

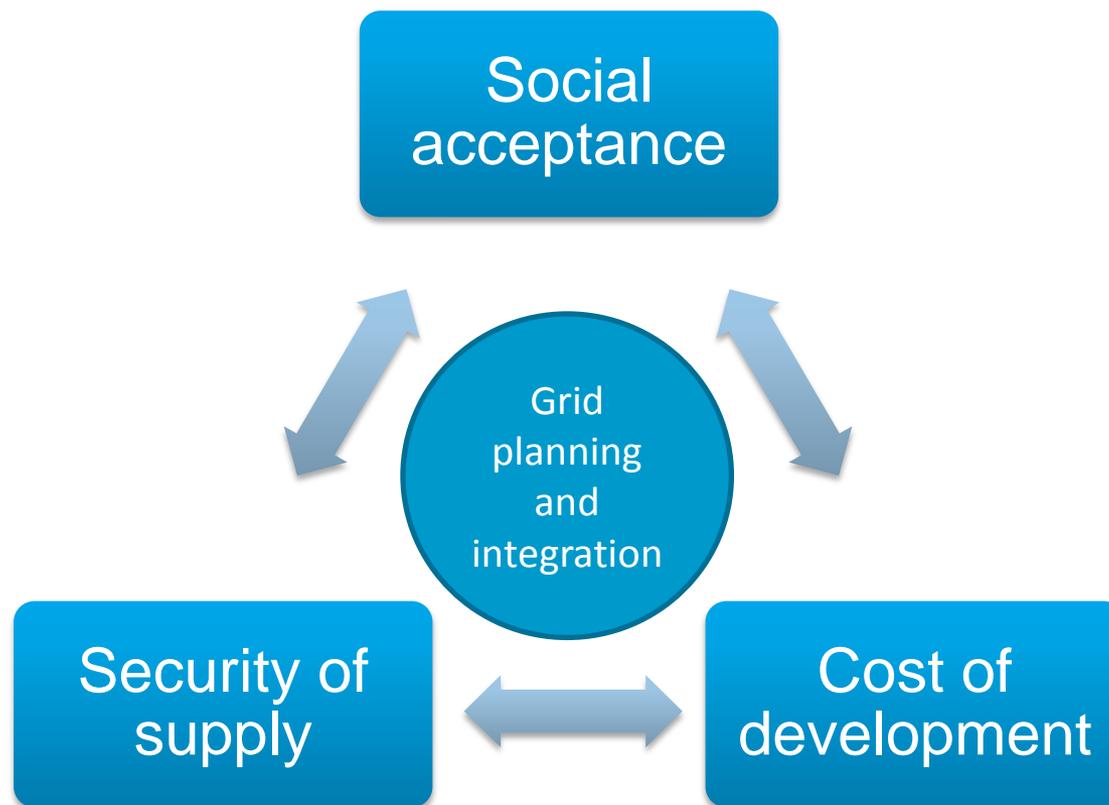
Global experiences in cross-border power system integration

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Power systems planners must balance competing goals



The Energy Trilemma

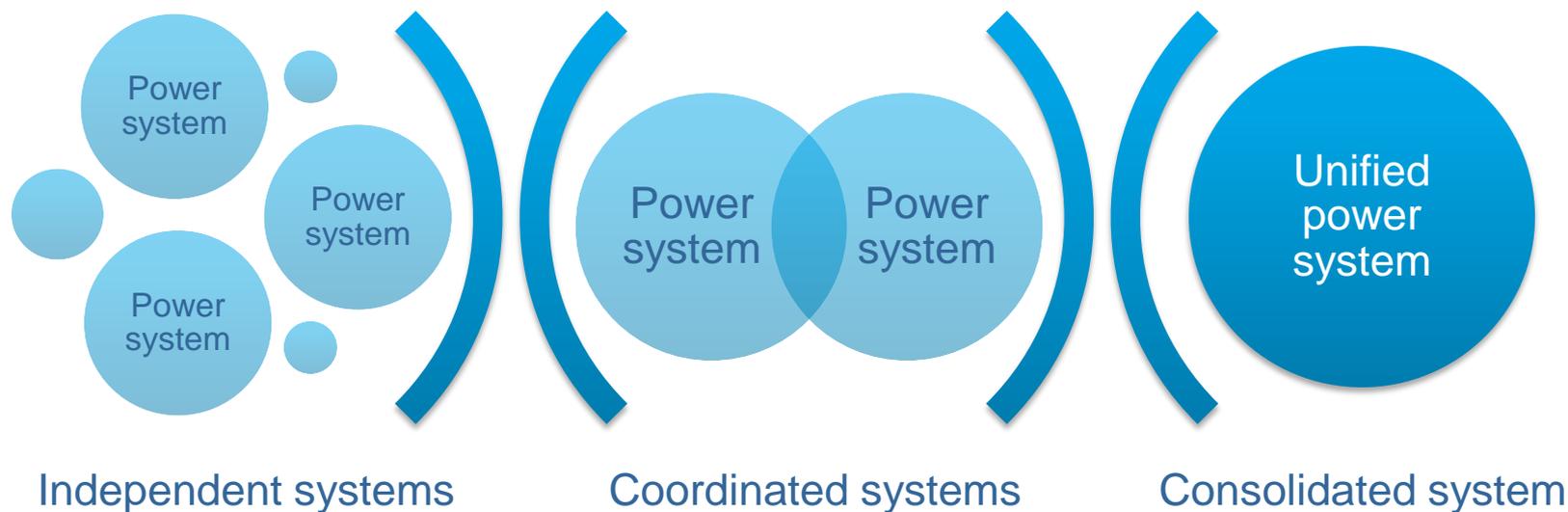


Effective transmission planning and regional integration can help resolve the energy trilemma, especially when other technology options are limited.

Regional integration: a matter of degree

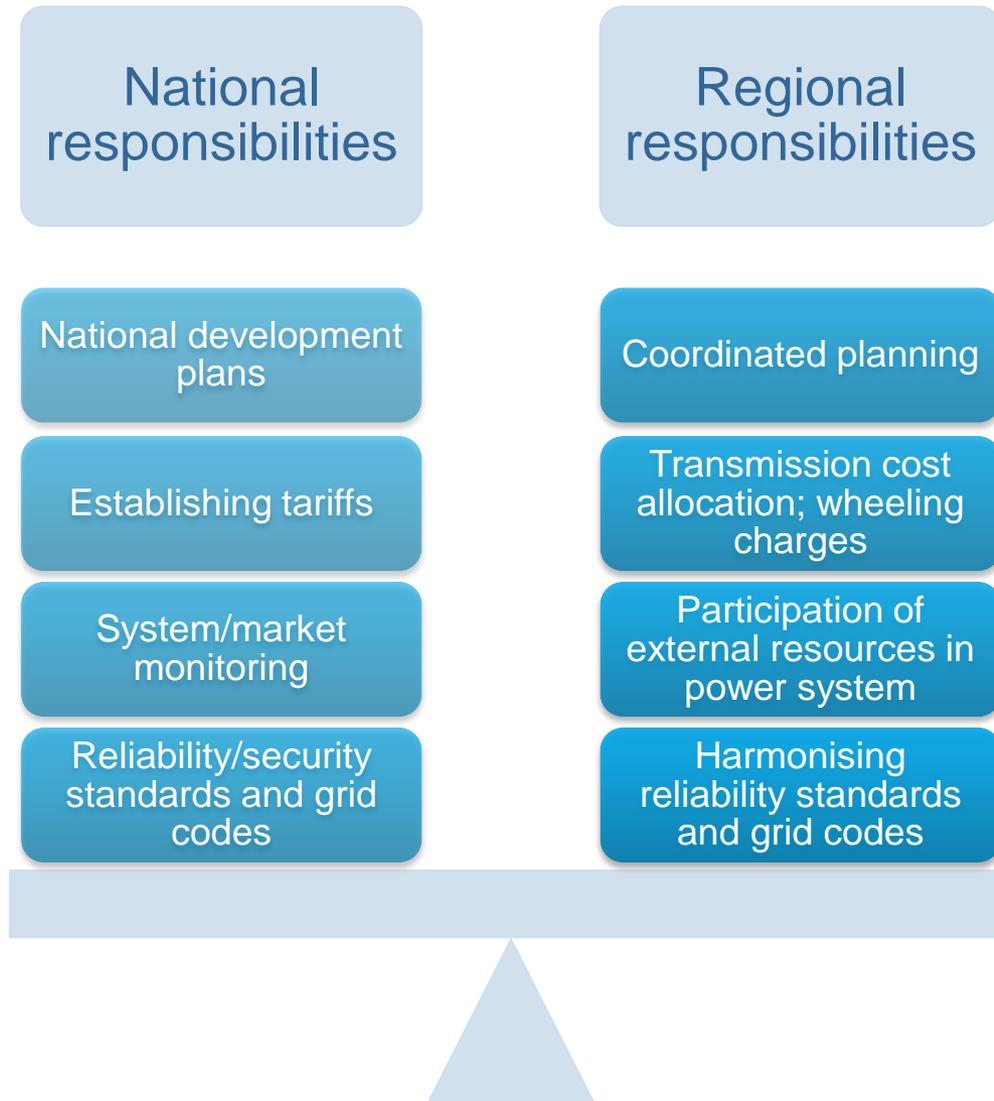


“If you want to go fast, go alone; if you want to go far, go together.”



Consolidated systems are best able to meet the technical requirements of decarbonisation, but require strong jurisdictional alignment. Coordinated systems require significant harmonisation, ideally supported by regional institutions.

What role for institutions in an interconnected world?



Different models for regional institutions



Loose cooperation

- ASEAN Energy Regulators Network
- MedReg (Mediterranean region)
- NordReg (Nordic Region)

Limited regional authority

- ACER (EU)
- CRIE (Central America)

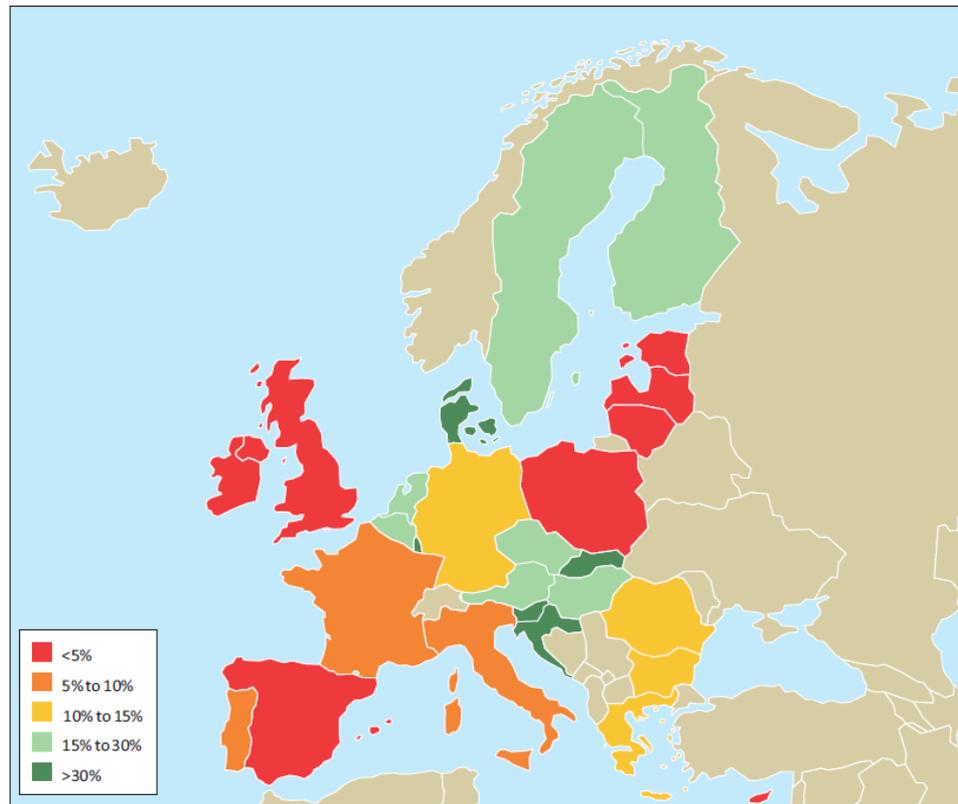
Strong regional authority

- FERC (US)
- NERC (North America)
- CERC (India)

EU power system integration: an ever closer union



Interconnection level assuming all Projects of Common Interest (PCIs) are completed



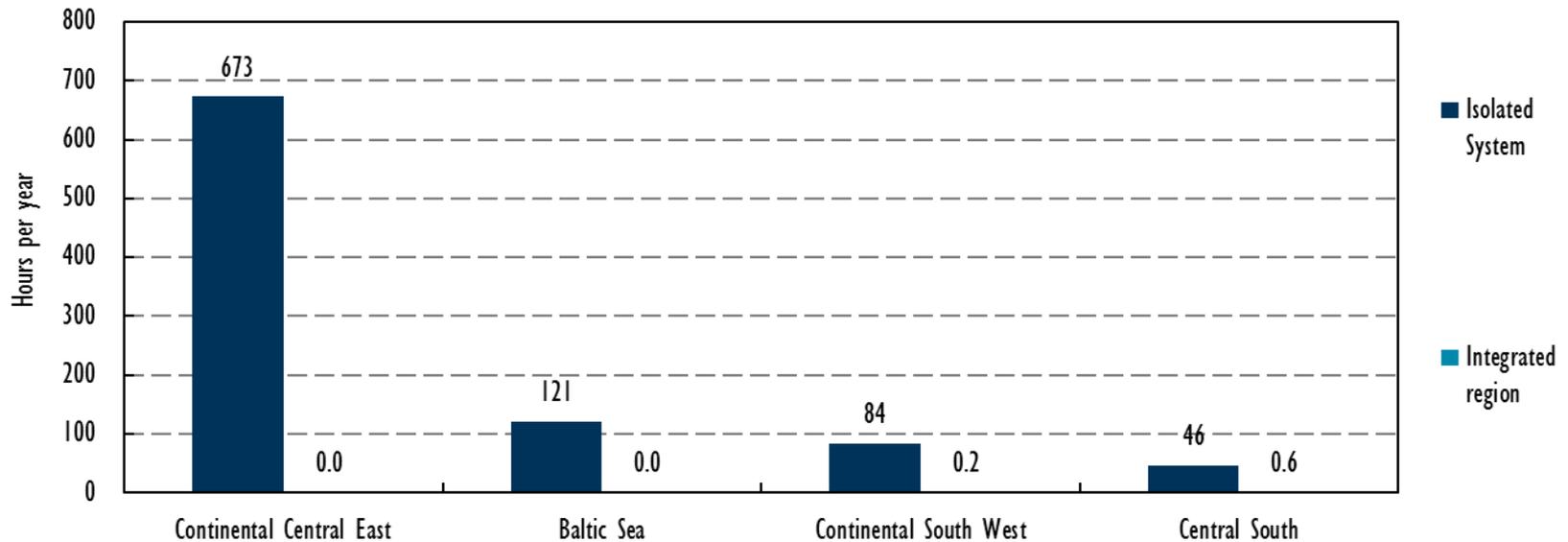
This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

The EU goal of a single, Internal Energy Market (IEM) is driven by a “market first” approach: free movement of goods, people, capital... and electrons.

Benefits of power system integration: increased reliability



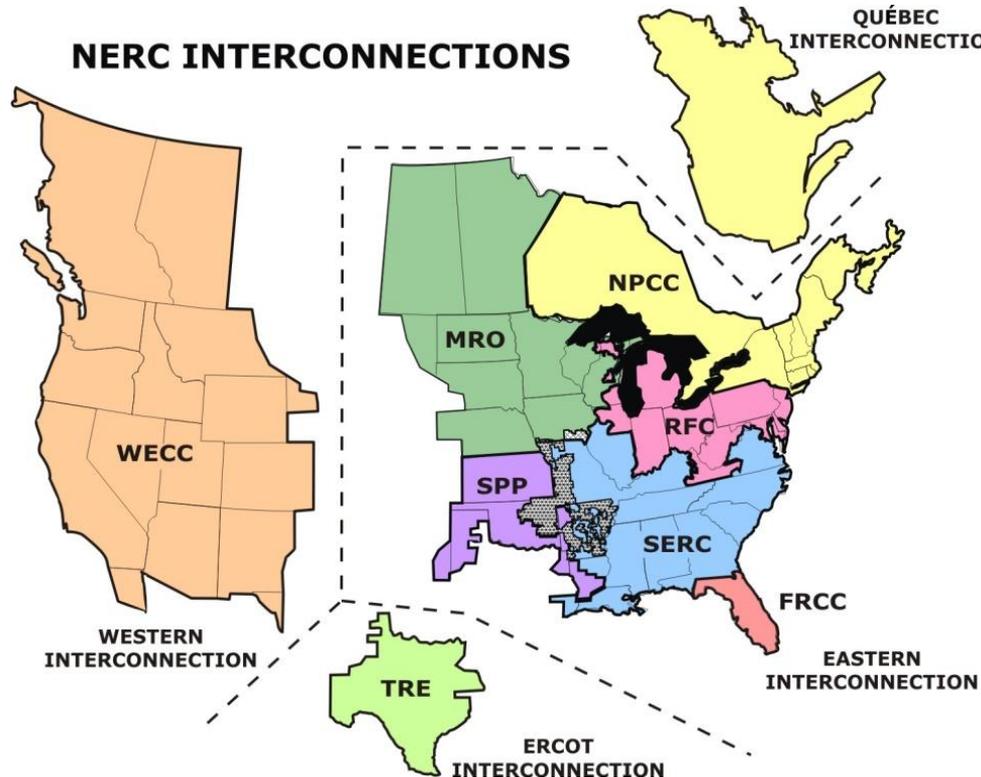
Loss of Load Expectation in 2020 for isolated systems and integrated regions (EU)



Historically, cross-border power sector integration often starts with the sharing of primary reserves.

North America: overlapping jurisdictional boundaries

North American Electric Reliability Corporation (NERC) regions

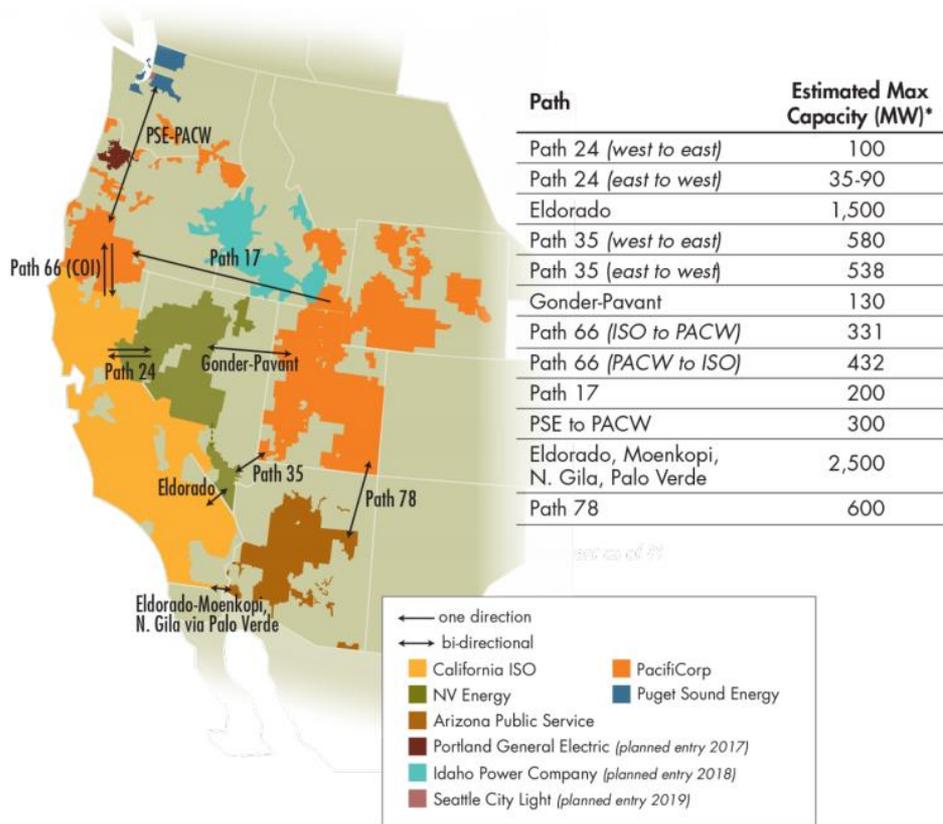


North America has many (at times overlapping) jurisdictional boundaries. Reliability standards have evolved from voluntary to mandatory.

US power system integration: economics and environment



Western Energy Imbalance Market (WEIM)

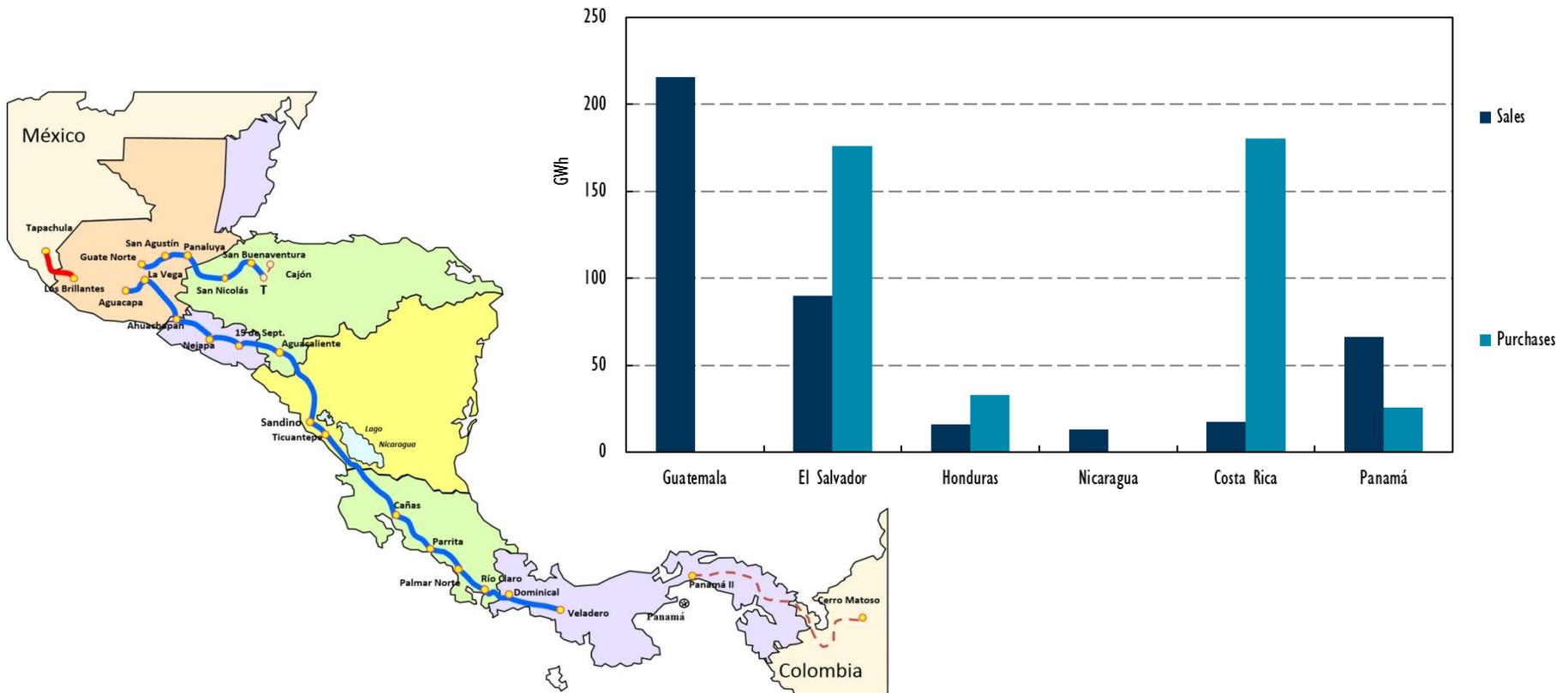


- Markets are already well interconnected, but rising VRE is driving deeper integration
- WEIM is a voluntary market, with CAISO as market operator
 - CAISO organizes market and, therefore, takes on regional responsibilities
- Economic and environmental benefits are real and significant
 - USD 143 million saved (2014-16)
 - 10 000 tonnes of avoided CO₂
 - Reduced reserves requirements (btw 400 and 500 MW)

Source: CAISO

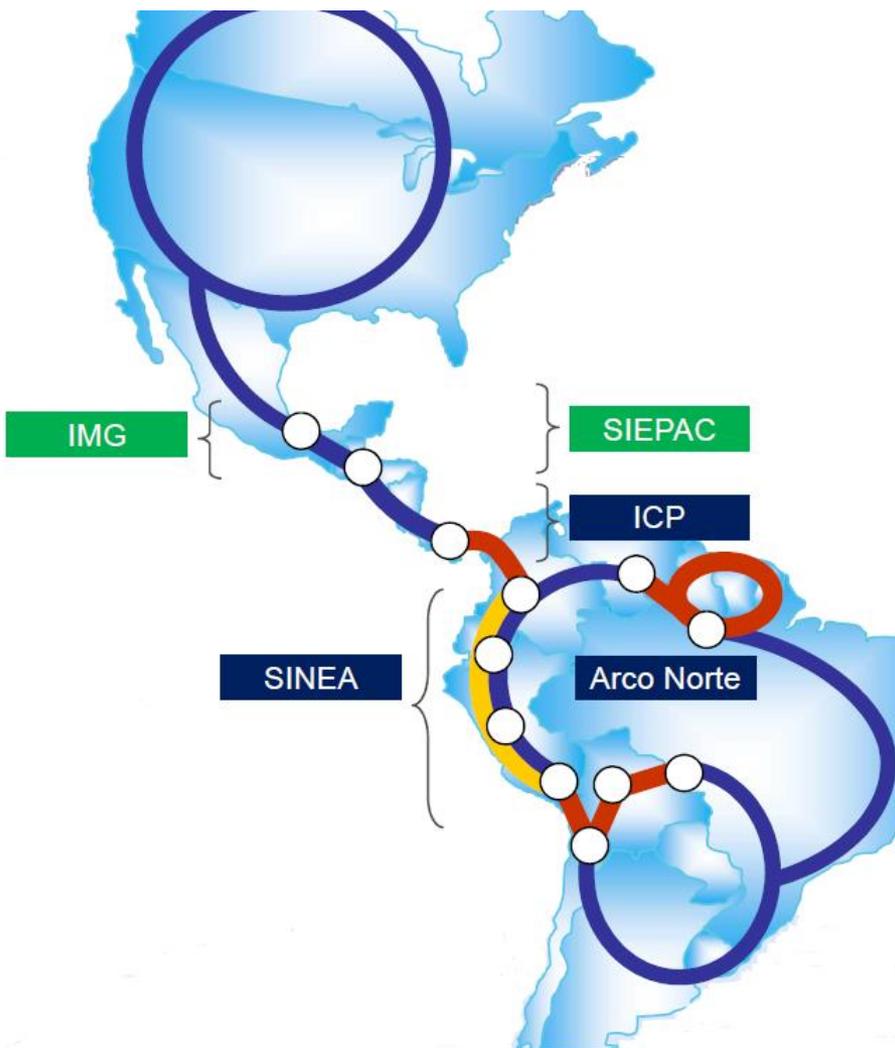
Central America: developing the SIEPAC line

SIEPAC system and annual trade volumes (2016)



SIEPAC development and trade is supported by a number of regional institutions: CRIE (regulator); EOR (system operator); EPR (transmission owner); CDMER (economic development). Imports are a small % of domestic consumption.

Latin America: an electricity superhighway?



Regional initiatives in South America

Country	SINEA - CAN	UNASUR	ALADI	MERCOSUR
Argentina		•	•	•
Bolivia	•	•	•	•
Brazil		•	•	•
Chile	•	•	•	
Colombia	•	•	•	
Cuba			•	
Ecuador	•	•	•	
Mexico			•	
Guyana		•		
Panama			•	
Paraguay		•	•	•
Peru	•	•	•	
Suriname		•		
Uruguay		•	•	•
Venezuela		•	•	•

Source: ISA ETESA, IEA research

Summary: lessons for ASEAN



- **Regional integration can help resolve the “energy trilemma”**
 - Economics, security and environment
- **Integration is a matter of degree**
 - No one path, but clear direction helps
- **Need to consider relevant jurisdictional boundaries**
 - Political, geographic, technical
- **Of crucial relevance: the boundaries of *decision making***
 - Are roles and responsibilities clearly defined?
 - Is decision making free of outside influence?
 - Are decisions enforceable?

Thank you

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Electricity Security Across Borders

*Case Studies on Cross-Border Electricity
Security in Europe*

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