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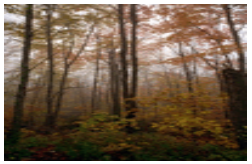
IRENA's work on technology integration planning




Climate Change Impact and Integrated Assessments
22 July-2 August, 2013, Snowmass, Colorado

About IRENA

IRENA
International Renewable Energy Agency

International organization supported by governments of member countries

Members: 161 countries (116 ratified)

Mandate: Sustainable deployment of the six RE resources (Biomass, Geothermal, Hydro, Ocean, Solar, Wind)

Programme of Work:

1. Knowledge, Policy and Finance [**Data & statistics; RE support policies; socio-econoimc impacts**]
2. Innovation and Technology [**Technology integration planning; technology costs and performance; project development; innovation policy**]
3. Country Support and Partnerships [**RE Readiness assessment, Capacity building**]

Energy Systems Models and IRENA

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IRENA provides interface between member countries and scientific community

- Provides access to IRENA's data/insights on renewable technology developments and resource potential assessments
- Incorporating the latest methodological development for better assessment of roles of renewables in power systems

IRENA applies Energy System models to country/regional level energy planning

- Model configuration for country/region's planning needs
- IRENA's own analysis
- Capacity building in planning

Regional/country RE scenario assessment

REMAP 2030

- Gap analysis between global target of doubling of RE share by 2030 and current RE policy goals of countries and regions based on country/region current policy scenario
- Global cost-supply curve for accelerated RE deployment

Topics covered

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Global Atlas updates

RE cost studies

Technology Brief

Africa studies

- RE power generation potential
- Power pool modelling
- Clean Energy Corridor Initiative and Capacity building

Grid and storage

- Technology brief
- Grid stability study for island states

REMAP 2030

- Country/regional studies
- ETSAP collaborations

GlobalAtlas

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- Global Atlas is a **Global Spatial Data Infrastructure**
  - Three main systems: Geoserver, catalogue, Atlas interface
- A global 'public library' of renewable resource maps – 300 + datasets
- The **GIS interface** is online and freely accessible. Basic users can access information and perform basic analyses.
- 'Advanced' users can create their own **online project maps**, embed those in their webportal, and use the online tools

GlobalAtlas

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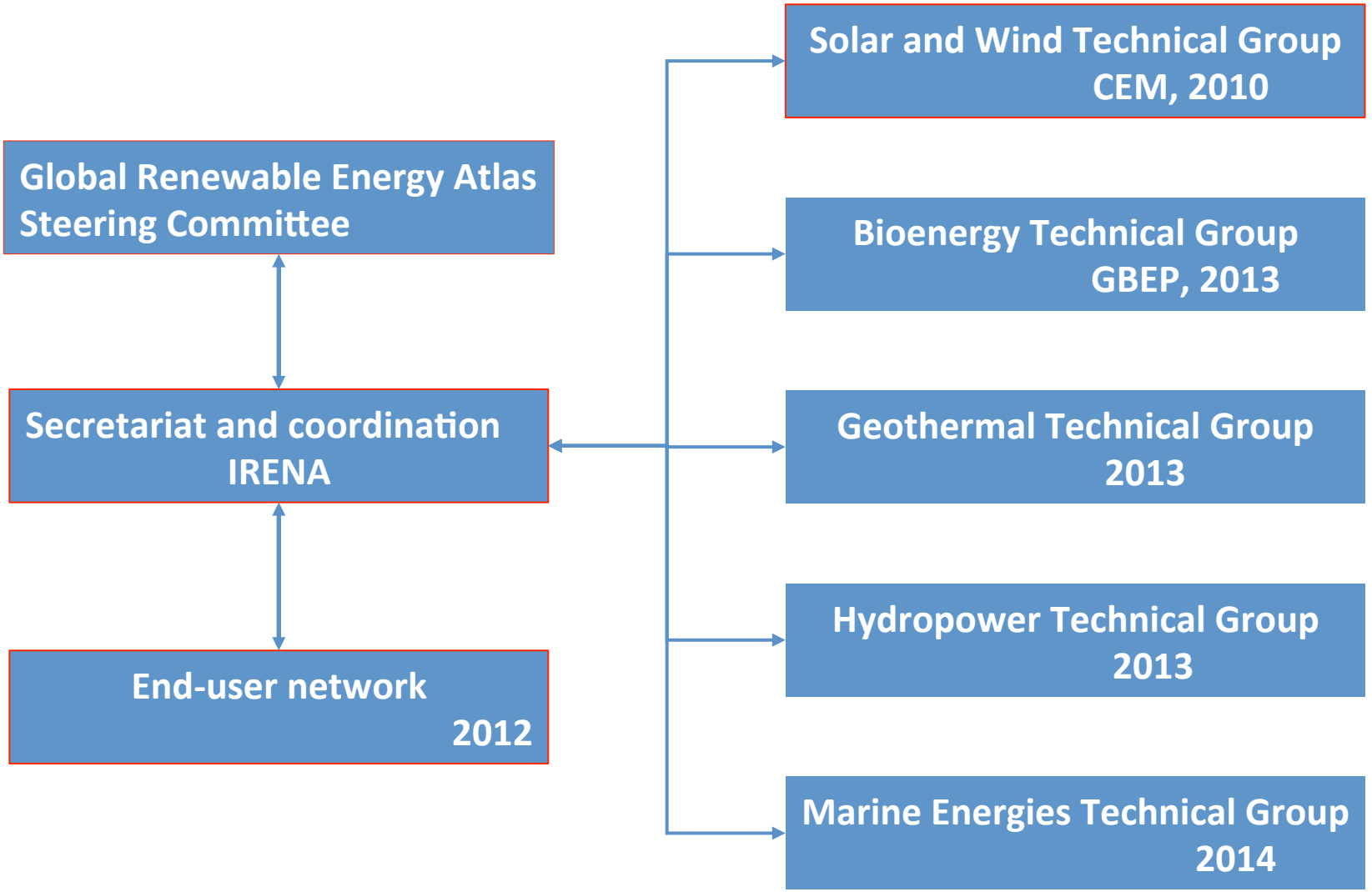
Global Atlas Institutional Structure



GlobalAtlas

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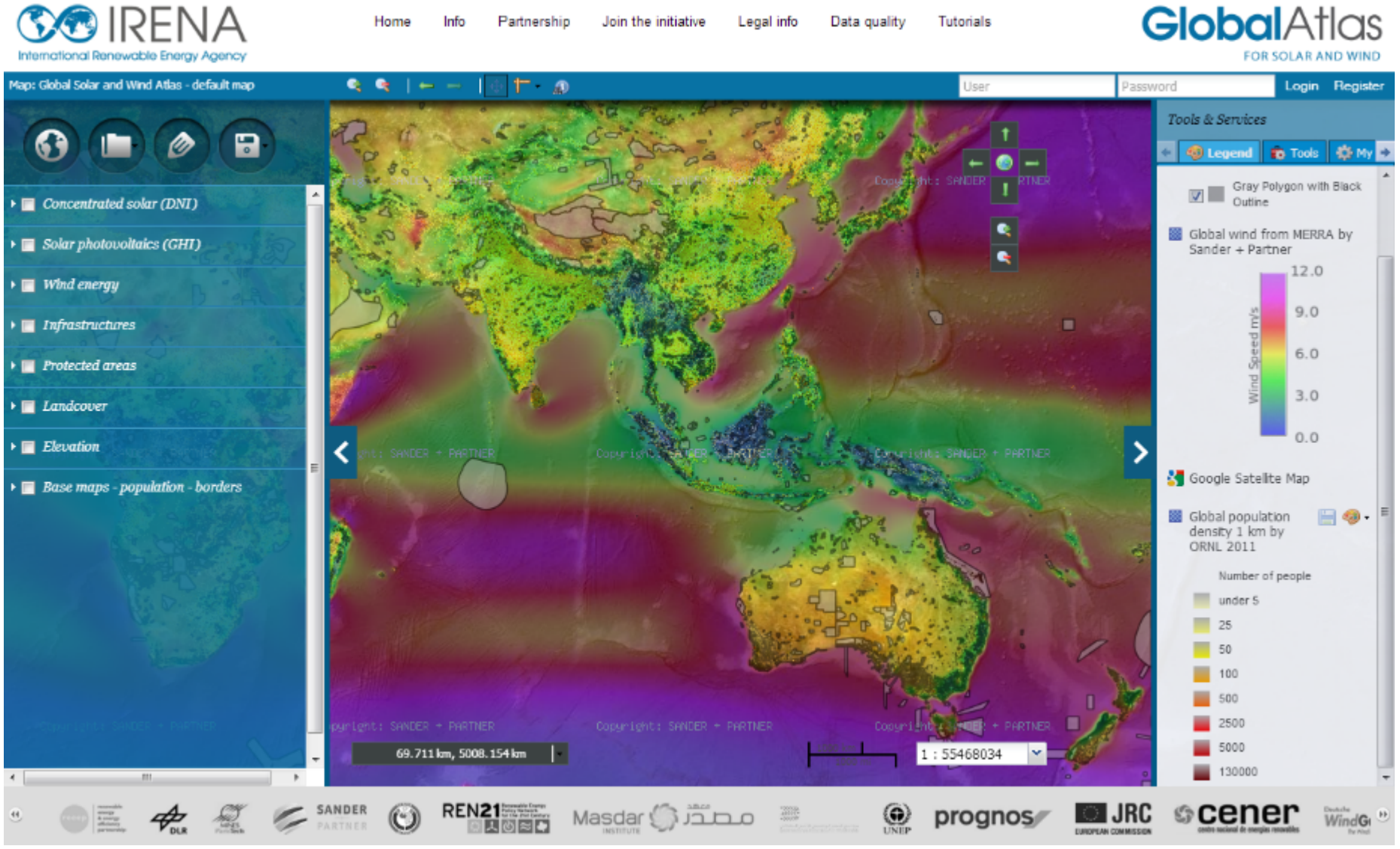
Example 1: Wind speed, population density, protected areas



GlobalAtlas

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First thematic maps are available and you can create your own!

Australia	http://irena.masdar.ac.ae/?map=406
Cuba	http://irena.masdar.ac.ae/?map=404
Ethiopia	http://irena.masdar.ac.ae/?map=312
MERRA dataset	http://irena.masdar.ac.ae/?map=399
Mongolia	http://irena.masdar.ac.ae/?map=318
Papua New Guinea	http://irena.masdar.ac.ae/?map=324
Serbia	http://irena.masdar.ac.ae/?map=317
Somalia	http://irena.masdar.ac.ae/?map=301
South African Wind Atlas	http://irena.masdar.ac.ae/?map=405
Sudan	http://irena.masdar.ac.ae/?map=321
Swaziland	http://irena.masdar.ac.ae/?map=299
Uganda	http://irena.masdar.ac.ae/?map=315
Yemen	http://irena.masdar.ac.ae/?map=382
Zambia	http://irena.masdar.ac.ae/?map=338

Ongoing work and next steps

- Integration of Countries' solar and wind data – display, point data
- Additional datasets coming online:
  - CENER – wind energy, global, 10 km
  - Private companies – solar, wind, global, 5km
  - DTU – wind energy, global, 3/5 km
  - NASA – solar, global, 10 km
- Significant improvements to the Atlas GIS, data display and analysis tools
- Expansion ongoing to other renewable energy sources

RE Costing

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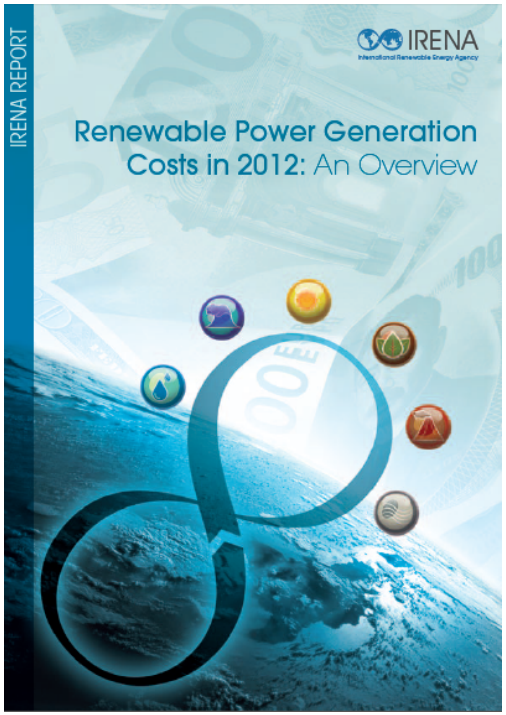

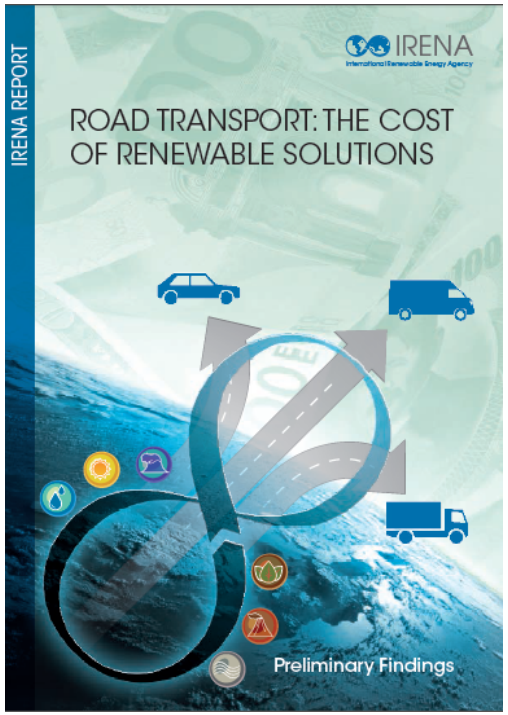

IRENA Renewable
COSTING ALLIANCE

Power generation LCOE

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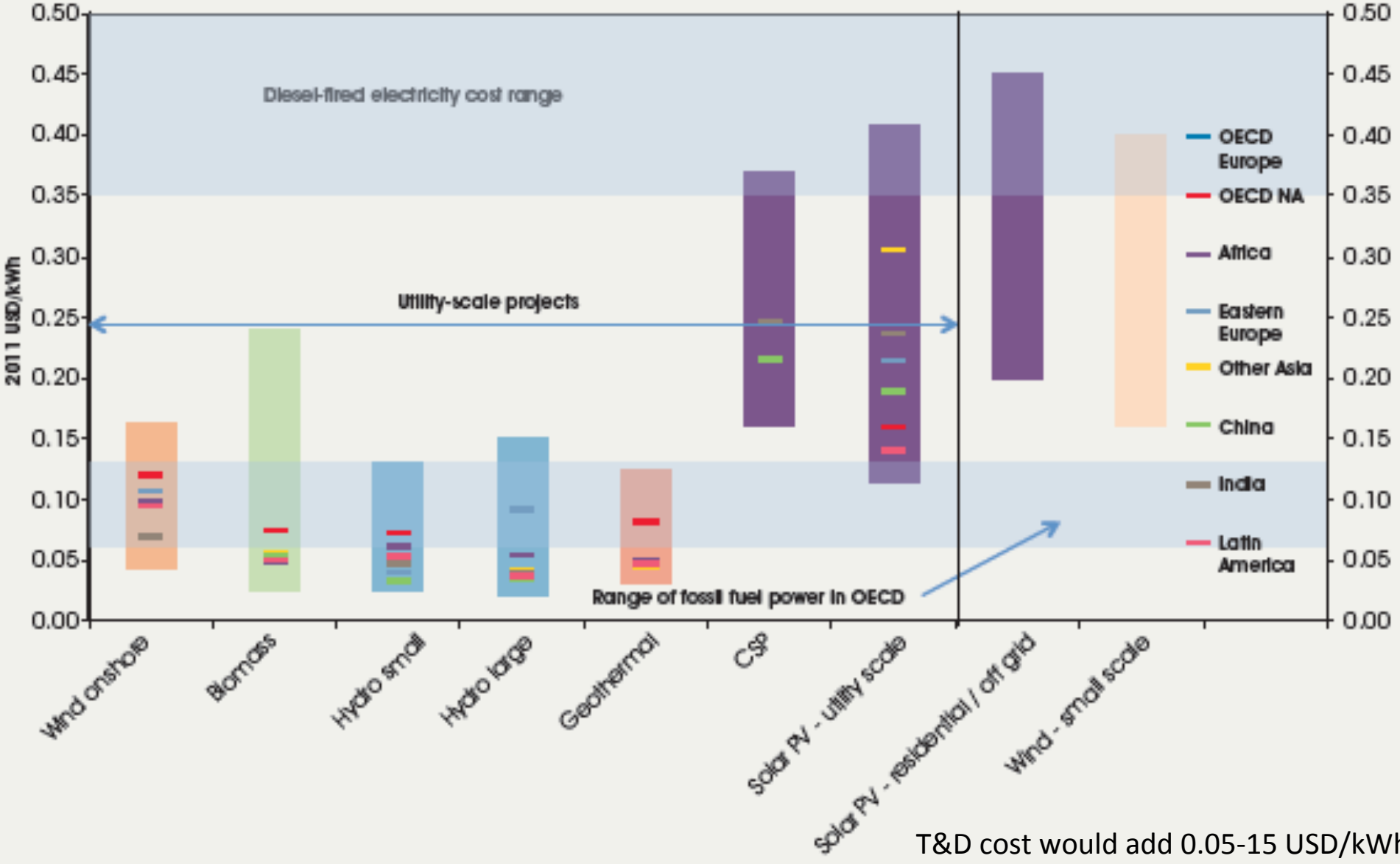

T&D cost would add 0.05-15 USD/kWh

Power generation LCOE

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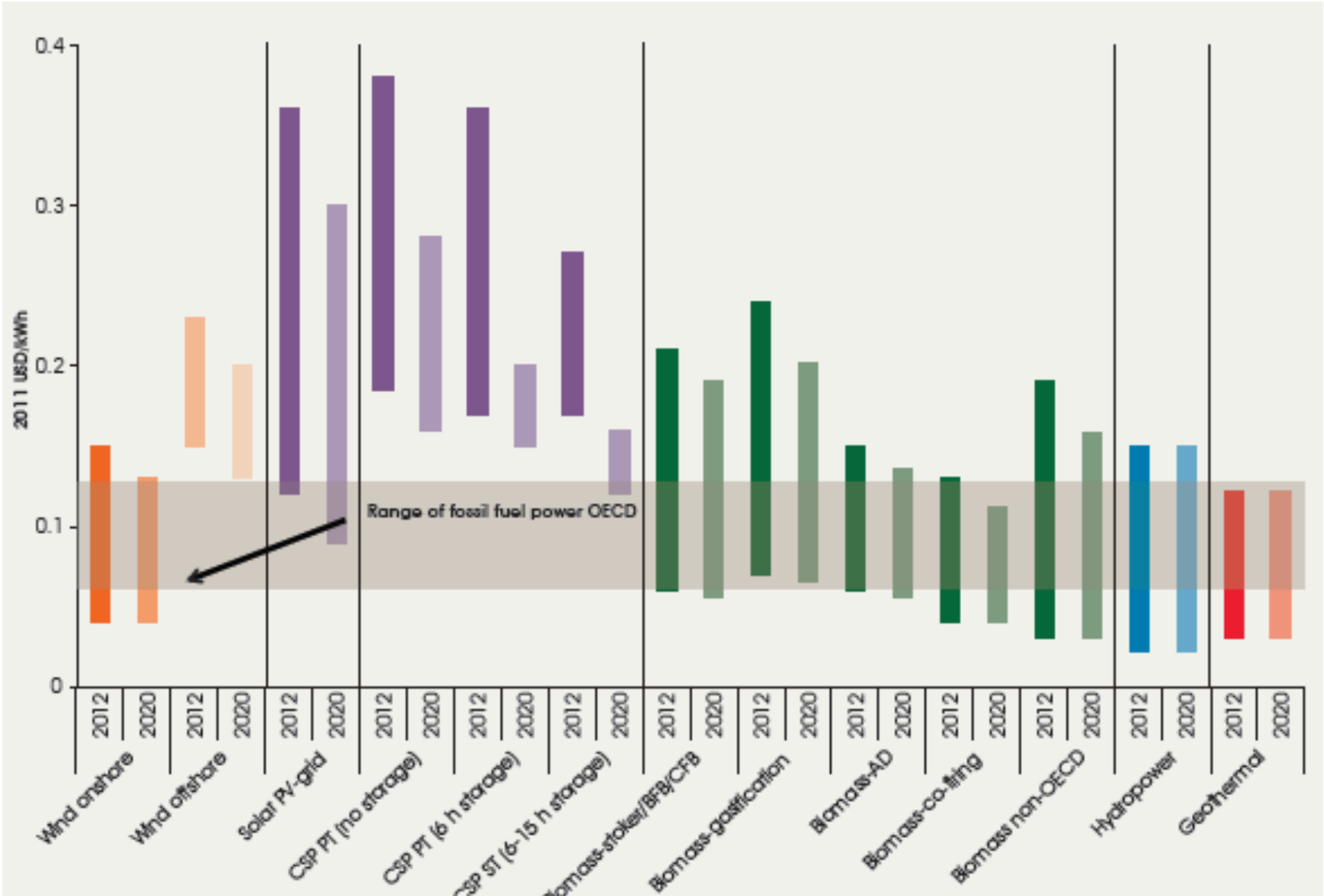

Transportation fuels
Production costs

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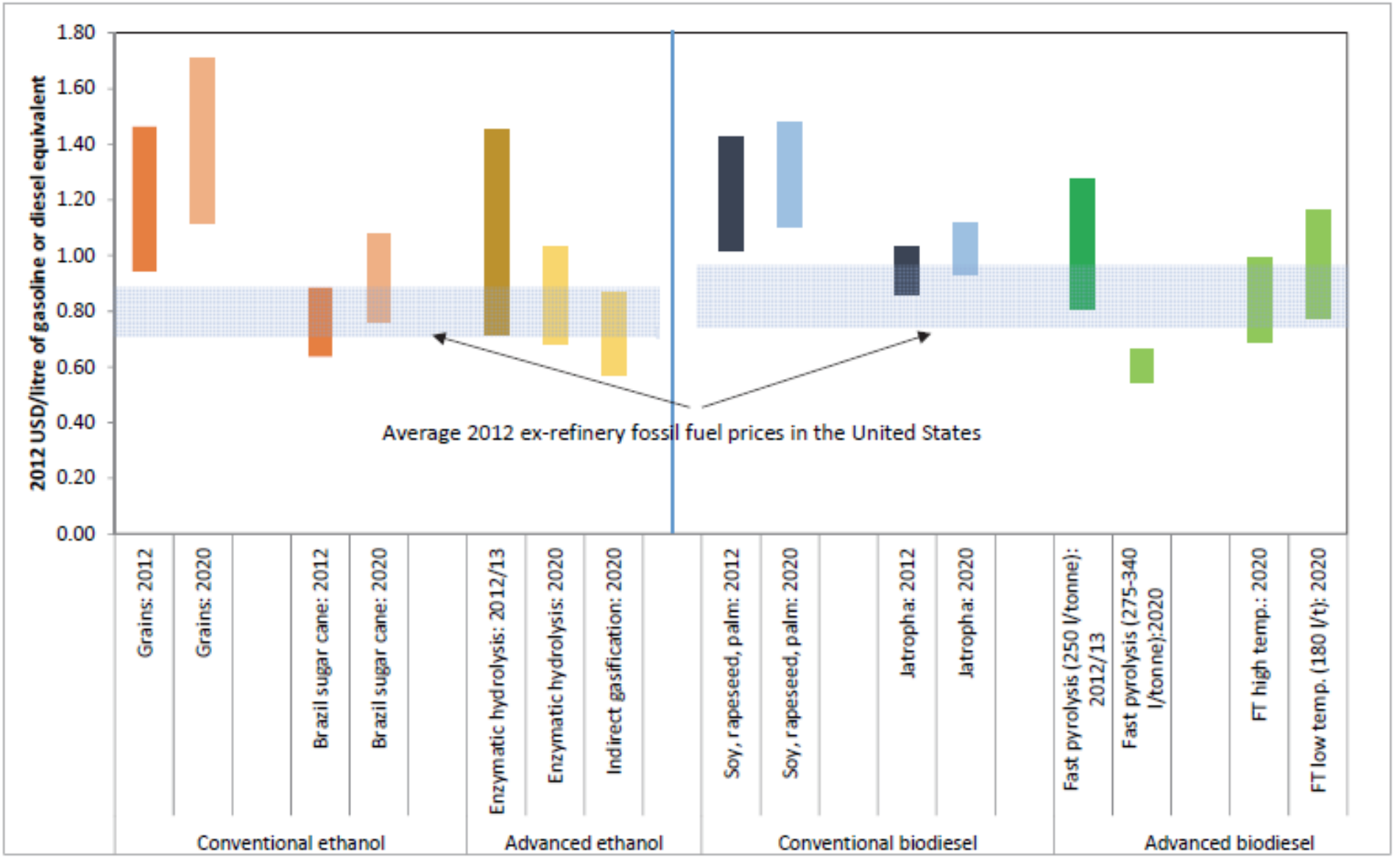

Technology briefs

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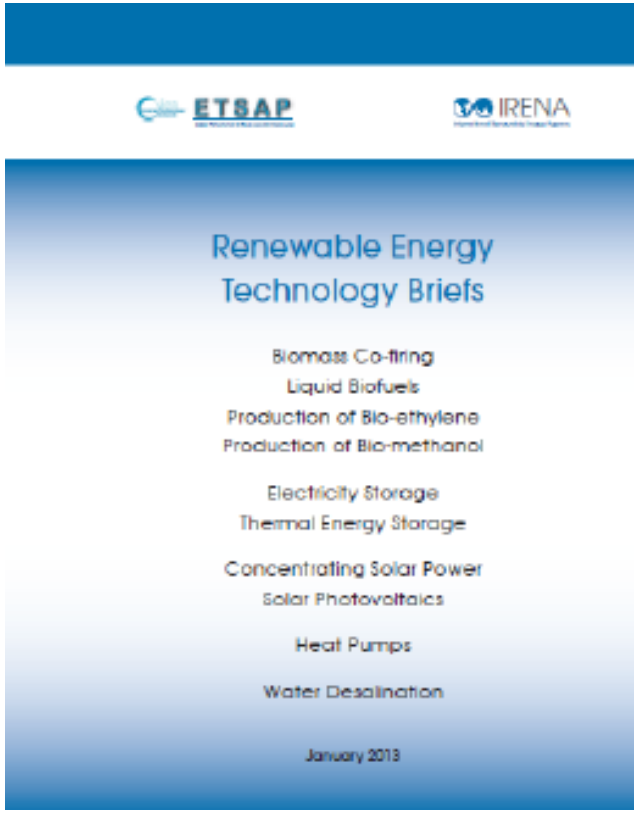
IRENA-ETSAP collaboration

- 10 ready, 15 in preparation
- Market trend
- Costs
- Technical parameters



Biomass co-firing
Liquid biofuels
Production of Bio-ethylene
Production of Bio-methanol
Electricity storage
Thermal Energy storage
Concentrating Solar Power
Heat Pumps
Water Desalination

Africa studies

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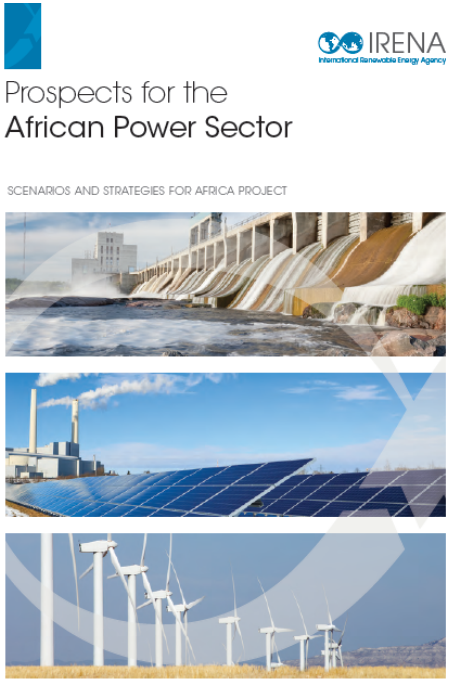
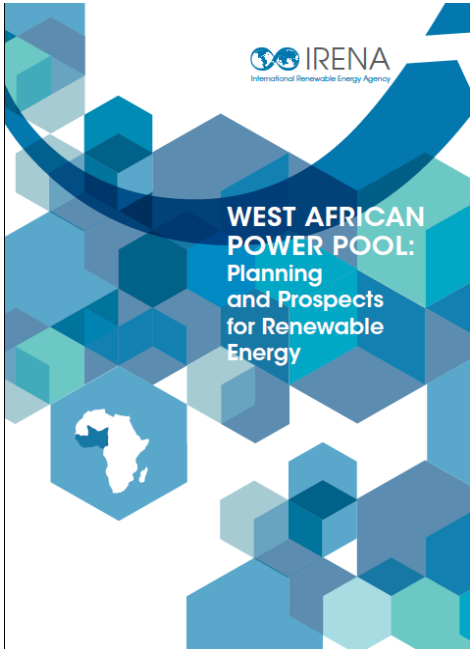
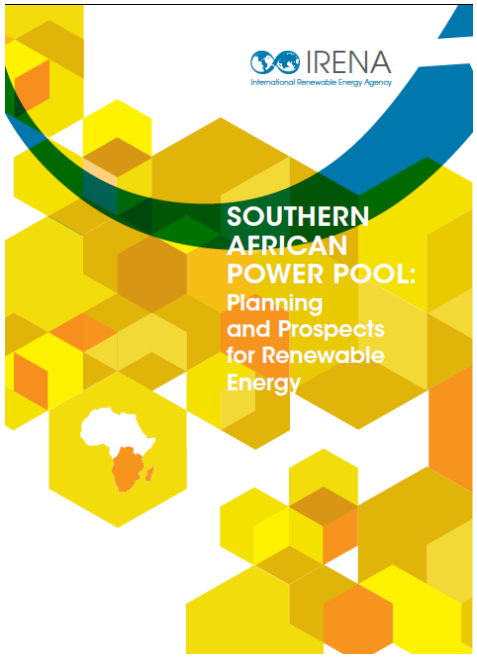


January 2012



June 2013
NEW



June 2013
NEW

Solar/Wind potential in Africa

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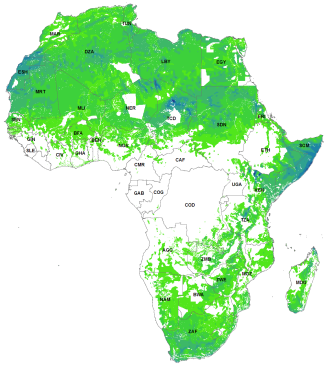
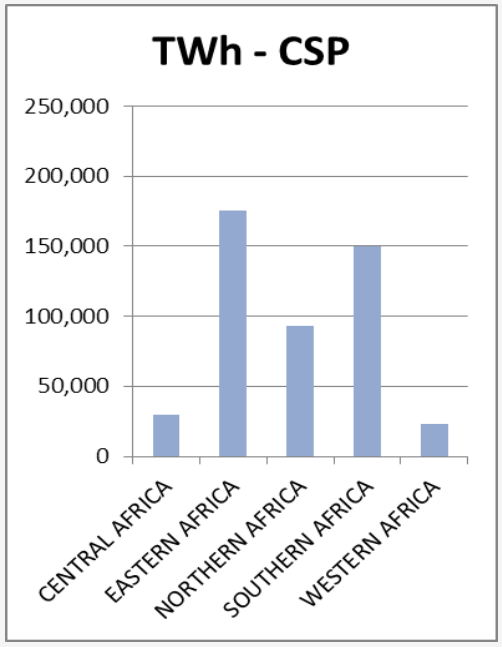
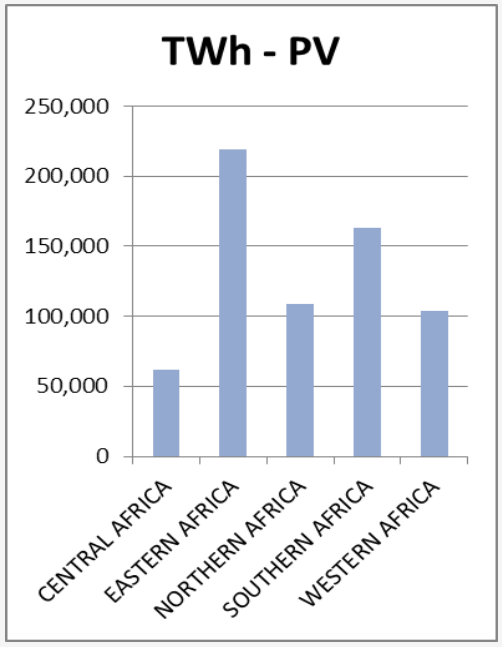
IRENA-KTH Study

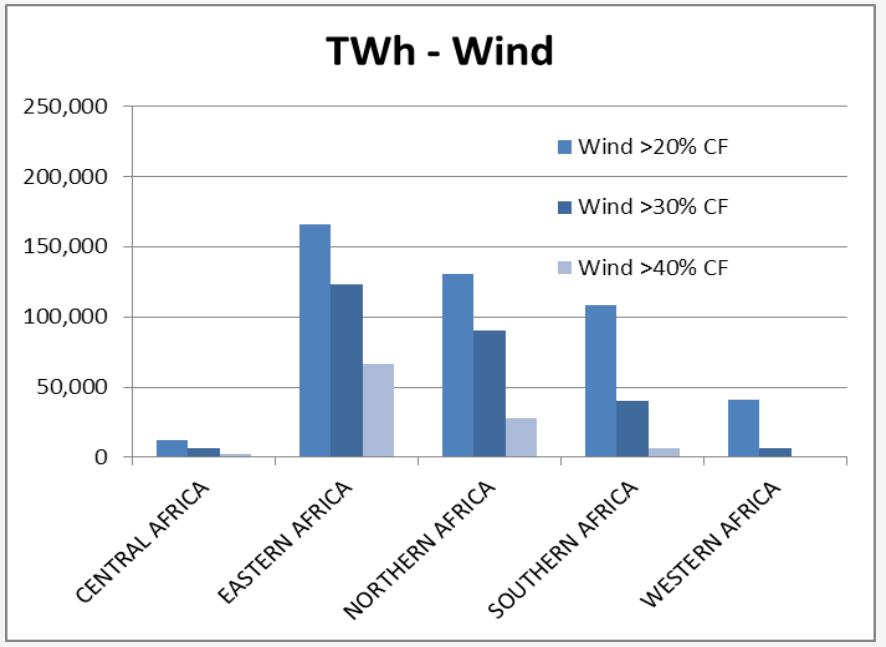


Exclusion zones:

- Water bodies
- Protected areas
- Forestry
- Urban settlements
- Agricultural land
- Sloped areas





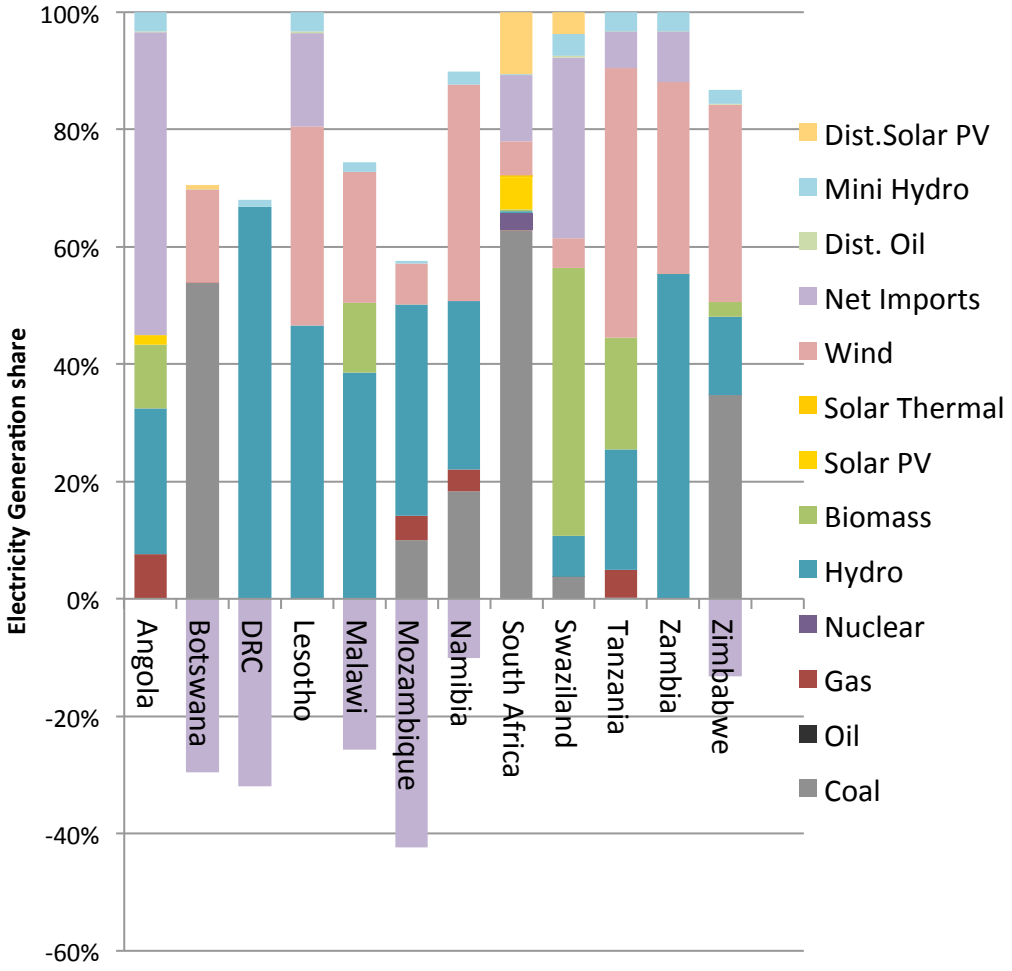


Modeling power sector in Southern and Western Africa

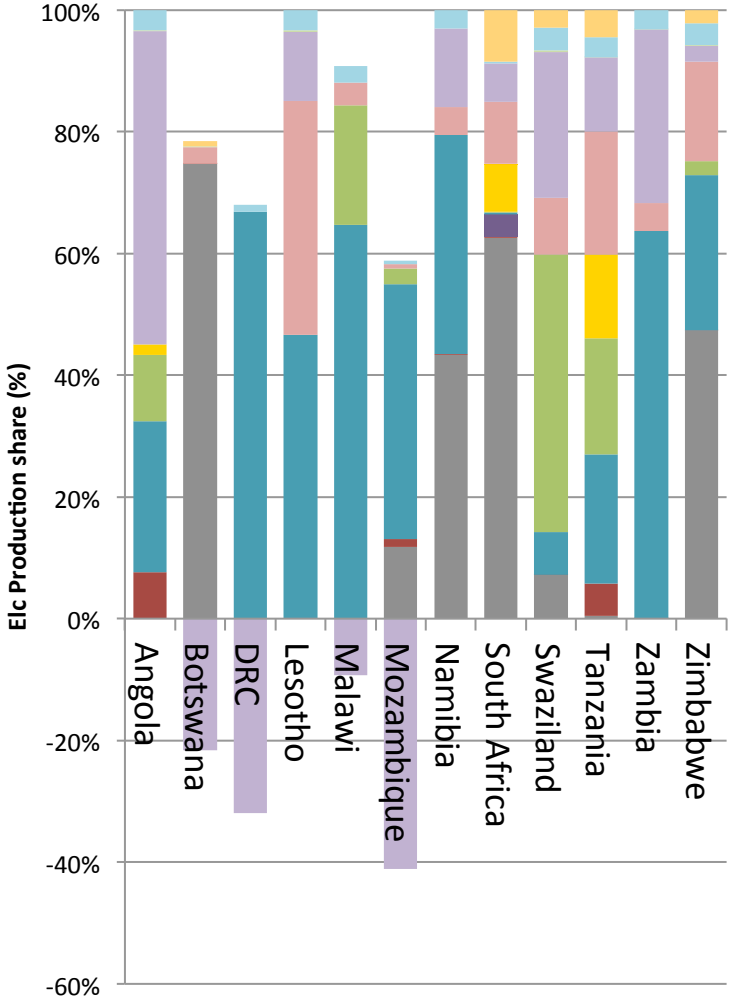
Special RE considerations:

- Site specific hydro power modeling (country specific cost supply curve)
- Storage options for roof top PV and CSP
- Capacity credit
  - Wind: country specific 0-20% depending on geographical distributions
  - Solar PV: 5%, solar CSP 15%
- De-rating RE capacity by the capacity factor to account for dispatch inflexibility
- Additional transmission investment (USD 365/kW; equivalent of LCOE 5 cents/kWh) to match the wind capacity when penetration is over 5% of total generation

Southern Africa: RE shares



Unified capacity credit (CC), no wind transmission costs



Country specific CC, with wind transmission costs

Modeling power sector
Further RE considerations

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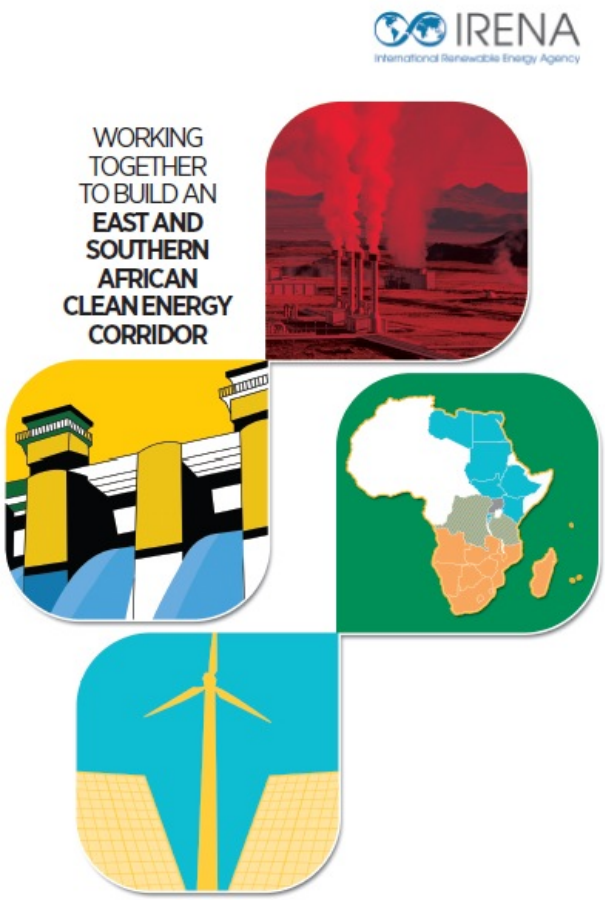
Special RE considerations:

- Seasonal variability of hydro and biomass resource supply
- Location specific capacity factor for solar PV
- T&D costs as a function of intermittent RE share
- Capacity credit of RE as a function of share
- Flexible demand
- Better modeling of ramp rate, start up costs, and minimum operation requirement
- Short term response services (to account for unpredictable variation of wind output)
- Parameterization of additional capacity requirements to account for predictable variation from the analysis of ramp-up needs on an extreme day

Power Pool Modeling next steps

Support for RE target setting for the ECOWAS region

- Data verification
- Development of new scenarios
- Capacity building



Clean Energy Corridor Project

- Support regional power pool development and integration for accelerated RE deployment
- Assist development of Master Plan fully accounting regional RE potential

Electricity Storage
Technology brief

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Installed capacity

- Pumped hydro: 150 GW in 2010 → 230 GW in 2020
- Battery storage in kWh scale
  - 77 MW advanced lead-acid capacity
  - <100 MW Lithium-ion capacity;
  - <50 MW NAS capacity

RE integration strategies for island states

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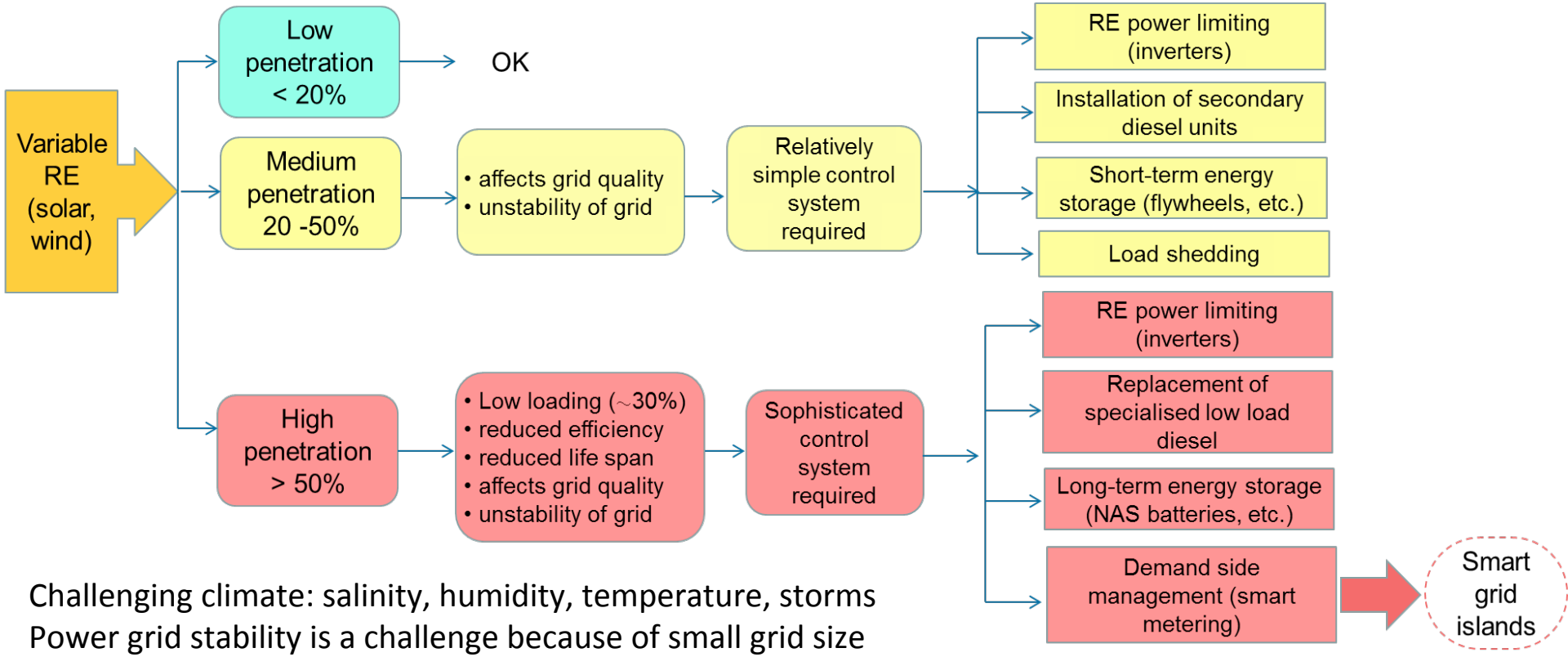
Technical and economic challenges rise as share of variable RE rises
A 100% transition is technically possible but the economic viability varies



Challenging climate: salinity, humidity, temperature, storms
Power grid stability is a challenge because of small grid size
Reliability of power generation

Grid stability analysis for island states

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- 5 pilot studies (Pacific and Caribbean) using Power Factory, focusing on frequency and voltage control
- How much RE can be integrated into small grids
- Technical solutions and their costs for RE integration
- Policy framework to reward flexibility
- Implications for a long-term investment planning

REMAP 2030

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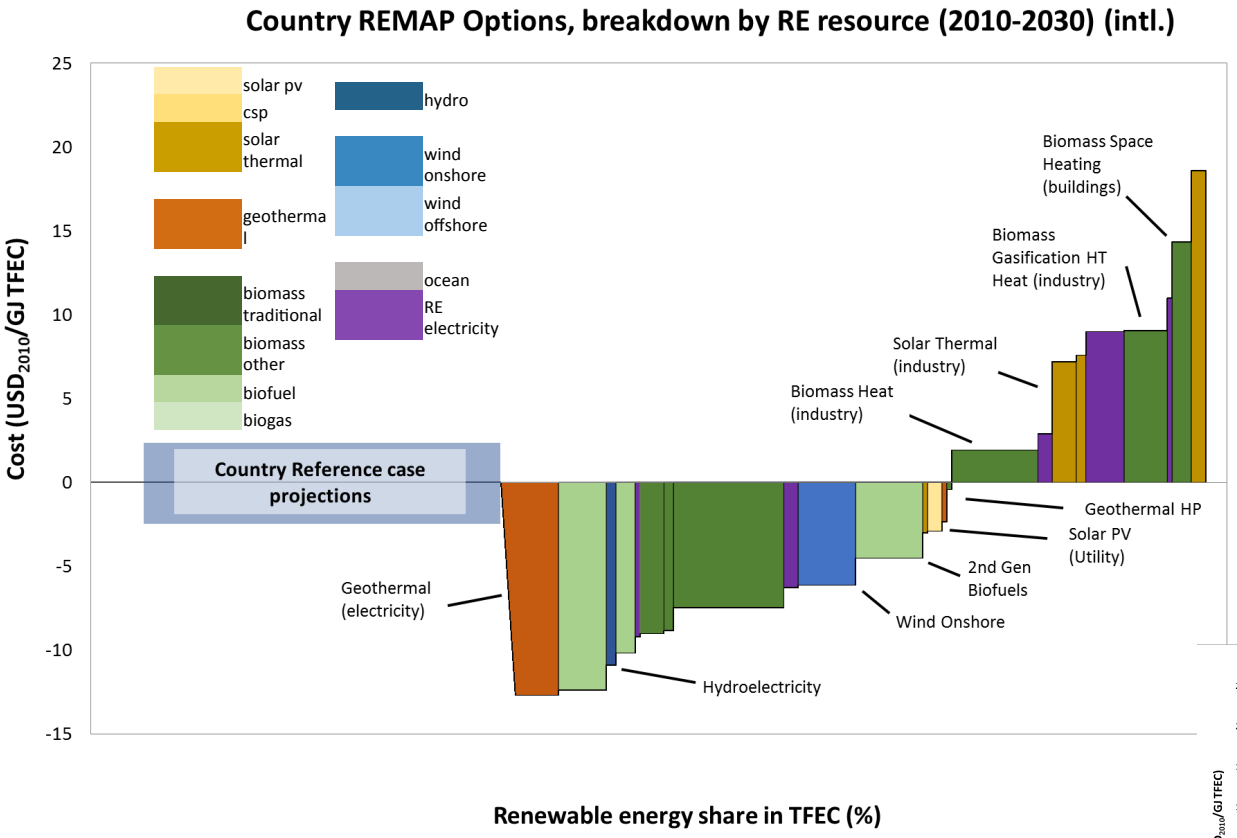
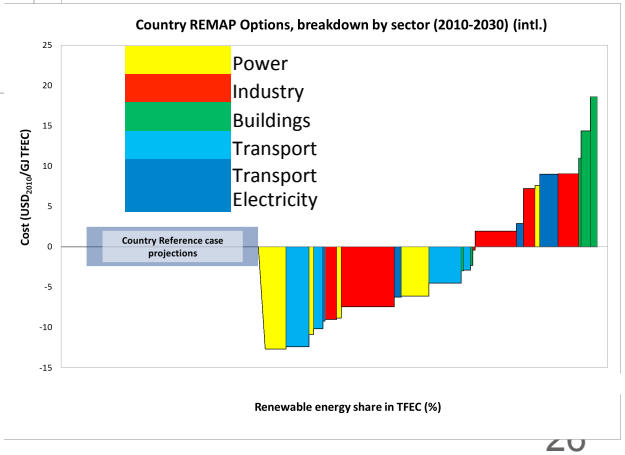
Global aspirational target of doubling the share of renewable energy by 2030 (SE4ALL)

- Global gap analysis based on collective bottom-up country/regional studies
- Bottom-up country studies supplemented by regional studies
  - Assessment of RE technology development according to energy master plans/policies
  - Assessment of costs/benefits associated with accelerated RE deployment beyond master plans
- Pilot studies with 24 major energy consuming countries and select smaller countries

Sample Cost-Supply Curve





REMAP collaboration with ETSAP

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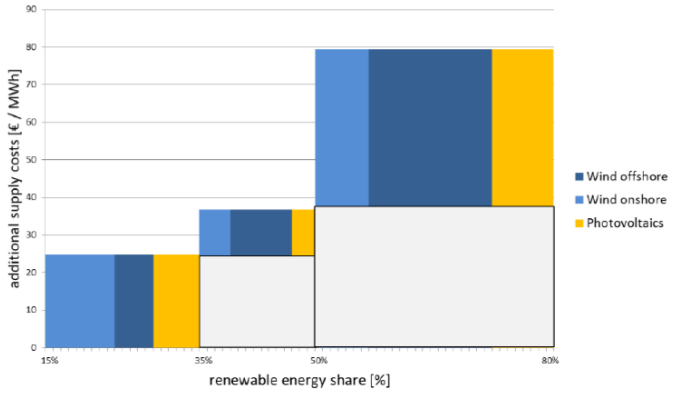
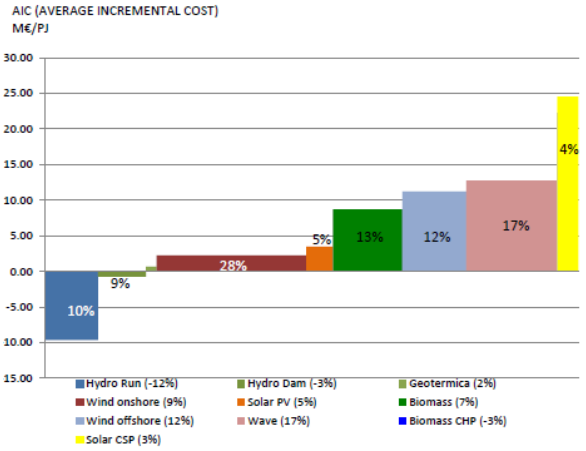
Development of country/regional cost-supply curve

- Supplement end-use technology oriented REMAP methodology
  - System integration costs
  - Path dependency
  - Trade etc
- Joint paper to be prepared
- Cooperation with RETD



Germany



Portugal

Topics covered

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Africa studies

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Grid and storage

- Technology brief
- Grid stability study for island states

REMAP 2030

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Thank you for your attention

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Power Generation Capital Costs

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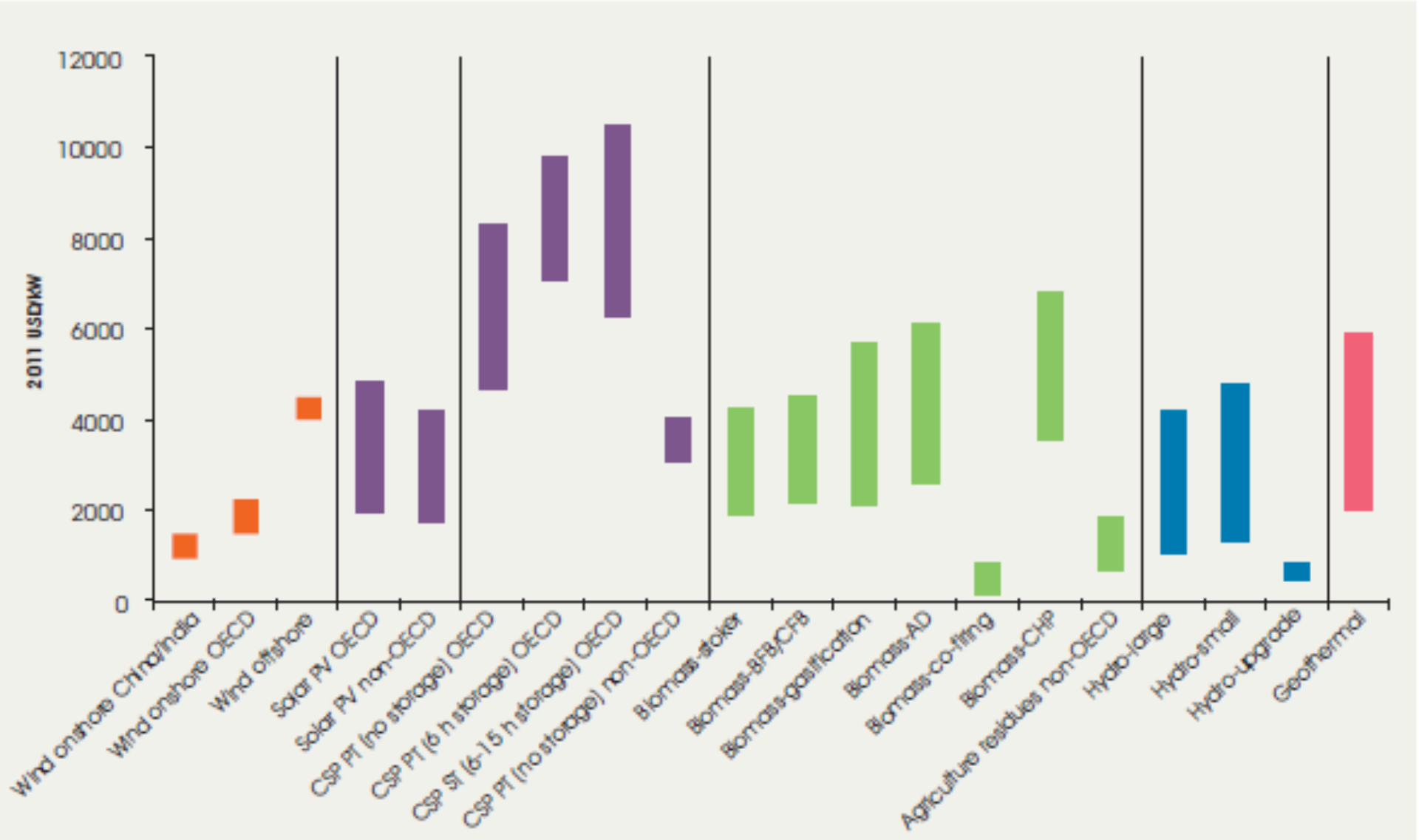
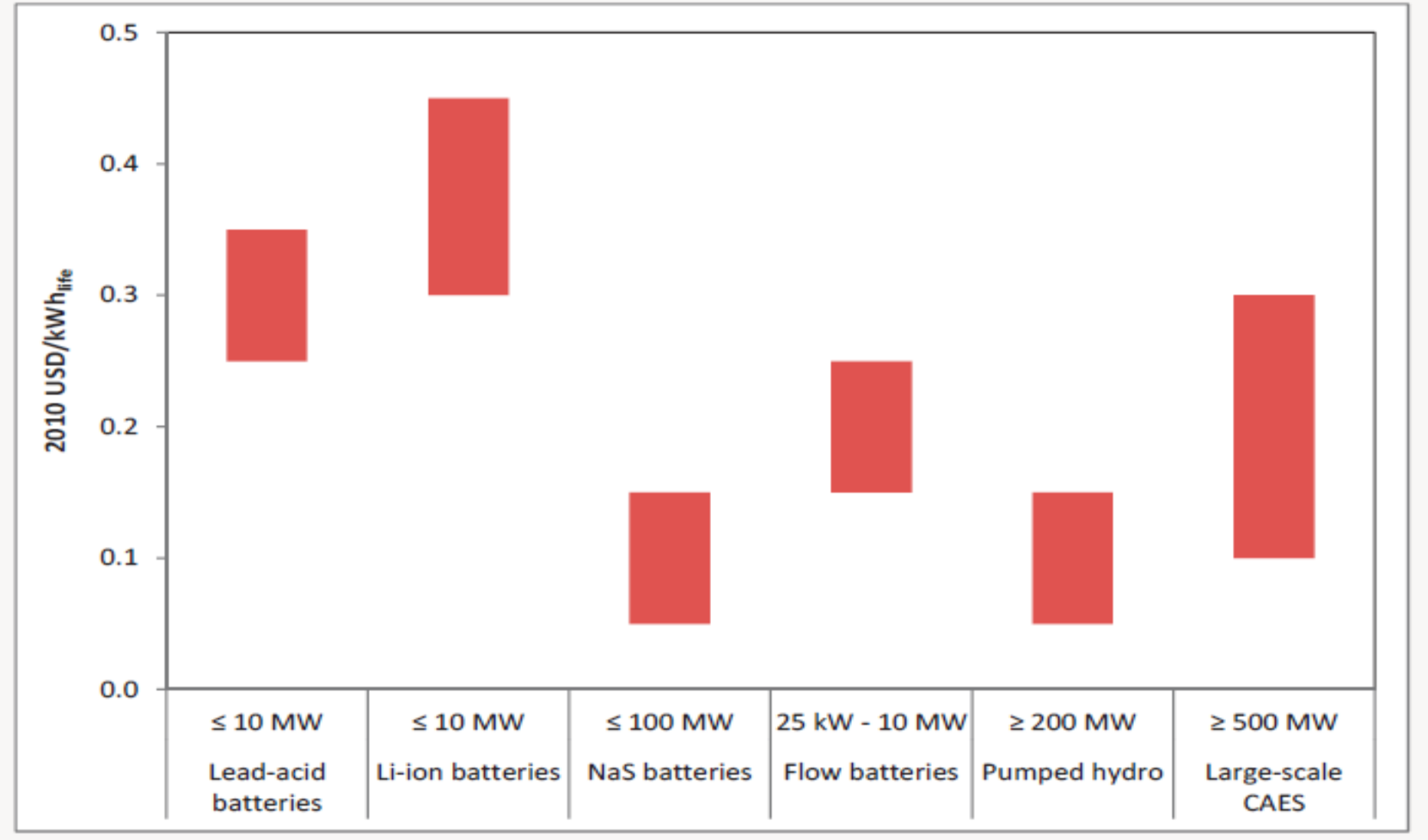


Electricity storage costs
A costly solution



Hydropower, including pumped hydro, will be crucial in integrating higher levels of variable renewables