Offgrid and minigrid renewable energy technologies and systems

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This presentation

- The energy access challenge
- Energy scenarios for Africa
- Offgrid and minigrid technologies
- The role of technology standards

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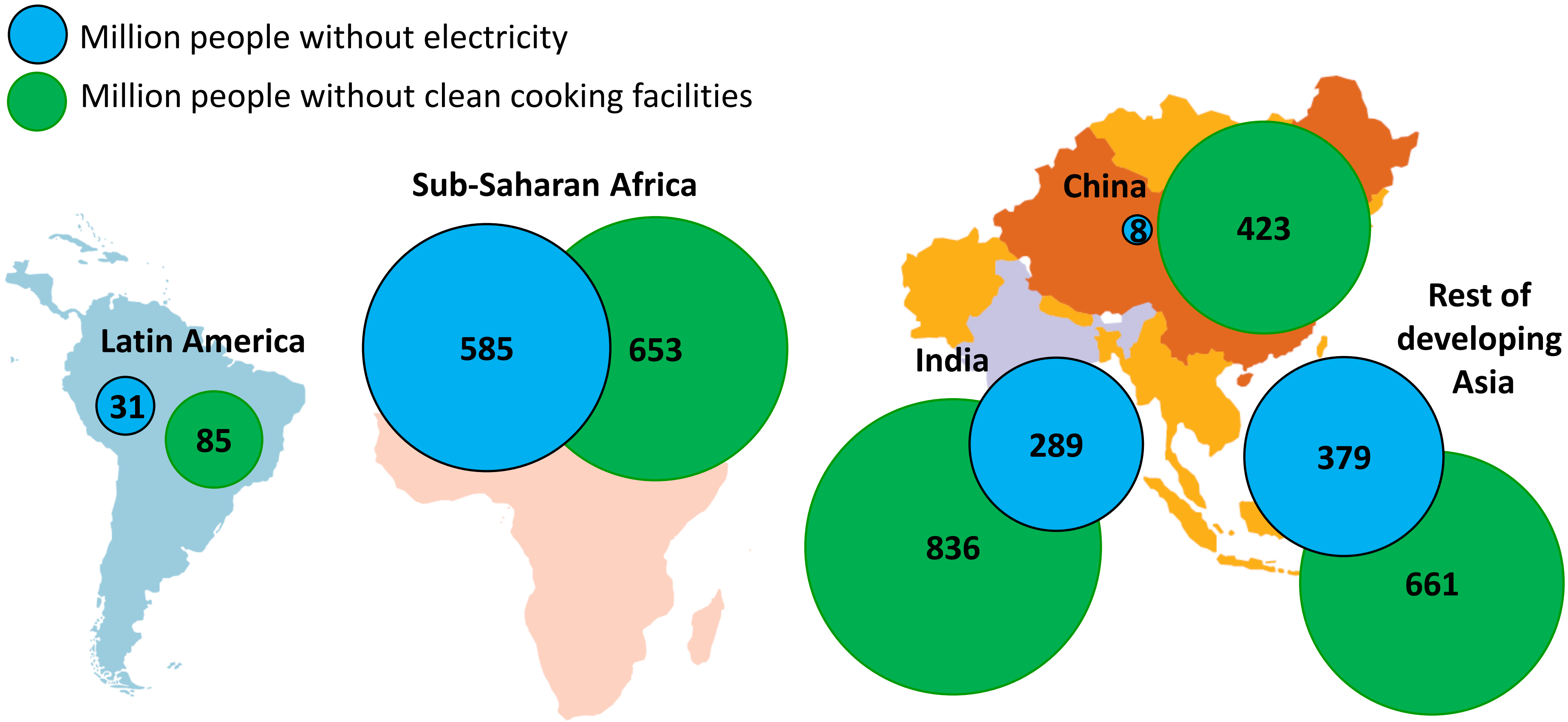
THE ENERGY ACCESS CHALLENGE

African energy access challenges

- Electricity access
- Electricity prices and subsidies
- Reliable electricity supply
- Traditional biomass use

Energy poverty is widespread

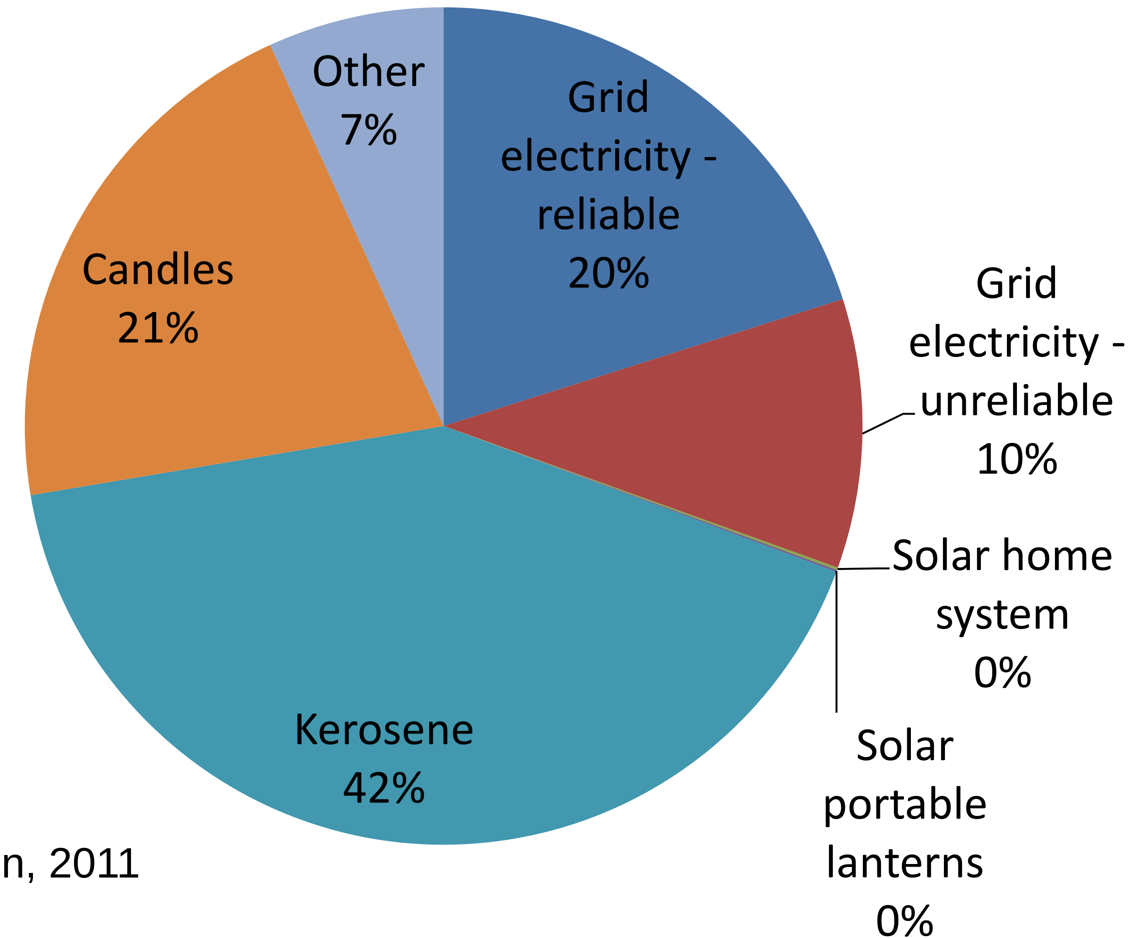


1.3 billion people in the world live without electricity – ½ in Africa

2.7 billion live without clean cooking facilities – ¼ in Africa

Source: IEA WEO, 2011

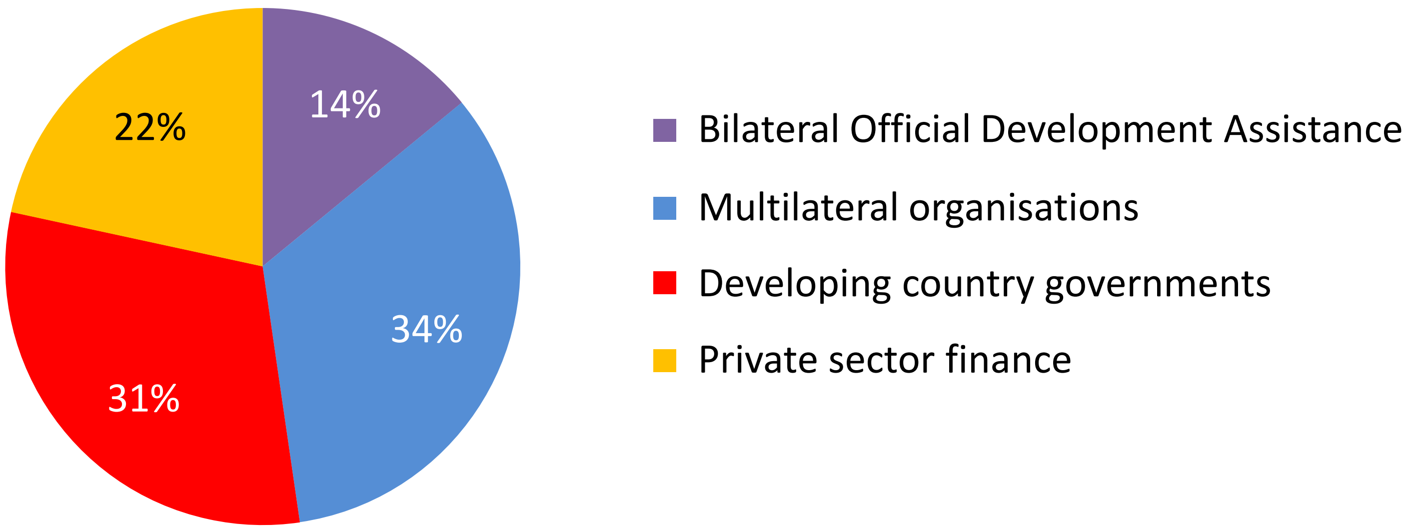
Lighting Sources in Sub-Saharan Africa



Source: Practical Action, 2011

Investment today is far from enough

Globally, $9.1 billion was invested in energy access in 2009

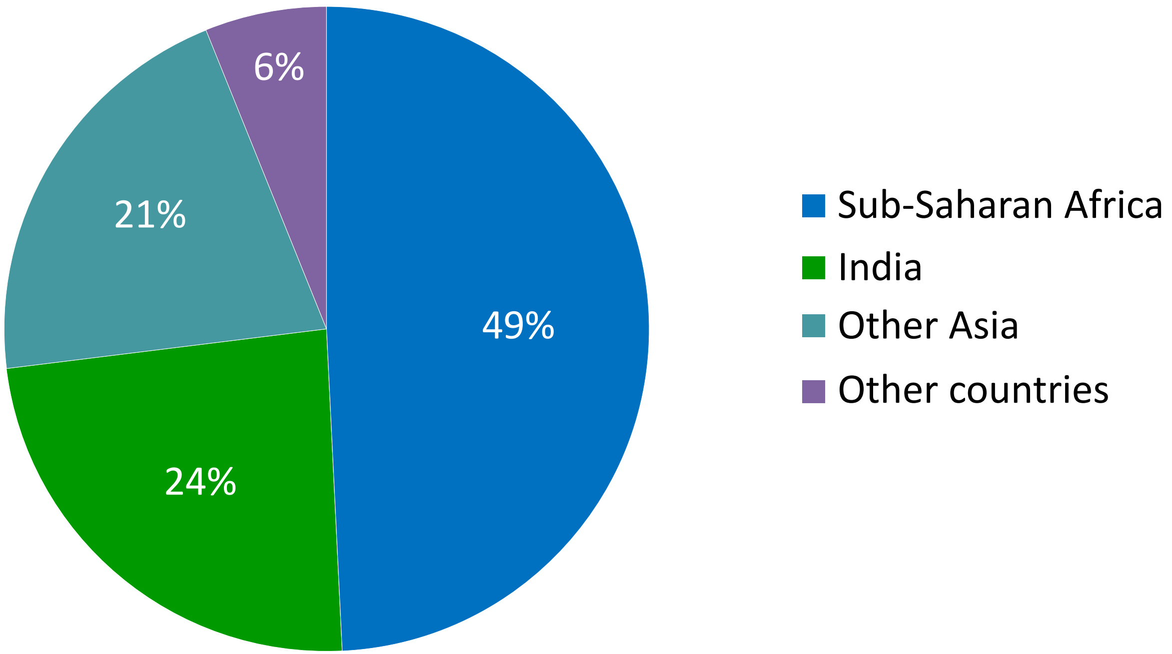


Current investment in providing energy access relies heavily on overseas development aid

Source: IEA WEO, 2011

Where is the investment needed?

$48 billion investment required, a 5.3-fold increase



Nearly half of the investment is needed in sub-Saharan Africa

Source: IEA WEO, 2011

Energy subsidies often miss the mark

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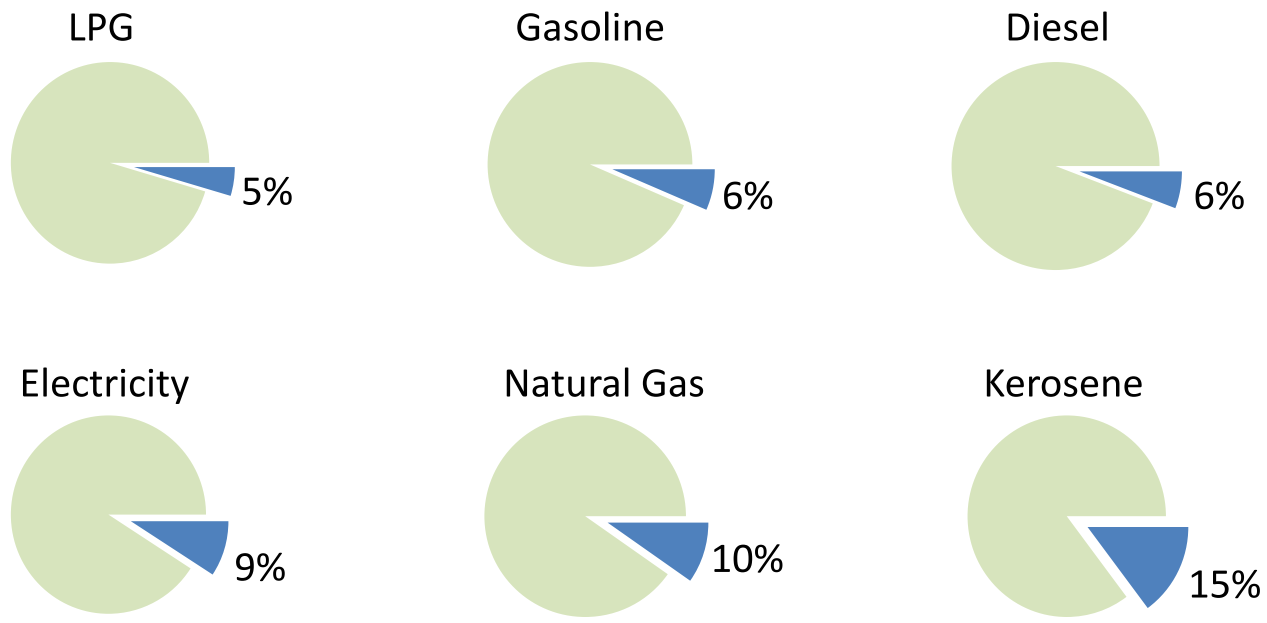
Share of fossil-fuel subsidies received by the lowest 20% income group, 2010



Only 8% of the $409 billion spent on fossil-fuel subsidies in 2010 went to those on the lowest incomes – a failed access policy

Source: IEA WEO, 2011

Power supply reliability

- Frequent blackouts
- High transmission and distribution losses ()
- Widespread use of diesel generators
  - Very expensive power (>USD 0.4/kW)
  - 400 MW installed in Nigeria alone in 2011
- Loss of economic activity

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ENERGY SCENARIOS FOR AFRICA

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Sustainable Energy for All (SE4ALL) and REMAP

- An initiative of the UN Secretary General
- 2012 „Year of sustainable energy for all“

- Framework released January 2012:
  - Global access to modern energy in 2030
  - Doubling of energy efficiency improvements
  - Doubling the share of renewable energy in 2030
- Private and public sector engagement needed
- Opportunity areas and hotspots are being elaborated at this moment

- **IRENA roadmap for renewables objective: REMAP**

Prospects for Primary Energy Demand in Africa

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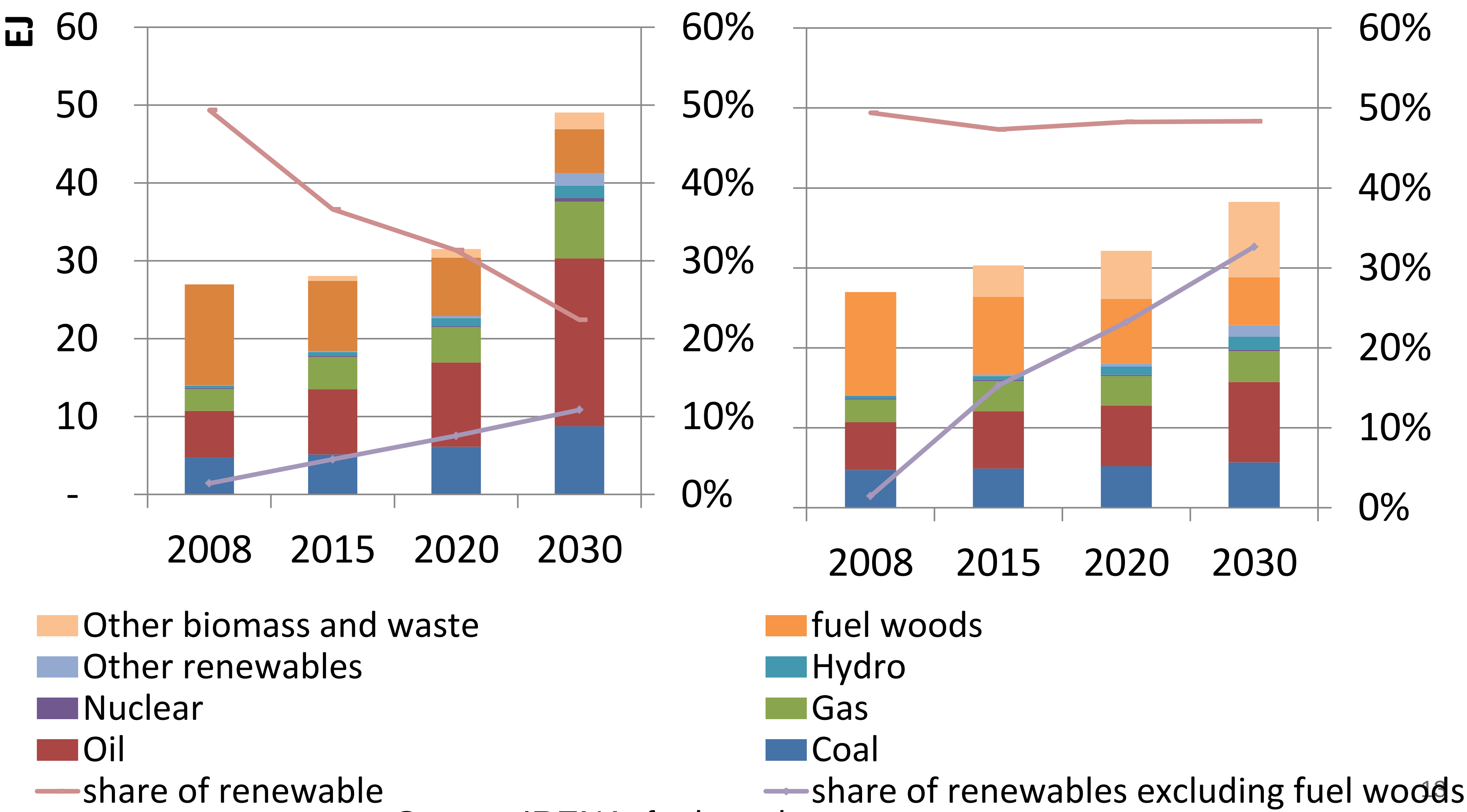
High GDP/Low Biomass scenario | Low GDP/high biomass scenario



Source: IRENA, forthcoming

Prospects for decentralized generation for 2030

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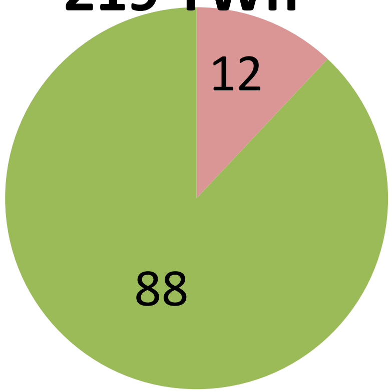
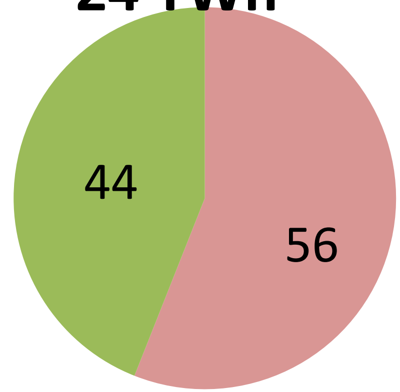
Southern Africa: Urban
219 TWh



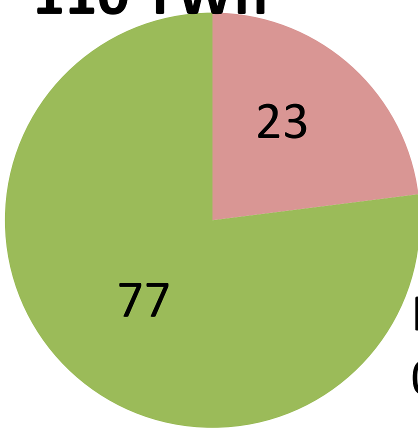
Range:
5-45%

Southern Africa: Rural
24 TWh



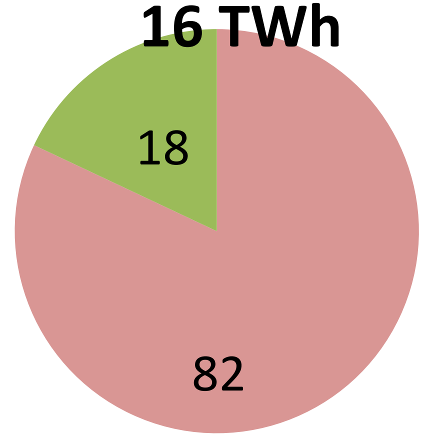
Range:
40-90%

Western Africa: Urban
110 TWh



Range:
0-60%

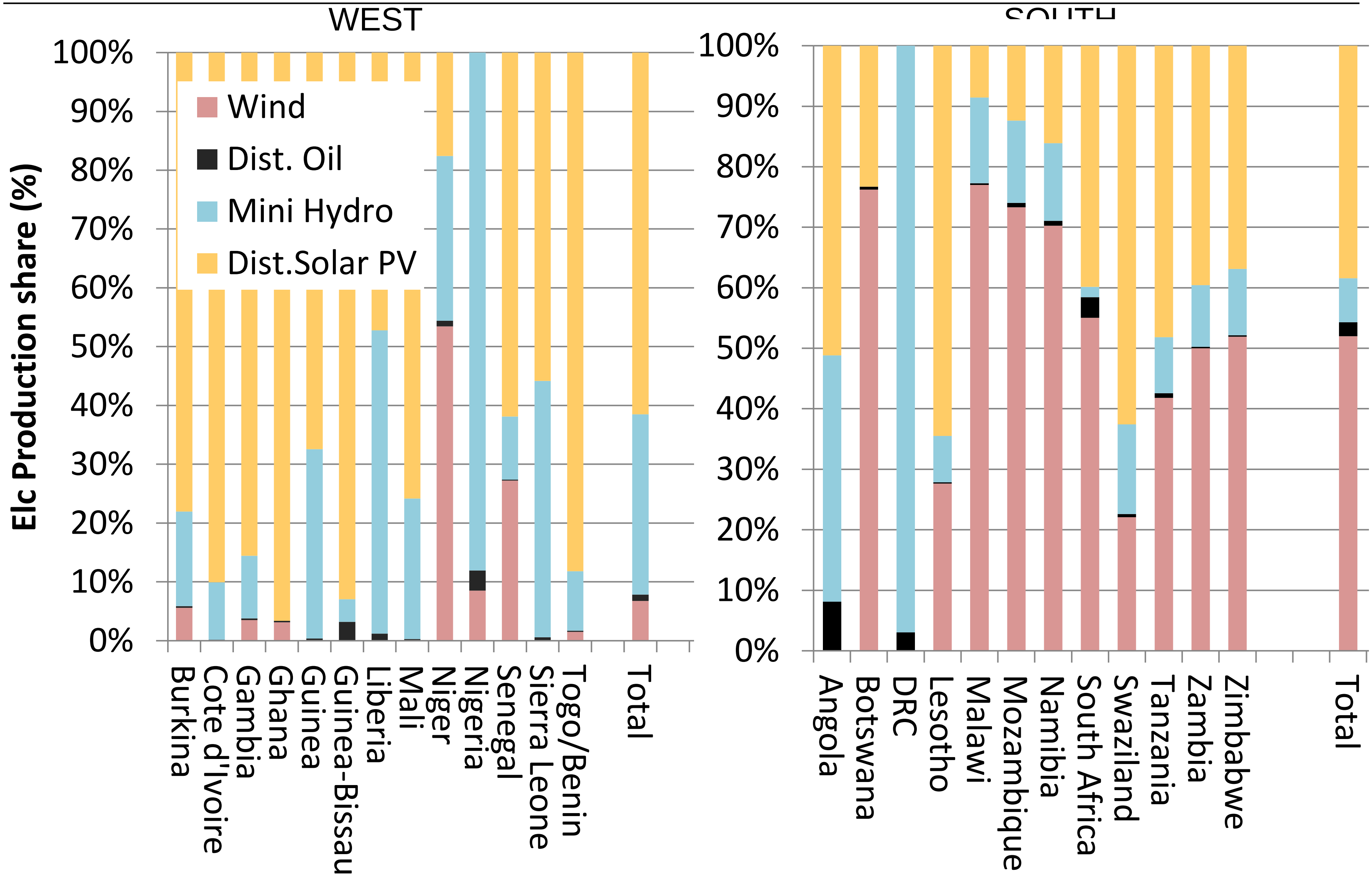
Western Africa: Rural
16 TWh



Range:
45-92%

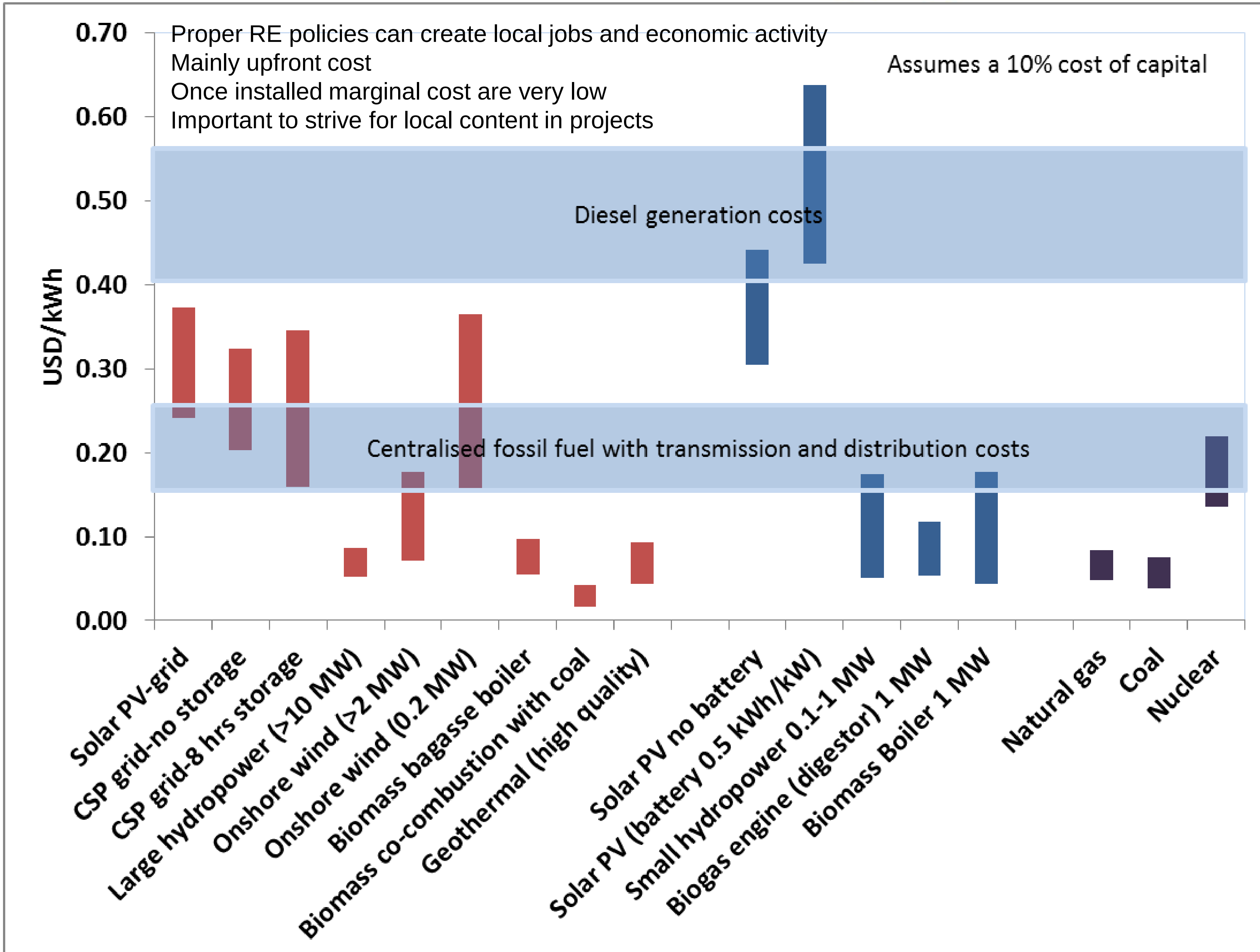
■ Decentralized ■ Centralized

Cost competitive distributed generation options in 2030



OFF-GRID AND MINI-GRID TECHNOLOGIES

Levelised cost of electricity



Minigrid and offgrid solutions

- Rationale: speed of grid extension, cost of grid extension
- Today diesel generators dominate in minigrids
  - Expensive power: USD 0.4/kWh
- Renewable solutions are cheaper
- Minigrid solutions
  - Small scale hydropower
  - Small wind turbines
  - Solar/diesel hybrids (where diesel supply is feasible)
  - Biogas power is emerging
  - Biomass gasification – limited application so far
- Offgrid solutions
  - Cost of solar lanterns and solar panels are falling rapidly

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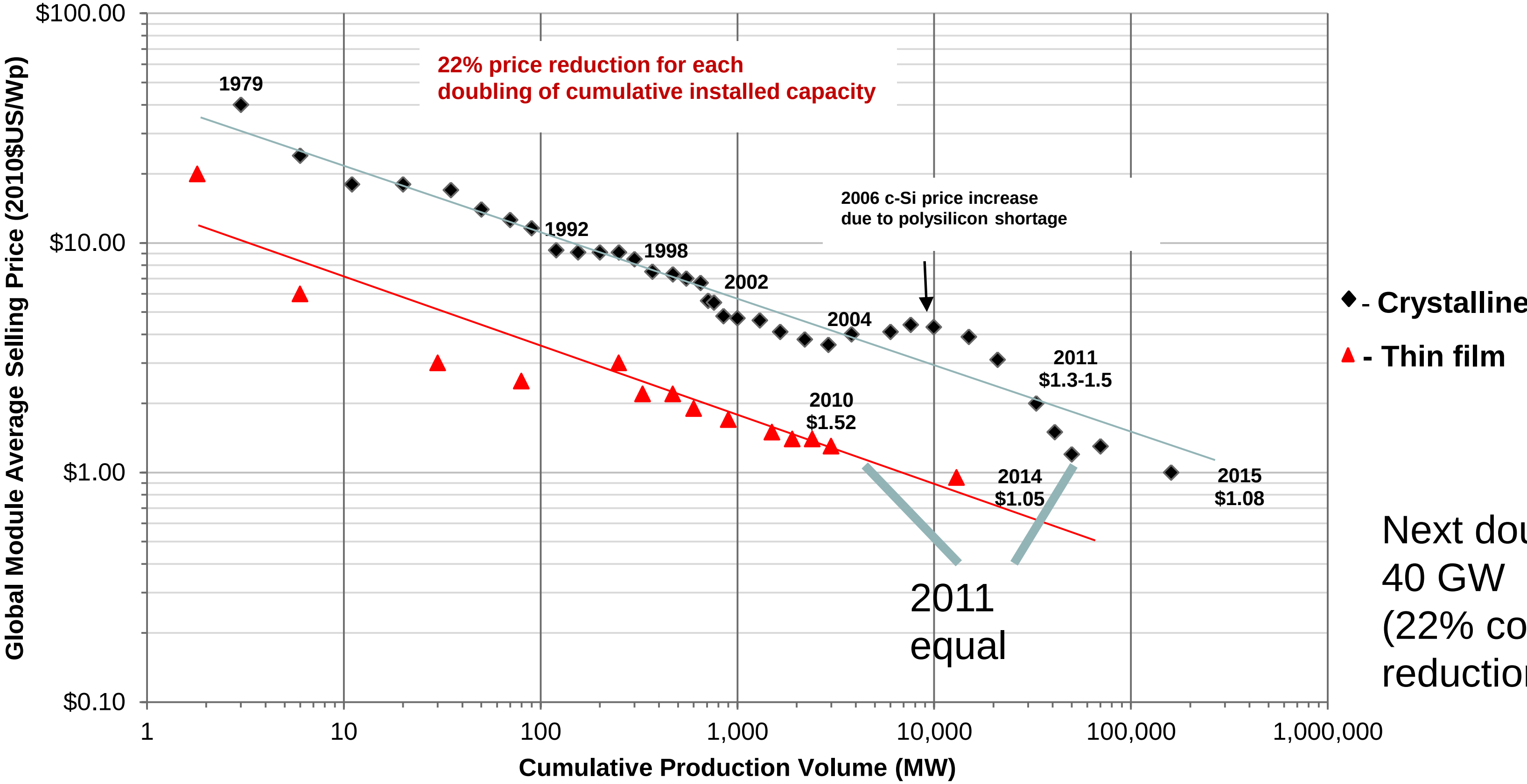
Rural electricity supply solutions

	Capital cost (USD)	Operating cost (USD/month)	Levelized monthly cost (USD/month)
Grid extension (coal/gas)	1000-3000	2-5	15-25
Mini-grids (biomass gasification, hydro, village biogas)	500-1500	2-4	10-20
Diesel generator	500-800	10-15	15-25
Biodiesel generator	500-800	10-15	15-25
Rooftop SHS incl 1 kWh battery	250-500	12-14	15-20
Solar kits (0.1 kW incl 0.5 kWh battery)	100-150	10	11-13
Solar lantern/rechargeable lanterns (0.01 kW/0.05 kWh battery)	20-40	1.5-2.5	1.75-3

Rapid and predictable cost reductions for PV modules

Learning curve: constant % cost reduction per doubling installed capacity



Next doubling 40 GW (22% cost reduction)

Source: Mints, Navigant, Bloomberg NEF, First Solar, NREL PV cost Model

PV grid projects in Africa

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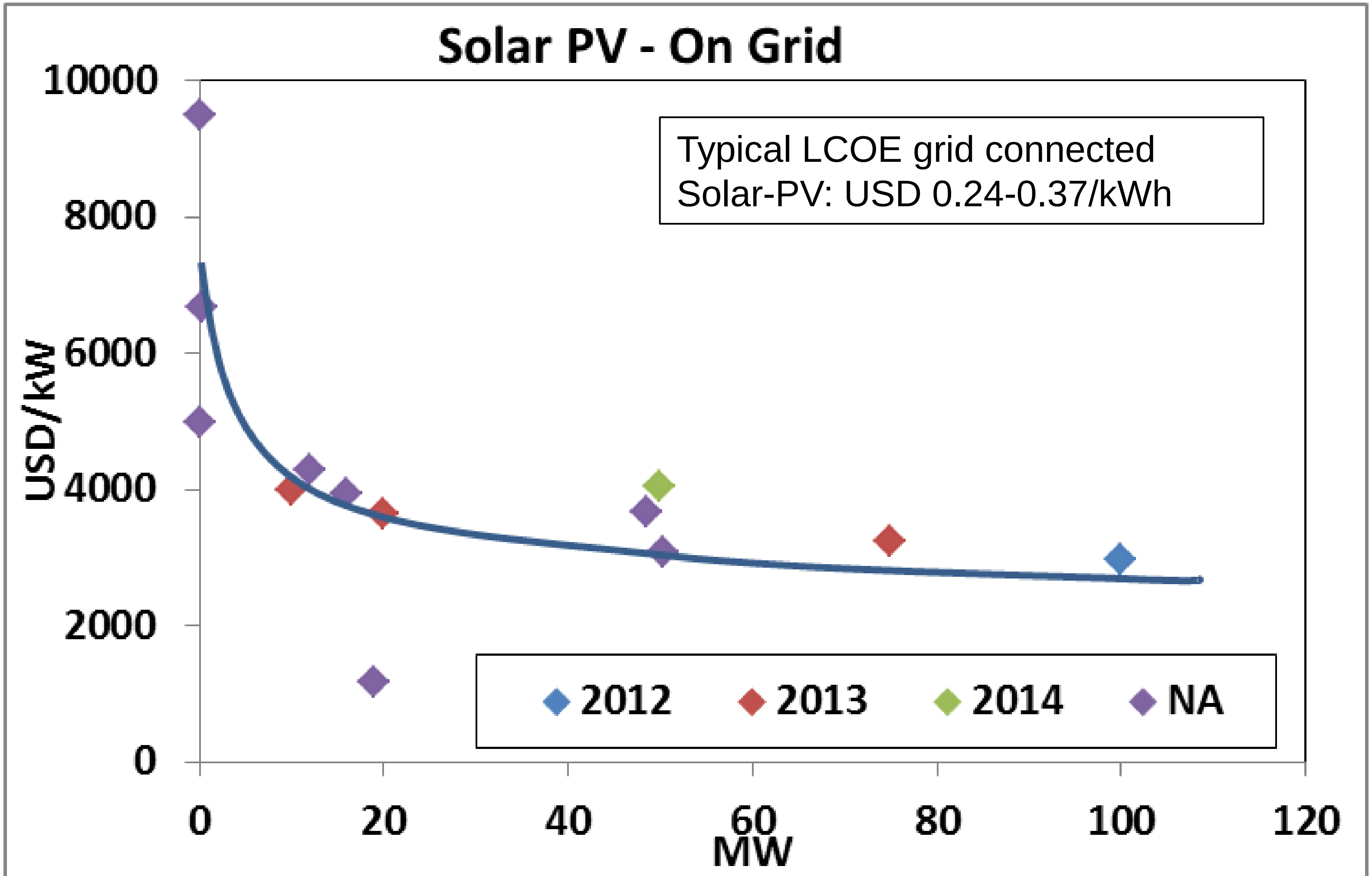
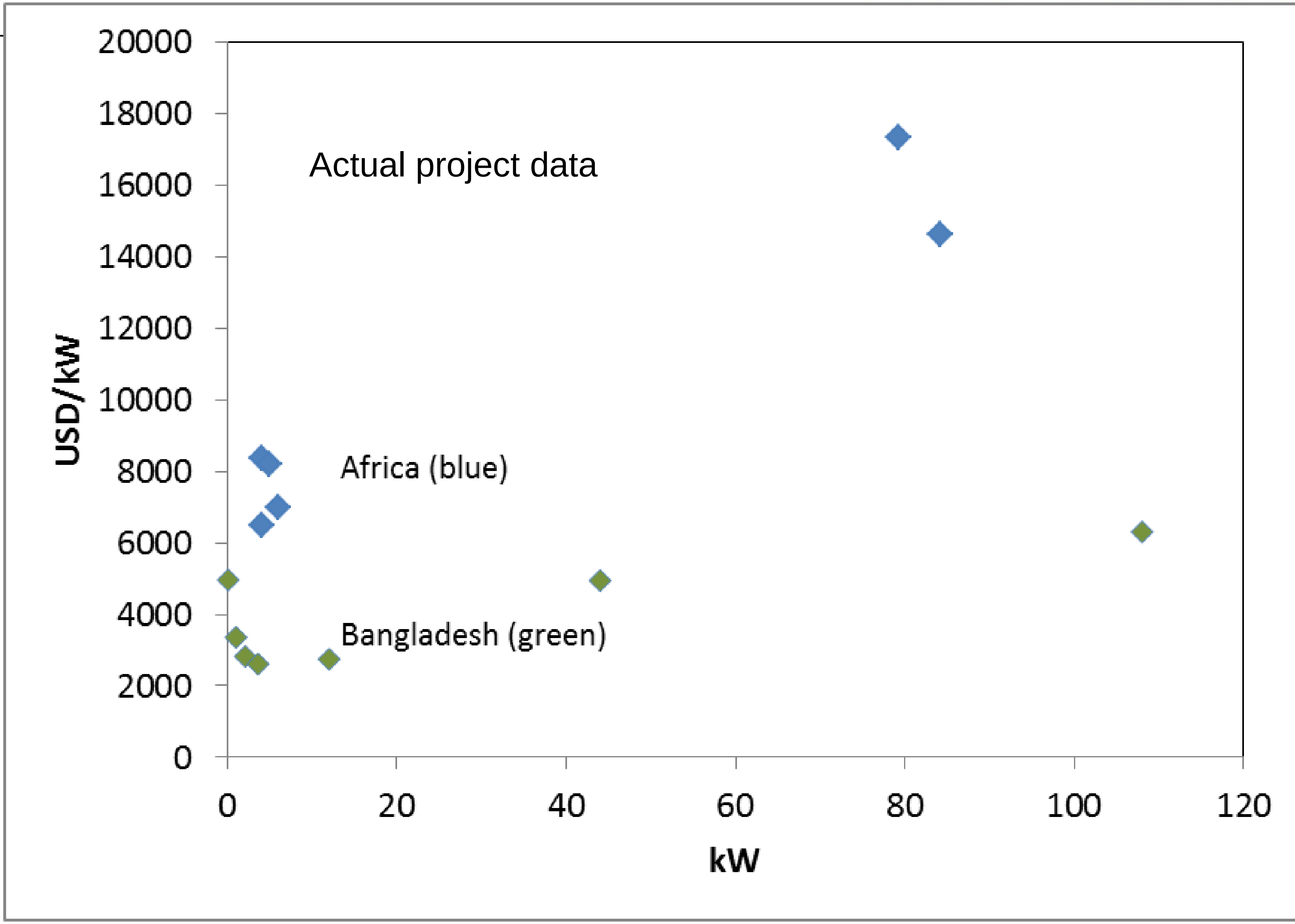
Larger projects in areas with good infrastructure are estimated to achieve competitive project costs



PV off-grid installed costs Africa and Bangladesh



Poor data availability, some very expensive projects

Source: IRENA/GIZ

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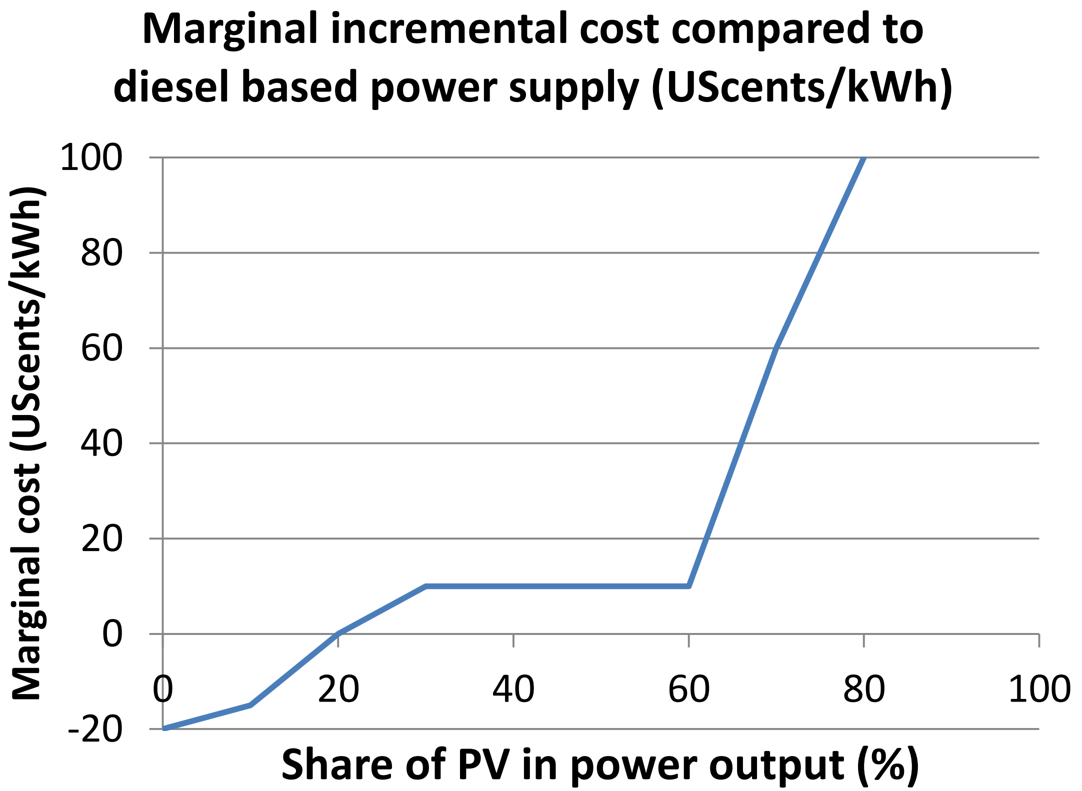
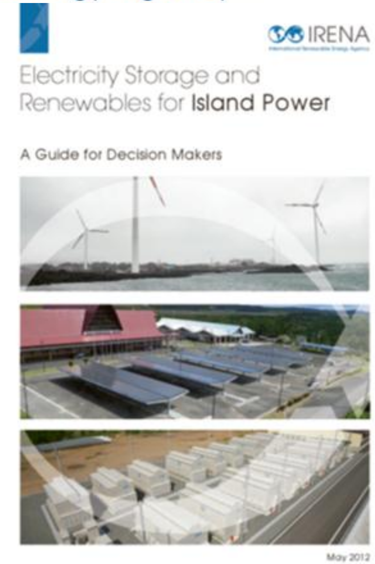
Not a single "true" cost figure – depends on system configuration – example island transition



Electricity storage options

- Storage adds considerably to electricity supply cost
  - Typically USD 0.2-0.4/kWh cost addition
- Small scale electricity storage systems
  - Batteries – 80-95% efficient
    - Lead-Acid - USD 500/kW – USD 250/kWh capacity – short life
    - Lithium USD – USD 1000/kW - USD 1000/kWh capacity – long life
    - NaS – 0.3 GW installed capacity (2012), USD 2000/kW – USD 250/kWh
- Large scale electricity storage systems
  - Pumped hydro storage – 127 GW installed capacity (2009) – 70-80% efficient – Typically USD 2000/kW or USD 25/kWh capacity



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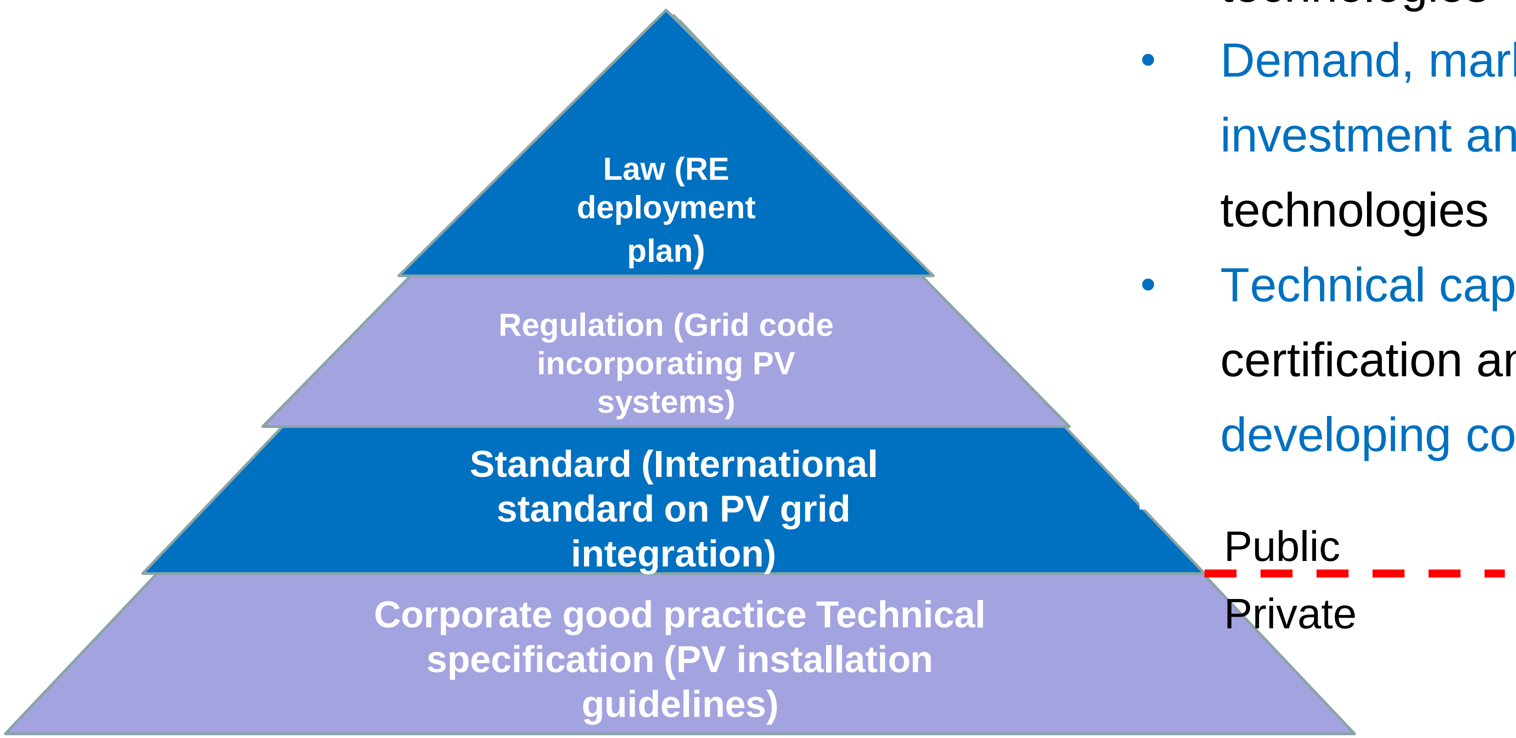
THE ROLE OF TECHNOLOGY STANDARDS

Use of standards within RE regulatory framework



Technology standards

- Reliability and performance of technologies
- Demand, market acceptance, investment and uptake of technologies
- Technical capacity on testing, certification and reliability in developing countries

Source: CEN (2008), Powerpoint presentation "The Strategic Importance of Standardization"

Available international standards for PV systems

The IEC has developed standards for critical components of off-grid PV systems: solar module, charge controller, lead-acid battery, inverters

Panels:

- IEC 61215 Ed. 2.0: Crystalline silicon modules
- IEC 61646 Ed. 1.0: Thin-film photovoltaic Charge Controllers:

Charge Controllers:

- IEC 62509 Ed.1: Performance and functioning of photovoltaic battery charge controllers
- IEC 62109: Safety of power converters. Part 3: Controllers

Inverters:

- IEC 62109 Safety of power converters for use in photovoltaic power systems. Part 2: Particular requirements for inverters.

BOS components and minor equipment:

- IEC 60669-1: Switches for household and similar fixed-electrical installations. Part 1: General requirements.
- IEC 60227-1-4: Polyvinyl chloride insulated cables of rated voltage up to and including 450 V/750 V-Parts 1-4: General requirements

Source: Alliance for Rural Electrification (2011) "Technologies, quality standards and business models""

No testing and certification mechanisms?

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Result

↓

Lack of confidence on the technology (case small wind power)

Source: Peterschmidt, N. (2012), Powerpoint presentation "Small wind turbines for mini grid" - INENSUS

Certification of PV systems against international standards

The use of PV modules certified to international standards is becoming increasingly common against the following standards:

- IEC 61215 – Crystalline silicon terrestrial photovoltaic (PV) modules; Design qualification and type approval – and;
- IEC 61646 - Thin-film terrestrial photovoltaic (PV) modules; Design qualification and type approval

Initiatives for ‘low-cost’ PV testing facilities:

- Lund University in Sweden with Maputo University
- Project: “Low-cost” modular solar laboratories for developing countries
- Based on the initial experience of build a solar lab in Mozambique, this project sets out the goal of build 15 solar low-cost laboratories using existing capacity in local Universities

Facilitating developing countries engagement in standardization

Engagement from developing countries in the standardisation process is crucial:

- Examples of initiatives to promote this engagement are the **ISO-DEVCO** and the **IEC-Affiliate Country Programme**
- IRENA is working to continue exploring new options for:
  - Increasing the participation and contribution of developing countries in the international standards development process
  - Establishing affordable testing and certification schemes for RE equipment in developing countries

Stakeholders' network met in IRENA's IITC premises to discuss actions to address such issues. Workshop report to be available soon

Thank you !

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