

Role of Transmission System Operators (TSOs) in Regional Electricity Trade

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Before we start...

- Regional and national TSOs play an important role in regional trade
- ENTSO-E in the EU plays a regional TSO role, representing and overseeing national TSOs
- In the PAEM, it is proposed that the Arab TSOs Committee play the role of regional TSO representing and providing oversight of national TSOs in the Member States
- This presentation provides an overview of the roles and responsibilities of the Arab TSOs Committee and the national TSOs relating to regional trade in the PAEM
- The roles and responsibilities of these entities are documented in the PAEM and General Agreements

Agenda

1. Overview of the US electricity market and the role of NERC
2. Overview of the EU electricity market and the role of ENTSO-E
3. Roles and responsibilities of the Arab TSOs Committee and the National TSOs in the PAEM
4. Organization and priorities of the Arab TSOs Committee

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Overview – US Electricity Market

- Electricity consumption in the United States was about 3.9 trillion kilowatthours (kWh) in 2021
- The U.S. has about 1.2 million megawatts of generation capacity, including:
 - 44% Natural gas
 - 27% Nuclear, hydro and wind together
 - 18.5% coal
 - 5%. Solar
 - 12% Other forms of energy
- Solar capacity has increased dramatically with more than 25,000 MW installed since 2020, a 60% increase. Solar was the leading source of new utility-scale capacity in 2021
- Wind capacity has increased by 29% since 2020

US Market - Institutions



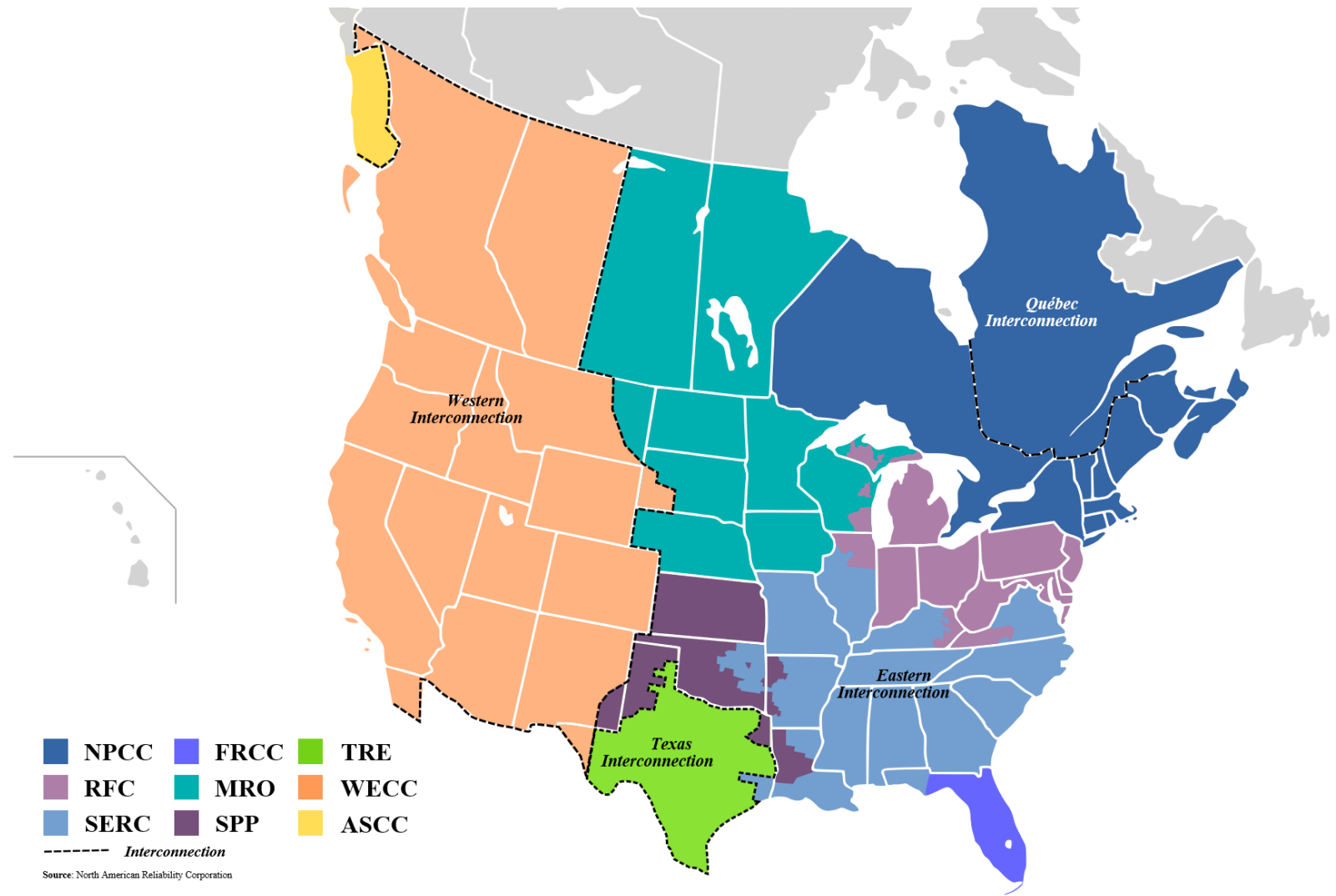
and other ISOs

Role of the NERC



- NERC, the North American Electric Reliability Corporation, is an independent, not-for-profit, international regulatory agency whose mission is to assure the effective and efficient reduction of risks to the reliability and security of the grid
- NERC develops and enforces Reliability Standards; annually assesses seasonal and long-term reliability; monitors the bulk power system through system awareness; and educates, trains, and certifies industry personnel
- NERC's area of responsibility spans the continental United States, Canada, and the northern portion of Baja California, Mexico
- NERC is the Electric Reliability Organization (ERO) for North America, subject to oversight by the Federal Energy Regulatory Commission (FERC) and governmental authorities in Canada
- NERC's jurisdiction includes users, owners and operators of the bulk power system, which serves nearly 400 million people

- MRO – Midwest Reliability Organization
 - MISO
 - MRO-Manitoba Hydro
 - MRO-SaskPower
- NPCC – Northeast Power Coordinating Council
 - NPCC-Maritimes
 - NPCC-New England
 - NPCC-New York
 - NPCC-Ontario
 - NPCC-Québec
- RF – ReliabilityFirst
 - PJM
- SERC – SERC Reliability Corporation
 - SERC-East
 - SERC-North
 - SERC-Southeast
 - SERC-Florida Peninsula
- SPP – Southwest Power Pool
 - SPP
- Texas RE – Texas Reliability Entity
 - Texas RE-ERCOT
- WECC
 - WECC-CA/MX
 - WECC-NWPP-AB
 - WECC-NWPP-BC
 - WECC-NWPP-US
 - WECC-RMRG
 - WECC-SRSG



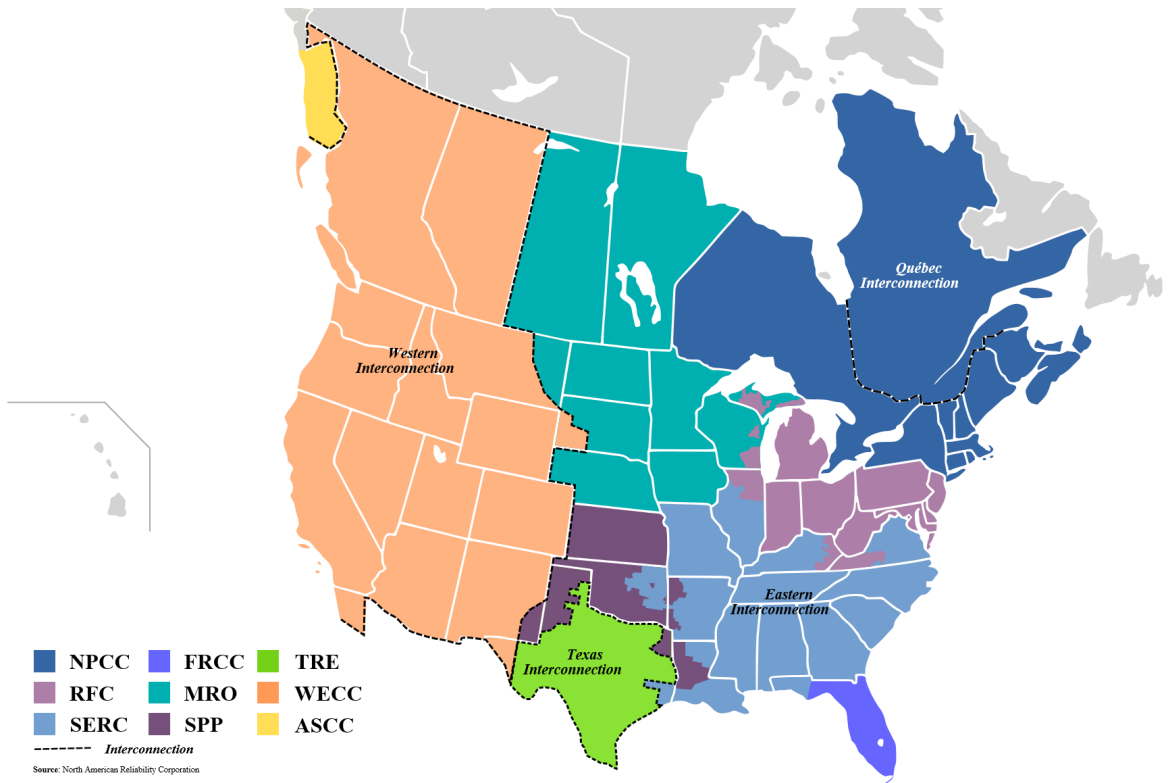
- NPCC
- FRCC
- TRE
- RFC
- MRO
- WECC
- SERC
- SPP
- ASCC

----- Interconnection
 Source: North American Reliability Corporation

Role of the NERC (continued)

- The vision for the Electric Reliability Organization Enterprise, which is comprised of NERC and the six Regional Entities, is a highly reliable and secure North American bulk power system

- The six Regional Entities include:
 - The Midwest Reliability Organization
 - The Northeast Power Coordinating Council
 - Reliability First
 - SERC Reliability Corporation
 - Texas Reliability Entity
 - Western Electricity Coordinating Council



Role of the NERC (continued)

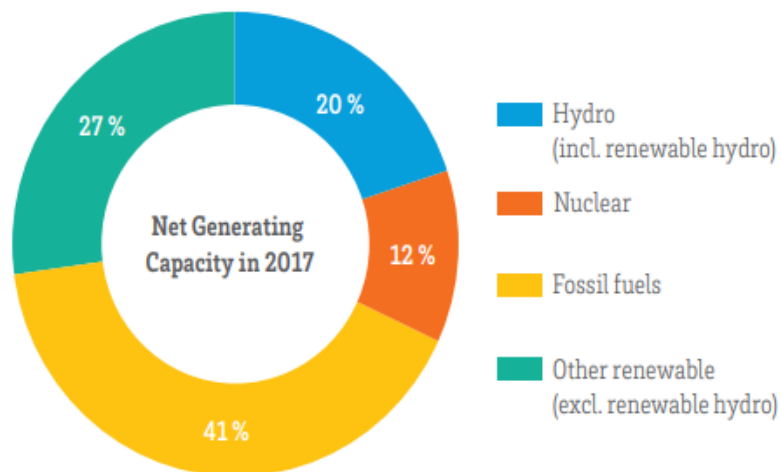
- NERC has a 12-member Board of Trustees (Board), comprised of 11 independent trustees and NERC's president and chief executive officer serving as the management trustee
- The Board has several committees to facilitate oversight of the organization in the areas of:
 - Finance and audit,
 - Corporate governance and human resources,
 - Compliance, technology and security nominations, and
 - Enterprise-wide risk

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Europe – Increased RE Integration

- Installed Capacity: 1,060GW (end of 2017)
- Comparing 2017 to 2016,
 - Wind Gen increased by +9.8%,
 - Solar Gen increased by +6.1%
- Nine countries within the ENTSO-E perimeter exported more than 10% of their national generation to neighboring ENTSO-E members.



(RES) (excluding hydro) almost 30 % of the total net generation capacity

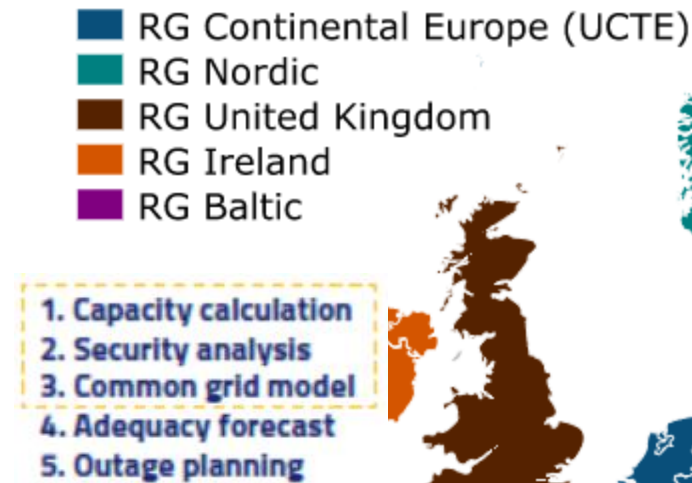
+7 TWh
OF CROSS BORDER EXCHANGES IN ENTSO-E BETWEEN 2016 AND 2017

26%
INCREASE IN EFFICIENT USE OF INTERCONNECTION BETWEEN 2010 AND 2017

€2.5b-€4b per year
BENEFITS OF ELECTRICITY MARKET COUPLING/INTEGRATION

European Case

- ACER (EU Agency for the Cooperation of Energy Regulators) is the Regional Regulator
- Separate TSO and MO Roles
- ENTSO-E is the regional System Operator: 39 Member TSOs from 35 countries
- Regional Security Coordinators harmonize operations between member TSOs



- EU Network of Transmission System Operators for Electricity (ENTSO-E) is the association for the cooperation of European TSOs responsible for the secure and coordinated operation of Europe's electricity system
- ENTSO-E is the common voice of the national TSOs, providing expert contributions and a constructive view to energy debates to support policymakers in making informed decisions

ENTSO-E key responsibilities include:

- Development and implementation of standards, network codes, platforms and tools to ensure secure system and market operation as well as integration of renewable energy
 - Assessment of the adequacy of the system in different timeframes
 - Coordination of the planning and development of infrastructures at the European level (Ten-year Network Development Plans)
 - Coordination of research, development and innovation activities of national TSOs
 - Development of platforms to enable the transparent sharing of data with market participants
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- ENTSO-E supports its members in the implementation and monitoring of the agreed common rules
 - ENTSO-E serves the interests of society by optimizing social welfare in its dimensions of safety, economy, environment, and performance

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Summary of Roles of TSOs

The regional TSO:

- represents the interests of national/state TSOs
- ensures consistency of application of power system planning and operating standards across the region
- develops the regional plan for transmission expansion

The national/state TSOs are responsible for:

- generation and transmission dispatch in a fair and non-discriminatory manner
- planning and operating their national/state electricity systems
- ensuring that security of supply and reliability are adequate at all times consistent with guidelines endorsed by the regional TSO and documented in the grid code

Organization of PAEM (continued)

1

Pan-Arab advisory and regulatory (PAN-ARAB ARC) committee

- Review and advise on market governance documents, changes to governance documents, transmission tariffs, generation reserve criteria, cross-border transmission allocation, available transmission capacity, and so on.
- Ensure compliance with governance documentation including nondiscriminatory access.
- Market surveillance.
- Dispute resolution.

Market
Surveillance
Group

2

Arab TSOs (PAEM TSOs) committee

- Coordinate and cooperate with national TSOs.
- Play active role in rule-setting process.
- Promote market integration, reliability, and security of supply.
- Research and development, promote public acceptability.
- Participate in energy policy.

Regional
Market
Facilitator

3

PAEM Secretariat

- Provide administrative support to regional governing entities.
- Perform market monitoring function under Pan-Arab ARC.
- Maintain comprehensive information systems.
- Carry out other tasks as assigned.

PAEM: Roles and Responsibilities of the National TSOs

The National TSOs are responsible for electricity dispatch in their domestic electricity systems including transactions in the PAEM based on the principles of fairness, efficiency, safety and transparency, including:

1. Ensuring that adequate transmission capacity is available to meet the short- and long-term demands for transmission service in a reliable and secure manner
2. Balancing the domestic electricity system on a moment-to-moment basis taking into account exchanges with other Member States in the PAEM
3. Ensuring adequate system/ancillary services to maintain the reliability of the domestic electricity systems, taking into account exchanges with other Member States in the PAEM
4. Exchanging information with the National TSOs and sub-regional TSOs of other interconnected systems necessary to ensure secure and efficient operation and the coordinated development and interoperability of the interconnected system

Roles and Responsibilities of National TSOs (continued)

5. Ensuring non-discriminatory transmission service for PAEM Participants
6. Submitting proposed charges to the Pan-Arab ARC for use of the domestic transmission system
7. Submitting proposed charges to the Pan-Arab ARC for the provision of balancing energy
8. Coordinating on a timely and regular basis with the Regional Market Facilitator on available transmission capacity including capacity on the International Interconnections
9. Preserving the confidentiality of commercially sensitive information and promoting greater efficiency in the domestic electricity markets and the PAEM
10. Conducting operation and dispatch in conjunction with the Regional Market Facilitator using economic criteria, seeking to maintain satisfactory levels of security, quality and reliability

Roles and Responsibilities of National TSOs (continued)

11. Reviewing and verifying in conjunction with the Regional Market Facilitator the technical feasibility of Bilateral and Multilateral Contract transactions in the PAEM
12. Developing in conjunction with the Regional Market Facilitator and the Arab TSOs Committee the Planning Statement setting out the indicative expansion plan for generation and transmission, including reserve margins
13. Entering into connection agreements with owners/operators of connection facilities in its domestic electricity system
14. Providing technical information on the facilities under its control to the Regional Market Facilitator

Roles and Responsibilities of Arab TSOs Committee

The objective of the Arab TSOs Committee is to coordinate and cooperate in the PAEM with the National TSOs and the Regional Market Facilitator, and perform other responsibilities as identified below:

1. encourage coordination and cooperation among National TSOs
2. promote market integration, reliability and security of supply, efficiency, and technical innovation
3. coordinate implementation of Member State network plans (for construction and operation activities)
4. coordinate administration of the Arab Grid Code and issues arising from interface with network codes of Member States
5. prepare performance standards and procedures and submit for review and approval by the Pan-Arab ARC
6. prepare and submit for review and approval by the Pan-Arab ARC capacity obligations to be carried by Member States
7. prepare and submit for review by the Pan-Arab ARC proposals for the construction and expansion of international interconnection facilities
8. prepare and submit for review and approval by the Pan-Arab ARC methodologies for calculating tariffs and fees for regulated activities in the PAEM and transmission services charges for international transactions

Roles and Responsibilities of the Arab TSOs Committee (continued)

9. assess and make recommendations relating to the need for changes to the Arab Grid Code
10. review and submit for approval by the Pan-Arab ARC changes to standards and other lower hierarchy documents associated with the Arab Grid Code
11. review and approve an auction process for international interconnection capacity developed and submitted by the Regional Market Facilitator
12. research and development relating to reliability and security of supply issues
13. promote public acceptability of the PAEM
14. participate in the development of energy policy relating to the PAEM
15. make recommendations to the Pan-Arab ARC for enforcement action to be taken against any person in breach of the General Agreement
16. otherwise coordinate implementation of decisions of the AMCE and the Pan-Arab ARC on matters related to the PAEM
17. otherwise provide advice as required to the AMCE on issues relating to the construction, operation and maintenance of any international interconnection in the PAEM
18. propose changes to the General Agreement, the PAEM Agreement and the Arab Grid Code to the Pan-Arab ARC

Roles and Responsibilities of the Arab TSOs Committee (continued)

In discharging its responsibilities, the Arab TSOs Committee shall coordinate with Member States with respect to **planning**, including:

- collecting information from the Member States pertaining to:
 - load forecast,
 - generation and transmission expansion program,
 - installed generation capacity, and
 - operating reserve requirements
- assessing generation capacity reserves and Member State capacity obligations
- recommending rules and procedures as required to determine the capability of installed capacity resources, peak and energy demand, and publish these rules and procedures once approved by the Pan-Arab ARC
- advising on matters affecting Member State compliance and adherence to capacity obligations
- advising on the adequacy of the PAEM with respect to reliability and quality of supply, reserves, available transmission capacity, transmission congestion and power exchange flexibility

Roles and Responsibilities of the Arab TSOs Committee (continued)

- advising Member States on load forecasting accuracy, loss of load expectation, installed reserve margins, and proposing short and long-term solutions to operational problems and issues that may arise
- recording information of any major deviations from recommendations for corrective actions relating to capacity obligations
- reviewing fees, charges, tariff proposals relating to capacity obligations
- reviewing any required changes to the Arab Grid Code

Roles and Responsibilities of the Arab TSOs Committee (continued)

In discharging its duties, the Arab TSOs Committee shall coordinate with Member States with respect to **operations** which shall include:

- matters relating to the operational aspects of the PAEM
- matters relating to the metering, accounting and payment provisions in connection with the PAEM
- matters relating to the security and stability of operations of the interconnected system including loss of load expectation
- coordination of maintenance schedules affecting the PAEM
- advice on the methodology for determining the quantity of reserves that Member States should maintain in order to meet their capacity obligation
- the determination and allocation of losses for transactions in the PAEM
- matters arising from time to time with respect of the Arab Grid Code
- reviewing the methodologies to be applied for calculating tariffs, rates and charges in the PAEM
- investigating major faults related to the PAEM

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Organization of the Arab TSOs Committee

- The Arab TSOs Committee will not have its own administrative structure and will be supported by the PAEM Secretariat
- The Arab TSOs Committee will report to the AMCE
- In discharging its duties the Arab TSOs Committee may create sub-committees for the purpose of carrying out specified delegated activities. Each Member State must be represented on the sub-committees
- The Arab TSOs Committee will include one representative from each Member State who shall possess a vote. The Regional Market Facilitator and sub-regional TSOs can nominate one representative but will not possess a vote
- A representative on the Arab TSOs Committee will be a senior member of the entity responsible for the transmission function in its national electricity system
- Observer States may also nominate a senior member from the transmission function in its national electricity system, but the member shall not possess a vote



Organization of the Arab TSOs Committee (continued)

- The Regional Market Facilitator and the sub-regional TSOs will nominate a senior member of its staff for membership on the Arab TSOs Committee
- Each Member State, the Regional Market Facilitator and the sub-regional TSO may replace its nominated representative with a person who to act as a representative from time to time
- The office of a nominated representative will be vacated if he ceases to be a senior member of the entity responsible for the transmission function in the national electricity sector of a Member State or if he fails to perform tasks, death or resignation
- A Member State shall promptly notify the PAEM Secretariat in writing of any vacation of the office of its representative
- A representative can hold any office in its appointing Member State and receive remuneration from the Member State
- A representative can have commercial or other business dealings in connection with the PAEM provided that the dealings are disclosed to the Arab TSOs Committee

Organization of the Arab TSOs Committee (continued)

- One member of the Arab TSOs Committee shall act as Chairman and two members shall act as Deputy Chairmen. The Chairman and Deputy Chairmen must be from a Member State but may not be from the same Member State at the same time
- Each of the Chairman and Deputy Chairmen shall have a term of two years
- The positions of Chairman and Deputy Chairmen shall be rotated among the Member States
- The role of the Deputy Chairmen shall be to support the Chairman and to discharge the duties of Chairman in cases where the Chairman is unavailable
- **No representative shall be entitled to remuneration or payment of expenses incurred in performance of its duties as a representative of the Arab TSOs Committee**
- **Each Member State shall be responsible for paying all costs incurred by it in relation to its participation in the Arab TSOs Committee**



Sub-Committees of the Arab TSOs Committee

- As noted, in discharging its duties the Arab TSOs Committee may create sub-committees for the purpose of carrying out specified delegated activities. Each Member State must be represented on the sub-committees
- This is a common setup globally. For example:
 - NERC has several active sub-committees, working groups and task forces:
 - Event Analysis Subcommittee
 - Performance Analysis Subcommittee
 - Real Time Operating Subcommittee
 - Resources Subcommittee
 - Frequency Working Group
 - Reserves Working Group
 - ENTSO-E has established a Research, Development and Innovation (RDI) Committee with a number of working groups responsible for development of: an RDI Roadmap, RDI Implementation Plan, RDI Monitoring Report and various position papers

Sub-Committees of the Arab TSOs Committee (continued)

- GCCIA has 2 standing committees, including a Planning Committee and an Operating Committee both of which report directly to the GCCIA Board of Directors
 - The Planning Committee coordinates planning issues, including policy, between the GCCIA and GCC Member States, and advises the GCCIA on planning matters referred to it. It presents its recommendations on policy/regulatory issues to the GCC Advisory and Regulatory Committee through the GCCIA; e.g., load forecast, expansion plans, installed capacity obligation, operating reserves, etc.
 - The Operating Committee coordinates operations issues between the GCCIA and GCC Member States and advises the GCCIA on operations matters referred to it; e.g., operations, metering and accounting related to the interconnector, security/stability/loss of load expectation target values, etc.

Sub-Committees of the Arab TSOs Committee (continued)

- The Interconnection Agreement for the Electrical Interconnection among the Five Electrical Power Utilities of Egypt, Iraq, Jordan, Syria & Turkey (EIJST) likewise has standing committees, including a Steering Committee, a Planning Committee and an Operating Committee
 - The Steering Committee promotes the reliable and efficient operation of the interconnection and interconnected power systems; e.g., establish common reliability criteria, determine and monitor planning and operating rules, review network performance, etc.
 - The Planning Committee insures coordination of planning activities between members; e.g., reviews load forecasts and generation and transmission expansion plans, supply adequacy, etc.
 - The Operating Committee ensures delivery of, and payment for, power and energy in accordance with the Agreement; e.g., interconnection operations, metering, billing and settlement, coordination of maintenance schedules, allocation of losses, etc.

Thank You