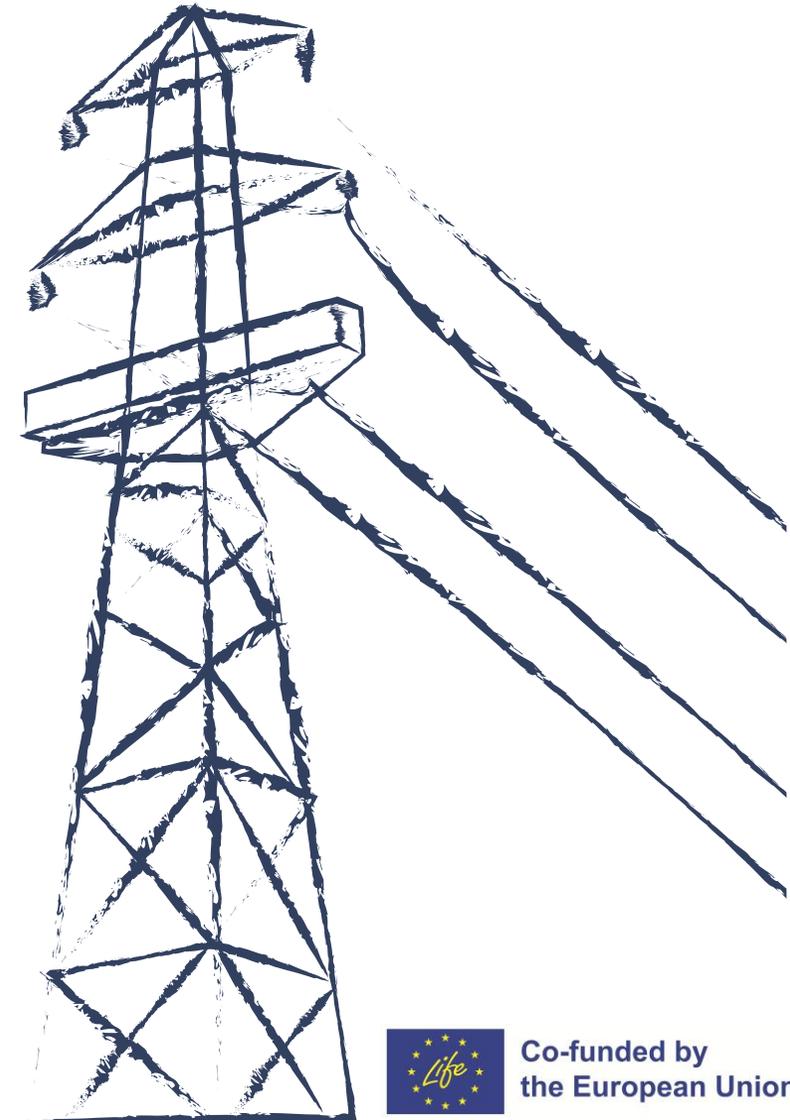
World Bank's Energy Global Department  
12 February 2026

Andrzej Ceglarz, Renewables Grid Initiative

Franck Dia Wagoum, ENTSO-E

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# Renewables Grid Initiative

RGI is a unique collaboration of NGOs and Transmission System Operators (TSOs) from **across Europe**

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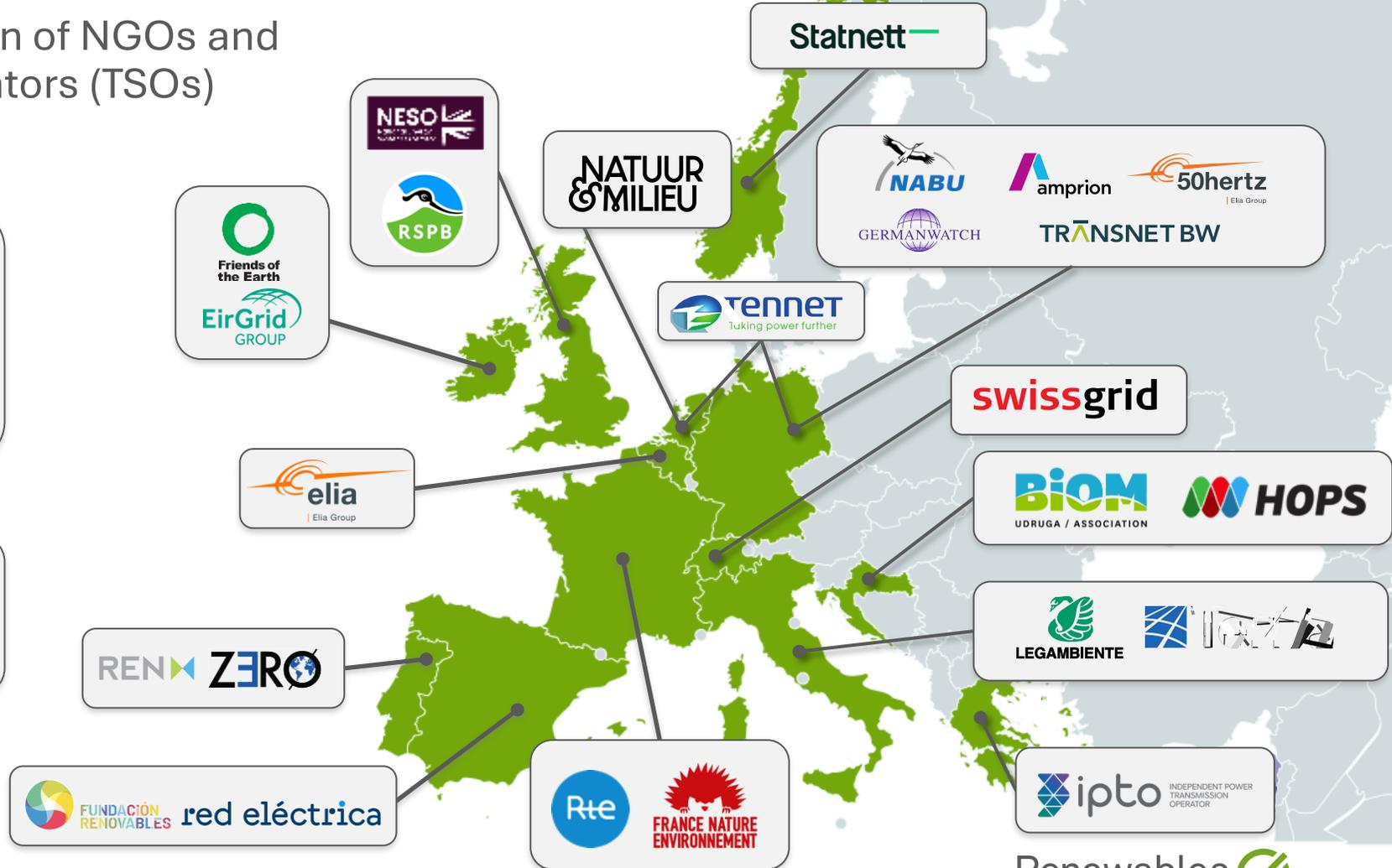
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# ENTSO-E

Association gathering **40 electricity TSOs** across Europe, spanning over 36 countries

Activities driven by legal mandates defined by European Regulations

Serves as forum for knowledge sharing between our members

**Mission:** ensure secure and optimal functioning of the pan-European interconnected power system

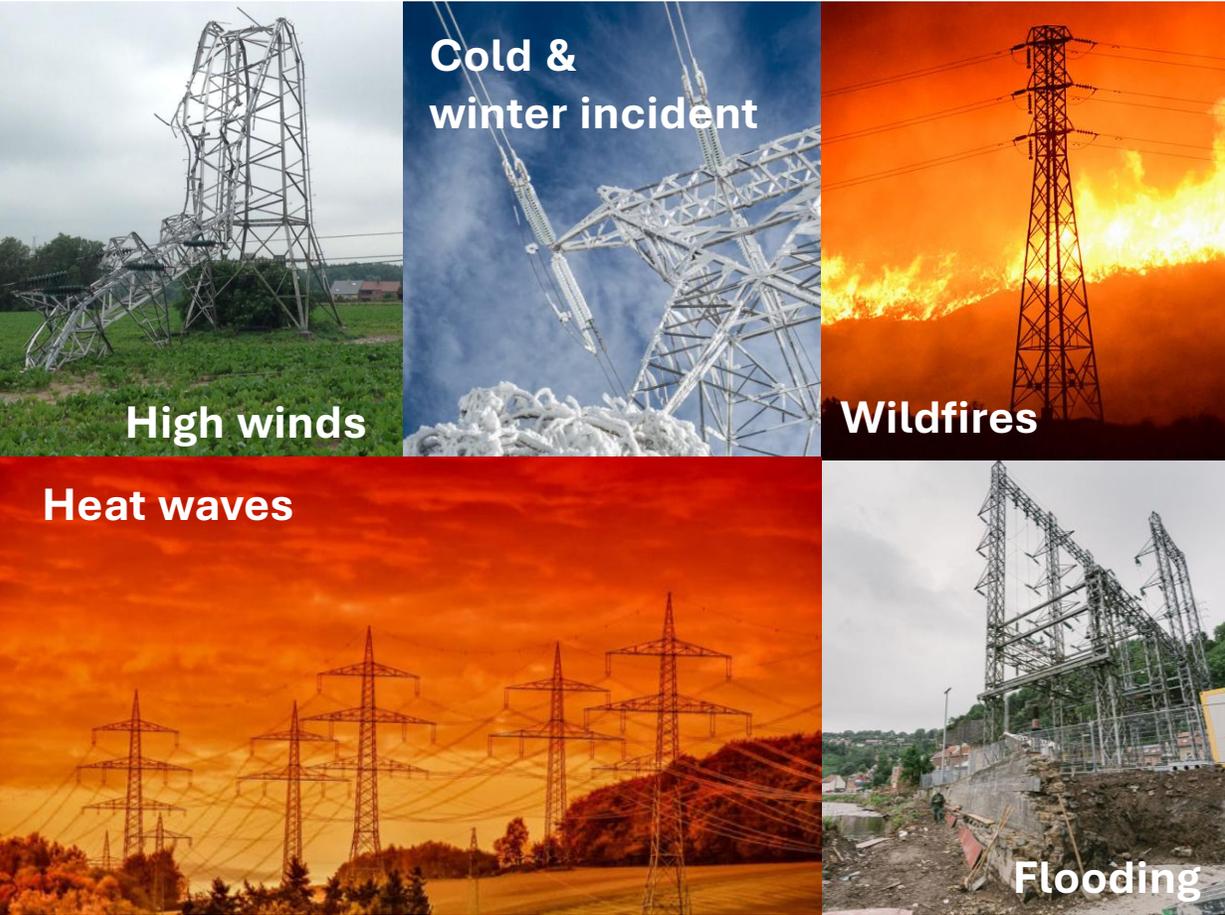
Enable the integration of electricity generated from renewable energy sources and of emerging technologies.



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# Climate change and the electricity system



Changing climate and weather patterns as well as extreme weather events are already having an immediate **impacts on energy systems** and **physical infrastructure**



Source: Elia; 2025.

Source: Unsplash



# Preparing European electricity grid for climate change

May '22

TEN-E Regulation revision – a need to incorporate climate change aspects in electricity grids planning, ensuring cost-effective solutions

Nov '22 /  
March '23

ESABCC recommendations to assess climate adaptation costs, benefits and measures in TYNDP & the CBA Methodology

April '23

How to assess climate adaptation and resilience measures in a cost-effective way?

RGI & ENTSO-E joined forces to develop climate resilience and adaptation indicator for the CBA Methodology



Oct '23



Which practices, approaches and solutions could be recognised as climate adaptation and resilience measures?

Nov '25



12/02/2026

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# Structuring climate risks & adaptation measures

Public database incl. best practices



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## Enhancing Climate Adaptation and Resilience in European Electricity Infrastructure

When you submit this form, it will not automatically collect your details like name and email address unless you provide it yourself.

### Background information

Despite the European commitment to reduce the greenhouse gases emissions and to keep the global temperature below 1.5 °C, in line with the Paris Agreement, the electricity system is facing immediate and near future impacts of the climate crisis that are expected to continue and may even intensify. These impacts vary from more frequent and extreme weather events like heatwaves, droughts, or floods, to coastal erosion from rising sea levels, which affect not only electricity infrastructure but the entire energy system, including supply and demand sides. Climate adaptation means taking action to prepare for and adjust to both the current effects of climate change and the predicted impacts in the future. This action entails financial implications deriving from investments in preventive, mitigation or restorative measures to keep electricity systems in operation.

To address the foreseen impacts of climate change and extreme weather events on electricity infrastructure, the TEN-E Regulation envisages that the European process of electricity infrastructure planning should adequately consider climate adaptation aspects. In order to comply with this requirement, ENTSO-E's in its Cost-Benefit-Analysis (CBA) methodology is working on incorporating a new quantitative indicator for climate adaptation and resilience measures. The new indicator is planned to be incorporated into the 5th edition of the CBA Guideline, complementing other CBA indicators. Learn more about ENTSO-E's CBA Methodology here: <https://bit.ly/4eNrvHW>.

Data sources: academic literature, research (EIB, ESABCC), RGI & ENTSO-E Members' input (workshops, reports, survey)

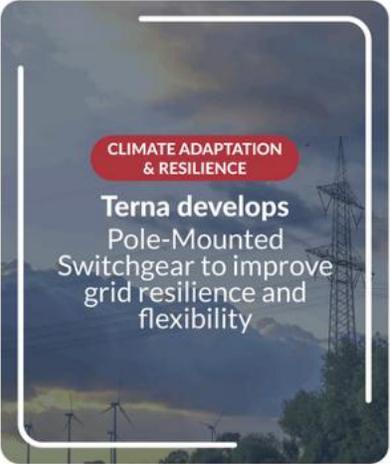
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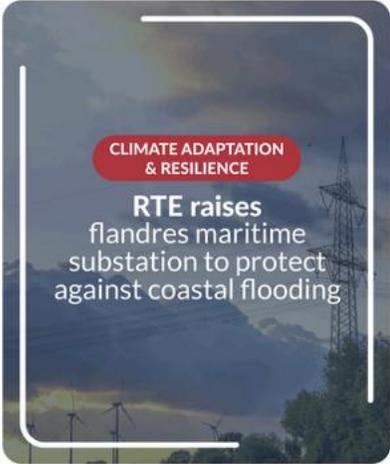


# Increasing grids resilience: examples of TSOs' practices

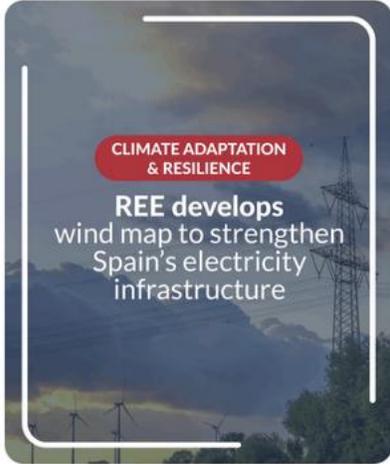
Grid operators are implementing different climate resilience and adaptation measures, encompassing different types of activities: **preventive**, **mitigation**, **restorative** and **monitoring**.



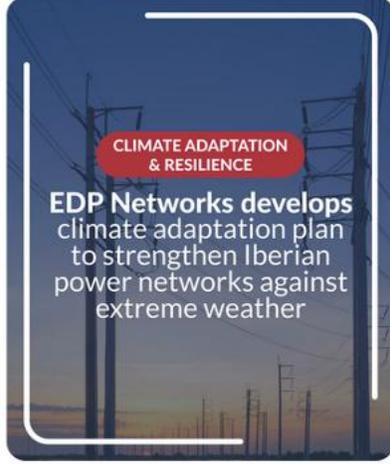
Italy 2025  
Terna Develops Pole-Mounted Switchgear To Improve Grid Resilience And Flexibility  
Terna



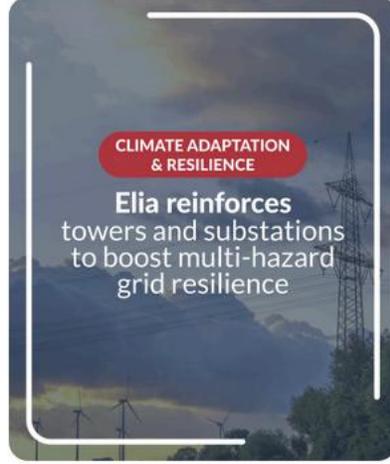
France 2025  
RTE Raises Flandres Maritime Substation To Protect Against Coastal Flooding  
RTE - Réseau de Transport d'Electricité



Spain 2025  
REE Develops Wind Map To Strengthen Spain's Electricity Infrastructure  
REE - Red Eléctrica de España



Europe 2025  
EDP Networks Develops Climate Adaptation Plan To Strengthen Iberian Power Networks Against...  
EDP Networks



Germany 2022  
Elia Reinforces Towers And Substations To Boost Multi-Hazard Grid Resilience  
Elia



Ireland 2025  
EirGrid Launches CP1300 Project To Improve Climate Resilience Across Ireland's Transmission...  
EirGrid



# Takeaways and the next steps

Need for a standardised framework on adaptation measures to guide grid operators and regulators

Data (and courage) needed to inspire others and provide evidence-based actions

No need to re-invent the wheel → creating synergies, linking existing initiatives & databases

In the EU context: Integrated Framework on Climate Resilience and Risk Management

# The Challenge: Climate Costs Are Hidden in Current CBA

## Current CBA Methods

- Climate adaptation increases upfront CAPEX
- Benefits of resilience not quantified
- Projects with adaptation measures appear less attractive
- Creates systematic bias against climate-proofed infrastructure

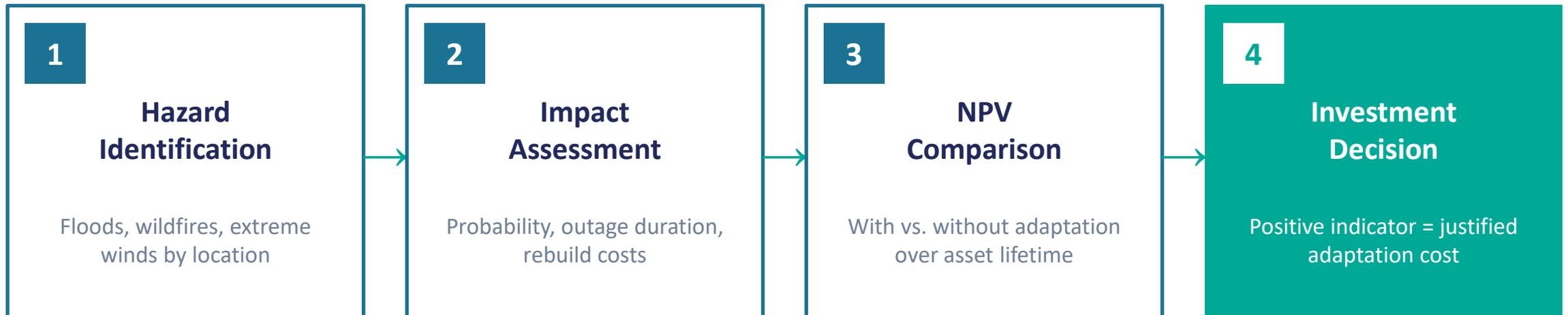
## The Consequence

- Outage costs and rebuild expenses not captured
- Investment decisions favor short-term savings over long-term value
- Increasing frequency, intensity and severity of climate hazards not properly reflected in current methodologies

**We need CBA methods that make the economic value of climate resilience visible and comparable.**

# Proposed Solution: NPV-Based Climate Adaptation Indicator

$$\text{Adaptation Benefit} = \text{NPV (Adapted)} - \text{NPV (Non-adapted with outages)}$$



*Integrated into ENTSO-E's Ten-Year Network Development Plan (TYNDP) CBA methodology*

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# Critical Input Parameters for Decision-Making

## Probability of Occurrence

- Climate projections by region
- Increasing frequency over asset lifetime
- Hazard-specific data (floods, fire, wind)
- Spatial databases (e.g., Climate-ADAPT)

## Duration of Outage

- Asset-specific (transmission lines vs. substations vs pylons)
- Hazard-specific (operational vs. physical damage)
- Range from days to months
- Partial recovery phases considered

## Cost Components

- Adaptation CAPEX premium
- Rebuild costs (non-adapted)
- Lost socio-economic welfare during outage
- Operating costs differential



Insight: TSO surveys confirm these parameters are context-specific. Simplified assumptions may work if transparently documented.

# Potential Implications for Development Finance

## For World Bank Operations

- Standardized framework allows comparison across projects and countries
- Makes resilience benefits visible in appraisal documents
- Supports evidence-based allocation of adaptation finance
- Aligns with MDB climate co-benefits tracking

## ENTSO-E TYNDP CBA

- Required (EU) Regulation 2022/869 to assess climate adaptation taken for TYNDP projects
- Methodology tested in European TYNDP context
- Can be integrated into national grid planning processes
- Data requirements are pragmatic: ranges acceptable where precision is limited
- Builds local capacity for climate-informed infrastructure planning

**Key Takeaway: Climate resilience can and should be integrated into standard CBA - a methodology exists, can be refined, and transparency about assumptions matters more than false precision.**

# NPV Framework: Technical Detail

## NPV Adapted

Higher CAPEX + OPEX  
 Full benefits over asset lifetime  
 No outage losses  
 No rebuild costs

## NPV Non-Adapted

Lower CAPEX + OPEX  
 Benefits minus outage periods  
 Rebuild costs after hazard events  
 Probability-weighted scenarios

Parameter	Description	Source
<b>d</b>	Duration of outage	TSO/asset-specific
<b>p</b>	Probability of hazard occurrence	Climate projections
<b>R</b>	Rebuild CAPEX	Project promoter
<b>B</b>	Annual socio-economic benefit	CBA methodology
<b>T</b>	Economic lifetime (typically 25 years)	Standard assumption
<b>r</b>	Societal discount rate (typically 4%)	CBA methodology

# THANK YOU!

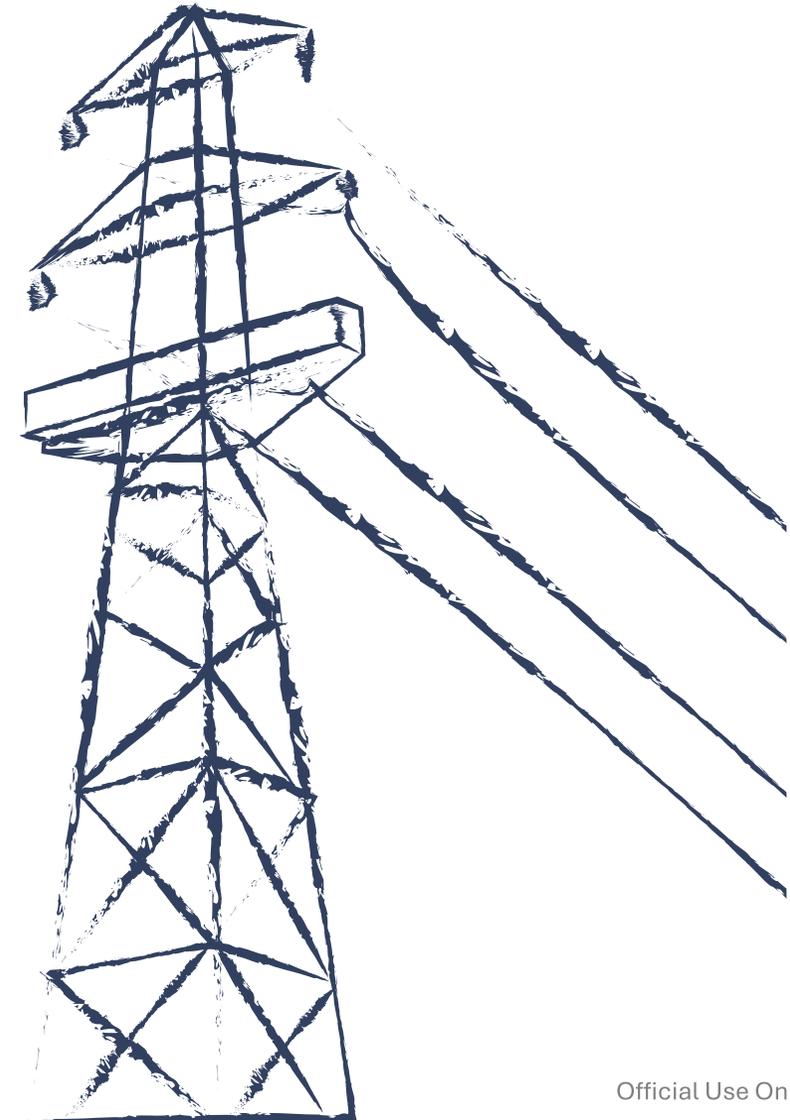
## Let's stay in touch!



**Andrzej Ceglarz, RGI**  
Director – Energy Systems



**Franck Dia Wagoum,**  
**ENTSO-E**  
Long term planning specialist



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