



**WORLD BANK GROUP**  
Energy & Extractives

# Marchés concurrentiels de l'électricité et développement durable

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## L'intégration régionale et les échanges transfrontaliers

Mirlan Aldayarov - Markets, Connectivity, Trade  
(MARCOT) program lead

Cotonou – June 28, 2022

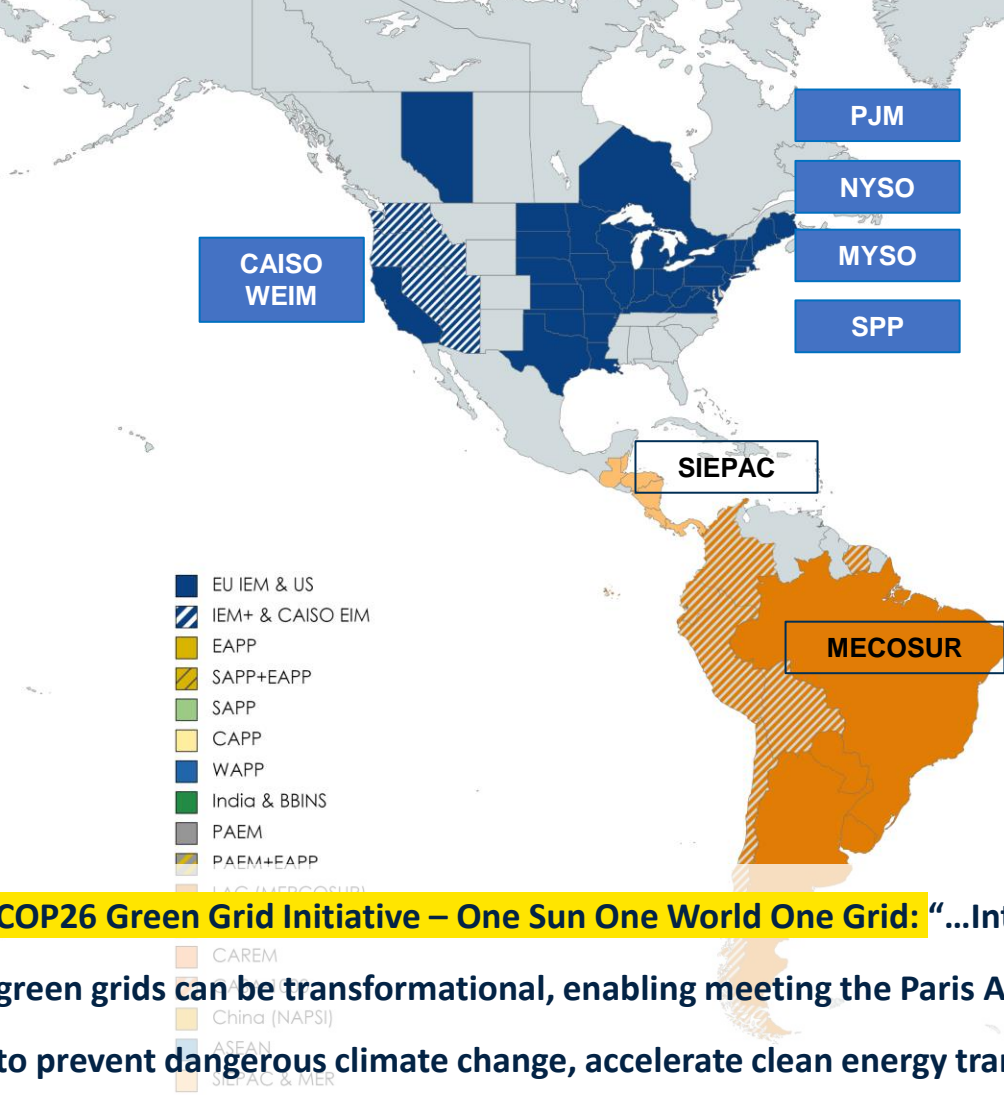




# Regional markets worldwide

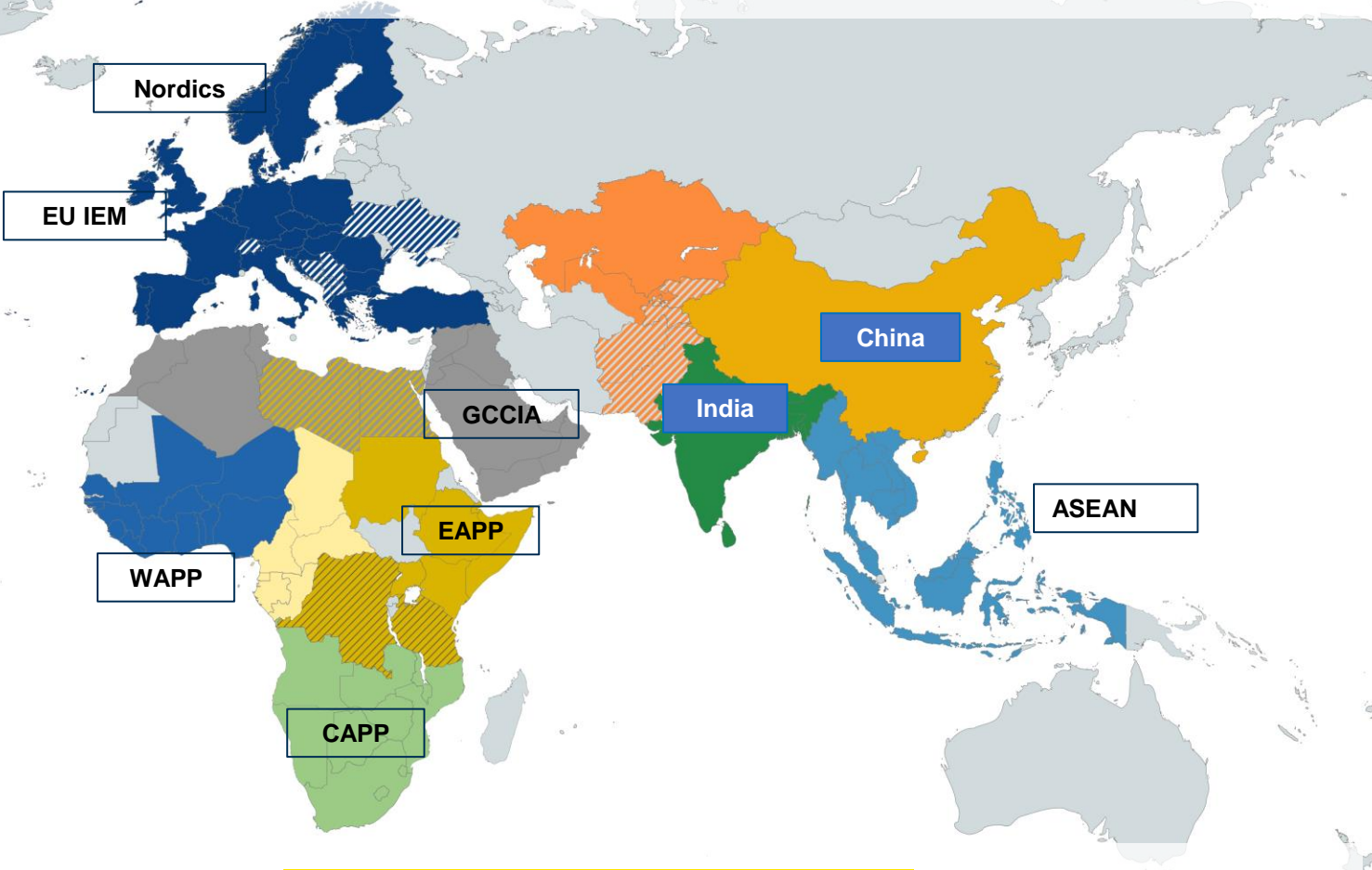
Multi-national

One country, multiple states/provinces



**COP26 Green Grid Initiative – One Sun One World One Grid:** “...Interconnected green grids can be transformational, enabling meeting the Paris Agreement targets to prevent dangerous climate change, accelerate clean energy transition, and achieve the SDGs...”

**Sustainable Development Goal 7 (SDG-7):** “...is to provide access to affordable, reliable, sustainable and modern energy for all.”



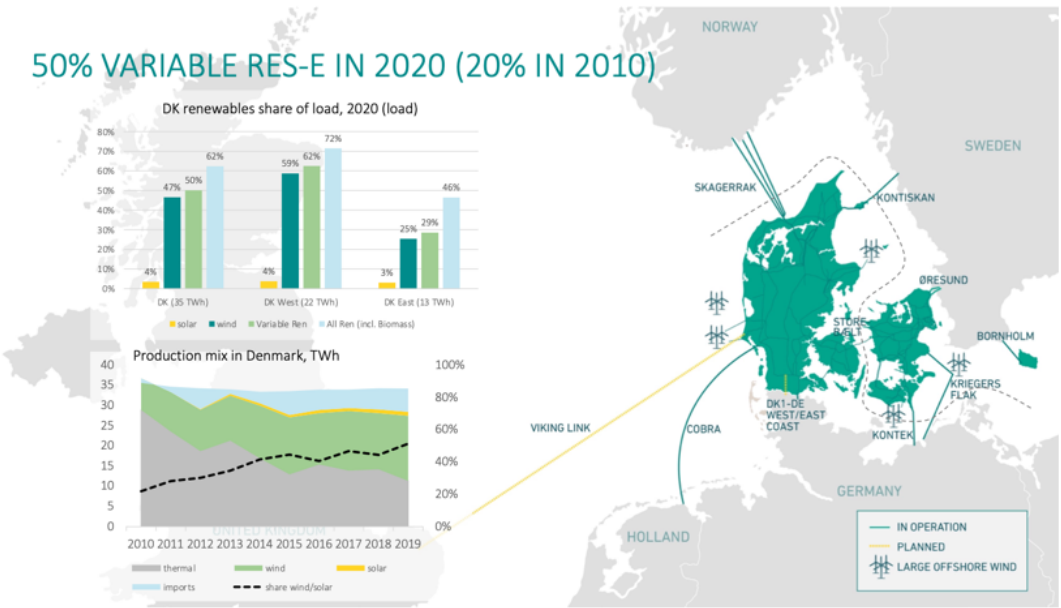
**WB Climate Change Action Plan 2021-2025:** “...The WBG's priorities in the sector include... regional power cooperation and trade.”

# Regional Markets Benefits - Reliability: ...allows maintaining the highest security of supply even with record high shares of VRE...

## Regional markets – providing higher security of supply

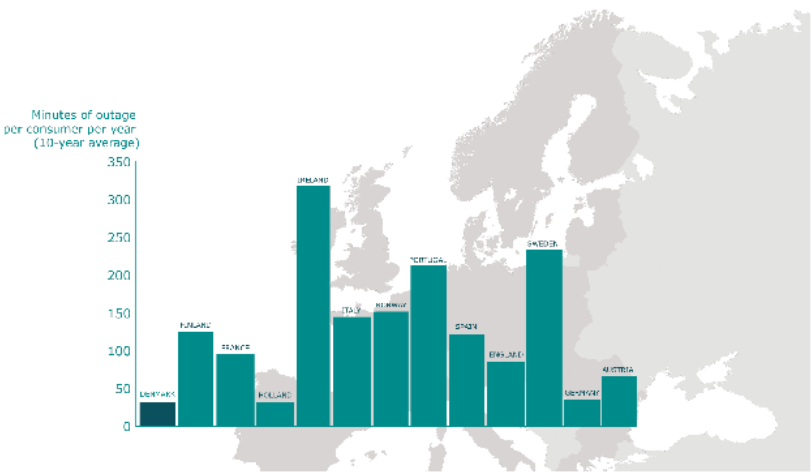
Example from Denmark – they rely on the well-integrated European regional market

50% VARIABLE RES-E IN 2020 (20% IN 2010)



.....YET HIGH SECURITY OF SUPPLY

Danes have electricity 99.9% of the time



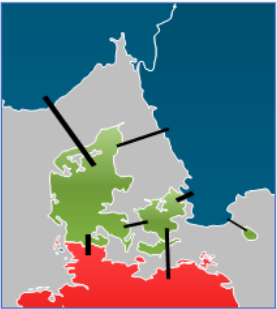
Common price 20% of time



Common with Nordics 50%



Common price with DE – 20%

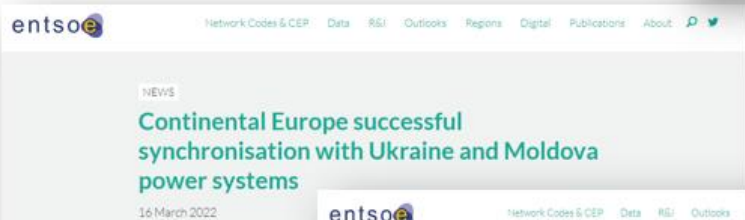


Own price – only 10%

Source: ENERGINET

**Regional Markets Benefits - Reliability:** ...provides security of supply at times of crises....  
Synchronization with ENTSO-E started in the middle of the war, helping Ukraine to keep lights on. Yet a very first step for full integration.

**March 16** is a historical day when synchronous operation started in the middle of the War. On April 26, Ukrenergo became an observer member of ENTSO-E.

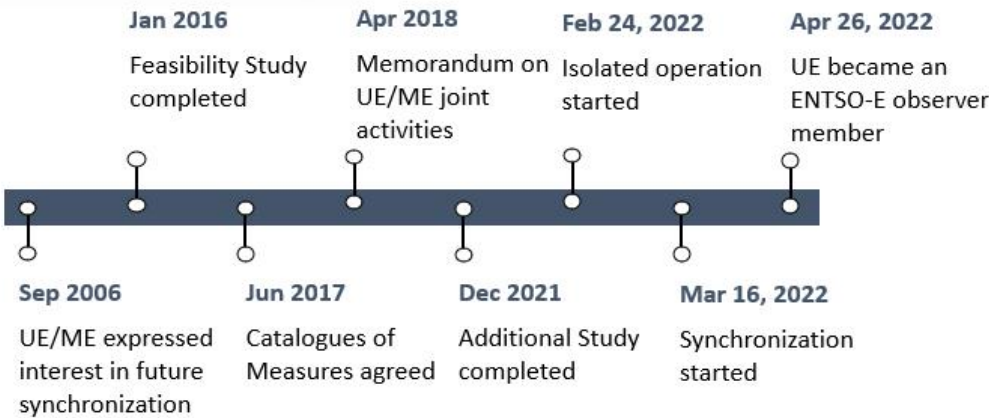


**1 million customers** lost electricity at peak due to the War. Synchronization ensures grid reliability.



**\$1.2 billion** annual benefit with “full market integration”. Benefits stem from system reliability/stability, supply diversification, and competitive & transparent markets.

**15+ years** of preparation with intense 5 years. The War accelerated the process. Original target was 2023.





## Regional Markets Benefits - Affordability: ...cross-border trade delivers substantial benefits and mitigates price volatility...

ACER has recently done an in-depth study of the impact of the EIM in light of the events the last period

### Case: Cross-border trade delivers substantial benefits and mitigates price volatility

To estimate the benefits from cross-border electricity trading in Europe in 2021, ACER asked the European NEMOs to conduct an analysis for 2021. It compared actual 2021 market results ('historical' scenario) with a scenario where all cross-border capacities were set to zero (the 'zero scenario', implying no electricity trade across Member State borders)<sup>9</sup>. The difference in welfare benefit between the historical and the zero scenario (see Figure 11) is a proxy for the yearly welfare benefits currently obtained from cross-border trade in day-ahead markets. The benefits of cross-border electricity trading amounted to around 34 billion Euros in 2021 (source: ACER based on NEMOs). More than one third of these benefits correspond to the last quarter of 2021, when power prices were at their highest.

**Figure 11: Estimated monthly welfare benefits (Billion EUR) from cross-border electricity trade in 2021**



Source: ACER based on NEMOs' simulations.

In addition to the considerable savings associated with the current level of market integration, the analysis shows that this integration also reduces significantly price volatility. Figure 12 displays the differences in average price volatility between the two scenarios. It shows that price volatility would have been considerably higher (around seven times as high) if national markets were isolated.

**Figure 12: Price volatility (EUR/MWh) in integrated and isolated electricity markets in the EU in 2021**

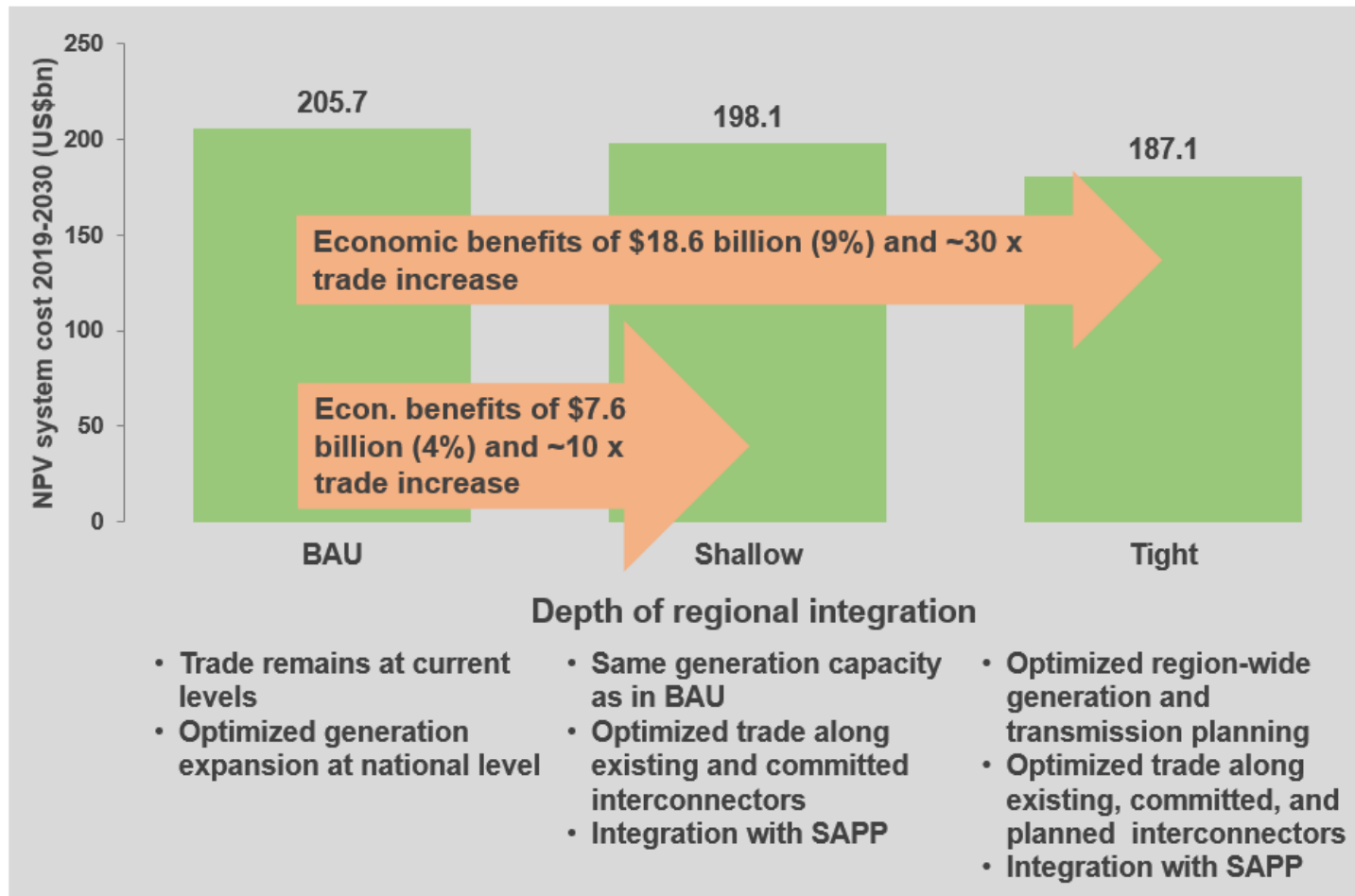


Source: ACER based on NEMOs simulations.

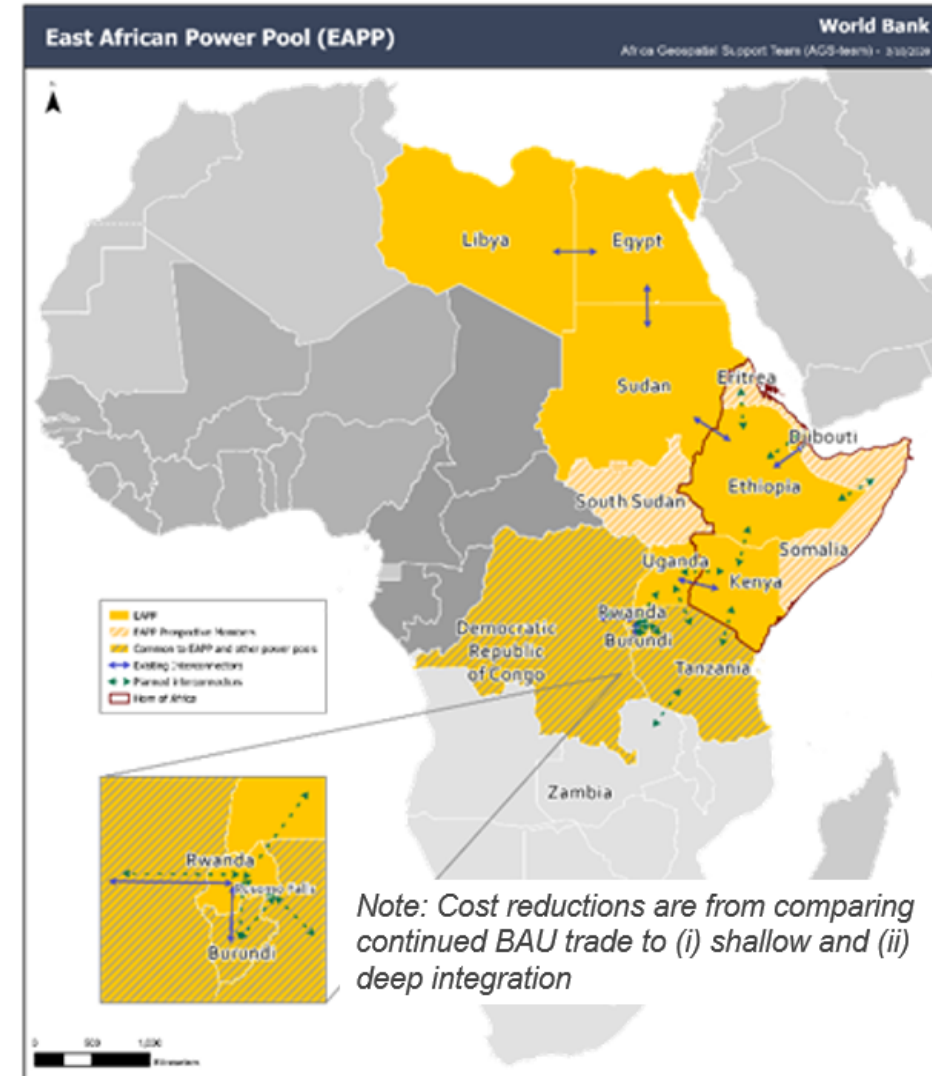
Volatility was estimated by using the standard deviation of day-ahead wholesale prices. The standard deviation was calculated per bidding zone for the whole year, then averaged out across the EU.

*“Overall, in 2021, cross-border trade delivered an estimated **34 billion Euros** of benefits while helping to smoothen price volatility.”*


## Regional Markets Benefits - Affordability: ...Low-cost hydro potential in the Eastern Africa Power Pool (EAPP) drive the large benefits of increasing trade in that region...




Source: Remy, Tom and Chattopadhyay, Debabrata (2020). Promoting better economics, renewables and CO2 reduction through trade: A case study for the Eastern Africa Power Pool. Energy for Sustainable Development 57 81-97.



**Regional Markets Benefits - Affordability:** ...WAPP regional trade benefits both importing and exporting countries, ultimately increasing access to green, reliable and affordable electricity...



**Supports transition to the new energy economy** including more solar, wind and hydro (trading countervailing variations in output, greater system inertia, scale efficient projects).



**Reduces electricity supply costs by \$660m p.a. (10% reduction)** through coordinated dispatch of lower cost generators and coordinated investment that takes account of lower cost regional options.

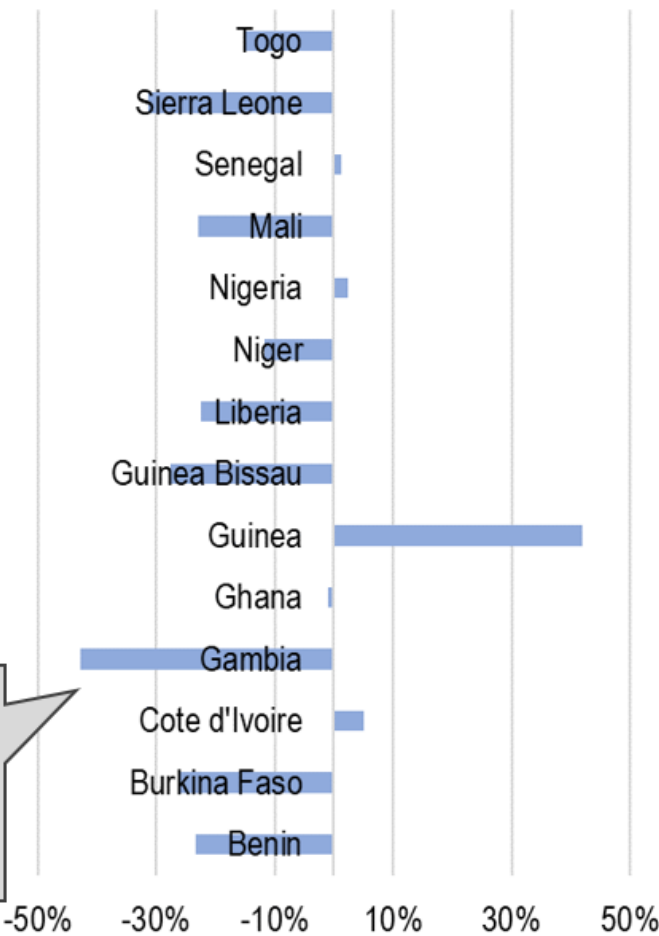


**Increases reliability of supply and resilience to shocks and effects of climate change** through increased supply options.

Source: World Bank analysis using EPM conducted for the ECOWAS White Paper  
Note: Cost reduction is from comparing no trade to deep regional integration

Greatest beneficiaries of regional power trade in WAPP are smaller countries currently reliant on oil-fired power generation

Percentage change in average generation cost





Regional Markets Benefits – Sustainability & Modernity : ...Its is inevitable. Almost all countries pledged to reach net-zero emissions...

# By What Year Have Countries Pledged to Reach Net-Zero Emissions?

Already Achieved	2030	2035	2040	2045	2050		2053	2060	2070
Bhutan	Barbados	Finland	Austria	Germany	Andorra	Jamaica	South Korea	Turkey	India
	Maldives		Iceland	Sweden	Argentina	Japan	Spain		Mauritius
	Mauritania			Nepal	Australia	Laos	Switzerland		
					Brazil	Latvia	UAE		
					Bulgaria	Liberia	United Kingdom		
					Canada	Lithuania	United States		
					Cape Verde	Luxembourg	Uruguay		
					Chile	Malawi	Vatican		
					Colombia	Marshall Islands	Vietnam		
					Costa Rica	Monaco			
					Cyprus	Montenegro			
					Denmark	Nauru			
					Dominican Republic	New Zealand			
					European Union	Panama			
					Fiji	Portugal			
					France	Rwanda			
					Hungary	Seychelles			
					Ireland	Solomon Islands			
					Israel	Slovakia			
					Italy	Slovenia			

Several design choices impact the rigor of these targets.  
Read our paper *Designing and Communicating Net-Zero Targets*

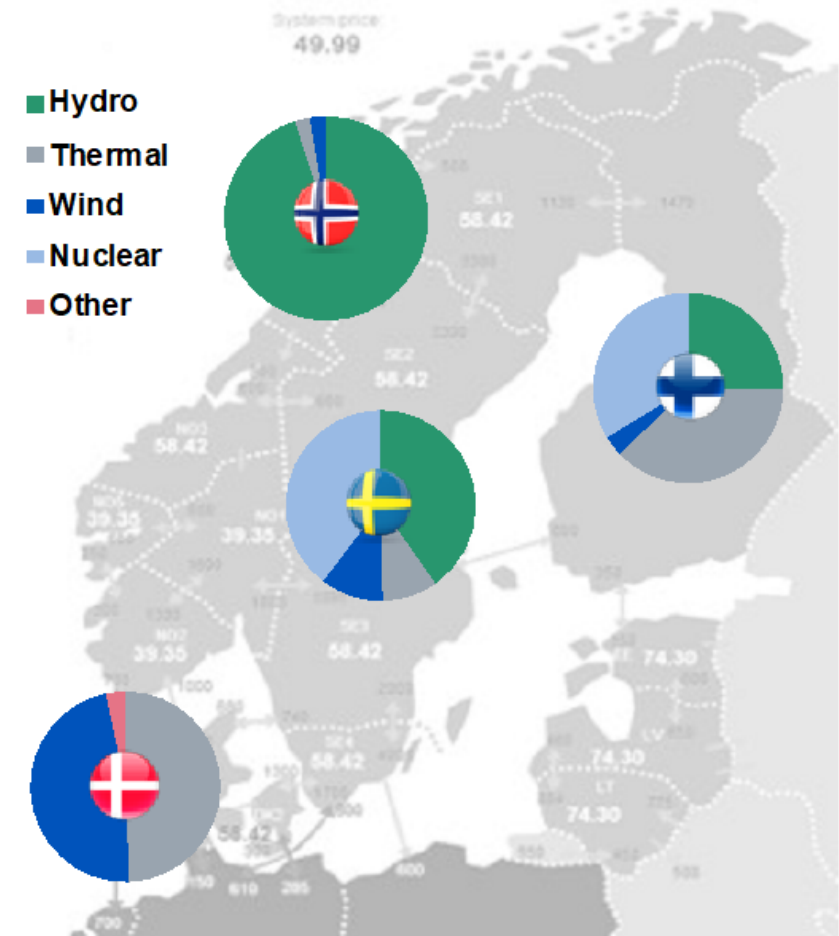
- Net-zero target set in law or policy
- Political pledge to reach net zero

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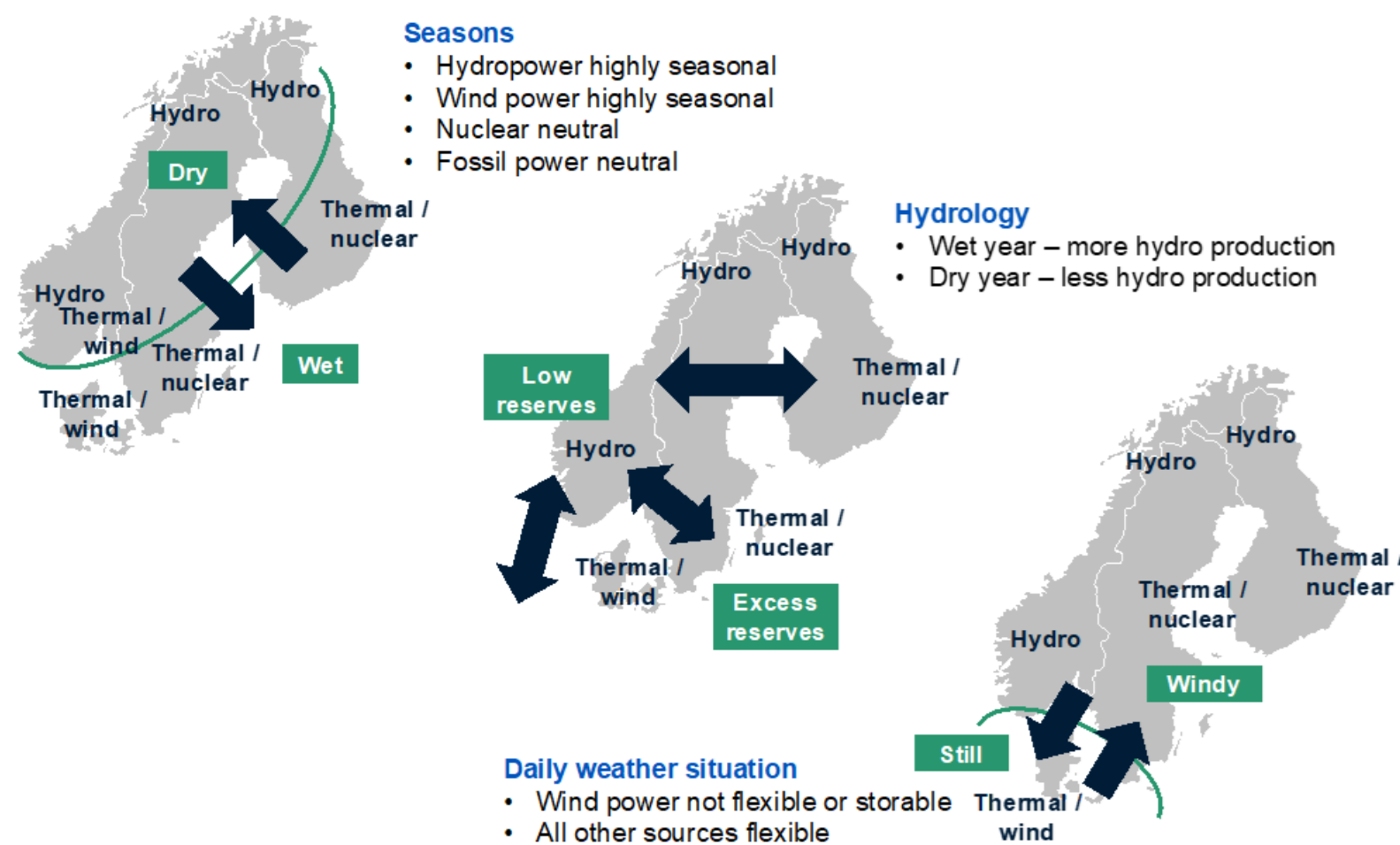


# Regional Markets Benefits – Sustainability & Modernity : ...Utilizing the value of differences secures optimal use of resources and more stable prices and allows for better integration of RES...

Nordic power production capabilities



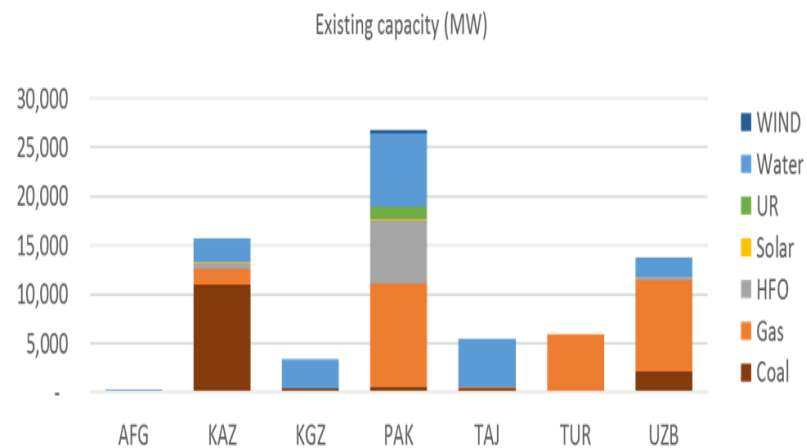
Connecting markets with differing production profiles provides stability to the system



# Regional Markets Benefits – Sustainability & Modernity : ...In Central Asia it can support countries addressing energy sector structural issues and accelerate the regional decarbonization agenda...

## Benefits of regional electricity trade and cooperation in Central Asia

- Increased energy security and system reliability (if well managed)
- More efficient and effective use of infrastructure
- Economies of scale in investments
- Greater renewable energy penetration
- Reduced cost of supply for consumers



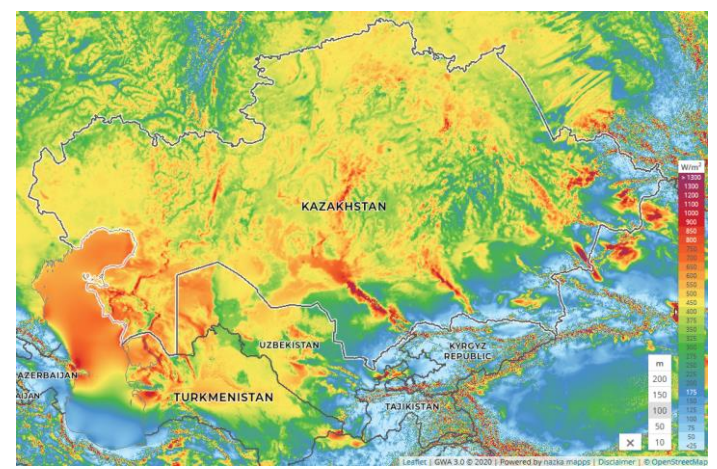
## Electricity trade is key to support the regional decarbonization agenda and Paris Agreement objectives

- Very good availability of different renewable energy sources in Central Asia
- The geographical and connectivity conditions offer great potential for reliable and green power supply in the region and potential of hydrogen development

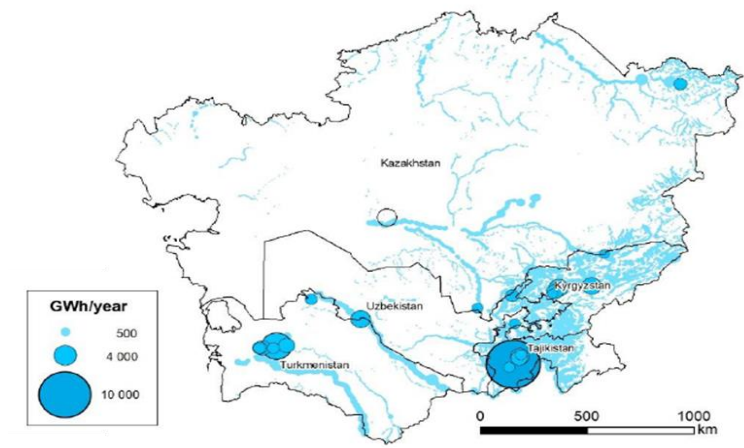
Solar



Wind

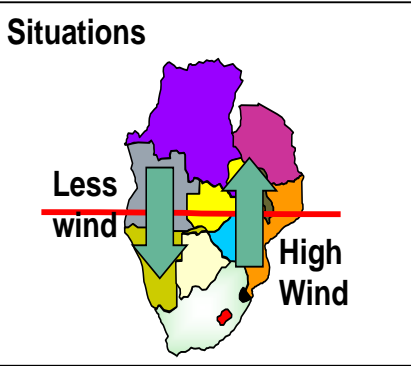
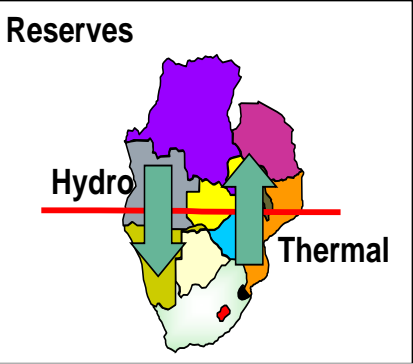
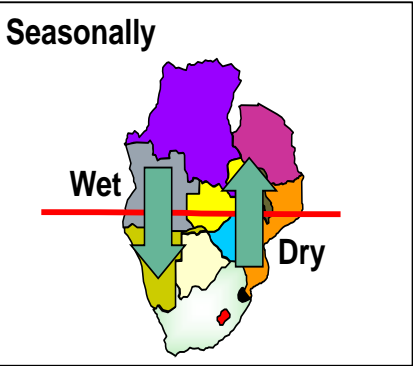


Hydro





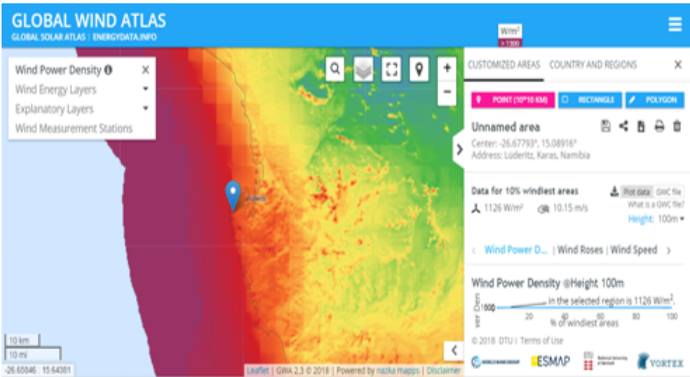
# Regional Markets Benefits – Sustainability & Modernity : ...and this can be the case in all regions – for example in SAPP...



- ➡ Complementary production
- ➡ Increased security of supply
- ➡ Cost synergies

In SAPP, single buyer market models dominate, but these are evolving.

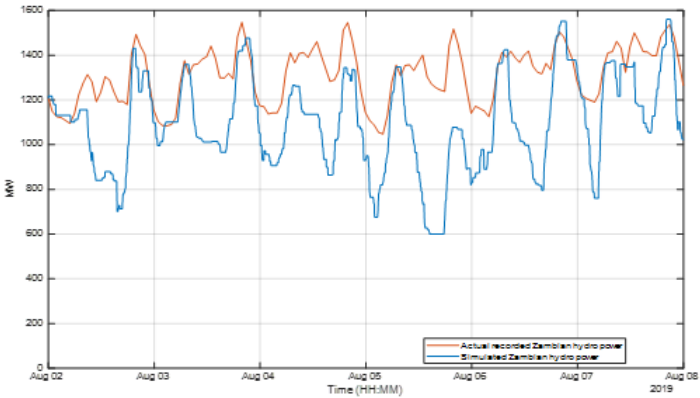
Power exports and imports are mainly undertaken by the national power utilities, but IPPs are now able to export under the Namibian MSB market model.



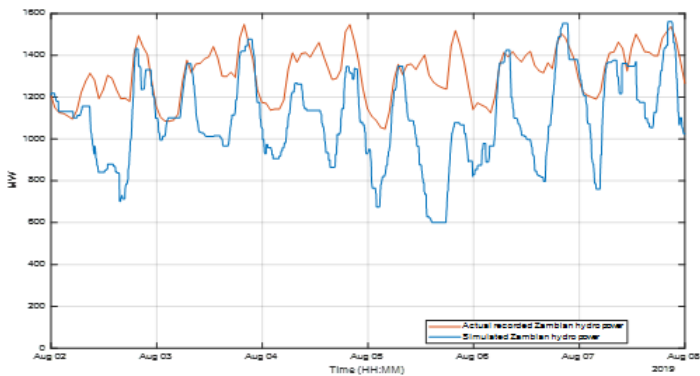
The Namibian electricity market design – the MSB model – appears to offer the most flexibility for renewable IPPs entering the market.

Output with additional 400 MW of wind and 400 MW of solar power

Zambian Hydro power plant



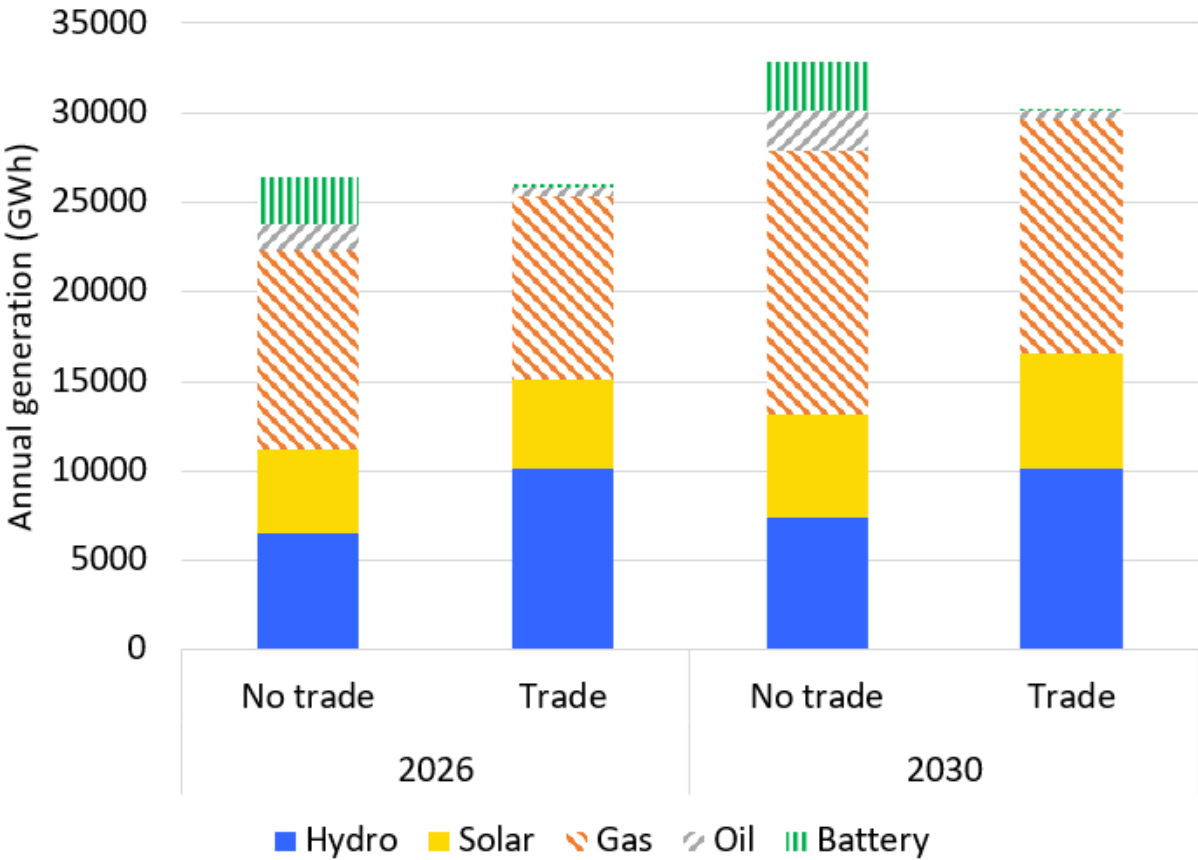
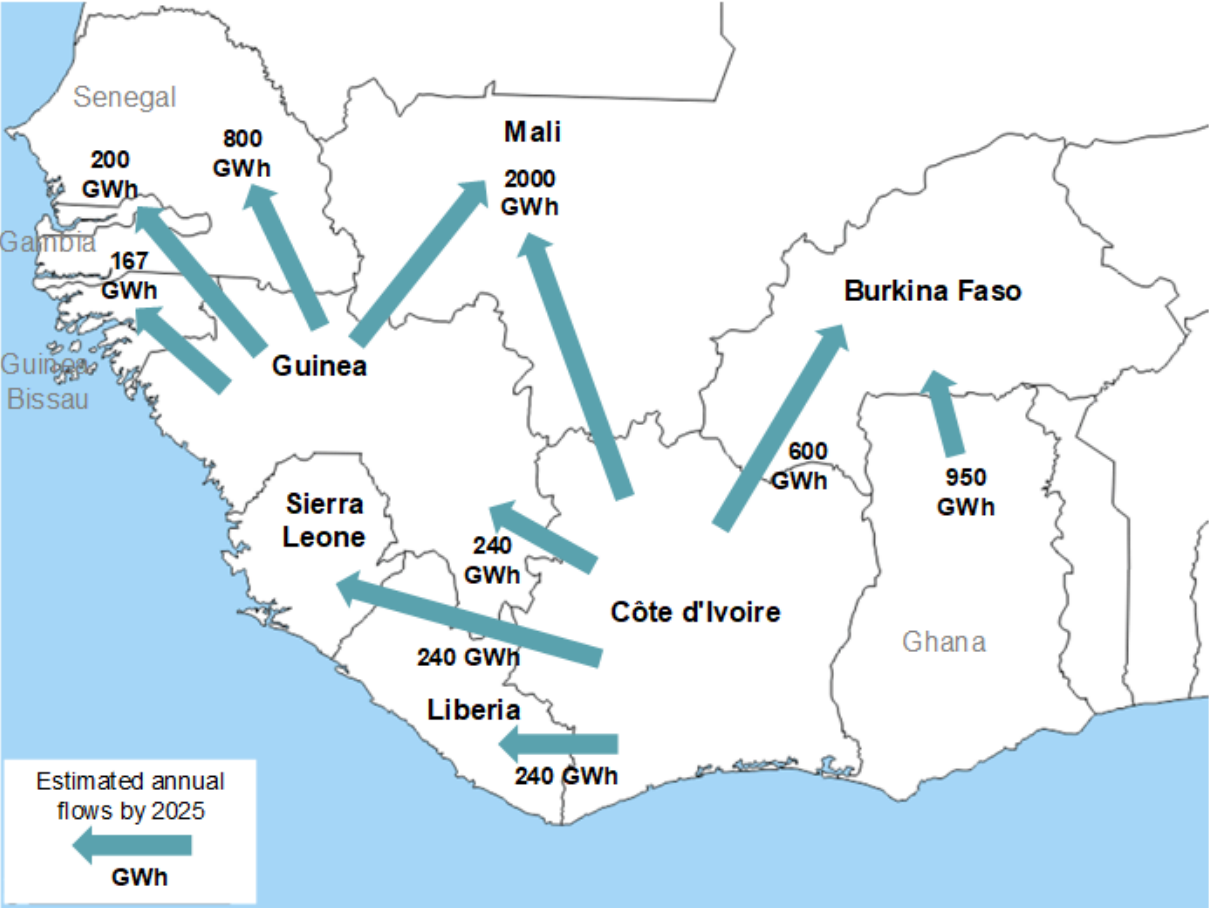
Interconnector flows Namibia-Zambia



The modeling shows that there are a lot of untapped possibilities, but to make this viable, access to the SAPP regional markets is vital; and this is now happening in Namibia (and Zambia)

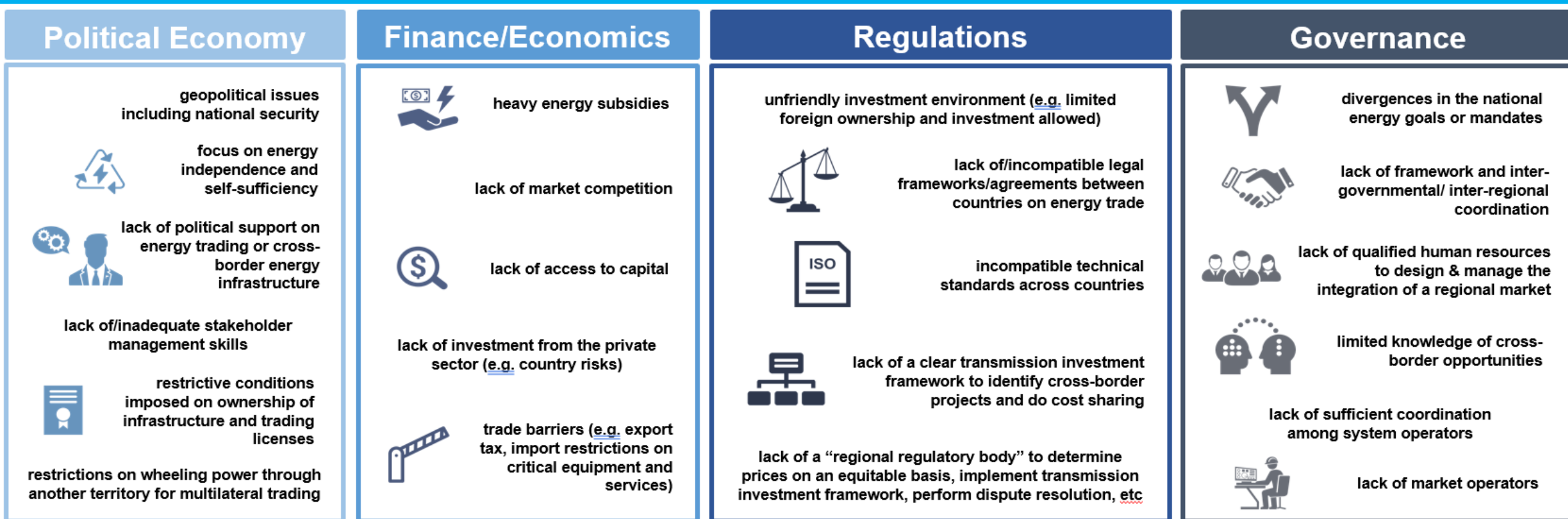
Regional Markets Benefits – Sustainability & Modernity : ...and in WAPP too

➡ more hydropower and more solar PV  
➡ less gas and less oil






**Challenges exist:** ...that need to be overcome in order to develop a more integrated power market – both at regional and national levels – requiring synched actions...



**Two national-level underlying factors:**

1. Financial Viability of Utilities
2. Macroeconomic Sustainability considerations

## Regional market design: Establishing a market is not as complex as perceived – you mainly need to decide on few design features to tailor to your conditions

		<b>“Centralized” (or US) model</b>		<b>“Decentralized” (or EU) model</b>
Physical		TSO constructs dispatch schedule and issues dispatch instructions	<b>Central dispatch vs. Self-dispatch</b>	Parties self-dispatch, with TSO performing residual dispatch to adjust marker positions
		TSO decides on plants commitments to turn plant on/off	<b>Central commitment vs. Self-commitment</b>	Parties take own commitment (start/stop) decisions for their units
		Nodal pricing within specific T-areas	<b>Nodal vs. Zonal</b>	Zonal (or national) pricing over large geographic area
Market		Single marketplace option (for particular timeframe)	<b>Single vs. Multiple Markets (algorithms)</b>	Multiple marketplace options (for particular timeframe)
		Gross Market (to settle all volumes)	<b>Gross market vs. Net market</b>	Net (residual) market (principally to settle delta volumes)
		Designated trading windows	<b>Discrete vs. Continuous trading</b>	Continuous trading opportunities without interruptions
		Trades placed at common auction clearing price	<b>Pay-as-Clear vs. Pay-as-Bid</b>	Trades based on individual bid prices



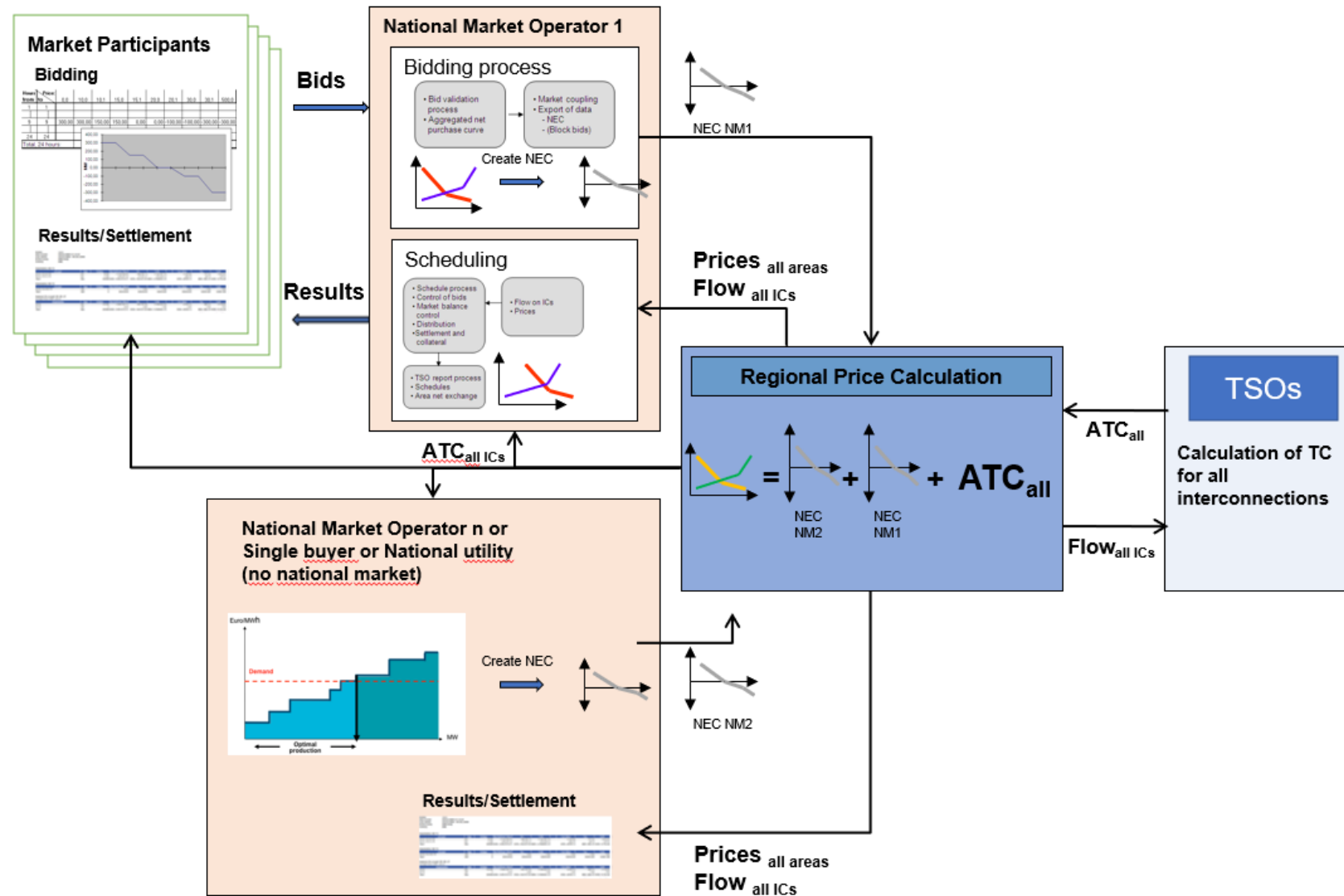
**Stages of regional market:** These benefits increase as integration gets deeper. It may take time to achieve well functioning regional power markets, but stages do not need to be sequential

There are 5 five main characteristics of integration – measuring degree of physical interconnection (hard infrastructure) and harmonized operational, trading and market rules (soft infrastructure).

	Stage 1	Stage 2	Stage 3
<b>Regional Supply and Connectivity</b>	<ul style="list-style-type: none"> <li>Typically starts with 2 countries, later a wider interconnected grid</li> </ul>	<ul style="list-style-type: none"> <li>Interconnected grid involving a number of neighboring countries</li> </ul>	<ul style="list-style-type: none"> <li>Operation of a fully synchronous, multi-country, interconnected power system</li> </ul>
<b>Planning and Investment Coordination</b>	<ul style="list-style-type: none"> <li>National planning and investment</li> </ul>	<ul style="list-style-type: none"> <li>Some coordination of national investments with optimized regional investment plan</li> </ul>	<ul style="list-style-type: none"> <li>Regional integration body empowered to require investments in agreed upon regional plan to be implemented</li> </ul>
<b>Cross-border Trading Arrangements</b>	<ul style="list-style-type: none"> <li>Long-term bilateral Power Purchase Agreements (PPAs)</li> </ul>	<ul style="list-style-type: none"> <li>Long-term PPAs supplemented with short-term markets</li> </ul>	<ul style="list-style-type: none"> <li>Electricity pricing market competition achieved (spot, day-ahead, transmission capacity auctions, etc.)</li> </ul>
<b>Technical and/or Regulatory Harmonization</b>	<ul style="list-style-type: none"> <li>Simple rules agreed upon for the operation of the interconnected system</li> </ul>	<ul style="list-style-type: none"> <li>Harmonization of rules, grid codes</li> </ul>	<ul style="list-style-type: none"> <li>Harmonization of rules, grid codes, and transmission tariffs</li> </ul>
<b>Regional Institutional Architecture</b>	<ul style="list-style-type: none"> <li>Simple institutional arrangements with National vertically integrated utilities (VIU) or Transmission System Operator (TSO)</li> </ul>	<ul style="list-style-type: none"> <li>Number of VIU, national TSO, regional institutions</li> </ul>	<ul style="list-style-type: none"> <li>Complex institutional arrangements with different types of institutions, some national VIU or TSOs, Regional TSO, Regional Regulators, market operators, etc.</li> </ul>

## Benefits

# Regional Markets: ...the need for a flexible approach allowing for regional cooperation, but maintaining national control of the assets...



## Flexibility is needed in:

- **Market design** – allowing future evolution of markets
- **Market Rules** – easy access to markets to new players
- **Market Platforms** – managing changes in the market framework
- **Legacy contracts** – respecting these
- **Market opening** – not a big bang where all join at the same time



## Worldwide experiences: A few examples of success stories of ongoing engagement on regional power markets

### ...close coordination with partners in Southern Africa...



#### RESPONSE

- **TA funding:** \$8.5m from AREP MDTF leveraging \$20m from IDA
- Dedicated team & coordination with donors



#### RESULTS

- Overall trade volume **3 times** larger
- Share of market-based trade increased from **10% to 33%** of overall trade in 2019
- Introduction of Day-Ahead, Intra-Day Markets
- Innovative financing mechanisms for transmission



#### BENEFITS & CHALLENGES

- Regional integration scenario can bring **\$37 billion** of savings in 15 years
- Requires: (i) unlocking transmission constraints, (ii) scaling up renewable generation, (iii) enhancing trading instruments



#### Africa facts:

- 22 countries in the region received financial support to develop transmission interconnection capacity...
- Financing in regional energy hard infrastructure is close to \$7 billion over the last ten years...





## Worldwide experiences: A few examples of success stories of ongoing engagement on regional power markets

### ... in Middle East ...



#### RESPONSE

- Focused support with analytical and feasibility studies, facilitation in development and enabling legal framework, and capacity building and knowledge sharing.

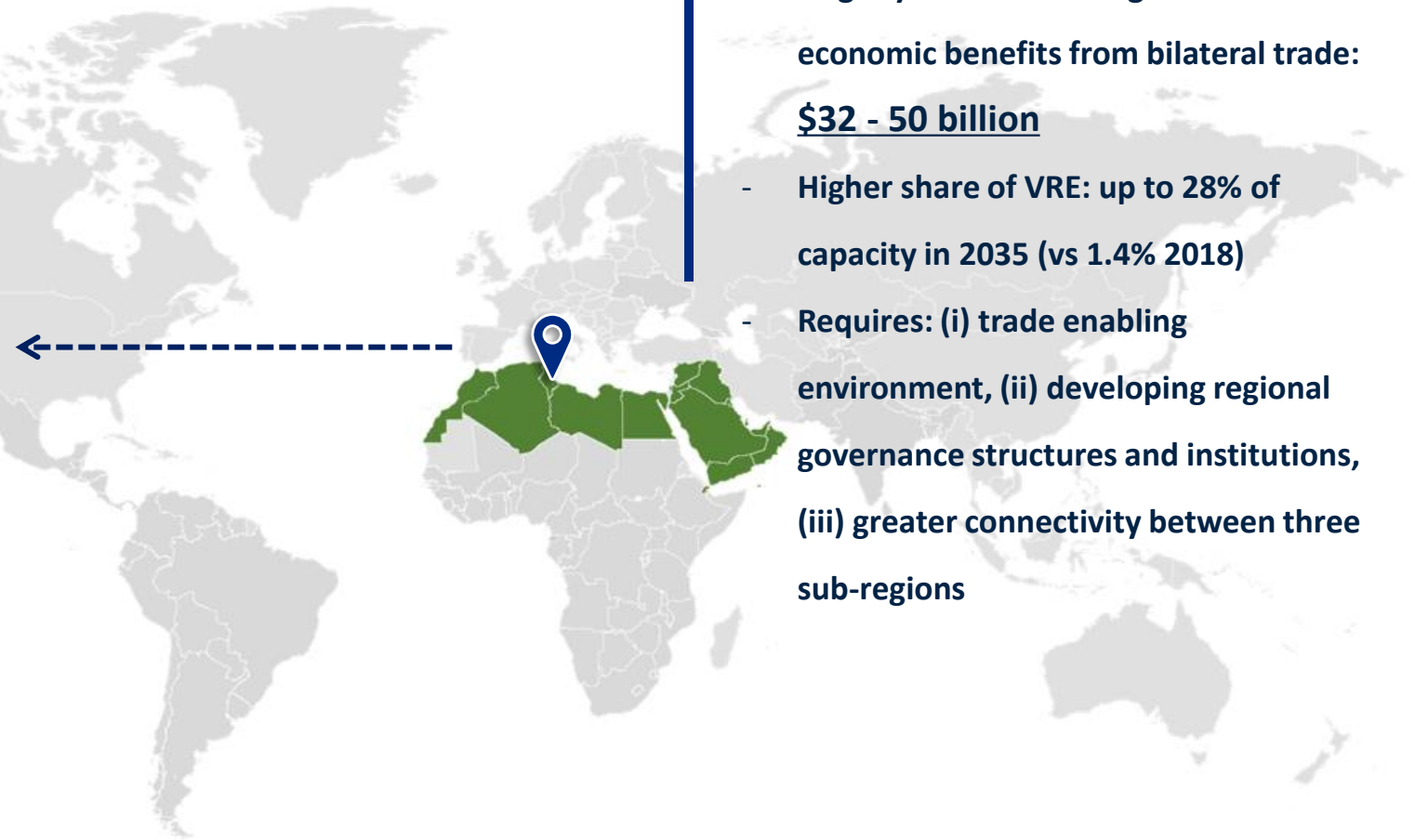
#### RESULTS

-  Two foundational market agreements - General (legal) and Market (commercial) - endorsed by the Arab Ministerial Council for Electricity (AMCE)
- Bylaws and technical rules agreed
- Several interconnectors under developments/appraisal



#### BENEFITS & CHALLENGES

- Huge system cost savings and shared economic benefits from bilateral trade: **\$32 - 50 billion**
- Higher share of VRE: up to 28% of capacity in 2035 (vs 1.4% 2018)
- Requires: (i) trade enabling environment, (ii) developing regional governance structures and institutions, (iii) greater connectivity between three sub-regions



## Worldwide experiences: A few examples of success stories of ongoing engagement on regional power markets

### ... and in West Africa...



#### RESPONSE

- Coordinated support from various programs, comprising capacity building, support in developing policy actions, and addressing political economy constraints.



#### RESULTS

- First ever regional DPF (\$300m) with common set of policy actions
- Ongoing projects to connect all 14 countries by 2024
- Key agreements and ECOWAS Securitization Directive adopted



#### BENEFITS & CHALLENGES

- Benefits from regional trade would amount up to billions in a year
- Requires: (i) building least-cost physical infrastructure, (ii) building trust in trade, (iii) reducing payment risks and financial sustainability plans, and (iv) institutional capacity



#### Africa facts:

- 22 countries in the region received financial support to develop transmission interconnection capacity...
- Financing in regional energy hard infrastructure is close to \$7 billion over the last ten years...





Thank you.

For more information, contact:  
Mirlan Aldayarov, [maldayarov@worldbank.org](mailto:maldayarov@worldbank.org)