Overview of regional power markets development and relevant global lessons to the Pan-Arab Electricity Market (PAEM)

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Abdulaziz Alshalabi, Energy Specialist
Doug Bowman, Energy Consultant
Waleed Alsuraih, Lead Energy Specialist

Increasing awareness and buy-in of electricity trade benefits at the political level are major challenges in developing countries

- Countries around the world are increasingly pursuing the integration of national electricity markets into larger regional electricity markets- however pace and level of trade vary significantly in different regional electricity markets.
- Increased cooperation in electricity trade among countries brings different benefits, such as:

1. Increased energy security
2. Improved reliability and efficiency
3. More efficient & effective use of infrastructure
4. Economies of scale in investments and Facilitation of financing for new investments
5. Greater renewable energy penetration and associated environmental co-benefits
6. Reduced cost of supply for consumers

Global market integration and trade experience shows…

- A trading framework governed by a power pool where regional supply and demand are settled producing hourly locational prices is the most efficient option
- Trade can increase regional total surplus (i.e. minimizing total generation cost) by increasing access to lower cost generation resources and fuels; as well as exploiting synergies between the profiles of different demand and renewable resources among the countries in the region
- There is no evidence to suggest that any of the existing or developing regional integration/trade schemes got the model right at the initial stage of integration
- It is clear that learning from others mistakes enables policy makers to avoid wasting time and resources
- **One size does not fit all.** As a result, the approach to regional market development must be tailor-made to suit the circumstances. Political factors and the historical evolution of the regional arrangements are typically at least as important as the technical and economic factors.

Typical phases in regional power market integration: transitions across these phases is evolutional and adaptive in nature

	Bilateral Arrangement	Shallow Integration	Deep Integration
Regional Connectivity Architecture	Typically starts with 2 countries, later a wider interconnected grid	Interconnected grid involving a number of neighbouring countries	Operation of a fully synchronous, multi-country, interconnected power system
Cross-Border Trading Arrangements	Long-term bilateral Power Purchase Agreements (PPAs)	Long-term PPAs supplemented with short-term markets and cross-border transmission tariffs	Electricity pricing competition achieved through a range of market mechanisms (spot, day-ahead, ancillary services, transmission capacity auctions, etc.)
Technical and/or Regulatory Harmonization	Simple rules agreed upon for the operation of the interconnected system	Harmonization of rules, grid codes, and transmission tariffs	Harmonization of rules, grid codes, and transmission tariffs
Planning and Investment Coordination	National planning and investment	Some coordination of national investments with optimized regional investment plan	Regional integration body empowered to require investments in agreed upon regional plan to be implemented

Source: ESMAP, World Bank Group

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Most relevant to Pan-Arab region in the short to medium term

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Source: ESMAP, World Bank Group

European and North-American market integration were driven by both technical (mainly reliability) and economic objectives

- **European integration:** driven by post-war needs to restore electricity supply. Integration was led by engineering communities and non-governmental organizations such as UCTE in parallel to broader political integration. The original objectives were to:
  - Increasing efficiency of production
  - Energy security
  - Utilizing excess hydropower
  - At a later stage emphasis emerged on competition and sustainable energy supply
- **North-American integration:** coordinated by the North American Electric Reliability Corporation (NERC) since 1968, was motivated by system reliability and cost savings, brought to the fore by the Northeast Blackout of 1965, the largest power outage in American history

Developing regional electricity market is a long-term undertaking that requires consistent and dependable political support

- Having independent regional institutions, market rules, harmonized technical rules and regulations are essential for the success of regional electricity market but **not enough**
- The participating countries must have the political will to relinquish a portion of their energy supply responsibilities to the greater good of the region
- Concerns about national sovereignty and energy independence must be handled within a well-defined, sustainable, and trusted cooperation framework
- The EU reform process has been ongoing for the past 20+ years; still on and adaptive to evolving policy priorities and emerging energy challenges (national, regional, global):
    i. First liberalization initiatives adopted in 1996
    ii. Second liberalization initiatives adopted in 2003
    iii. Third liberalization initiative adopted in 2009
    iv. Reform continues to this day as the EU adopts additional resolutions to improve the workings of the Internal Electricity Market

Strong and independent regional institutions with broad decision-making authorities should evolve with market development

- Ensuring regional trade is conducted in a fair, non-discriminatory and efficient manner is a must for the market to organically grow and attract investments
- When trade languished in the United States, the Federal Energy Regulatory Commission took the bold step of requiring formation of Regional Transmission Organizations
- Likewise, the European Union has strong technical arm (i.e. European Network of Transmission System Operators for Electricity, ENTSO-E) and regulatory regional institutions (Council of European Energy Regulators CEER, and Agency for the Cooperation of Energy Regulators, ACER) that have evolved to play a key role in the success of gradually expanding electricity trade among member countries
- Clean Energy for All Europeans' (CE4ALL) Package of the EC introduces a new wave of amendments to create a secure and integrated EU energy market towards implement the Energy Union (including commitment under the Paris Agreement)

The PAEM's Guiding Principles and Objectives Provide Needed Balance Between National and Regional Electricity Markets

PRINCIPLES

OBJECTIVES

1

System optimization at the PAEM level

Reaching optimum power supply in the short and long run on an Arab regional rather than a national level.

2

Harmonization of laws and regulations

Electricity trade and exchange between electricity buyers and sellers should be empowered at the level of all Member States' markets, not just national markets, to ensure fair access to network and enhance competition.

3

Promote investments to advance trade

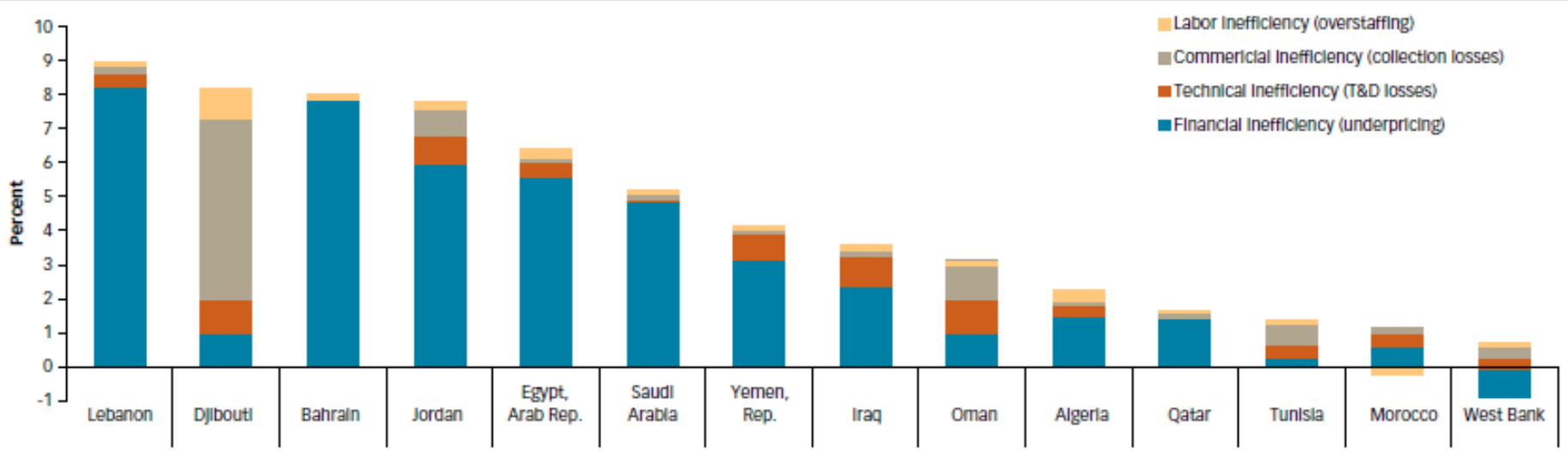
Supports regionally-significant power generation and transmission projects that maximize the benefits of the large regional competitive market.

To achieve the PAEM objectives, some steps to address the current situation across the PAEM' member states are needed

- **Building a must-needed and consistent momentum of political support**
- **Addressing the major energy prices distortions** (mainly fuel and tariff subsidies) in a systematic and transparent way
- **Overcoming the lack of trade pricing mechanisms** (i.e. limited price discovery to utilize most efficient, cleaner, and cost-effective supply)
- **Solving institutional weaknesses at the national level** – there are limited entities with the authority, expertise, incentive and financial resources to undertake regional trade
- Absence of a **harmonized regulatory framework** governing electricity trade and **independent institutions** to oversee operations and market development (to be addressed by the PAEM governance framework)

Financial performance of electric utilities in MENA is unsustainable, if not addressed, payment risks likely to emerge with large trade volumes

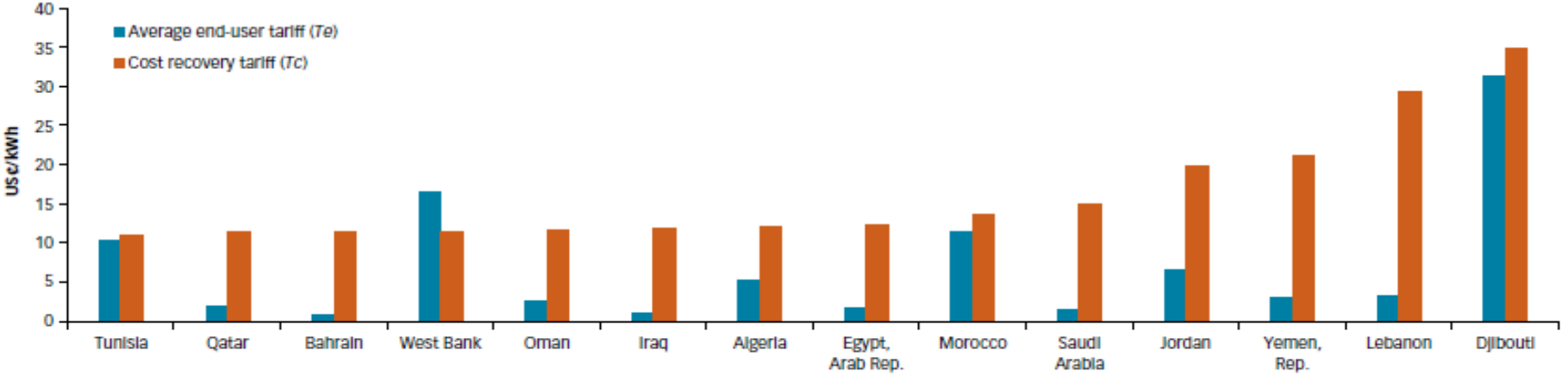
Financial Inefficiency (or tariff underpricing) is the key driver in quasi-fiscal deficit of the power sector as a percentage of GDP in 14 MENA economies, 2013



Source: World Bank calculations.

Note: GDP = gross domestic product; MENA = Middle East and North Africa; T&D = transmission and distribution.

The quasi-fiscal deficit of at least 13 utilities exceeds their revenue leading to lack of sufficient investments and higher off-taker payment risk



Source: World Bank calculations.

Note: MENA = Middle East and North Africa; kWh = kilowatt-hour

Addressing energy subsidies should be a priority for PAEM member states to make trade happens in a sustainable manner

- Subsidies on electricity tariffs in importing countries stress the financial condition of the importing country's electric utility, increasing off-take and payment risks

- Subsidies on electricity tariffs in the exporting county results in over-consumption, reducing the amount of electricity that could be traded at international prices.

- Subsidies on generation fuels may result in the unintended export of subsidies to the importing country.

Way forward for transitioning from developing the PAEM to market operations

- Advance the approval and signing of market governance documents (GA, PAEM Agreement, Grid Code)
- Implement intermediate trade arrangements that create a level-playing field (particularly trade pricing mechanisms)
- Build up the necessary market governance and institutions to organically enable market evolution and liquidity
- Engage different potential traders (e.g. large industries, Merchant power plants) to advance the market liquidity (i.e. higher trade volumes) and gradually induce competition

Thank You

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Annex

Matching the benefits with the drivers

Cases that are of relevance to the Arab countries in terms of how they have developed institutional capacity and processes:

Central American Electric Interconnection System (SIEPAC): All countries have cross-subsidization in their tariff structures. Market structures among the six countries varied from fully competitive wholesale markets to monopoly-integrated utilities acting as single buyer. Some countries have significant private sector participation in their power sectors, while others are limited to independent power producer (IPP) investment in generation. Large-scale development of generation projects in Central America, particularly hydropower, could only be attained in the broader regional market. SIEPAC network goal is to optimize shared use of hydroelectric power and reduce operating costs to overcome the periodic power shortages that countries experienced.

The Pennsylvania-Jersey-Maryland (PJM) interconnection: Established with the objective of sharing generation resources between the three US States to improve efficiency and minimize investment in generation and transmission capacity. Initial power-pool arrangement was to deliver least-cost dispatch of the mix of generation owned by the utilities. Overtime, the pool was expanded to utilities in other states. The PJM evolved to become independent of its utility owners and is now a not for profit limited-liability company.

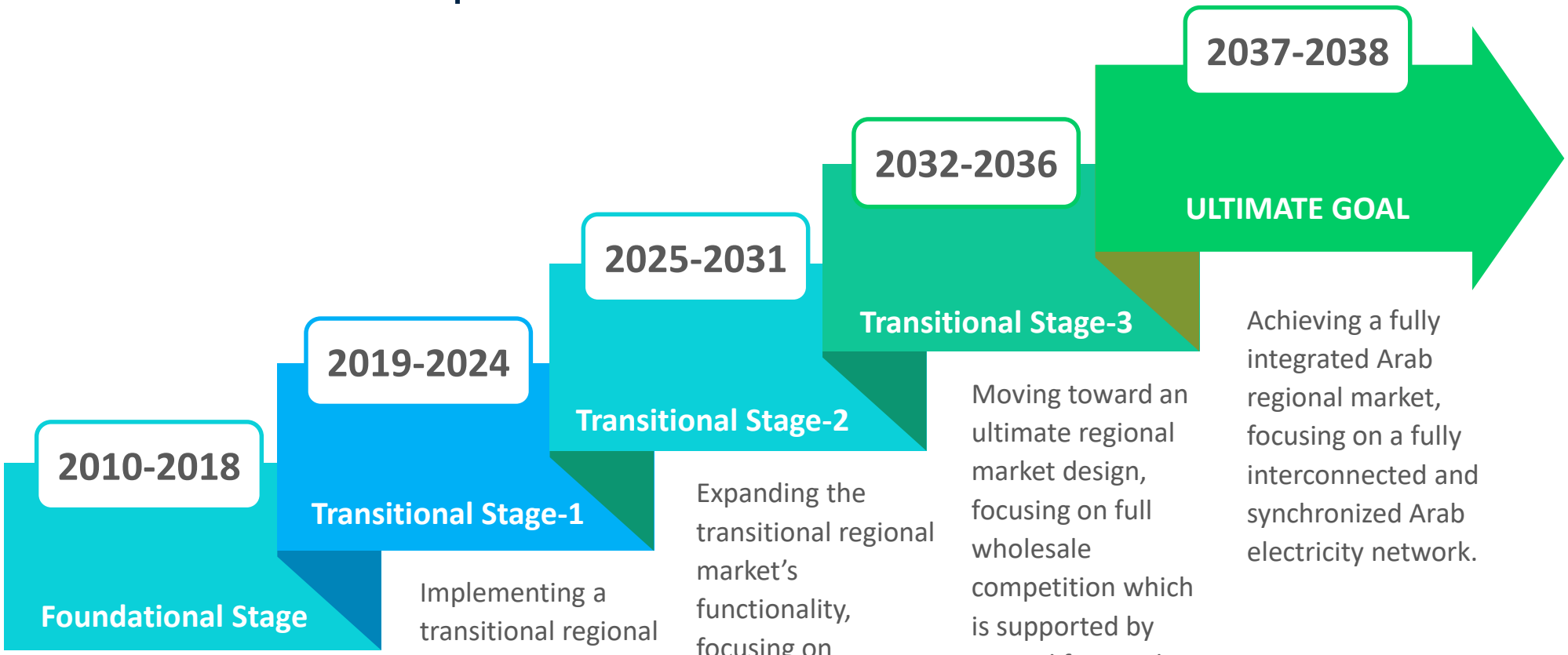
Matching the benefits with the drivers

Cases that are of relevance to the Arab countries in terms of how they have developed institutional capacity and processes:

EU Electricity Market: Established with the objective of ensuring the security and economy of electricity supply through the promotion of functional and competitive integrated regional electricity market. The EU electricity market design has progressed over the past 14 years through legislative directives designed to further market reform and improve competition. The focus of the directives has been on unbundling the monopoly elements, mainly the network operation from the other functions, ensuring third-party transmission access, independent regulation including oversight of cross-border exchanges and trade, and the opportunity for all consumers to choose their supplier. The EU continues to modify and refine its electricity market model through additional proposals aimed at strengthening competition.

Nordic Interconnected Power System: The main driver for this interconnection was to increase renewable energy generation. Following Nordic interconnection UCTE grid, the drivers evolved to be climate policy which stimulates the development of more renewable energy resources, technology development and a common European framework for markets, operation and planning.

A Competitive PAEM in 20 years: significant progress has been done, and much more needed to operationalize the market and realize the vision



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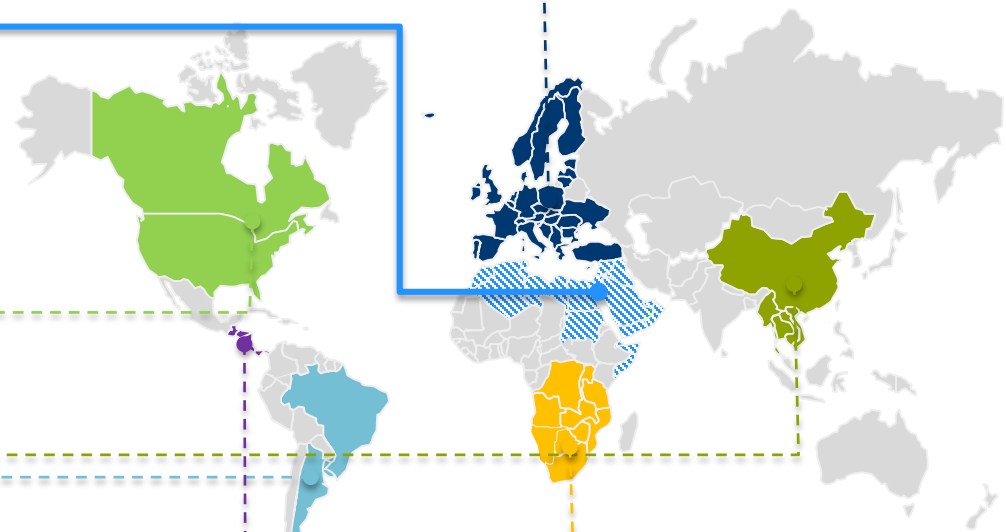
Once established, the PAEM has the potential in terms size and RESs potential to play a key role in trade within and beyond its borders

Electricity Pool	System size (GW)
European network of transmission system operators for electricity (ENTSOe)	1,030
Pan-Arab Regional Electricity Market (PAEM)	**246**
Brazil-Uruguay-Argentina	130
Mid-Western states (US) and Manitoba (CA)	110
Greater Mekong Sub-region and Nam-Theun 2	83
South African Power Pool (SAPP)	56
SIEPAC (Central American Countries)	10



- Market size estimated by total generation capacity installed or peak demand in 2016
- Map is for illustration of regional power pools and does not reflect geographical borders

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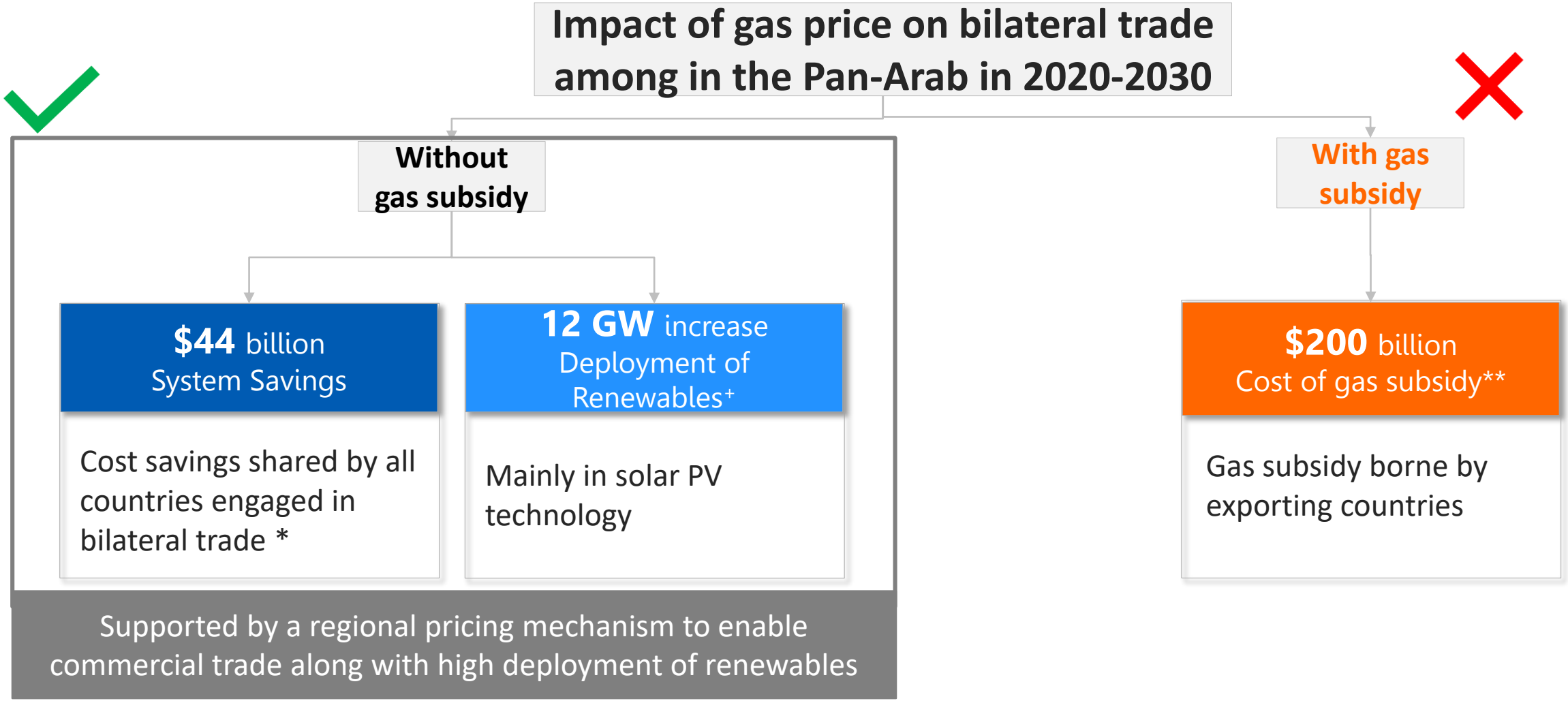
The cost of fuel subsidies for power generation diminishes the benefits of trade among Arab countries and discourages trade: PA-RETP tools addressed this issue



*System costs include capex savings in variable and fixed O&M, fuel, and unserved demand costs. Above figures show the preliminary results of World Bank electricity trade model between 18 countries. Model results should be updated upon further validating input data.
+ When trading electricity under economic natural gas prices compare to trading under subsidized gas prices.
** Expenses of using subsidized natural gas prices (for each country), instead of economic gas prices, to generate electricity.

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Envisaged key benefits of commercial trade in the PAEM as a result of the PA-RETP tools and analysis

Indicator	Estimated Benefits in 2020-2030
Improving energy security due engaging in cross-border transmission	**13.4% cost savings** on unserved demand
System costs savings (with a major role for gas as a main fuel for power generation to phase out liquid and expensive fuels)	**$44 billion**
Enabling efficient annualized investments to unlock trade potential and attracting private finance	**$18 billion**
Average utilization of existing and planned regional transmission lines by 2030	**44%** (i.e. 320% higher than 2017)
Unlocking significant value of electricity trade based on efficient and sustainable energy resources	**$12 billion** (i.e. higher market liquidity)
Emissions reduction- lower cost approach to achieve countries' INDC targets collectively	**20%** in comparison with 2017
Enabling higher share of renewable energy without compromising security of supply as PAEM serves as pool of supply and demand to balance the fluctuations of renewables generation	**10%** in comparison with 1% 2017
Catalyzing private investment in renewable energy technologies	**$62billion**

The World Bank proposed RPM pilot with prices based on a simple formula, using economic costs and based on three guiding principles