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REmap 2030 and the Role of Storage

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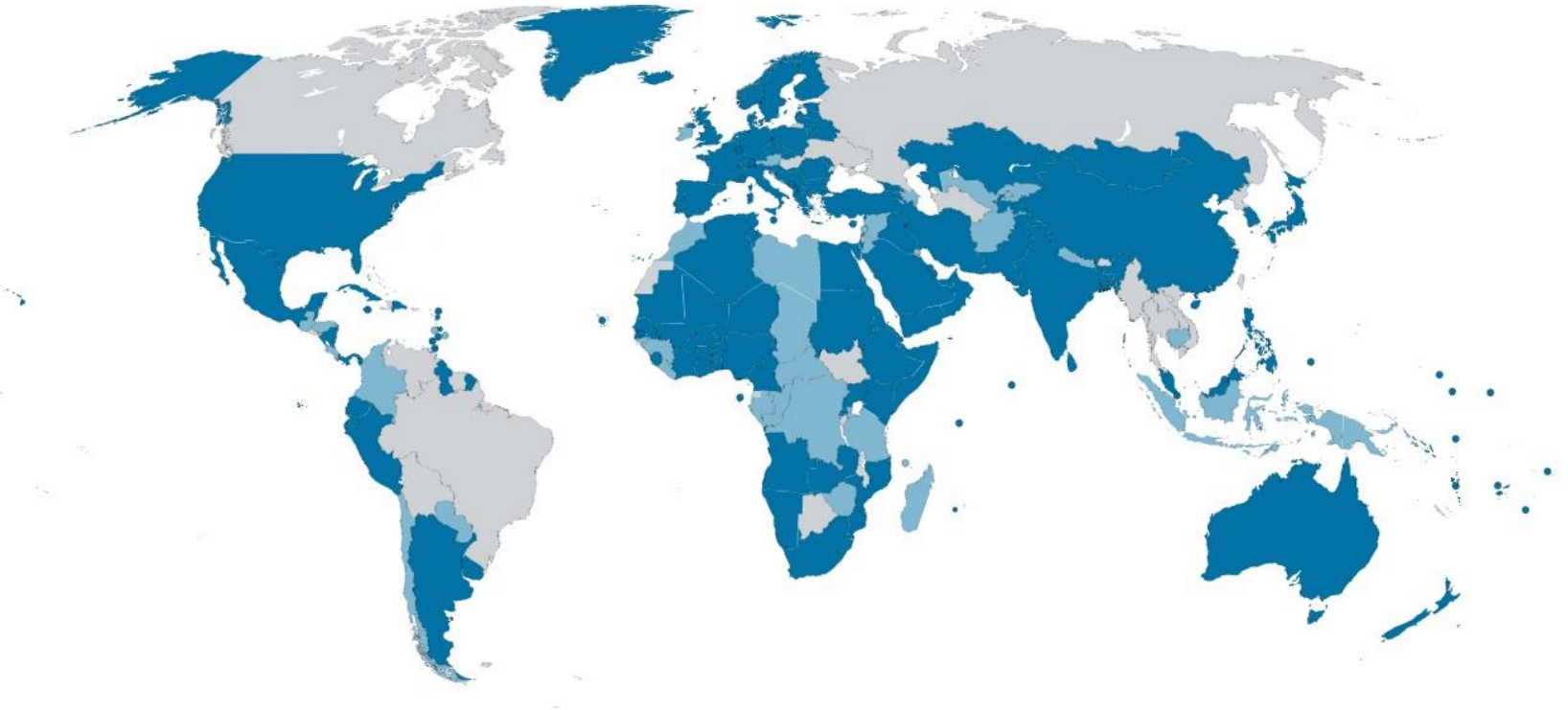
IRENA country membership is rapidly growing: 130 Members, 37 States in Accession



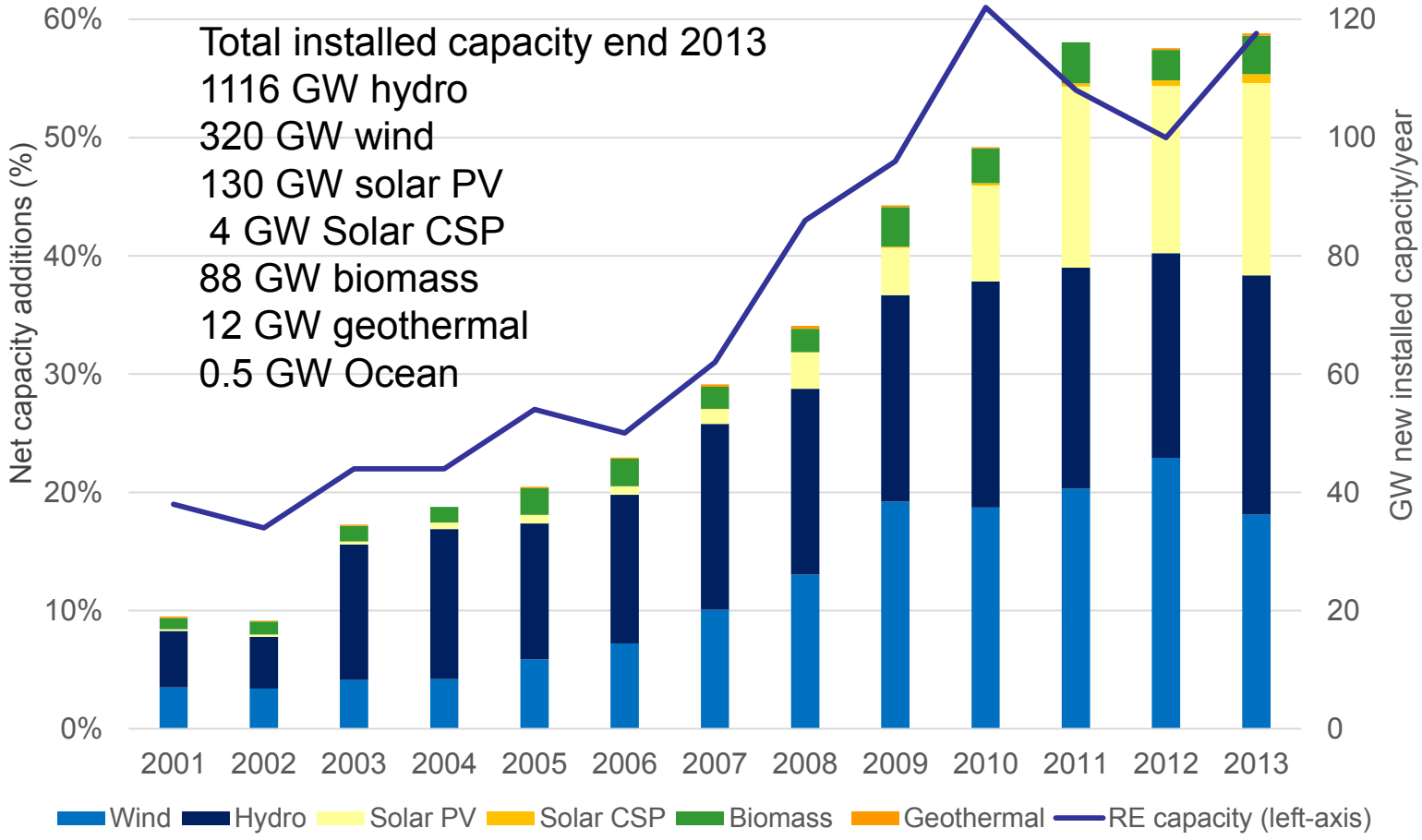
Established international cooperation framework for acceleration of RE deployment since 2011

Content

1. REmap 2030
2. The Role of Storage
3. IRENA Electricity Storage roadmap

About half of the new electricity generation capacity worldwide is based on renewable energy, largely of the variable type

The share has doubled in recent years



Source: Global data

Grid integration of variable renewables – storage is part of a package

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- Electricity supply must meet demand
  - Short term issues: frequency and voltage control (ST)
  - Long term issue: bulk storage (LT)
- Smart grids (information technology meets electricity grids)
- Supply side options
  - Regional spread (incl interconnectors) (ST/LT)
  - Diversify renewables resources (ST/LT)
  - Storage (ST/LT)
  - Backup capacity (eg gas turbines, NGCC, diesel engines) (ST/LT)
  - Export/import electricity (ST/LT)
  - Curtailment (ST)
  - Better forecasting (ST)
  - Enhance flexibility of fossil/nuclear plant (ST)
- Demand side management
  - Load shedding
  - Produce hydrogen, synthetic gas
  - Electric vehicles for storage, heatpumps etc

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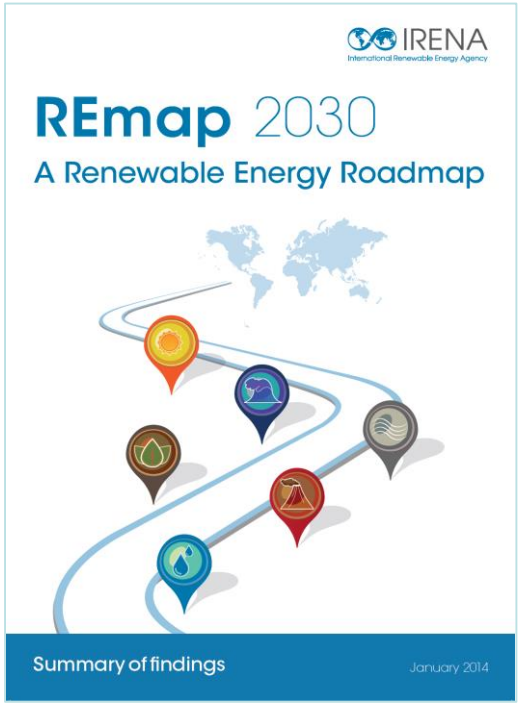
REmap 2030



What is REmap 2030?

Pathways for a doubling of the global RE share

IRENA is RE hub for SE4ALL: translate REmap into action

Technology options to meet the objective

Opportunities for international cooperation to realize this vision

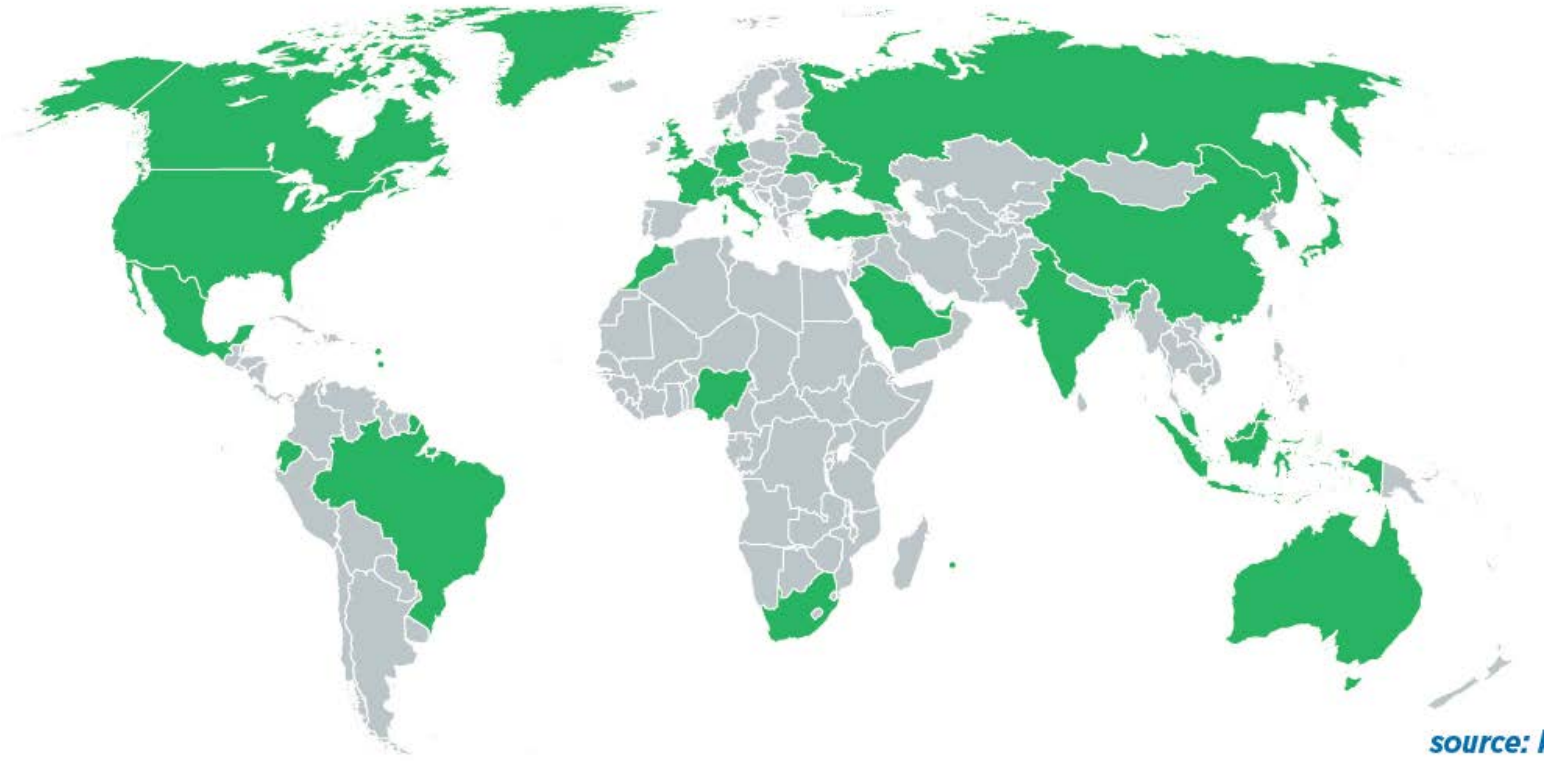
82 experts from 42 countries, 10 workshops, 3 webinars

REmap is an exploratory study, *not* a target setting exercise

Technology options instead of scenarios

- Based on national plans and scientific literature
- Characterized by their cost and potentials

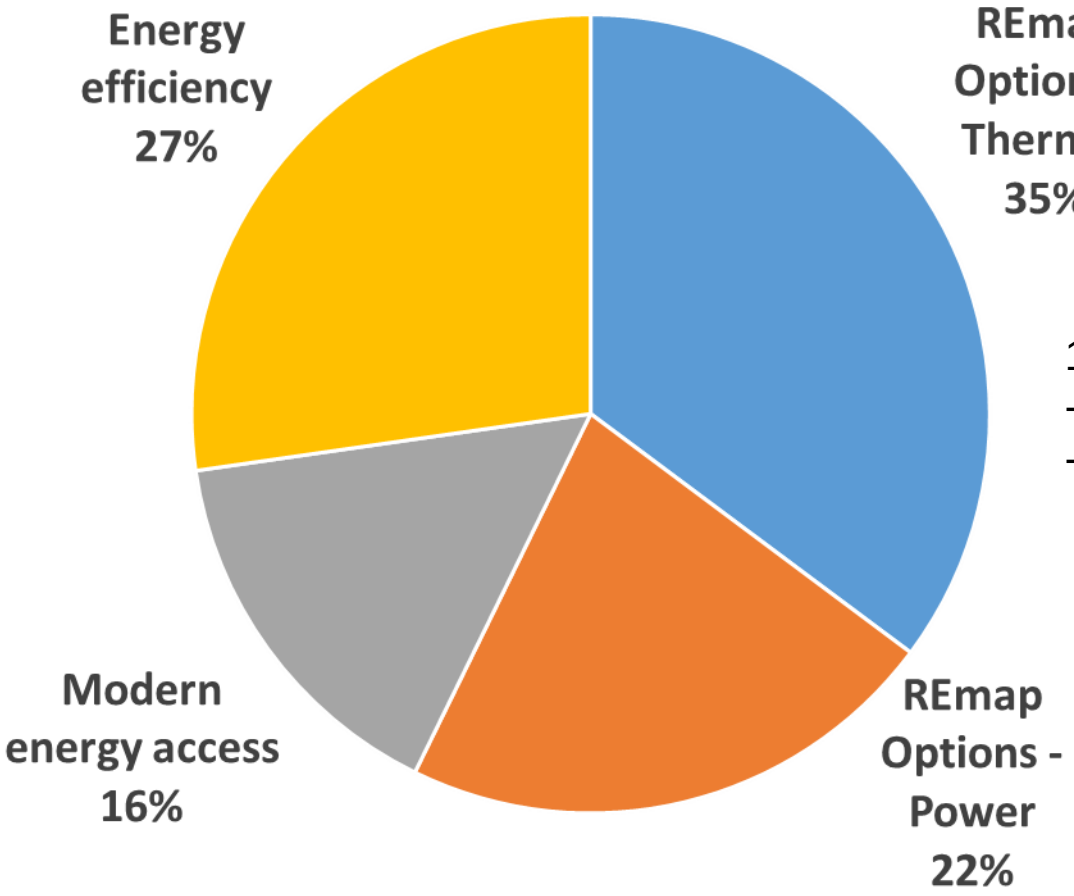
REmap 2030 coverage



26 countries representing **75% of global energy demand** in 2030

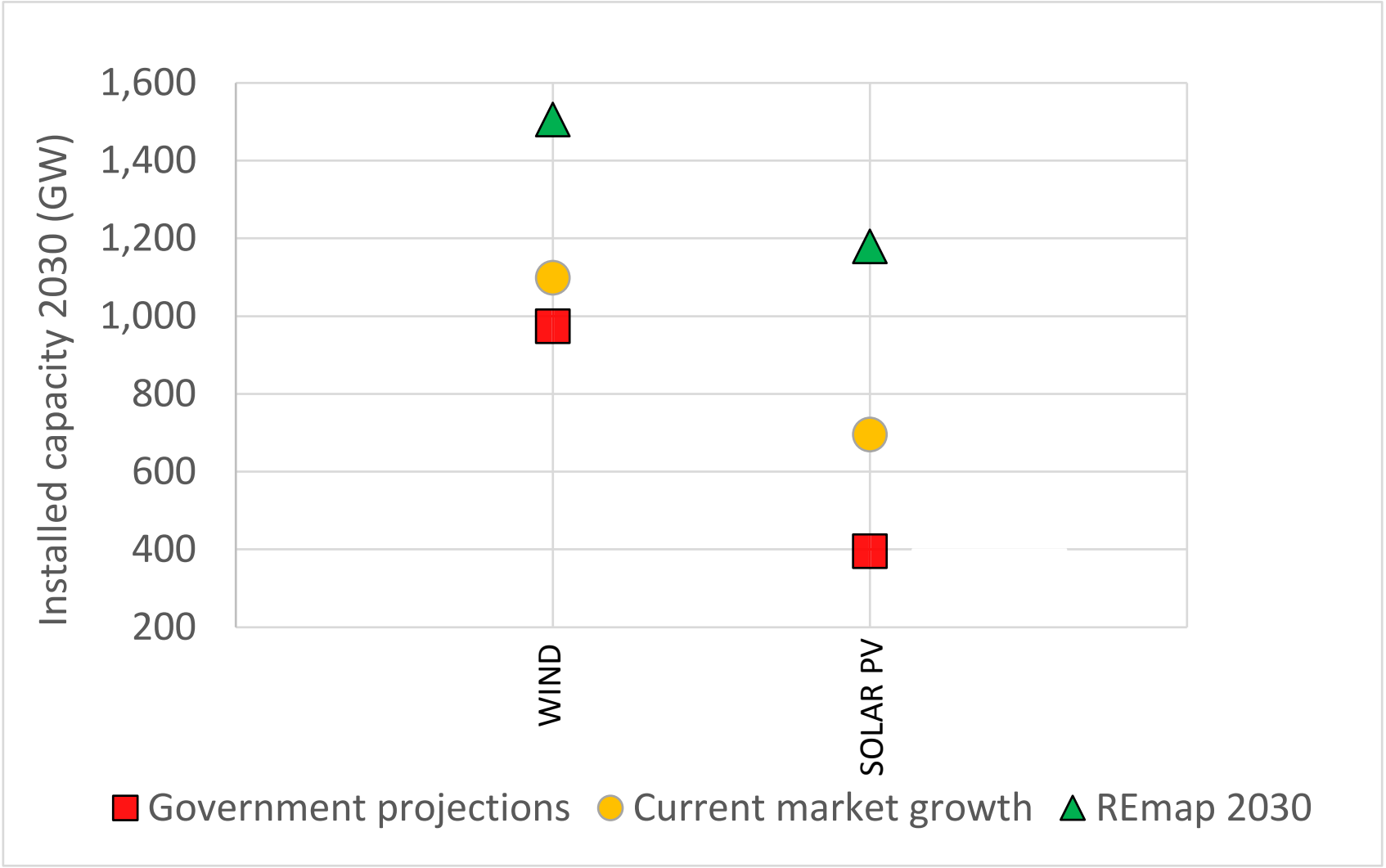
Country results are aggregated and extrapolated to global findings

Contribution to raising global modern RE share: from 14% in Reference Case to 36% in REmap 2030

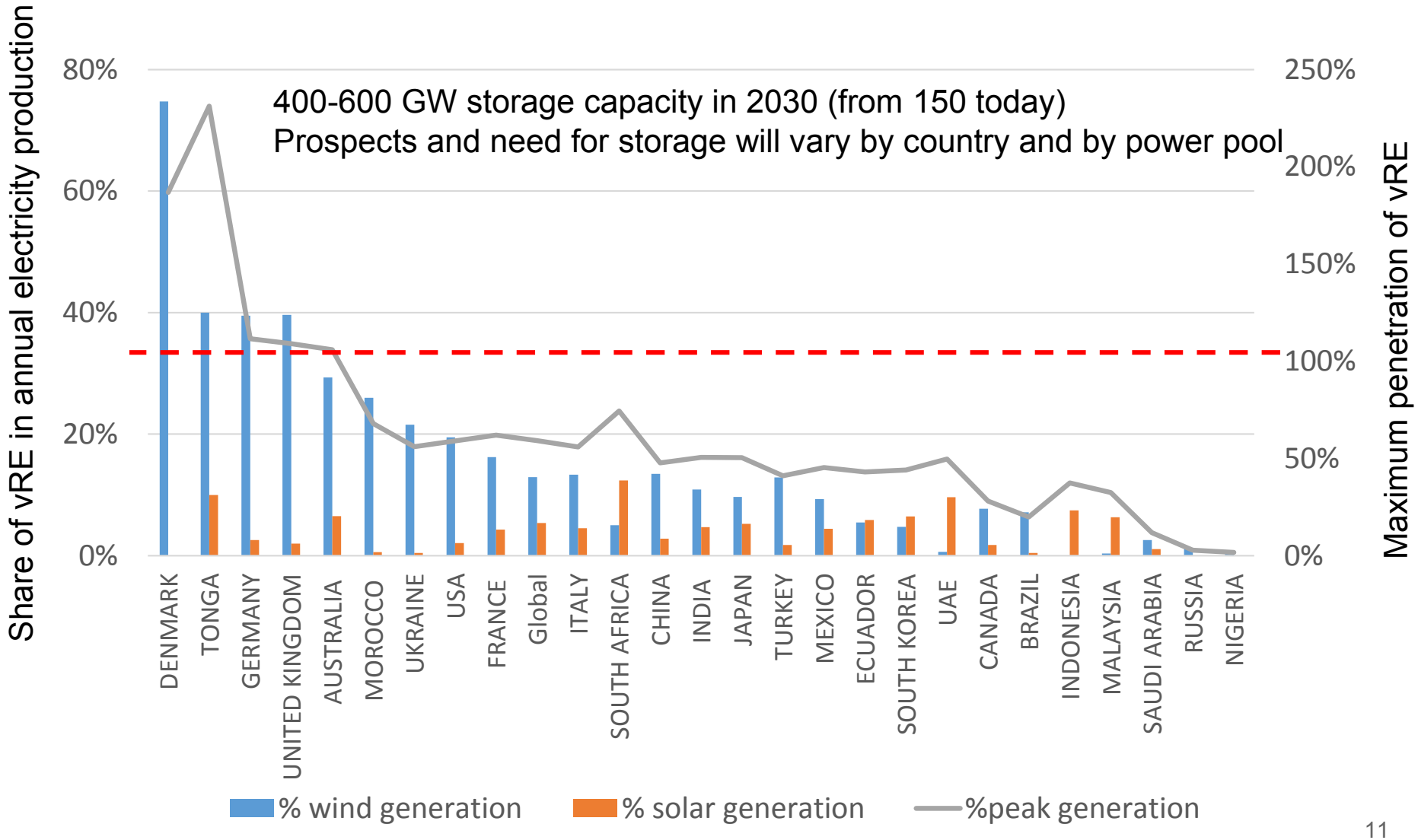


18% total RE in 2010
- 9% modern
- 9% traditional biomass

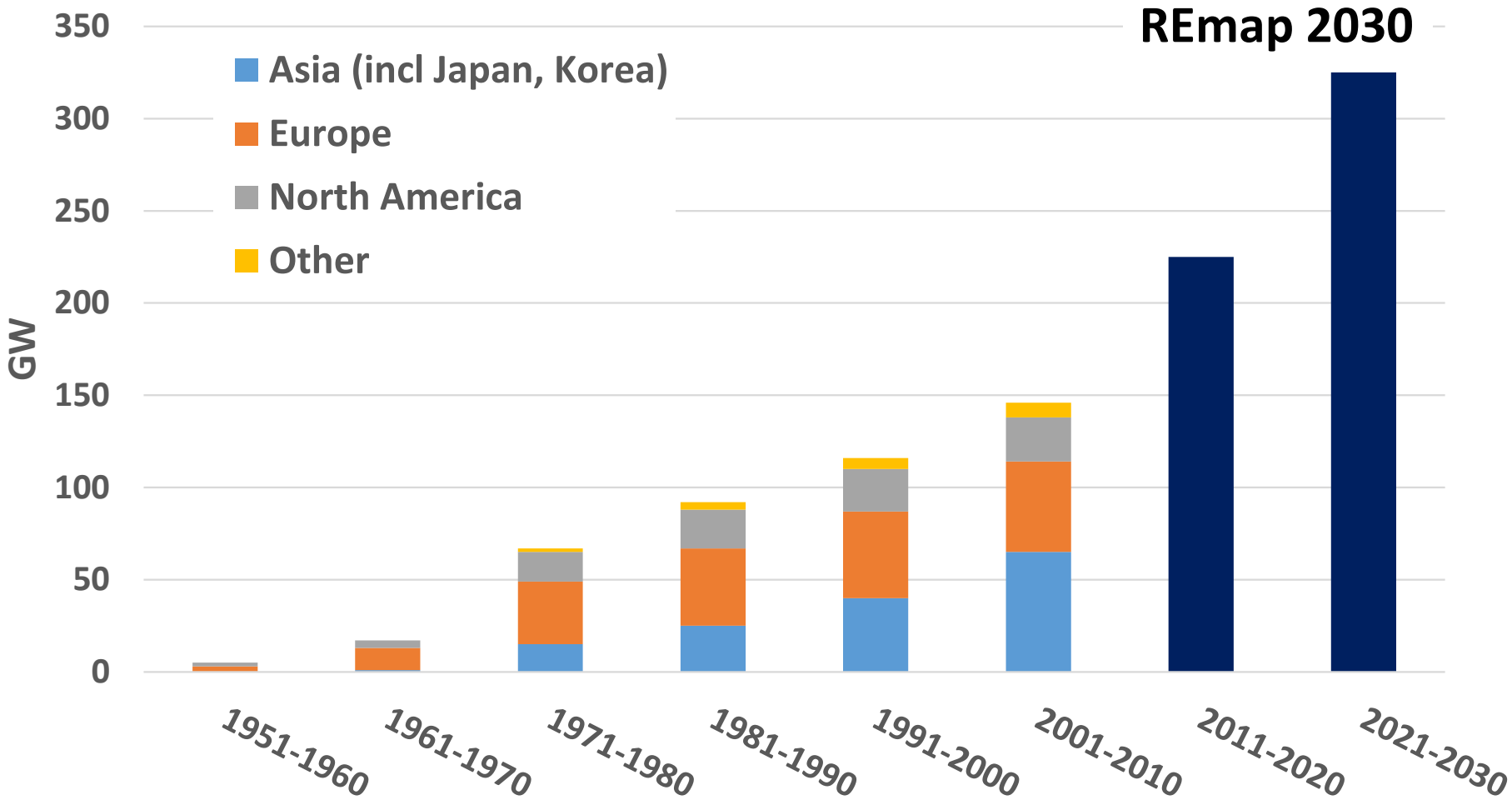
Governments underestimate growth of renewables



Shares of VRE in 2030

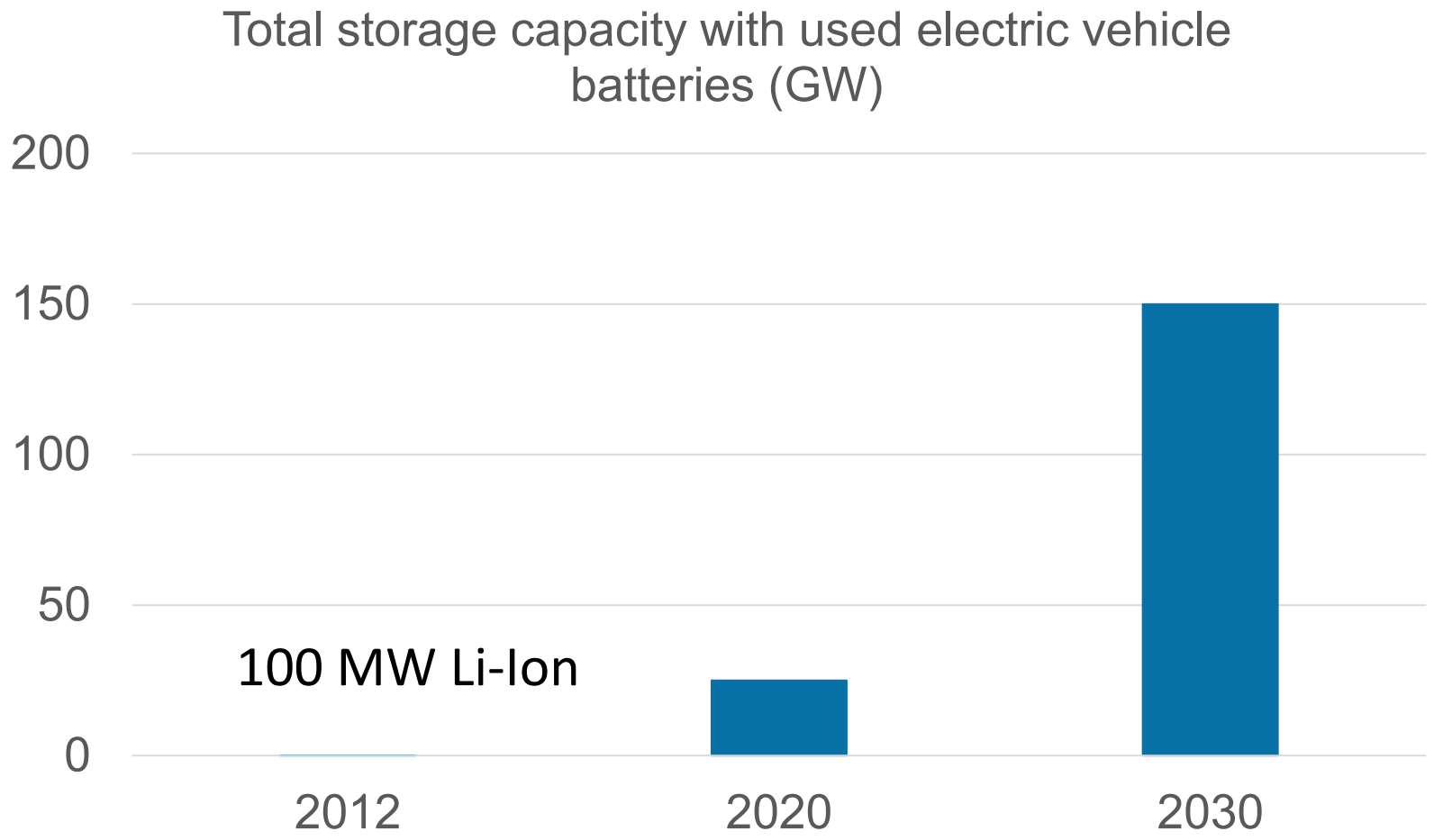


Pumped hydro



Electric vehicles & storage

Two options: used batteries or cars as storage option



25 million electric/PHEV vehicles in 2020, 160 million in 2030

Importance of grids for investments

40% of power sector investment needs

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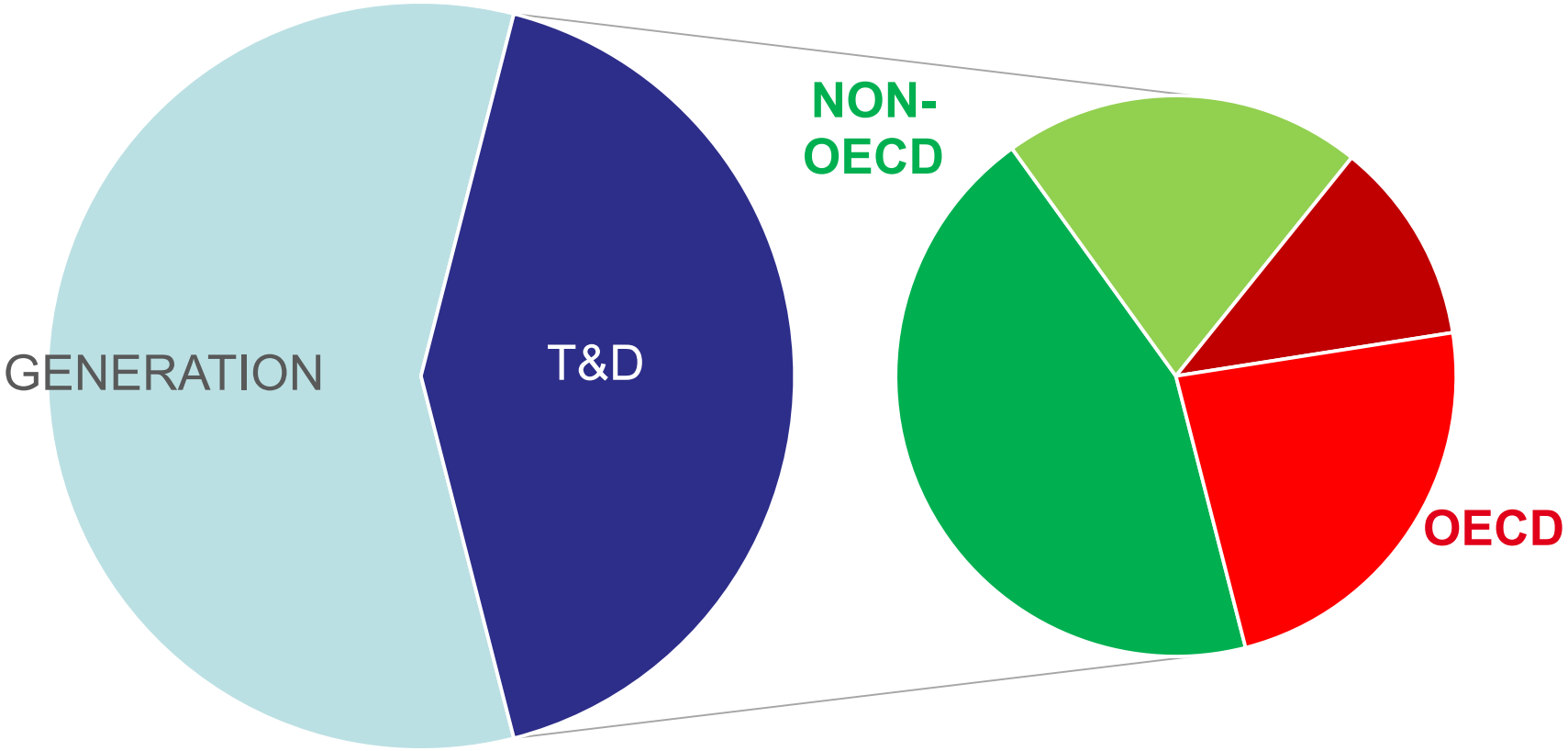
Total power sector investment needs up to 2035
(17 trln dollars)

Source: IEA WEO 2013

IEA estimates 5% of T&D cost for RE integration



2 THE ROLE OF STORAGE

Types of storage technologies

- Large scale electricity storage
  - Pumped hydro 150 GW
  - Compressed air electricity storage <0.5 GW
- Small scale electricity storage
  - Batteries <0.5 GW (NAS, Li-ion, lead-acid etc)
  - Redox flow batteries <0.1 GW
- Thermal storage (CSP<1 GW); cold storage (ice)
- Chemical products
  - Hydrogen and derivatives (eg power to gas) – not practiced today but technically feasible
- Fly wheels, capacitors for frequency control, not for bulk storage
- High storage efficiency is important for cost-effective storage
- Cost per kWh is inversely proportional with number of storage cycles
  - Seasonal battery storage makes no economic sense

IRENA grids & storage studies to date

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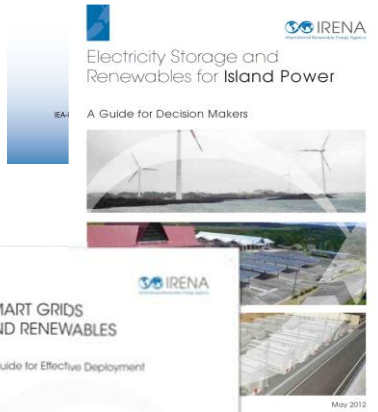
1. Technology brief on electricity storage
   - Pumped hydro dominant with 95% of storage capacity (150 GW compared to 5500 GW power generation cap)
   - New battery developments promising, but high cost
2. Storage for Islands: Guide for Decision Makers
   - Storage can increase efficiency of diesel generators even in absence of renewable
   - System integration is key factor
   - Transport costs of equipment, maintenance and operation can be complex
3. Smart grids and renewables
   - Important new technology solutions are emerging
   - Distributed storage is one of them
   - Complementary policies and regulations needed
   - Standards and grid codes
   - Set rules for ownership/control of distributed storage
- Grid stability studies



IOREC
International Off-Grid Renewable Energy Conference & Exhibition

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2nd International Off-grid Renewable Energy Conference and Exhibition (IOREC)

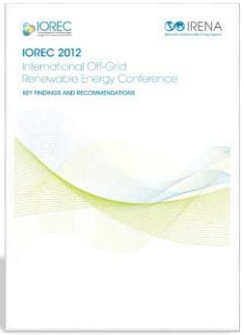
16-17 June 2014, Manila, Philippines

A biannual event on scaling up rural electrification through off-grid RE (mini-grids and stand-alone). The event is co-organised by IRENA, Asian Development Bank and Alliance for Rural Electrification.

The conference marks the beginning of the **Asia Clean Energy Forum 2014.**

IOREC 2012

- 350+ participants from more than 80 countries
- Representatives from 30 Rural Electrification Agencies and Ministries in charge of RE
- Speakers from 23 Countries



Objectives

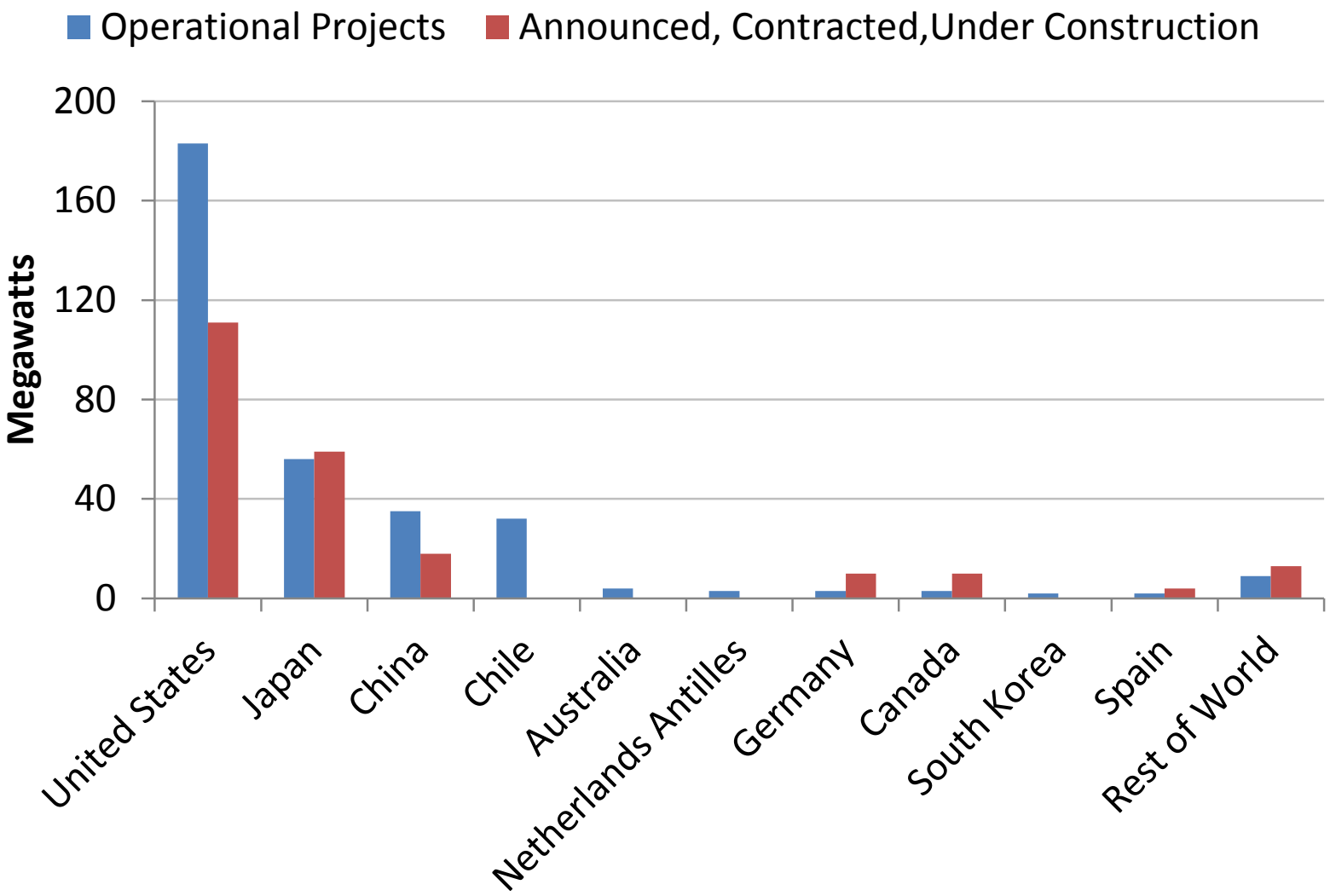
- Global platform to share experiences, lessons learned and best practices
- Discuss key barriers for stand-alone and mini-grid RE system deployment
- Connect stakeholders across the off-grid RE value chain

Topics to be covered

- Policy frameworks for off-grid RE scale-up
- Financing and business models for off-grid RE
- **Technology innovation, including storage**

For more information, visit: www.iorec.org

Electricity storage battery projects

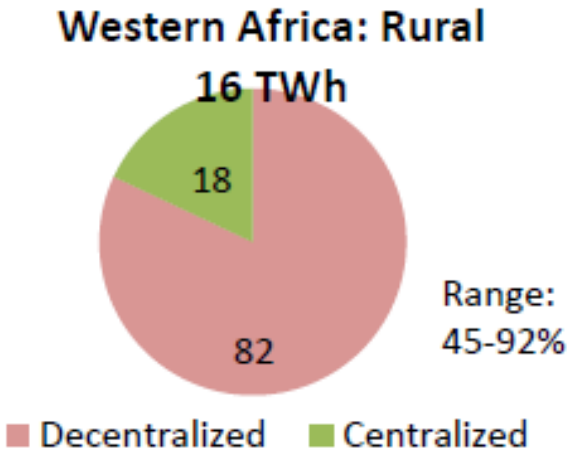


Data: DOE Global Energy Storage Database

Storage market

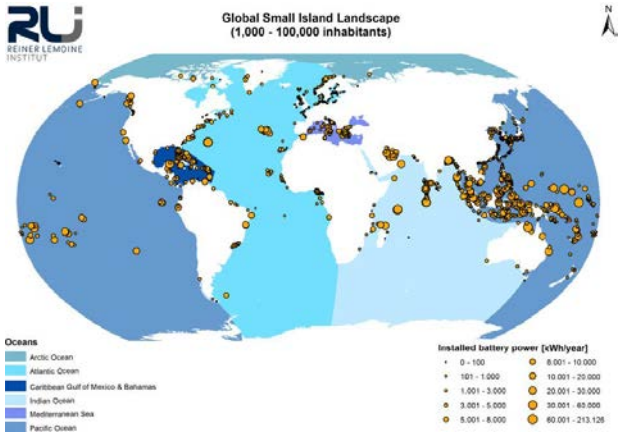
MINI-GRID & OFF-GRID

Source: IRENA 2012



ISLANDS

Source: Blechinger et al. 2014



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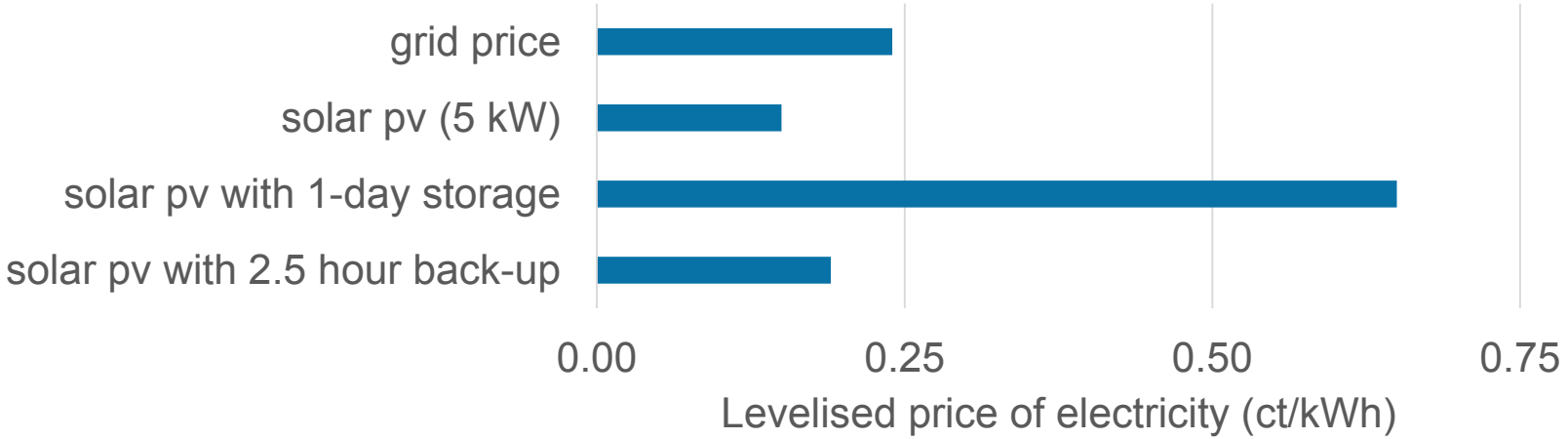
Source: Photon Consulting 2012



Storage Economics

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- Electricity prices do NOT reflect marginal cost in most markets for most consumers
  - This affects the storage business case for PV
- Variable renewables can affect the peak pricing
  - It is not possible to operate new pumped hydro competitively in Germany **because of** variable renewables
  - Pricing/market reform is a top priority
- Economics depend on the future of the system design (centralised/decentralized/demand development/peak reduction)
- Battery storage make economic sense where consumer prices are high
  - High taxes and levies (eg Germany)
  - High grid cost due to low demand density (eg South Australia)
  - High production cost due to diesel generators (islands, rural Africa etc)
- Battery systems 300-500 USD/kW used daily make economic sense
- Systems much more expensive than battery packs alone
- Distributed batteries can save on distribution cost

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IRENA ELECTRICITY STORAGE ROADMAP

Electricity Storage roadmap (1)
Largely technology oriented

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Organisation	Focus	Output
IEA	Global	Recommendations for action; IC
EASE/EERA	EU	RD&D priorities
NEDO	Japan	Performance indicators
ADEME	France	R&D priorities, barriers
CFLCF	UK	R&D priorities, barriers
NAATBatt	US	Survey
NY_BEST	New York	Policy proposals
Fraunhofer ISI	Electric Mobility	Performance indicators, R&D
U.S. DRIVE	Electric Mobility	Performance indicators, capacity
RECHARGE	Electric Mobility	Policy proposals

IRENA Technology Roadmaps Market & policy oriented

- **Aim:** Identify *key areas for international cooperation* to support the integration of variable renewables and the transition of the power infrastructures
- **Objectives**:
  - Address key techno-economic questions by policy makers
  - Explain relationship between policy and technology deployment
  - Provide platform for interaction between multiple stakeholders
  - Allow for prioritization of activities
- **Methodology:**
  - **Literature Review:** Bringing together existing roadmaps and studies from different countries
  - **Stakeholder workshops:** Understanding the needs from policy makers and other stakeholders

Workshop questions

- ***What electricity storage markets and applications*** *will be most relevant for the deployment of renewables?*

- *Which **technology developments** in storage are needed to facilitate renewable energy grid integration?*

- *What will be the **key drivers for commercialization** of electricity storage technologies for renewables deployment?*

- *Which **policies and regulations** for electricity storage are needed to support the accelerated deployment of renewables?*

- *Based on the answer above, what are the three key areas where IRENA members can support the electricity storage for renewables through **international cooperation** activities?*

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THANK YOU !

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