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Renewable energy
bridging continents

Desert Power 2050: PV in a sustainable power system for EUMENA

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Dii: 57 partners from 16 countries

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Dii's mission is to create Solar and Wind markets in the Middle East and North Africa

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Dii mission	***'What has to be done to cover, in partnership with the MENA-region, a substantial part of the local and European demand with electricity from sun and wind?'***

Dii objectives	**Create a favourable regulatory environment**	**Enable concrete reference projects**	**Develop a Rollout Plan until 2050**

Source: Dii

System perspective: integrated power system for the Middle East, North Africa and Europe

- In cooperation with Fraunhofer ISI
- First study considering electricity demand in all of MENA and Europe
- Detailed RE potential analyses for all of EUMENA
- Full year considered in hourly resolution
- Industry backed cost estimates
- Only high voltage transmission, one node per country optimized
- No off-grid installations

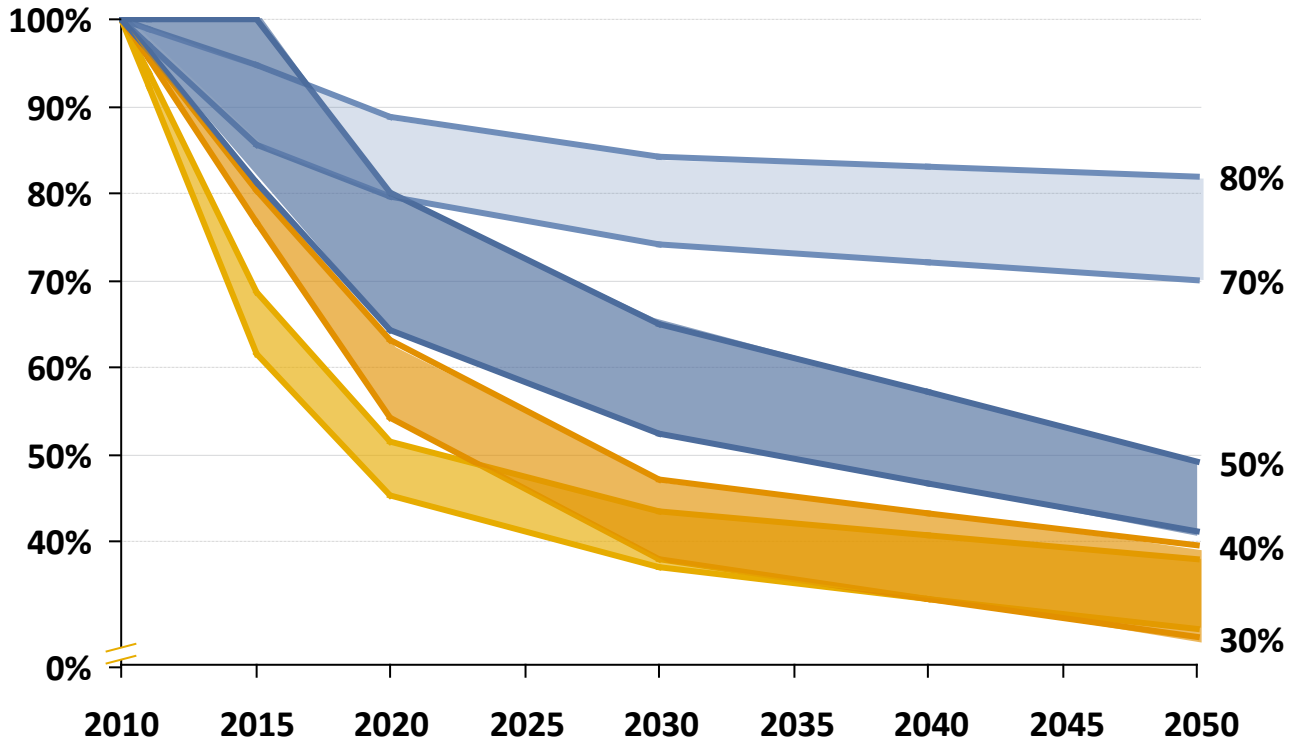
A total of 17 scenarios has been analyzed with respect to power system integration

Main Scenarios	Paradigm Shifts	Medium Impact Changes	Low Impact Changes
Connected Scenario	Low Demand Connected/ Reference x2	Delayed Grid	Delayed Renewables Cost Curves x4
Reference Scenario	Nuclear/CCS	Delayed Expensive Grid	Cheap Batteries
	Delayed Climate Action	High Land Use Europe	Maximum Cooperation
	Unlimited Carbon Emissions	High Capital Cost MENA	No NREAPs

Source: Dii, Fraunhofer ISI

Cost of Solar and Wind are decreasing rapidly

System cost per kW[1] in percent of 2010 cost estimate



Technology cost 2050

Wind on-shore: 900€/kW

Wind off-shore: 1350-1900€/kW[2]

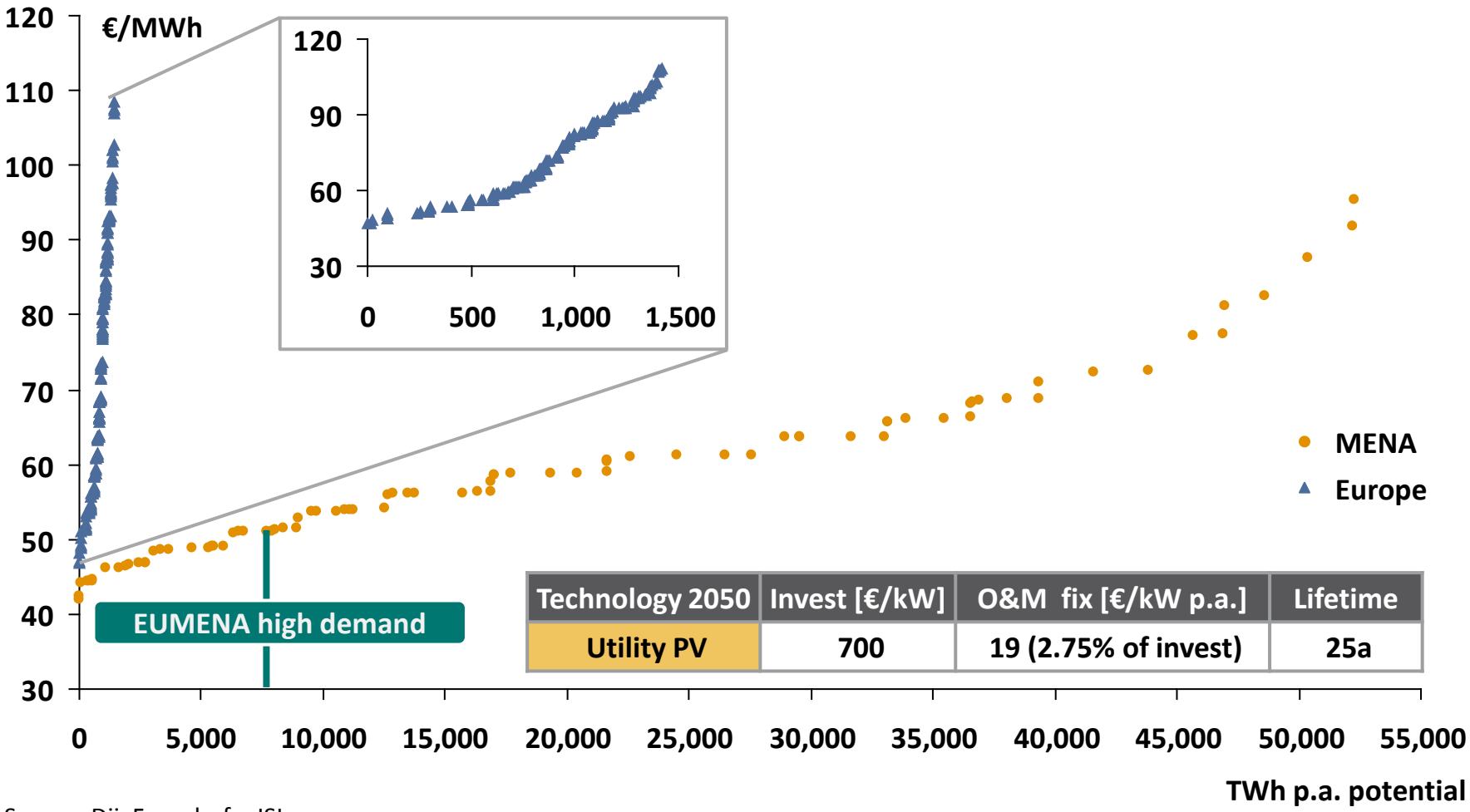
CSP with 8h storage: 2000€/kW

Utility PV: 700€/kW

Source: Dii 1. Refers to nameplate capacity, i.e. kW_p (kW peak) for Utility PV and Wind and kW_e (kW electric) for CSP 2. Depending on distance to coast/sea depth

MENA PV potential virtually infinite

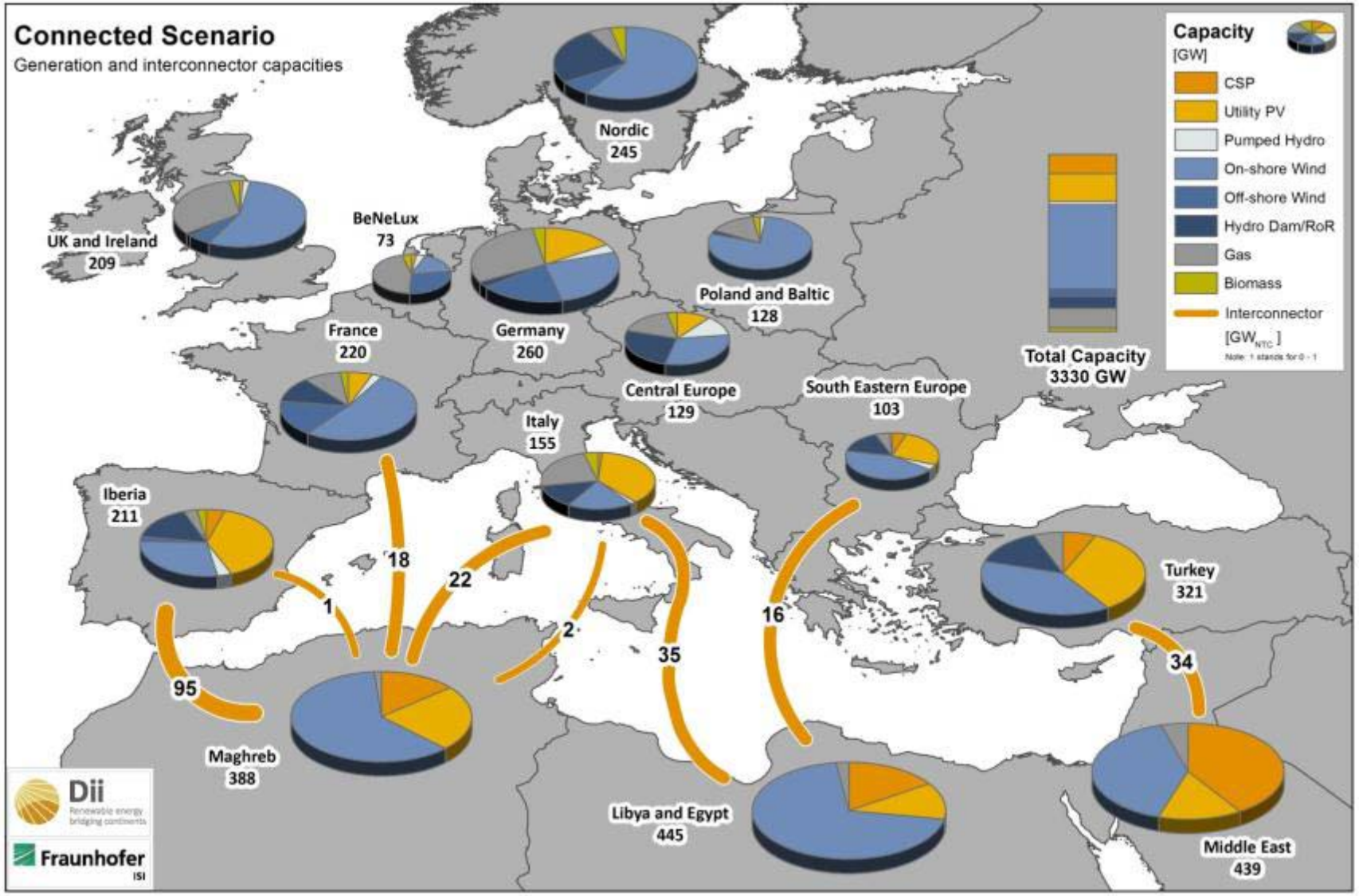
EUMENA Utility PV potential based on 2050 cost estimate



Technology 2050	Invest [€/kW]	O&M fix [€/kW p.a.]	Lifetime
Utility PV	700	19 (2.75% of invest)	25a

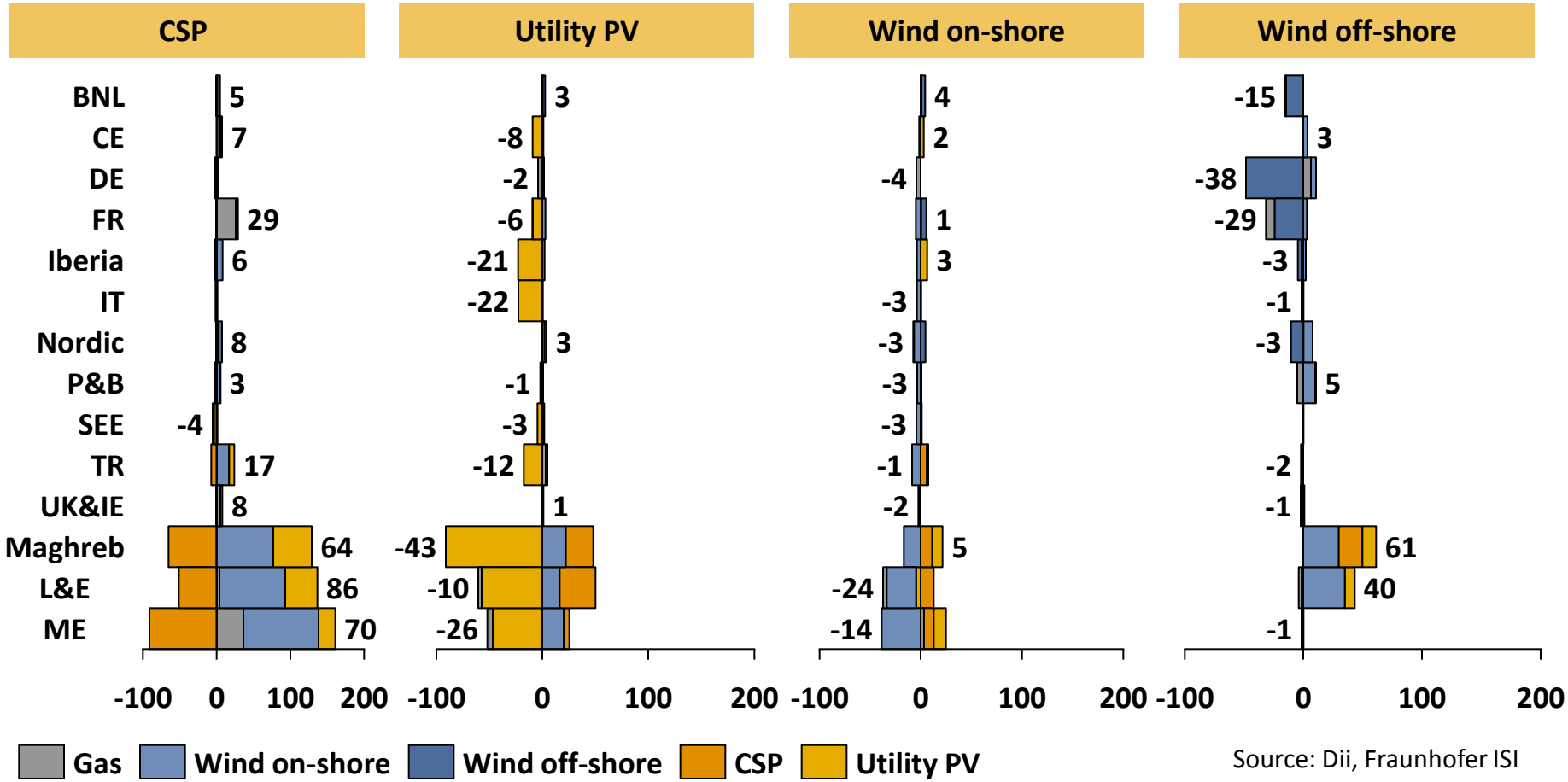
Source: Dii, Fraunhofer ISI

DP2050 electricity mix: High demand in Egypt and Middle East, met by Solar and Wind



Except for off-shore, technologies replaced mostly within the same region

Changes from Maximum Cooperation to Delayed RE Cost Curves [GW]

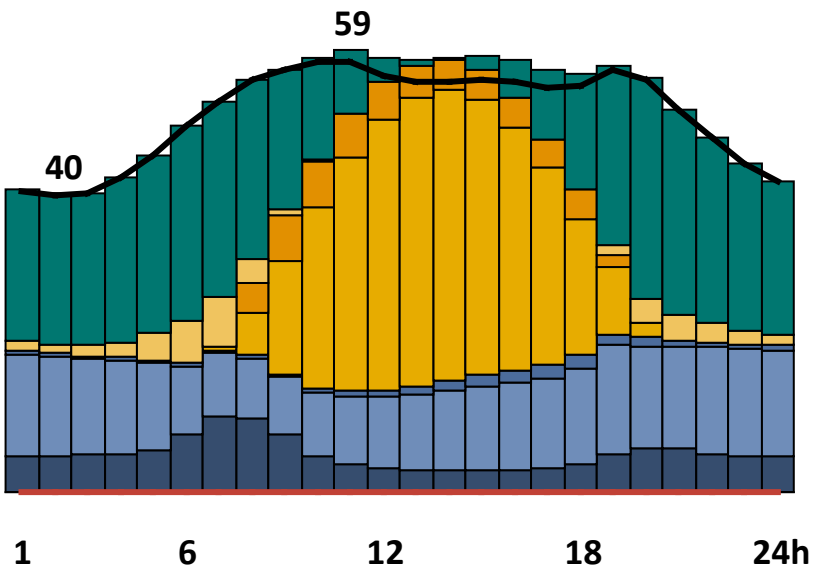


Source: Dii, Fraunhofer ISI

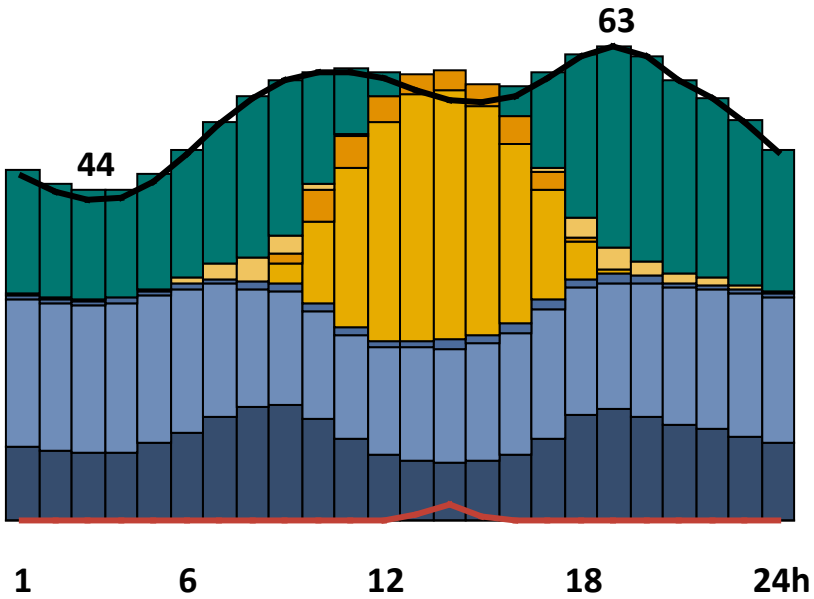
Spain is self relient when own solar produces, uses imports rest of the day

Average load and production per hour of day in GWh

Average summer day Spain [GW]



Average winter day Spain [GW]



Load
Export

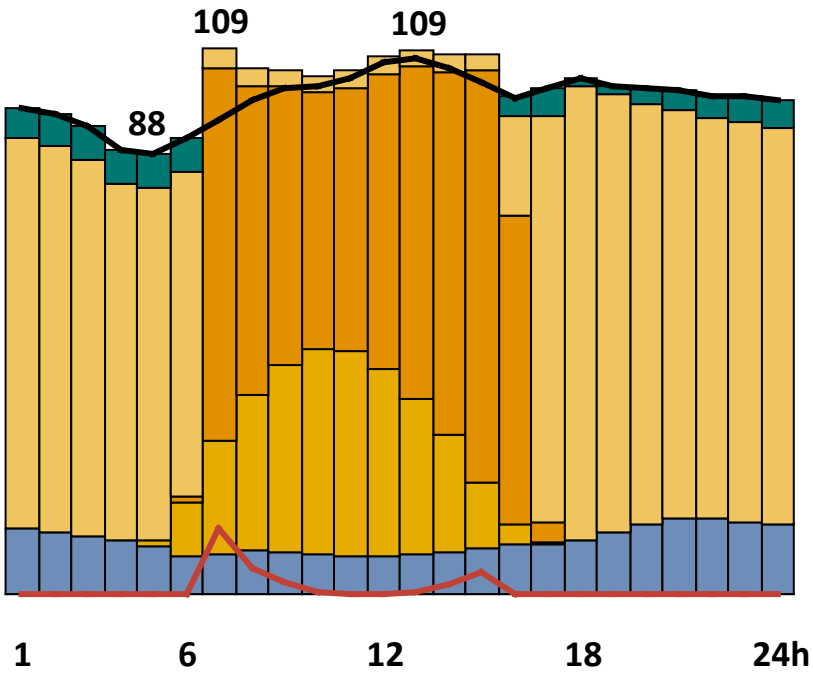
Supply: Import, Gas, CSP storage, CSP direct, Utility PV, Wind off-shore, Wind on-shore, Other renewables

Source: Dii, Fraunhofer ISI

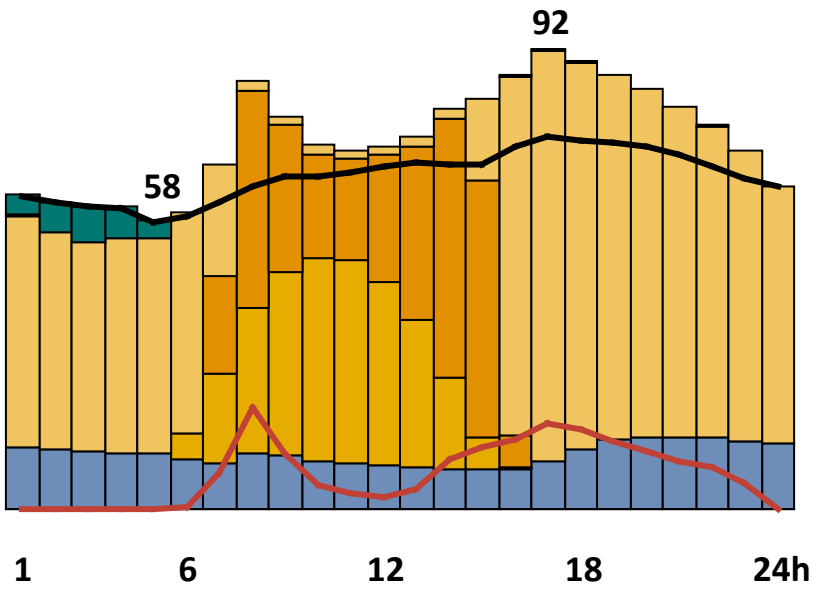
Saudi Arabia relies heavily on CSP and PV – im-/exports used to balance day/night time

Average load and production per hour of day in GWh

Average summer day Saudi Arabia [GW]



Average winter day Saudi Arabia [GW]



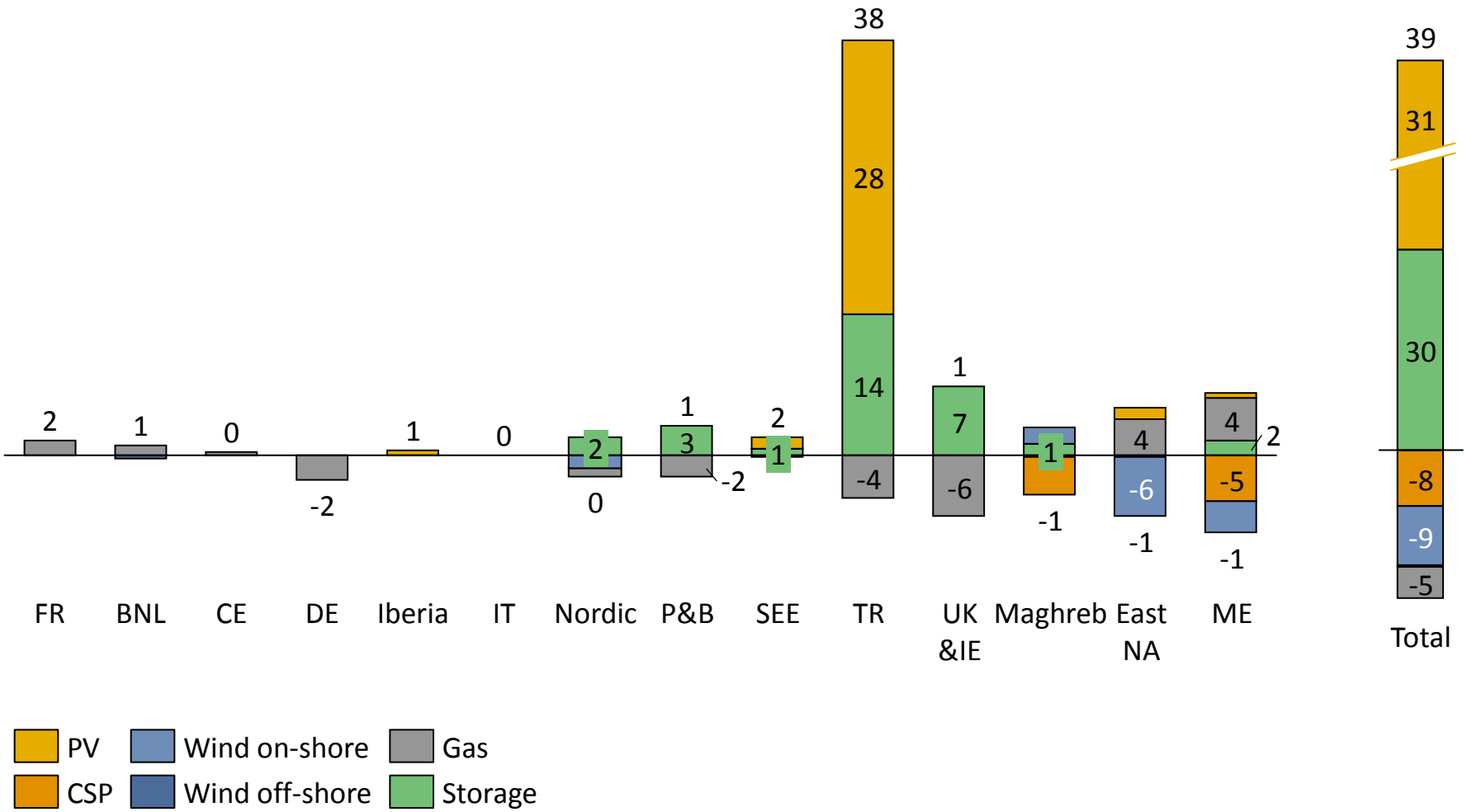
Load
Export

Supply: Import, Gas, CSP storage, CSP direct, Utility PV, Wind on-shore

Source: Dii, Fraunhofer ISI

14GW of very cheap storage enables increase in PV capacities in Turkey by 28 GW

No NREAP minus high interconnected without self supply limit



Note: comparison No NREAP vs. interconnected without self supply limit

Value of PV in a EUMENA electricity system

- PV potential is virtually infinite and much larger than that of Wind or CSP
- In an integrated, sustainable power system, PV as well as Wind and CSP will all play a crucial role with hundreds of GW installed – confirmed by more than a dozens scenarios
- PV installations in sunny countries are limited by peak demand and the ratio of peak vs. valley demand
- In a highly interconnected system, even eight hour storage at 500€/kW does not dramatically change this
- As of today, interplay of long distance bulk power transmission and distributed PV/storage cannot be modelled comprehensively

Long term perspective for PV in EUMENA is hundreds of GW of installations
- advantages of modularity and speed of installation should be leveraged today

DP 2050 as target picture – second part of study to illustrate pathways 2012-2050

Target picture (Summer 2012)

Pathways to implementation (Early 2013)

Desert Power 2050:
Perspectives on a sustainable power system for EUMENA

Which technological and geographical mix of RE is best suited to provide the EUMENA region with a sustainable, reliable and affordable power system?

Desert Power 2050: *Getting Started*

Actionable recommendations on all key aspects of implementing a fully integrated EUMENA power system based on RE

- Ramp-up of MENA RE
- Electricity highways connecting MENA & Europe
- Public support design phase-out
- Institutional framework
- Socio-economic effects

Source: Dii

3rd Dii DESERT ENERGY CONFERENCE BERLIN | 2012

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