Study Committee C1

POWER SYSTEM DEVELOPMENT AND ECONOMICS

Paper 10909_2022

Interconnection of South Asia for exchanging Renewable Energy General Overview

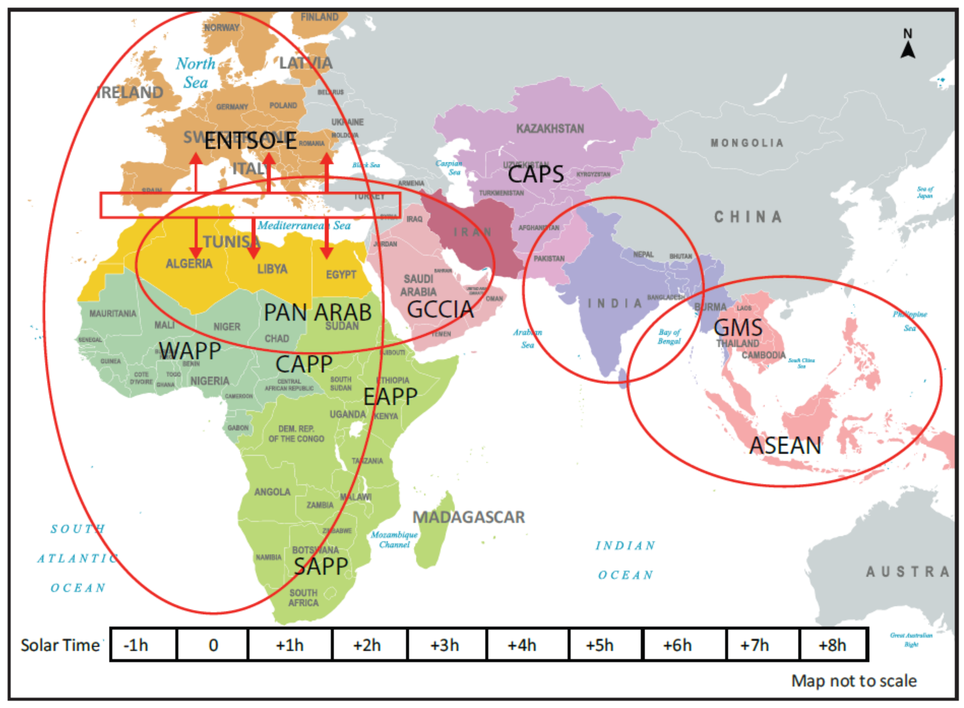
Philippe LIENHART* and Nicolas CHAMOLLET

EDF

Motivation

- The countries situated between tropics of Cancer and Capricorn with India at the fulcrum wish to develop an interconnected grid for helping all the participating entities in attracting investments in renewable energy sources as well as utilizing skills, technologies, and economy.
- The targets are the reduction of the CO2 emissions to meet the Paris Agreement commitments but also, at the same level of importance, helping people to get access at clean and affordable electricity.

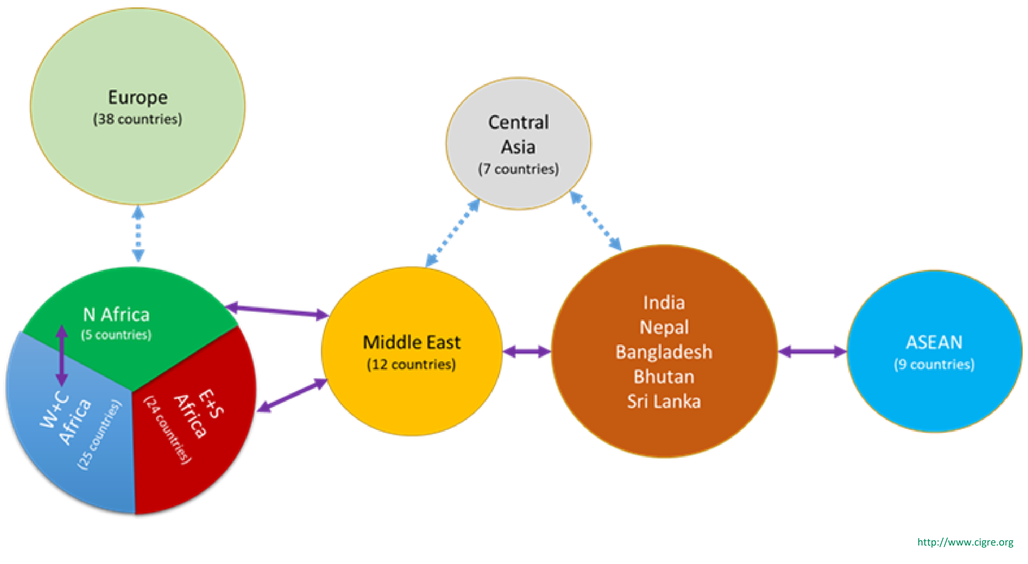
Study perimeter



- The study perimeter encompasses more than 120 countries from Scandinavia to the Philippines focusing on 4 main regional interconnections: Southeast Asia, South Asia, Middle East and African Power pools
- The study is taking into consideration the following regional interconnection initiatives: ENTSO-E, COMELEC, WAPP, CAPP, EAPP, SAPP, GCCIA, CAPS and GMS

An interconnection of interconnections

- Grid interconnections and RES are likely to play a key role in promoting regional cooperation and transition to low carbon power systems
- The concept of the project is to interconnect all forms of RES (solar, wind, hydro, green hydrogen, etc.) generators and loads across continents by interconnecting already established regional power networks.
- The study covers 2 fields of investigation:
  - The assessment of a long-term vision as a target for 2050 as well for the evolution of power mixes of the countries and the interconnection grid between the regions
  - The construction of a roadmap representing step by step the evolution of the 3 corridors SA-SEA, SA-ME and ME-Africa starting by the pilot interconnections
- The action plan from 2020 to 2050 gives:
  - The necessary grid for connecting Renewable sources with loads based on economic and reliability criteria
  - The management of the requested flexibility for facing the intermittency of Renewable energies
  - The assessment of the operational System safety
  - The implementation of market mechanisms enabling the exchange of electricity at best costs with merit order and cost-effectiveness criteria.
- This study represents a development strategy in space and time taking into consideration economic and financial approaches and, also regulation and power trade organizations that must be implemented at national and regional levels



Study Committee C1

POWER SYSTEM DEVELOPMENT AND ECONOMICS

Paper 10909_2022

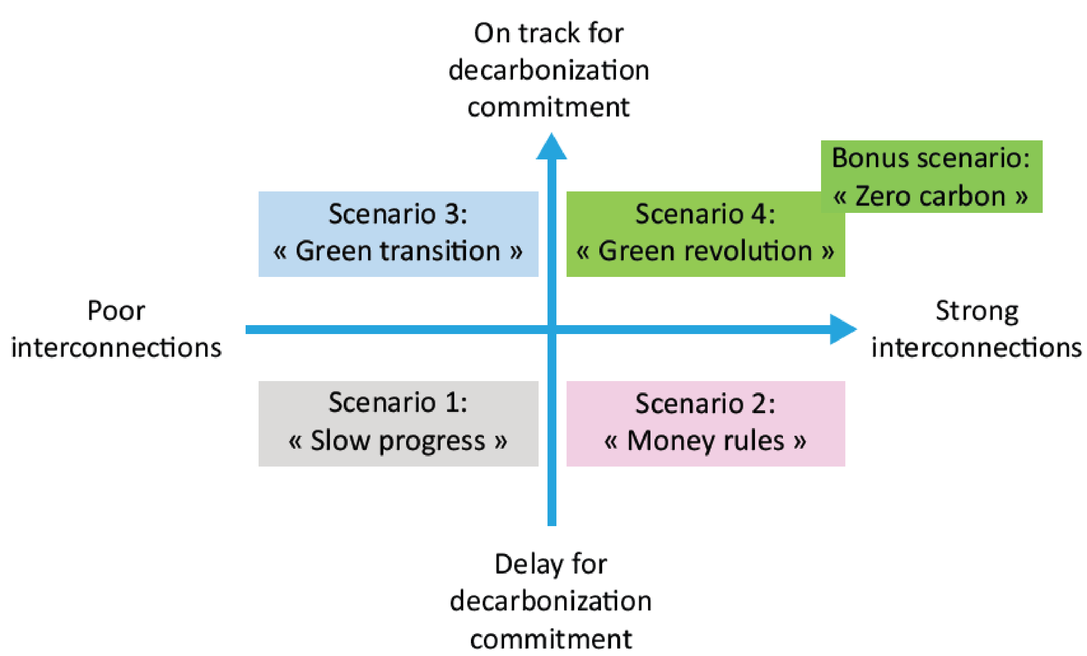
Interconnection of South Asia for exchanging Renewable Energy
General Overview
continued

Methodology

- The study consists in:
  1. Evaluating the techno-economic and commercial viability of global grid interconnection
  2. Supporting national Governments in establishing bi-lateral interconnections in a manner that contributes to regional interconnections
  3. Creating an institutional framework for global cooperation.
- The objective of the proposed study is to find an optimal combination of generation, storage, and interconnections that will minimize the total cost of a global interconnection system while maintaining system balance between supply and demand for each year from 2020 to 2050. To achieve this objective, it is quintessential to run an optimization simulation model that leads to an optimal solution based on various inputs. PLEXOS energy system modeling tool is used for conducting the study.
- The model considers as input data the technical assessment of existing regional power markets, electricity grid infrastructures, all generation technologies, renewable energy development plans, and gap analysis for each intra-region power market
- Electricity supplies from solar, storage, wind, and hydro are determined using location-specific capacity factors (CF) based on the Ninja public database and the profiles of NASA
- The estimated cost of these transmission technologies (OHL and USC) is taken according to projection data from manufacturers

Scenarios

- The simulations are performed for the various scenarios of envisaged supply mix and Global interconnections till 2050. In the current study, four + one scenarios are studied based on two dimensions:
  - The level of interconnection
  - The commitment to clean transition
- Scenario 1 “Slow Progress” (business as usual):
  - Less favorable economic and financial conditions
  - Low degree of integration of electricity markets
  - Low CO2 prices and high primary energy prices
- Scenario 2 “Money Rules”:
  - Less favorable economic and financial conditions
  - High degree of integration of electricity markets
  - Low CO2 prices and high primary energy prices
- Scenario 3 “Green Transition”:
  - Favorable economic and financial conditions
  - Low degree of integration of electricity markets
  - High CO2 prices and low primary energy prices
- Scenario 4 “Green Revolution”:
  - Favorable economic and financial conditions
  - High degree of integration of electricity markets
  - High CO2 prices and low primary energy prices
- Scenario 5 (Net Zero Carbon) is based on the Net Zero Carbon scenario defined by IEA in May 2021. This scenario defines the means to achieve global carbon neutrality while ensuring stable and affordable energy supplies and access and enabling robust economic growth.



Study Committee C1

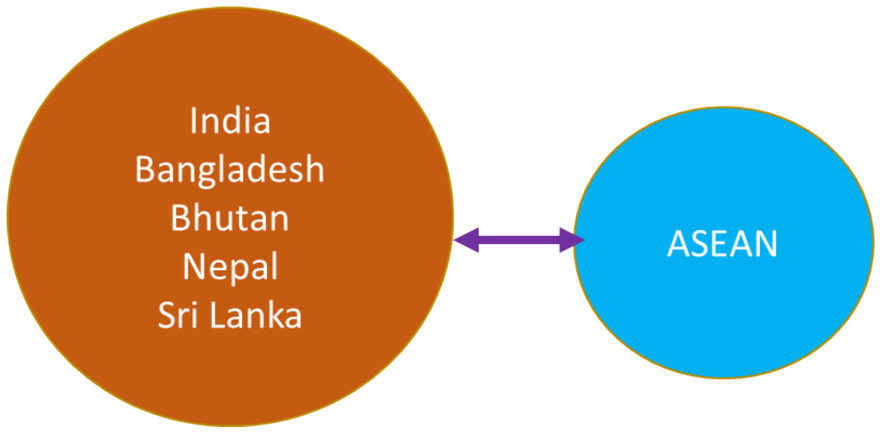
POWER SYSTEM DEVELOPMENT AND ECONOMICS

Paper 10909_2022

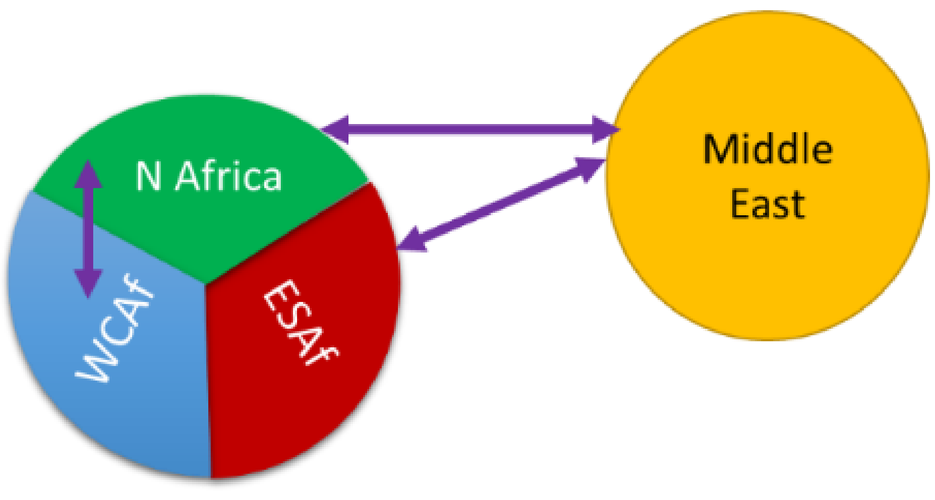
Interconnection of South Asia for exchanging Renewable Energy General Overview continued

Pilot interconnections

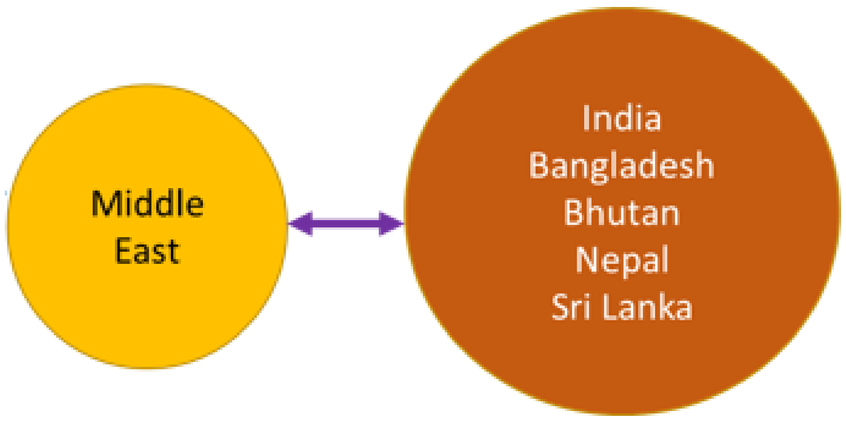
- **South Asia - ASEAN Interconnection:**

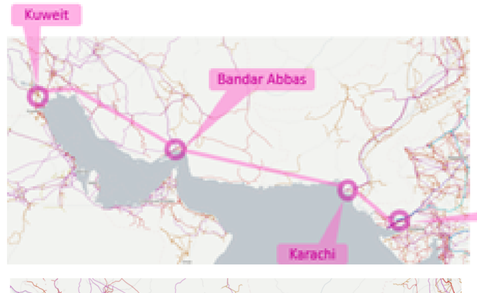


- **Middle East - Africa Interconnections:**

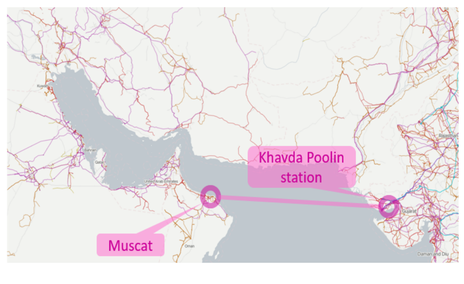


- **Middle East - South Asia Interconnection:**





OHL option



USC option

- The pilot interconnections are characterized by:
  - The line routings for the power overhead lines (OHL) and under-sea cables (USC)
  - The technical parameters of the power transmission assets subject to early deployment
- The study focuses on three corridors, for which the economic benefits of exchange of energy generated in regions from renewables & low carbon sources to regions with high energy demand and insufficient decarbonized generation are likely to outweigh the costs of the interconnection

Conclusion

The benefits brought by interconnections are:

- To get cheaper wholesale and retail prices with more cost-effective electricity imports
- To Improve flexibility for facing intermittency
- To improve system safety (to reduce the risk of blackout) with more available power
- To help for economical CO2 emission reductions and meet the commitments of the Paris Agreement