Power system connectivity and energy resilience

UNECE – UNESCAP Programme on Energy Connectivity in Central Asia and the Caucasus

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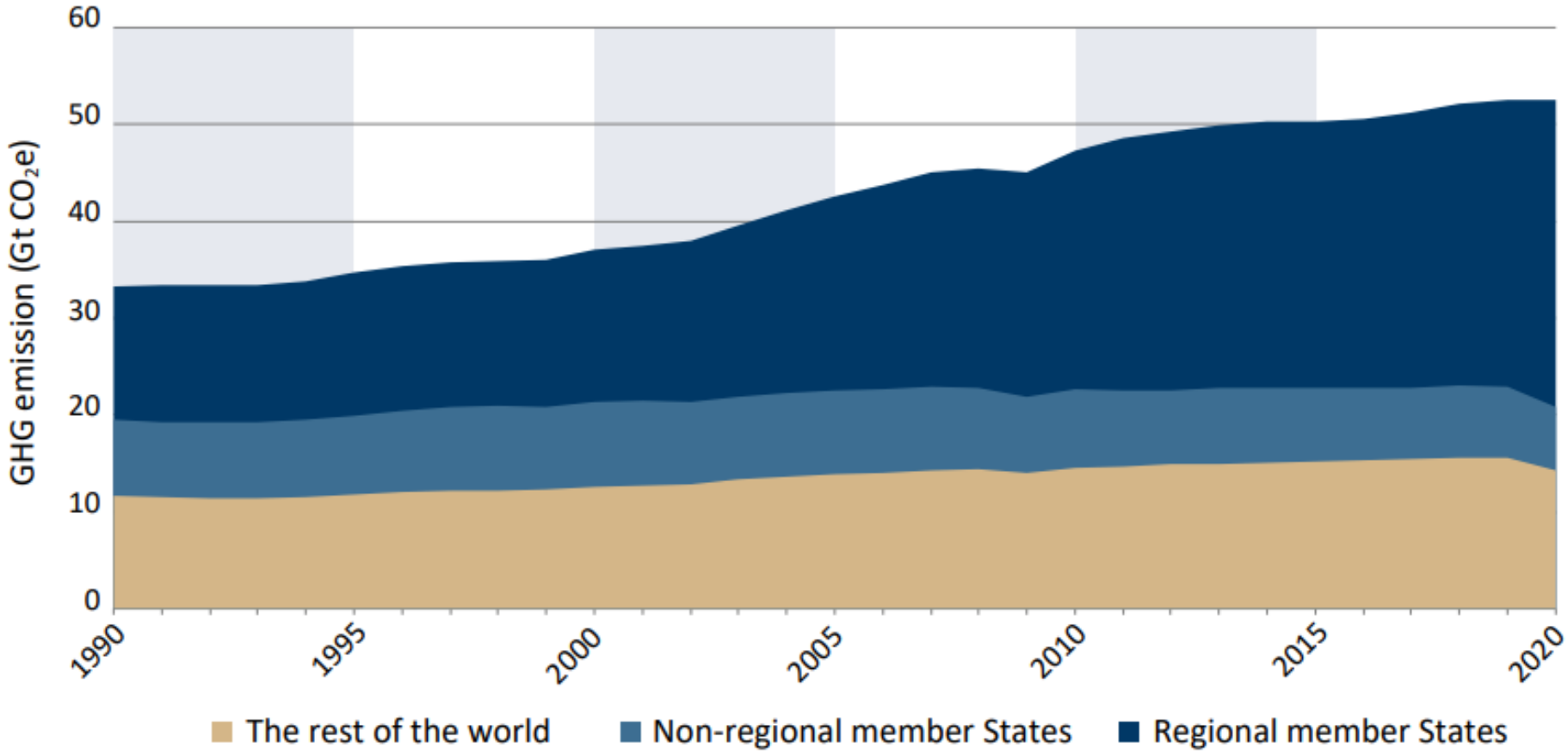
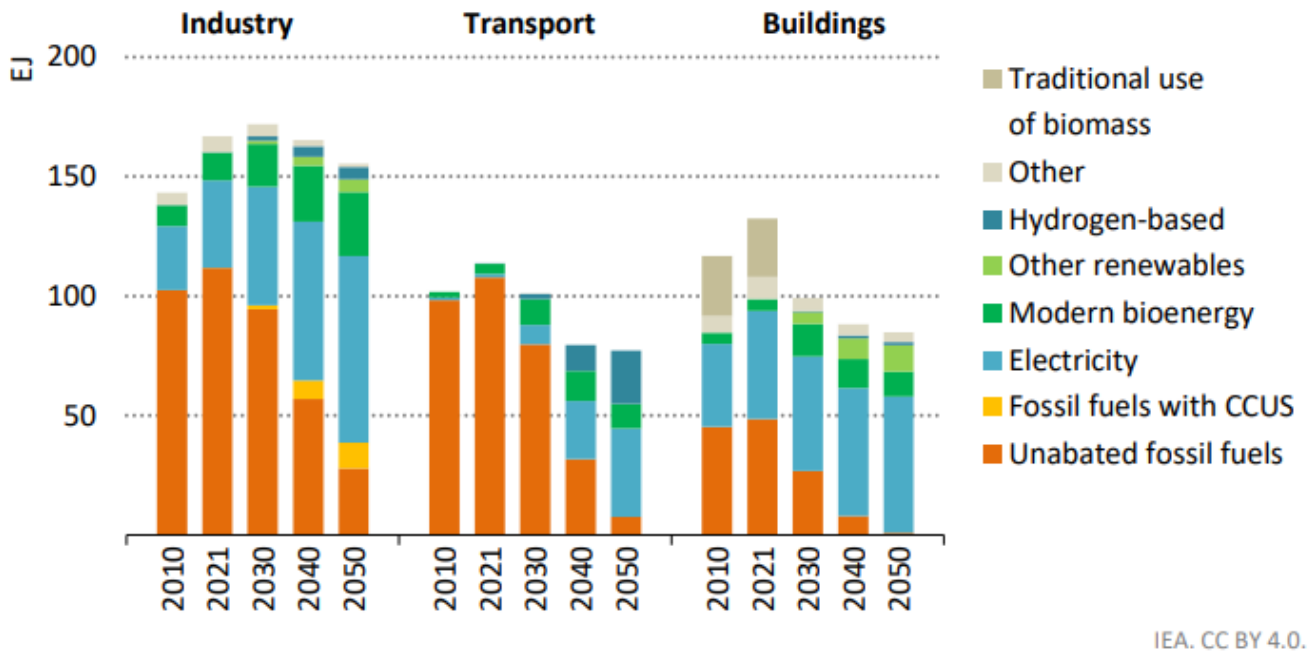
Asia-Pacific is the main driver of global GHG emissions

Greenhouse gas emissions trends in the Asia-Pacific region compared to the rest of the world, 1990–2020 (GtCO2e)



Electrification is a critical tool for decarbonization

Figure 3.4 ▷ Total final consumption by source in the NZE Scenario, 2010-2050



End-use sectors come to be dominated by electricity, which provides more than half of total final consumption by 2050

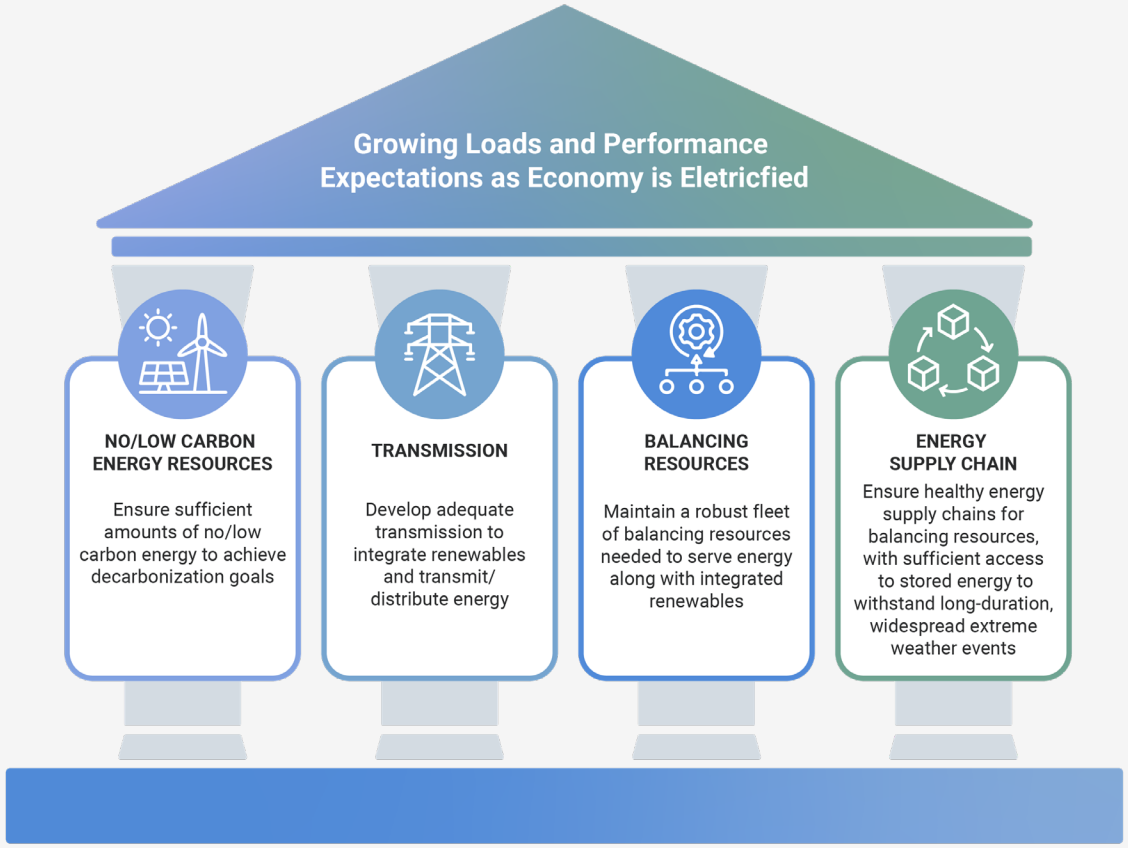
Note: Other renewables include solar thermal and geothermal used directly in end-use sectors.

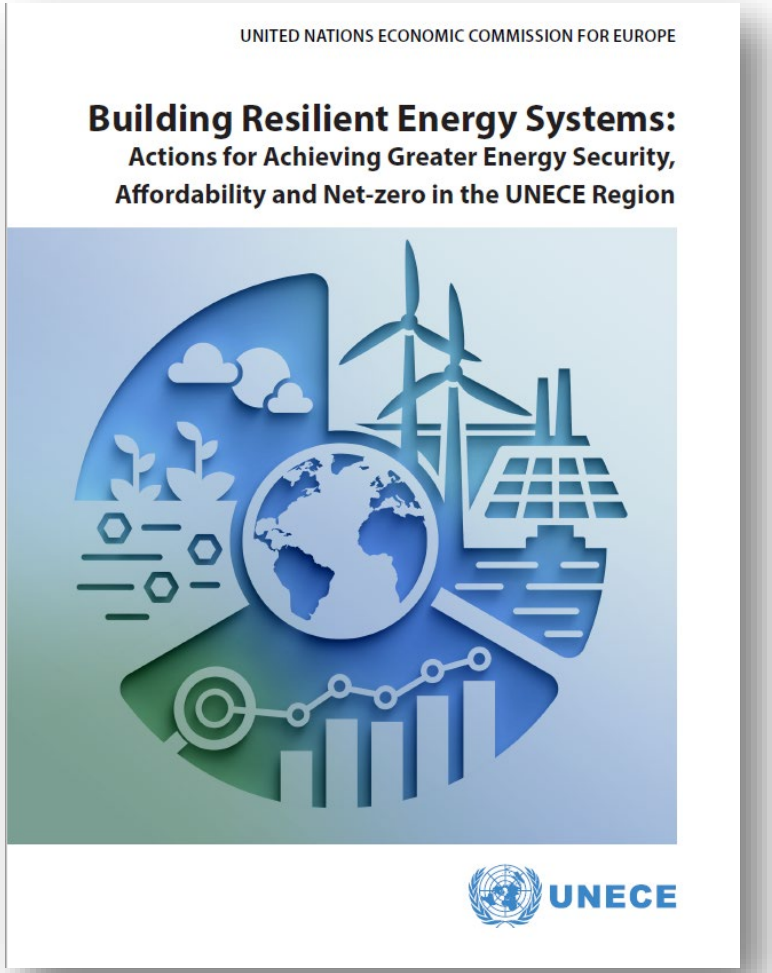
Achieving NZE requires:

- **Decarbonization of the power sector** through increased deployment of RE and zero-emission technologies
- Increased **end-use electrification**

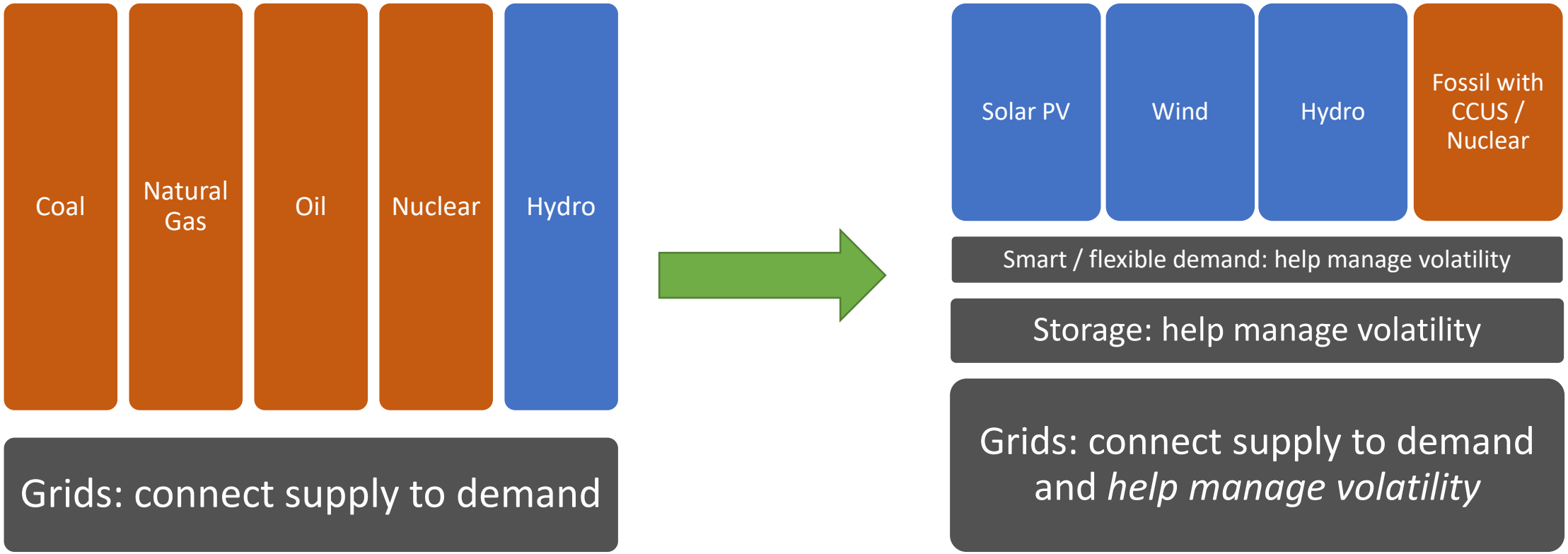
At the same time, the energy transition must ensure the secure and affordable provision of electricity to all

Electrification implies increasing demand and increased concerns over power system resilience





Energy transition implies a shift from *fuel-* to *weather-dependent* power systems



The need for larger, more integrated power systems

Economics
- Access to lower-cost resources
- Potential for export revenues
- Increased economies of scale

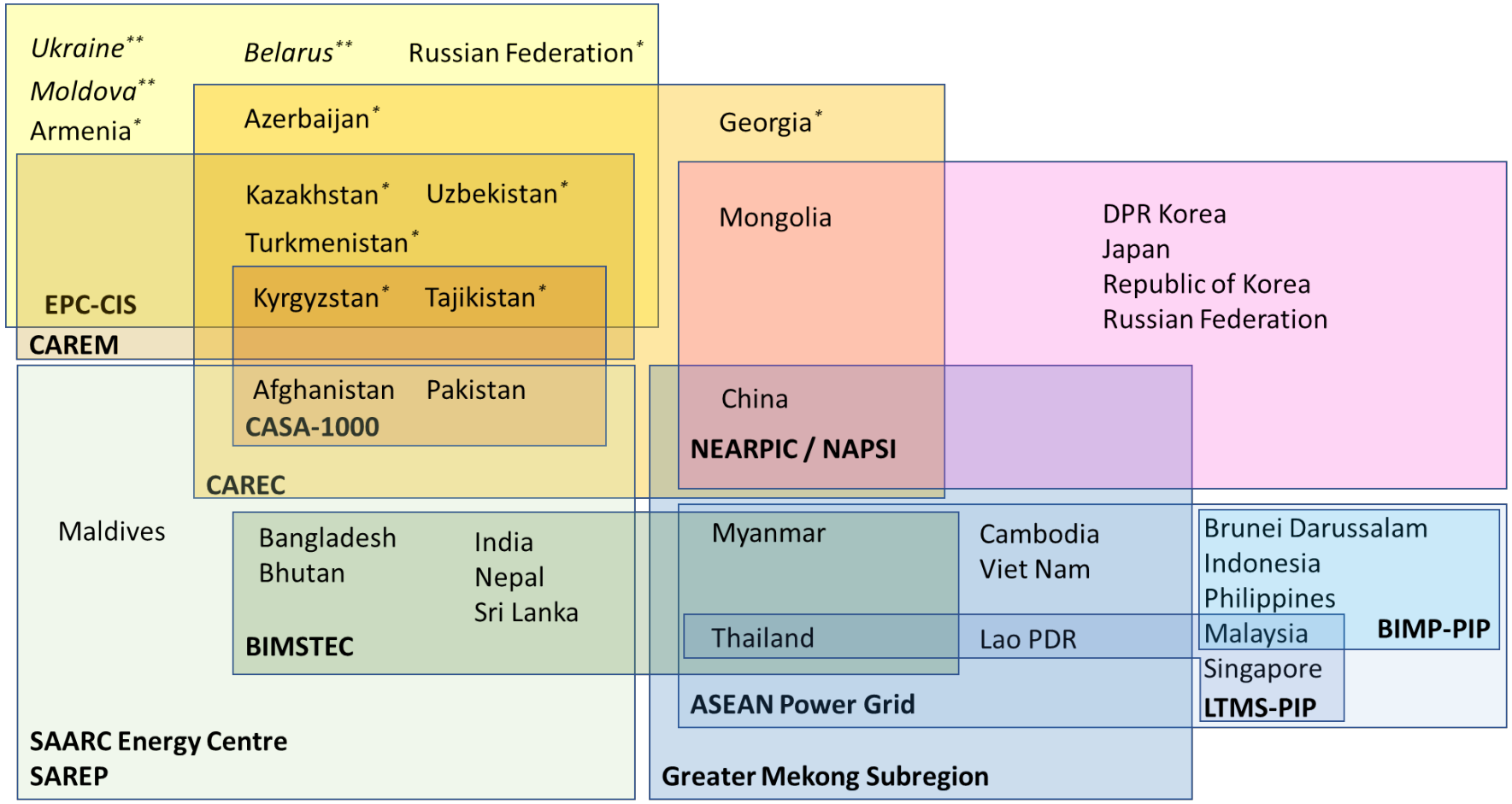
Security
- Lower reserve margin requirements
- Increase resource diversity

Sustainability:
- Access to regions with high RE potential
- Enables integration of variable RE (resource smoothing)

ESCAP's Regional Roadmap on Power System Connectivity

Planning	• Develop a regional master plan (Strategy 2) • Coordinate cross-border transmission planning (Strategy 6)
Financing and development	• Mobilize investment in cross-border infrastructure (Strategy 7)
Operations	• Move toward multilateral trading, competitive markets (Strategy 5) • Co-ordinate cross-border system operations (Strategy 6)
Cross-cutting	• Build trust and political consensus (Strategy 1) • Develop intergovernmental agreements (Strategy 3) • Coordinate, harmonize, and institutionalize policy and reg frameworks (Strategy 4) • Build capacity, share information, data, best practices (strategy 8) • **Ensure coherence of connectivity with the SDGs (Strategy 9)**

Multilateral connectivity initiatives in the region



* Member of UN ESCAP and UN ECE
** Member of UN ECE only

Benefits of connectivity – lower costs

Differences in electricity production costs in North-east Asia by scenario

Source: SEI

Connectivity lowers system costs

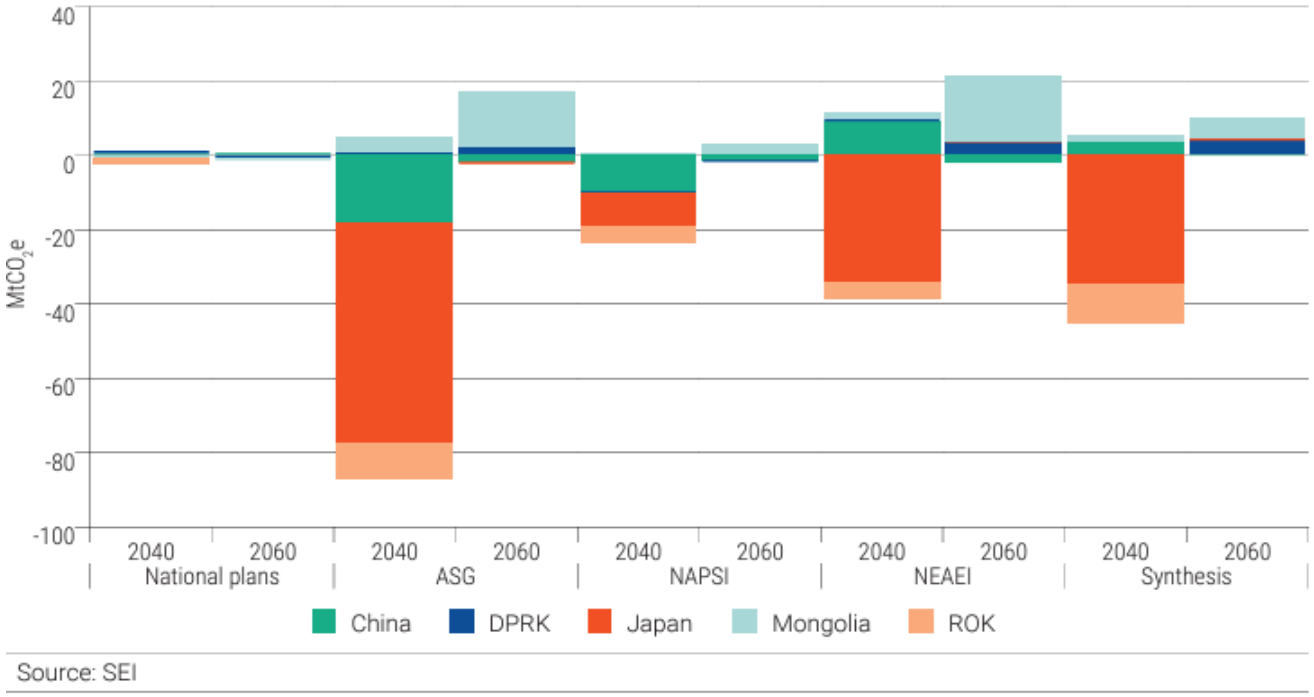
More integration reduces system costs by:

- Providing access to higher quality, lower cost RE resources
- Increasing utilization of resources / limits curtailment
  - **Also has security benefits**
- Allowing for mutual beneficial trading arrangements

Full report available at: https://www.unescap.org/kp/2023/green-power-corridor-north-east-asia-roadmap

Benefits of connectivity – faster energy transition

Changes in in GHG emissions in North-east Asia by scenario



Source: SEI

Integration <u>accelerates</u> energy transition

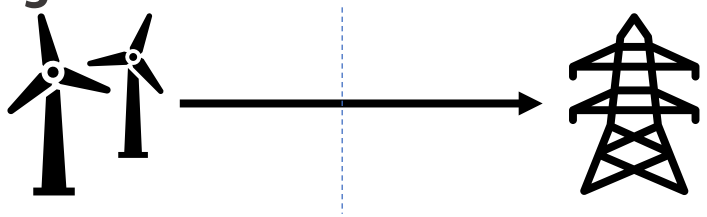
Investing in transmission helps to:

- Accelerate investment in RE – access to grid and demand enables increased investment
- Optimize the use of RE – reduces curtailment, allows for regional ‘resource smoothing’
- More rapidly reduce GHG emissions (more RE GW and GWh)

Full report available at: https://www.unescap.org/kp/2023/green-power-corridor-north-east-asia-roadmap

Models of cross-border integration

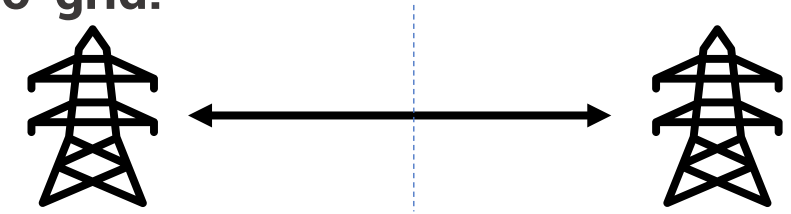
Point-to-grid:



- Allows for increased certainty of resource type and availability
- Enables integration of external resources into domestic system without considering conditions of host system
- Easier to measure costs and benefits (limited spillover effects)
- Limits potential for resources optimization at system level
- Limited potential for bidirectional and multilateral trade

- Example: Thai imports of hydropower from Lao PDR

Grid-to-grid:

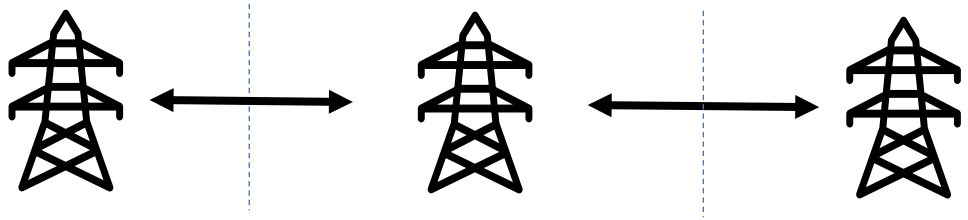


- Allows for flexible bidirectional and multilateral trade
- Allows for increased optimization at system level (helpful for security, RE integration)
- Harder to measure costs and benefits (increased spillover effects) – implications for cost sharing
- Requires increased data sharing
- Requires increased harmonization of grid codes, operational procedures
- Benefits from presence of regional institutions

- Example: Malaysia <-> Singapore; EU market coupling

Models of cross-border integration

Shared backbone

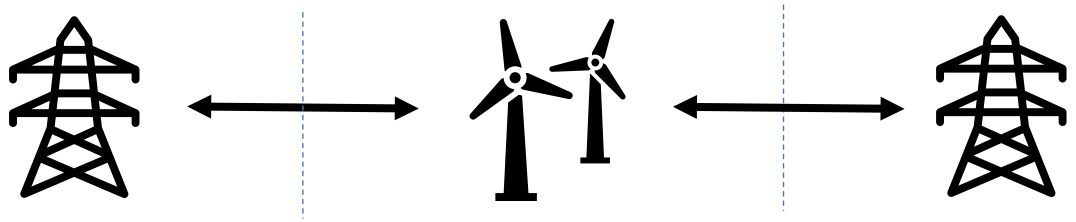


- Enables multilateral trading
- Enables increased regional optimization of resources while also allowing some resources to ‘opt out’
- Potential for free-riding (avoiding investments in domestic grid by utilizing backbone grid)
- Easier to measure costs and benefits (limited spillover effects)

- Example: SIEPAC

No operational backbone grids in Asia; some at various stages of consideration or development

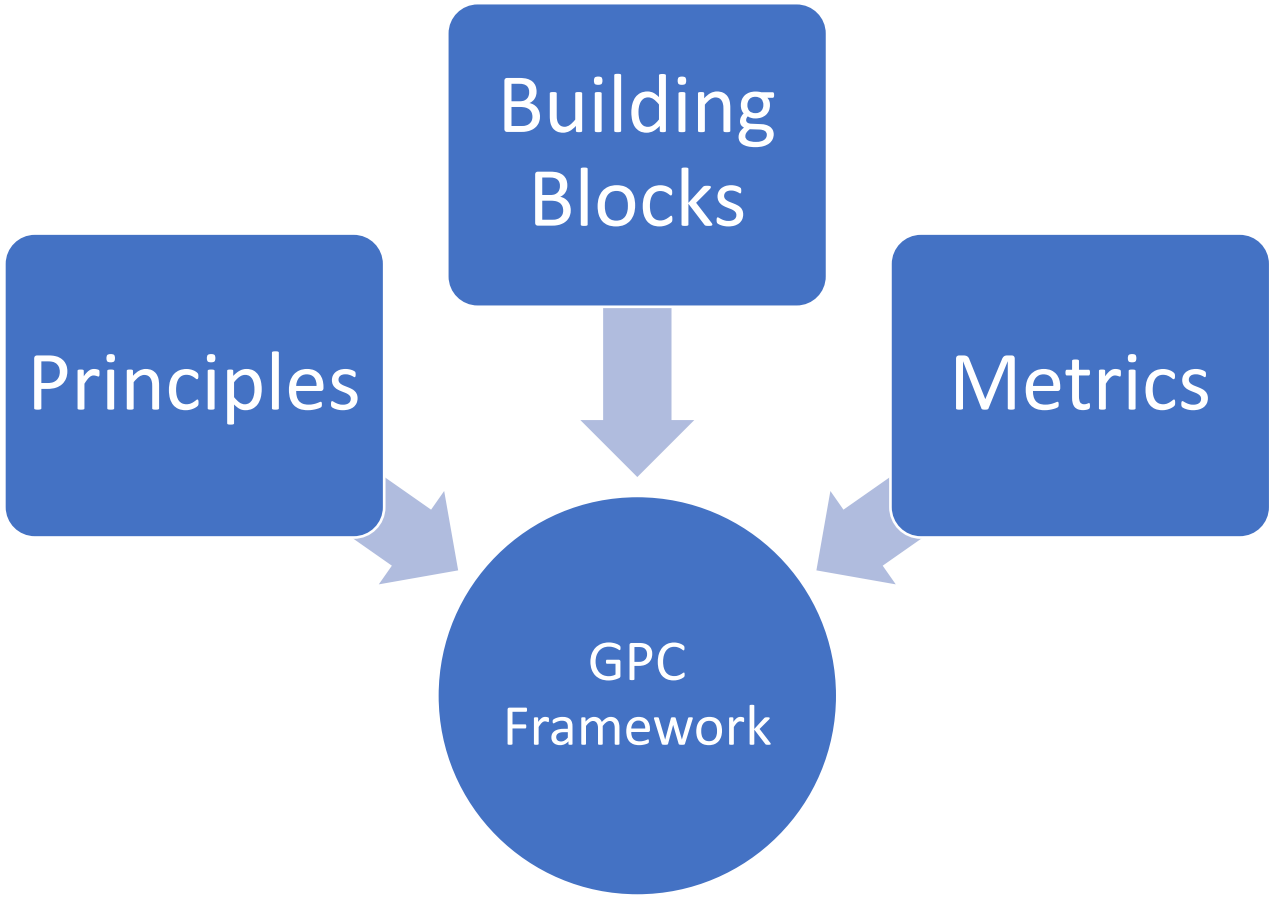
Hybrid:



- Combined interconnector and generation resource(s) (typically RE)
- Enables interconnection of remote resources among multiple countries / jurisdictions while also facilitating bidirectional trade
- Enables increased utilization of both grid and generation
- Currently being used for offshore wind resources in Europe
- Requires closely integrated system operations and clear cost sharing / recovery method

- Example: Belgium <-> Norway (feasibility study)

Sustainable power system connectivity: ESCAP's Green Power Corridor Framework



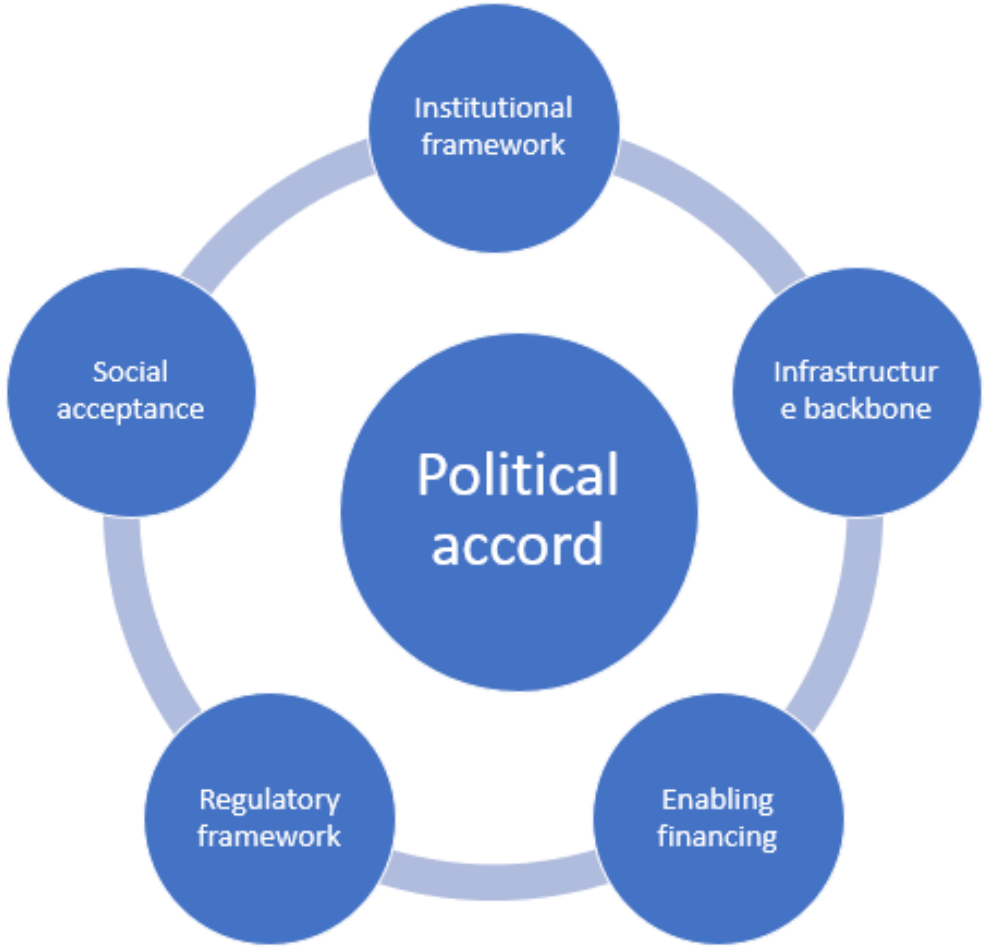
Connectivity can <u>enable</u> sustainable development, if utilized properly.

The GPC Framework aims to provide

- Practical and relevant **principles** to guide the development of connectivity initiatives
- **Building blocks** to structure and orient connectivity initiatives
- A set of **metrics** to enable the measurement of connectivity projects against relevant criteria

Green Power Corridor Framework Building Blocks

- **Political accord**: fundamental enabler of successful connectivity initiatives
- **Institutional framework:** To guide and monitor development
- **Enabling financing:** secure participation of all available sources of capital
- **Infrastructure backbone:** strengthen national and cross-border grid infrastructure to enable RE integration
- **Regulatory framework:** to enable secure, flexible and efficient operations
- **Social acceptance** : ensure public support, boost capacity, and maximize inclusion of relevant populations



UNECE – UNESCAP Programme on Energy Connectivity in Central Asia and the Caucasus

- **Project 1: Energy connectivity for sustainable development**

Enabling renewable energy resource sharing across borders (ECO-REM). Development of a roadmap to inform multilateral power trading.

- **Project 2: Energy Connectivity in Central Asia**

Improving resiliency of the energy systems in Central Asia through enhanced regional energy connectivity. Development of scenarios and a roadmap for a regionally interconnected energy system.

- **Project 3: Supporting increased energy security and resilience through energy transition**

Enhancing energy security and energy system resilience through energy connectivity. Technical workshops on building policy design capacity for resilient and connected energy systems in Kazakhstan and Uzbekistan.

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- **Project 3: Supporting increased energy security and resilience through energy transition**
  - Objective: to help member States increase their policy design capacity to enhance energy security and energy system resilience through energy connectivity
  - Key activity: development of tools and fostering multi-stakeholder partnerships for a resilient and interconnected power systems
  - Stakeholders:
    - national and regional stakeholders
    - development organizations
    - 5 UN Regional Commissions – UNECE, ESCAP, ECLAC, ESCWA, ECA

Moderated discussion

- What are the perceived challenges and potential benefits from the development of connectivity projects?
- How do Georgian government agencies, civil society groups, and other stakeholders currently collaborate on power system development?
- The GPC Framework has six building blocks: social acceptance, institutional framework, infrastructure backbone, political accord, regulatory framework, and enabling financing. Which building blocks are relevant to energy security and resilience in Georgia?
- What are existing strategic plans and current measures for the development of cross-border power system connectivity, including grid infrastructure development and power trade?
- In what ways can the shift towards renewable energy and improved connectivity drive economic growth and employment opportunities in Georgia?
- What potential avenues can be explored for public-private partnerships to advance energy connectivity and resilience effectively?

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