SGCC / VDE

‘China – EU Workshop on Global Energy Interconnections’

Dii / ‘Supporters of Desert Energy’

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Berlin, December 10th, 2015

Dii Background

- **Desertec Industrial Initiative** (Dii)
  - launched in 2009 as international industry initiative
  - Mission:
    - ✓ explore potential of renewable energy in the deserts of Northern Africa and the Middle East (MENA)
    - ✓ examine synergies to be captured through connecting the European and MENA power markets
    - ✓ improving market conditions for renewables in MENA

Evolution of Desert Energy

Development phases

2004 – Great Idea! Pre-phase

2009 – It works! Concept phase

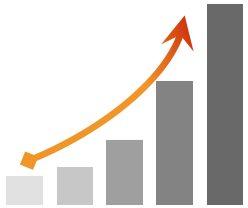
2015 – First Harvest! Implementation phase

2020 – Acceleration! Scale Up phase

- Studies on the **Desertec** vision by **DLR** (Deutsche Luft- und Raumfahrtzentrum) and **TREC** (Trans-Mediterranean renewable energy Cooperation Studies)
- Creation of **awareness and motivation**

- **Foundation of Dii GmbH** (Munich) in 2009
- **System, country and technology studies (Desert Power 2050, Desert Power: Getting Started)** by Dii supported by Dii's industrial, research and political network (e.g. Fraunhofer, CESI, Sonelgaz)
- Local adoption of idea
- **Preparation of services** for implementation phase

- **Being active locally** Foundation of Dii Ltd in Dubai
- **Identifying and solving practical hurdles** of wind/solar/grid projects in the field
- Creation of international industry network **'Supporters of Desert Energy'** and partnerships



- **Market accelera-tion** towards full renewable energy supply in MENA
- **Full Market integration** throughout MENA and connected markets. Increase of Desert Power share in energy mix

Source: Dii

Dii's Mission today

To facilitate the rapid deployment of utility-scale renewable energy projects in desert areas and to integrate them in the interconnected power systems

‘Supporters of Desert Energy’ Network

Key Initiators: ***RWE, SGCC, ACWA Power***

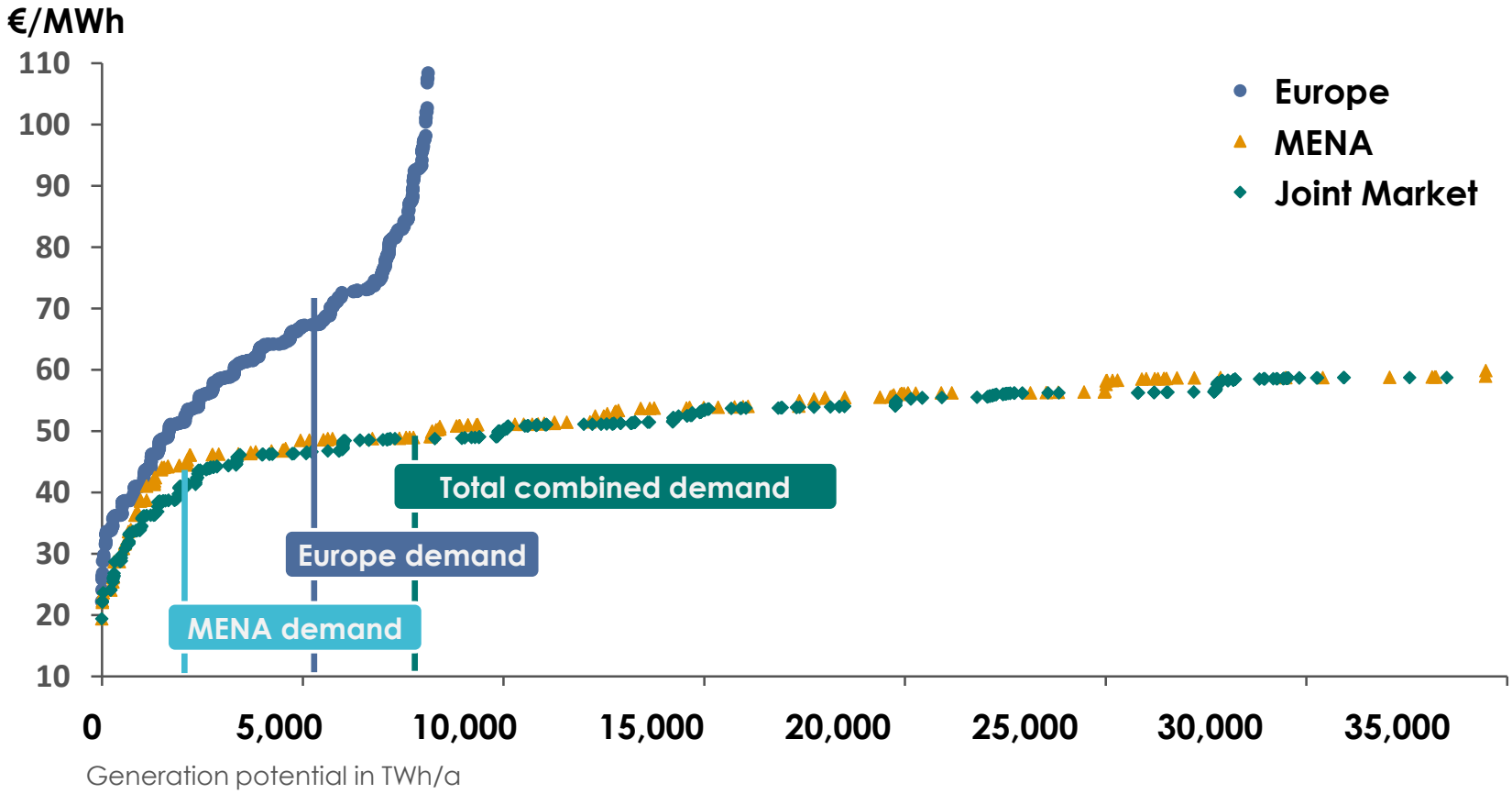
Current Status of the Industry Network

Key Objectives

- Taking away hurdles for emission free technology
- Capturing synergies through transmission capacities across national borders
- Thus, transparent, open markets offering **realistic price signals**
- Regional Participation
  - Localization and Job creation
  - Capacity building and Know-how transfer

Long term Supply Cost Differences between EU and MENAT offer major long term synergies

- Solar and Wind potentials compared to electricity demand



Dii Strategy: Step by Step

- Step 1: Paving the way locally
  - ✓ focus locally on **taking away hurdles** for upcoming RE projects including solar, wind, desalination, energy storage etc.
  - ✓ **Grid adequacy and market opening**, allowing smart interaction with demand
- Step 2: Capture Synergies
  - ✓ **Stable price signals** in each regional power market
  - ✓ **transmission grid reinforcements between (remote) markets**
    - Overlay HVDC, connecting regional markets
    - first cross border MENAT, then intercontinental Europe – Africa – West Asia and global

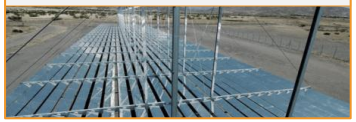
Key Components
Supply - Transmission - Demand

CSP

Parabolic trough

Power Tower

Fresnel



PV

Mono/Poly-Crystalline

Thin-film

Wind

On-shore

Desalination

Sea Water

Transmission

HVDC/HVAC Interconnections and local infrastructure Connecting markets

Demand Side

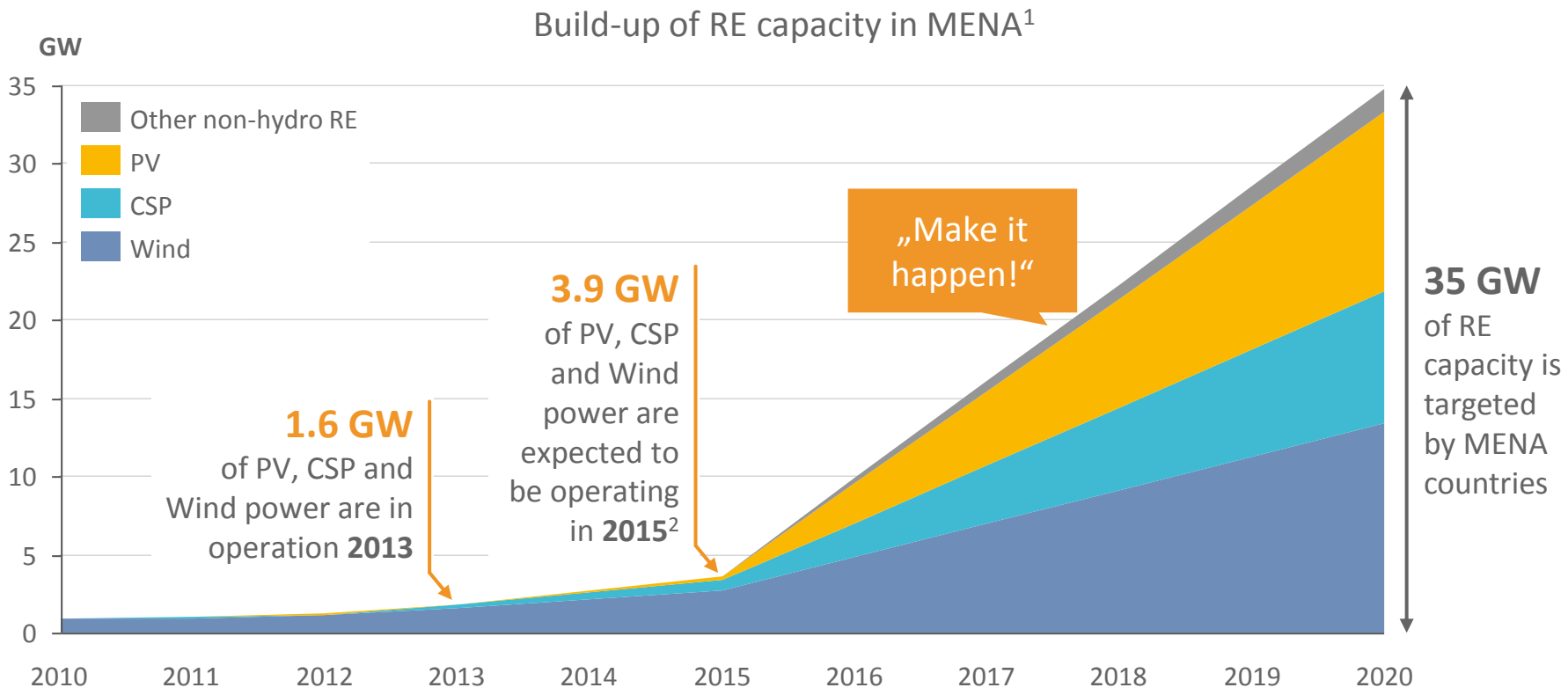
Improved responsiveness of demand to central control or price signals

Storage

power, heat, cooling, hydro etc

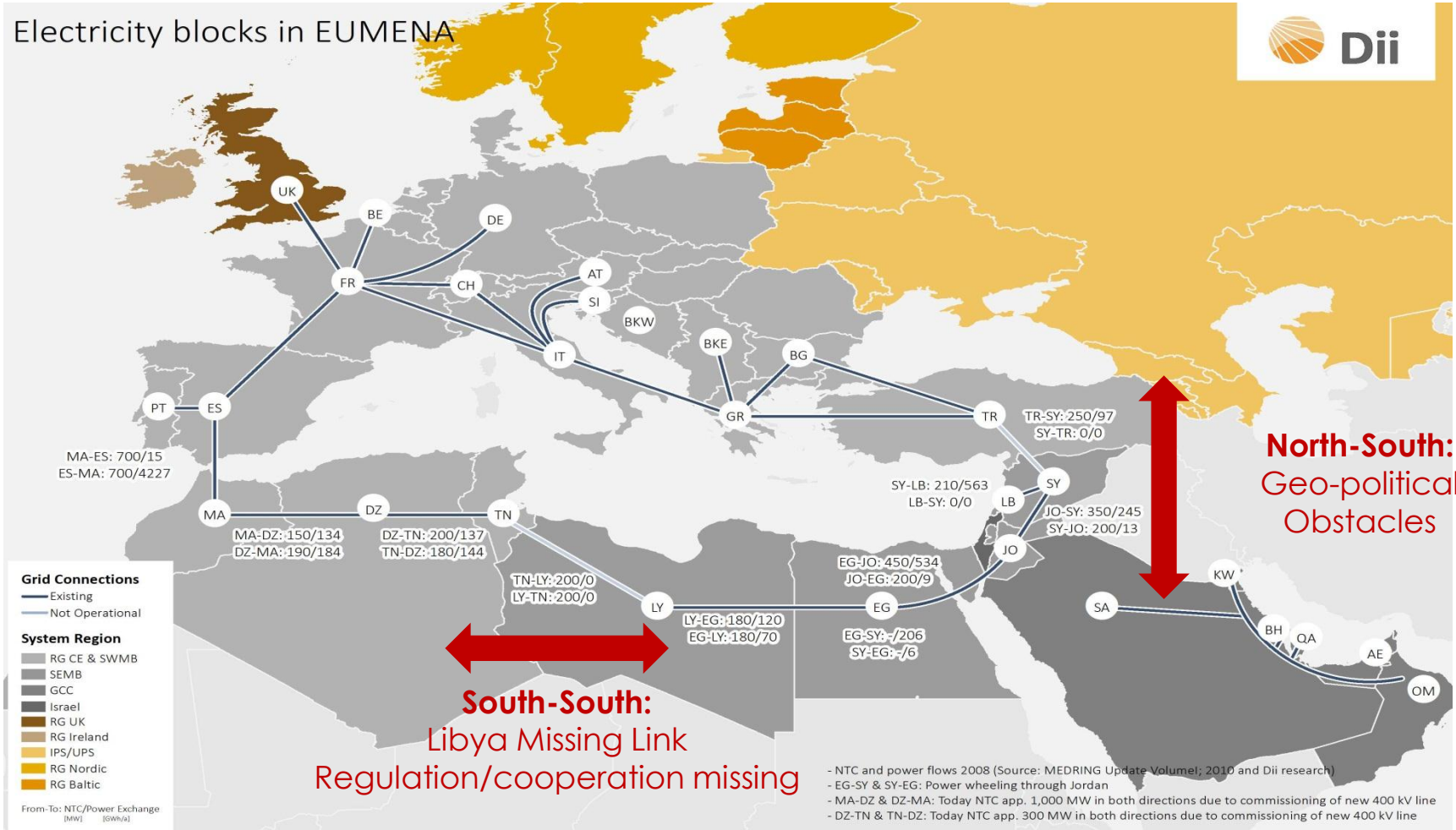
Expected RE development in MENA(T)

Removal of barriers => Acceleration of renewable energy capacity build-up

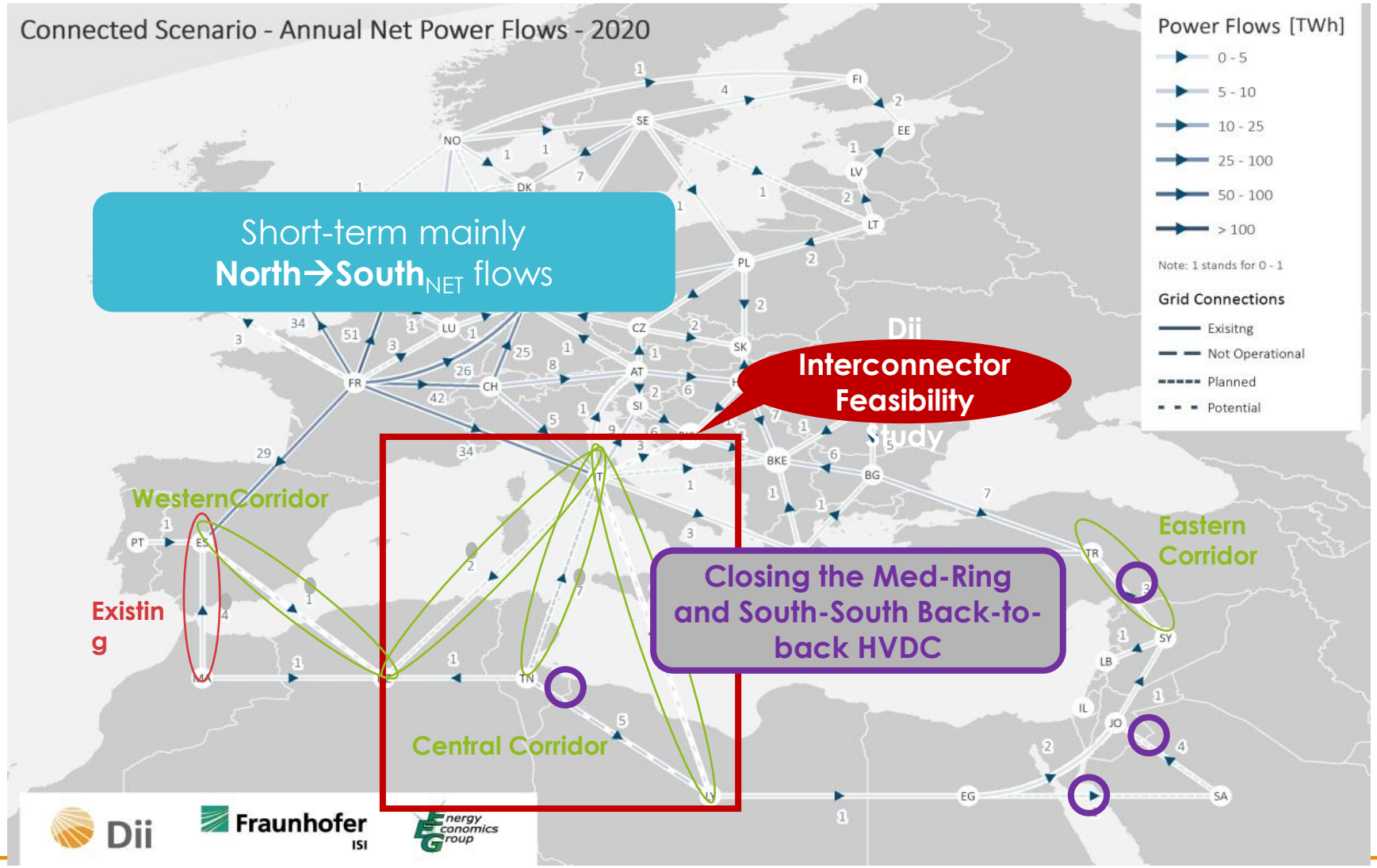


Note: 1) Dii Database holds data on grid-connected RE projects with a capacity above 1MW; MENA hereby includes Mauritania, Morocco, Algeria, Tunisia, Libya, Egypt, Jordan, Palestine, Israel, Syria, Iraq, Kuwait, Bahrain, Qatar, Saudi Arabia, United Arab Emirates, Oman and Yemen; 2) Not included are projects that have only been announced and projects with unfinished tenders; Status 2014 , Source: Dii

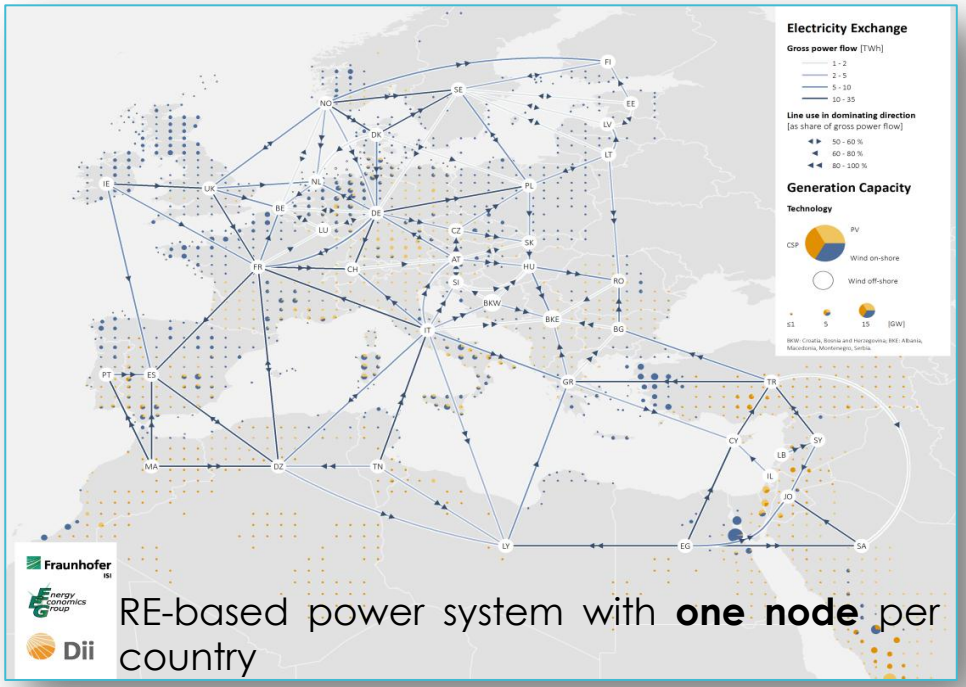
Present Mediterranean interconnections (schematic)



Economically viable investment opportunities in Cross-Med interconnectors exist today



Sample Study on long term intercontinental Transmission System for Capturing Synergies



Long-term 2050

Simple representation of transmission corridors (up to **5 nodes by country**)

Mid-term 2030

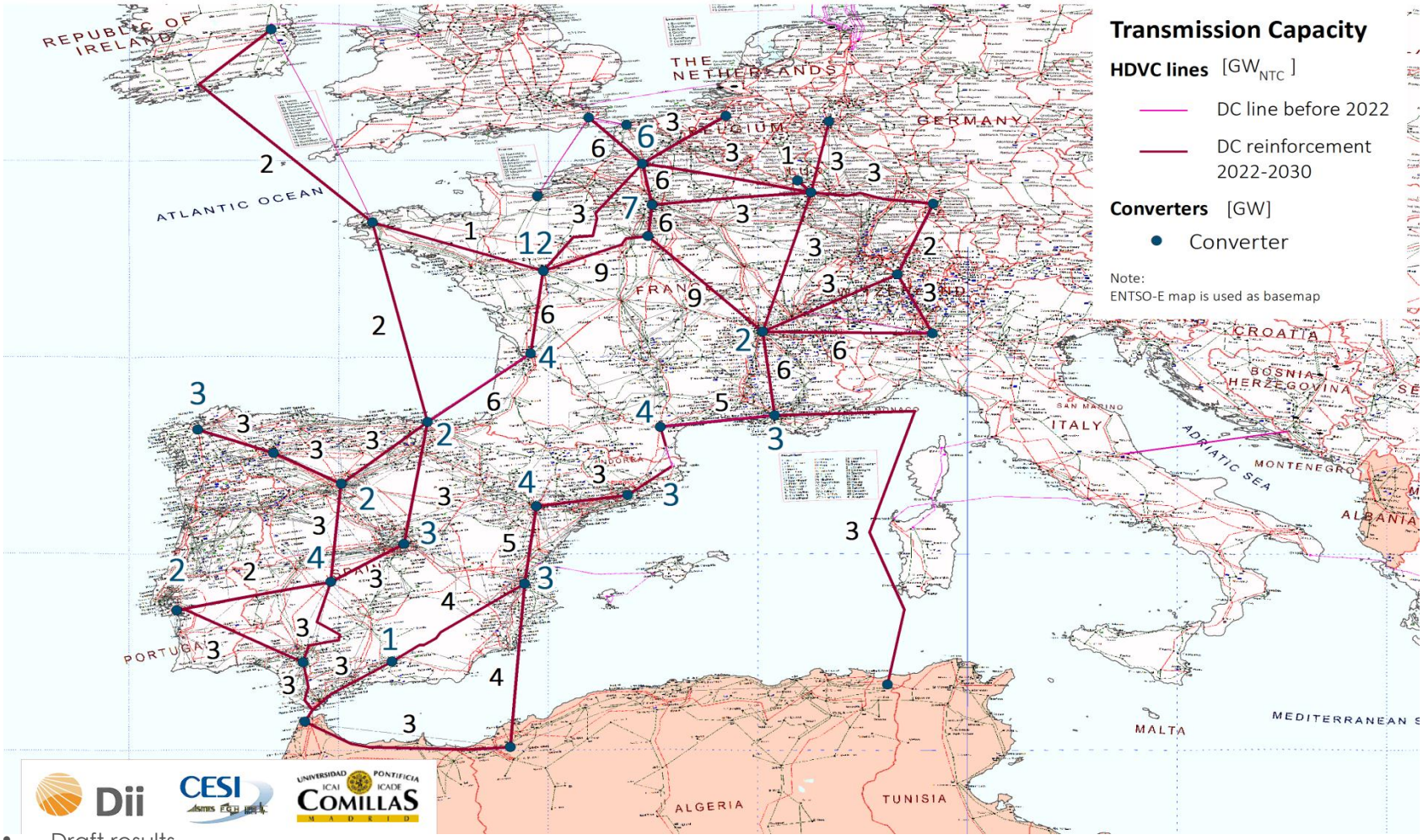
Detailed representation of transmission grids (several **hundred nodes**)

Dii Study in 2014 by Dii Transmission Group (Terna, REE, RWE, ABB (initially))
Modeling carried out by CESI/Comillas

- Reinforcements in mid- and long- term in terms of:
  - **Capacities** of the grid infrastructure
  - **Costs** of Investment and operation

Example of Interconnections SW Mediterranean – Central Europe: several 3 GW HVDC inter-regional lines

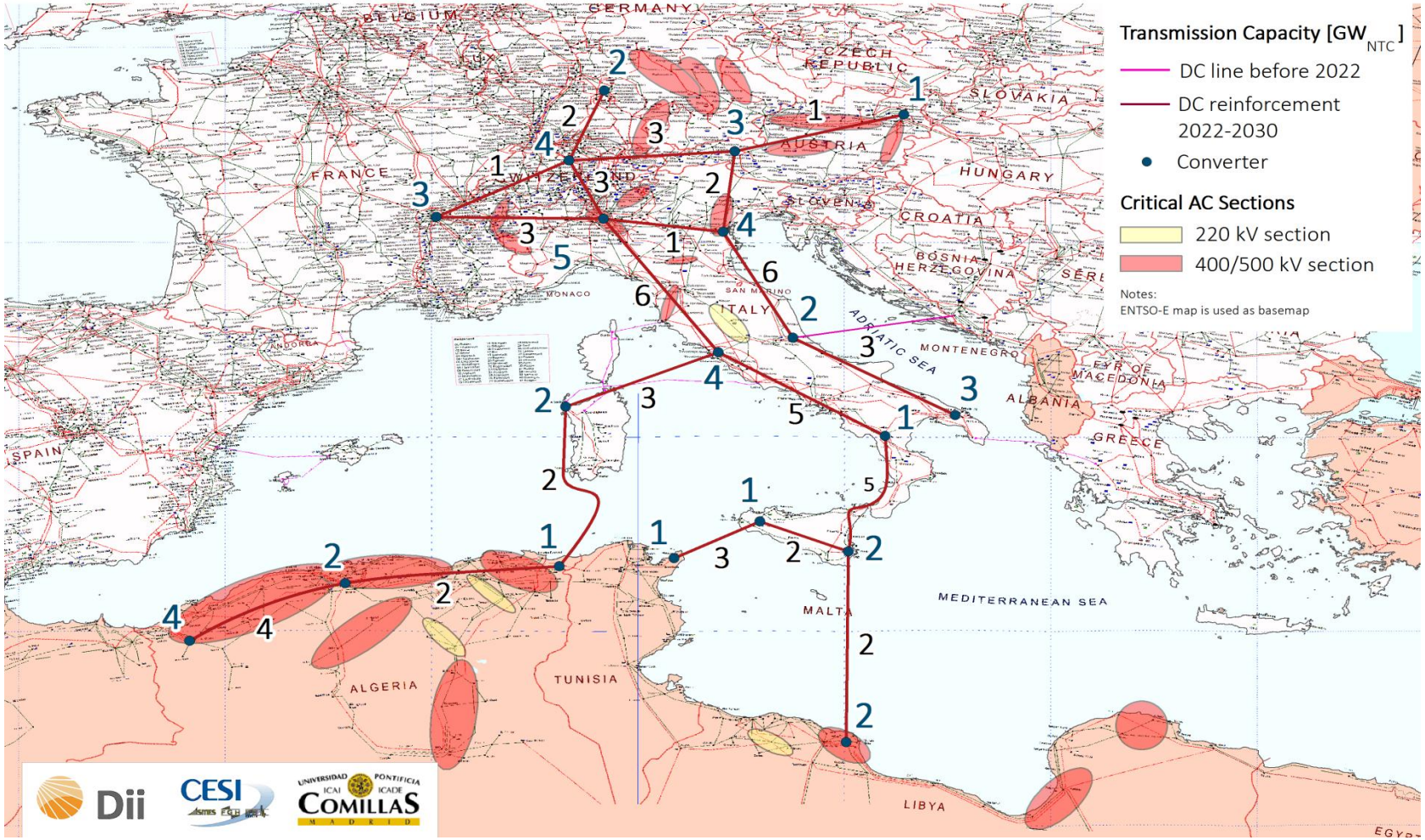
Grid expansion in the Western corridor between 2022 and 2030 [GW]



- Draft results

Example of Interconnections Italy - NA: 2-3GW HVDC submarine links and reinforcements in Europe

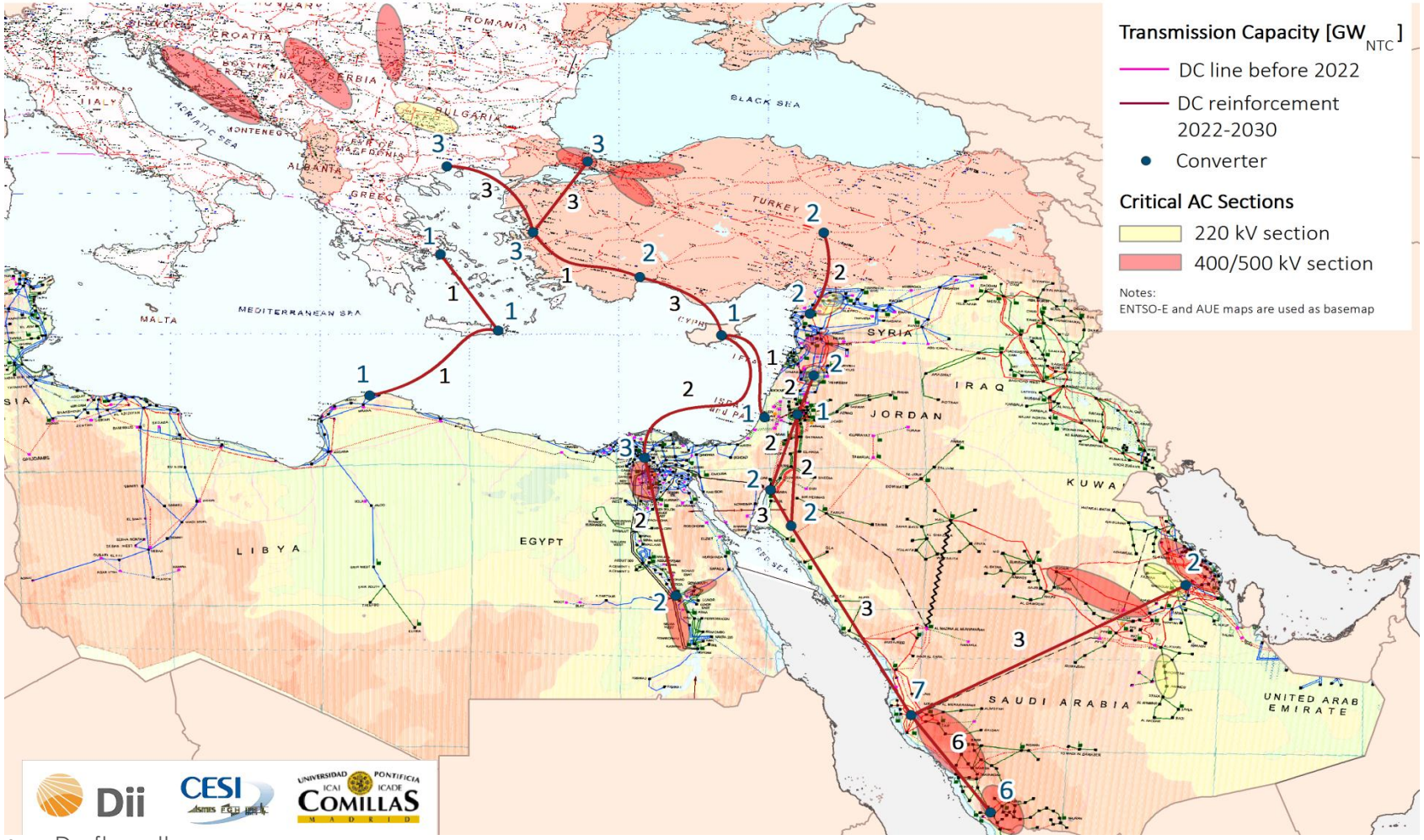
Grid expansion in the Central corridor between 2022 and 2030 [GW]



- Draft results

Example Interconnections: S-E Mediterranean: Up to 2 GW HVDC with North Africa/ Middle East plus AC reinforcements

Grid expansion in the Eastern corridor between 2022 and 2030 [GW]



- Draft results

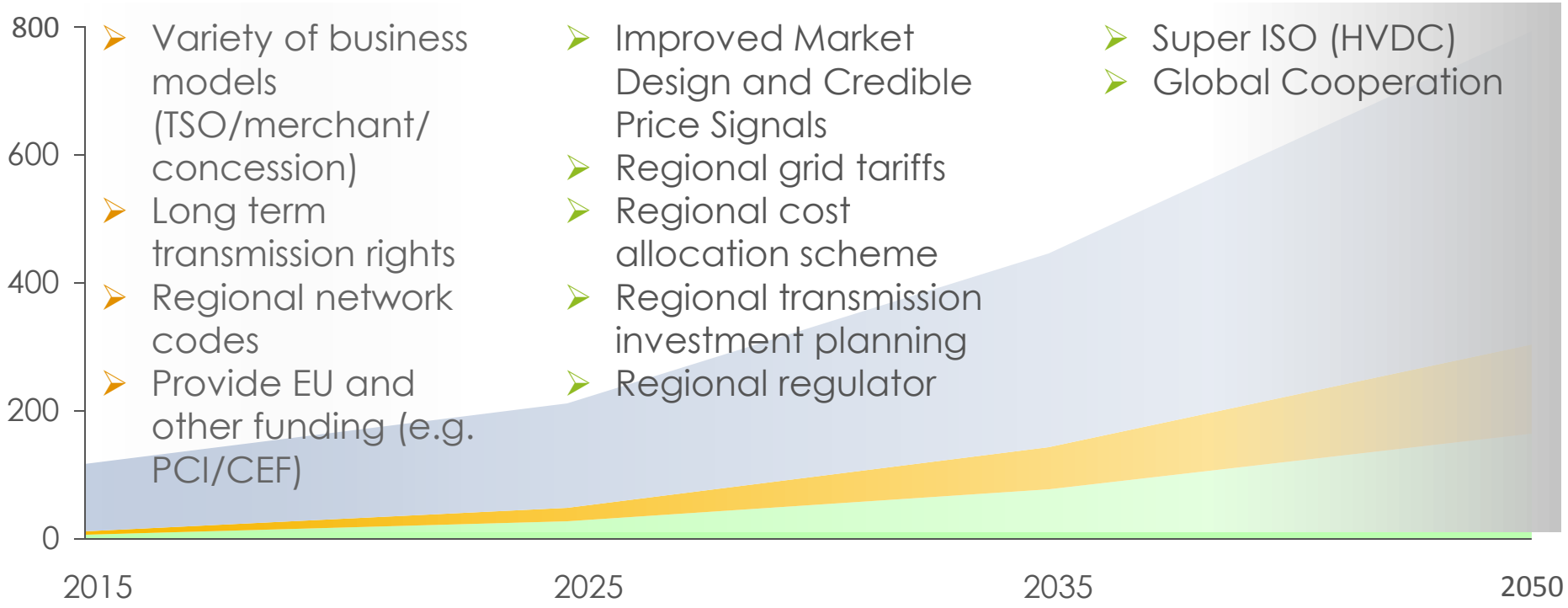
Extensive international co-operation and regulation needed in the longterm

Short term | Medium term | Long term

- Variety of business models (TSO/merchant/ concession)
- Long term transmission rights
- Regional network codes
- Provide EU and other funding (e.g. PCI/CEF)

- Improved Market Design and Credible Price Signals
- Regional grid tariffs
- Regional cost allocation scheme
- Regional transmission investment planning
- Regional regulator

- Super ISO (HVDC)
- Global Cooperation



Grid capacity in GW_{NTC}: Europe MENA Europe/MENA /beyond

Source: Dii

Summary

- First priority: **removing key hurdles** for RE projects in MENAT
- **Arrange access and reinforce** the grids and power markets
  - Open up power markets and smart interaction with demand
  - Provide credible Price Signals
- Major synergies to be captured by **connecting power markets**
  - Start planning economic Long Distance HVDC/HVAC infrastructure throughout Europe /Africa and Asia
  - Improve co-operation and regulation

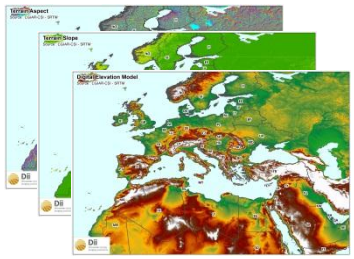
Appendix

- Dii website: www.desertenergy.org

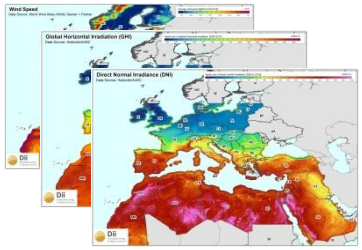
Dii databases and tools

- Extensive geo-data and renewable energy project data

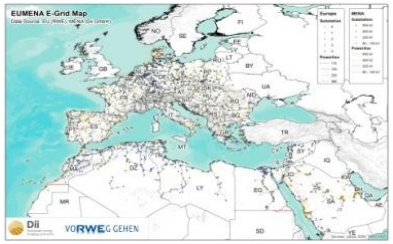
Geodatabase



Topography



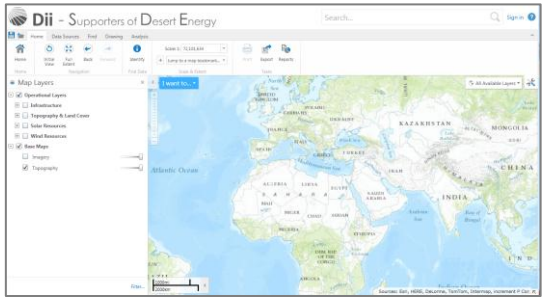
Potential resources



E-Grid

- Bird flyways
- Land-Use
- Restricted areas
- Bathymetry
- Geomorphology
- Hydrology
- Albedo factor
- And many more

Dii Project Data Base



- Existing installations
- Planned installations
- Grid Extensions (tbd)