INTERNATIONAL RENEWABLE ENERGY AGENCY

IRENA

International Renewable Energy Agency

Energy Planning and Renewable Energy in Africa

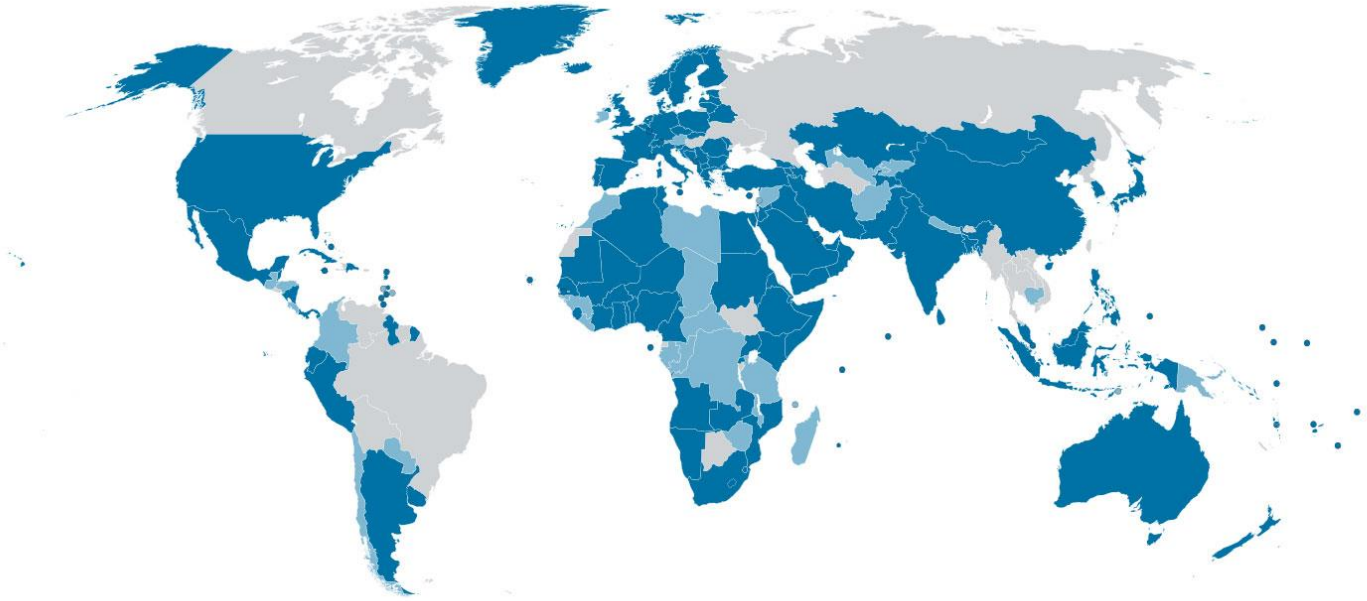
Asami Miketa

Bonn, 25 June 2015

The International Renewable Energy Agency

IRENA
International Renewable Energy Agency

The Voice, Advisory Resource and Knowledge Hub for 170 Governments



Renewable energy can:

- Meet our goals for ***secure***, ***reliable*** and ***sustainable*** energy
- Provide ***electricity access*** to 1.3 billion people
- Promote ***economic development***
- At an ***affordable cost***

Outline

What is energy planning?

What are the tools used?

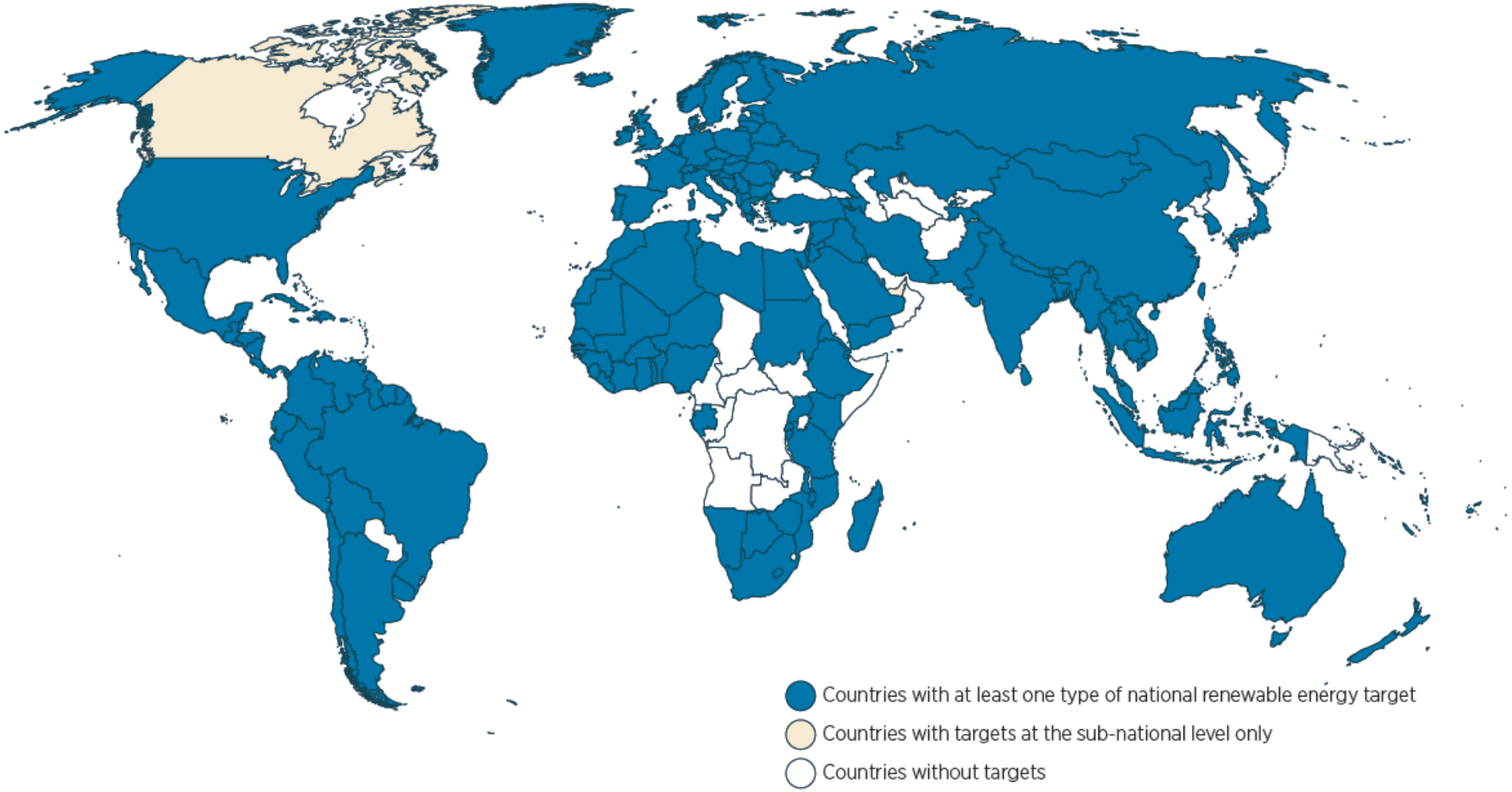
How we apply it in the African context

Long-term energy master plans

- Guide long-term sector development
- Based on quantitative analysis
- Cover whole energy systems
- Provide a basis for policy on technology choice and targets

131 countries have renewable energy target

IRENA
International Renewable Energy Agency



Planning for Global Transition

Infrastructure development

- Long lead-time
- Long technology life
- Rapidly developing renewable market
- Interconnected components
- Expensive

RE as a part of a system

RE deployment cannot be planned independent of the rest of the energy system

- Overall demand grows
- Age structure of the existing infrastructure
- Complementarity of technologies
- Consistency with other targets/objectives

→ To help improve RE representation in global/regional scenarios, and national master plans

IRENA Regional Action Agenda

renewable options for optimizing investment in electricity generation and transmission infrastructure

General lack of quality data for RE resources, their costs and associated benefits

8 of 15 ECOWAS countries use planning tools

4 of 14 SADC countries* use planning tools

Elements of good master plans

System perspective – rather than sub-sectorial
Country owned planning system in place
Based on transparent methodology
Regularly updated

Three components:

- **Sound statistics and data**
- **Transparent methodology**
- **Ownership of the planning skill**

IRENA activities

Global Atlas, Resource fact sheets, Technology briefs, Sectoral Roadmaps, Renewable Cost Alliance

Energy system analysis
Least cost investment planning
Grid stability study (power sector)

Renewable Readiness Assessment, Project navigator, Abu Dhabi Fund for Development

Good planning will bring…

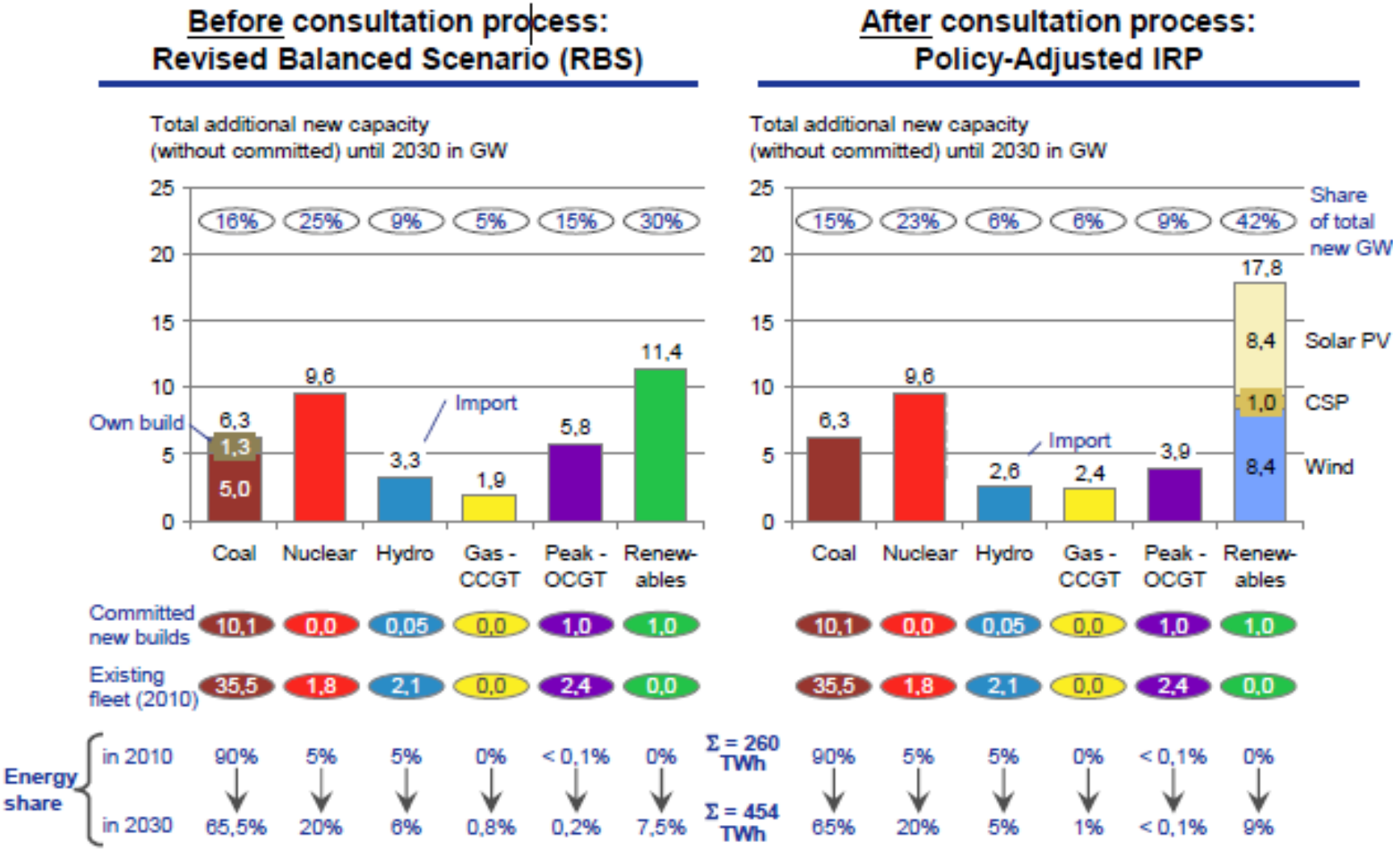
Platform for sub-sector coordination

Stability in future policy direction

Increase investors confidence

Efficient project appraisal by banks

Integrated Resource Plann in South Africa (power sector)



Source: ESKOM

What is energy planning?

What are the tools used?

How we apply it in the African context

Master plans need to answer:

- Energy requirement to achieve the aspiration of sustainable economic growth
- By when infrastructure needed to be in place?
- What are the appropriate mix of technologies?
- What are the best use of natural resources?

→ Energy system analysis is needed

Energy system models

Bottom up models

- Accounting – suited to demand side analysis (e.g., LEAP, MAED)
- Optimization – suited to supply side analysis (e.g., HOMER, MARKAL, TIMES, MESSAGE etc)

IRENA SPLAT models: optimization model built using the MESSAGE modelling framework

*The model calculates the least-cost **technically feasible** combinations of power supply options to meet the specified demand at a specified time, under **certain conditions***

Scenario development

The model calculates the least-cost **feasible** combinations of power supply options to meet the specified demand at a specified time, under **certain conditions**

Depending on the questions, the formulation of certain conditions are defined

- Assumption of costs
- Assumption of technology deployment speed
- Assumption on the availability of technology options and projects
- Assumptions on RE targets
- Assumptions on the power trade policy
- Assumptions on CO_2 policy, etc…

Energy system models

Tools are used to support decision making under uncertainty

Power sector planning tools

SPLAT tool

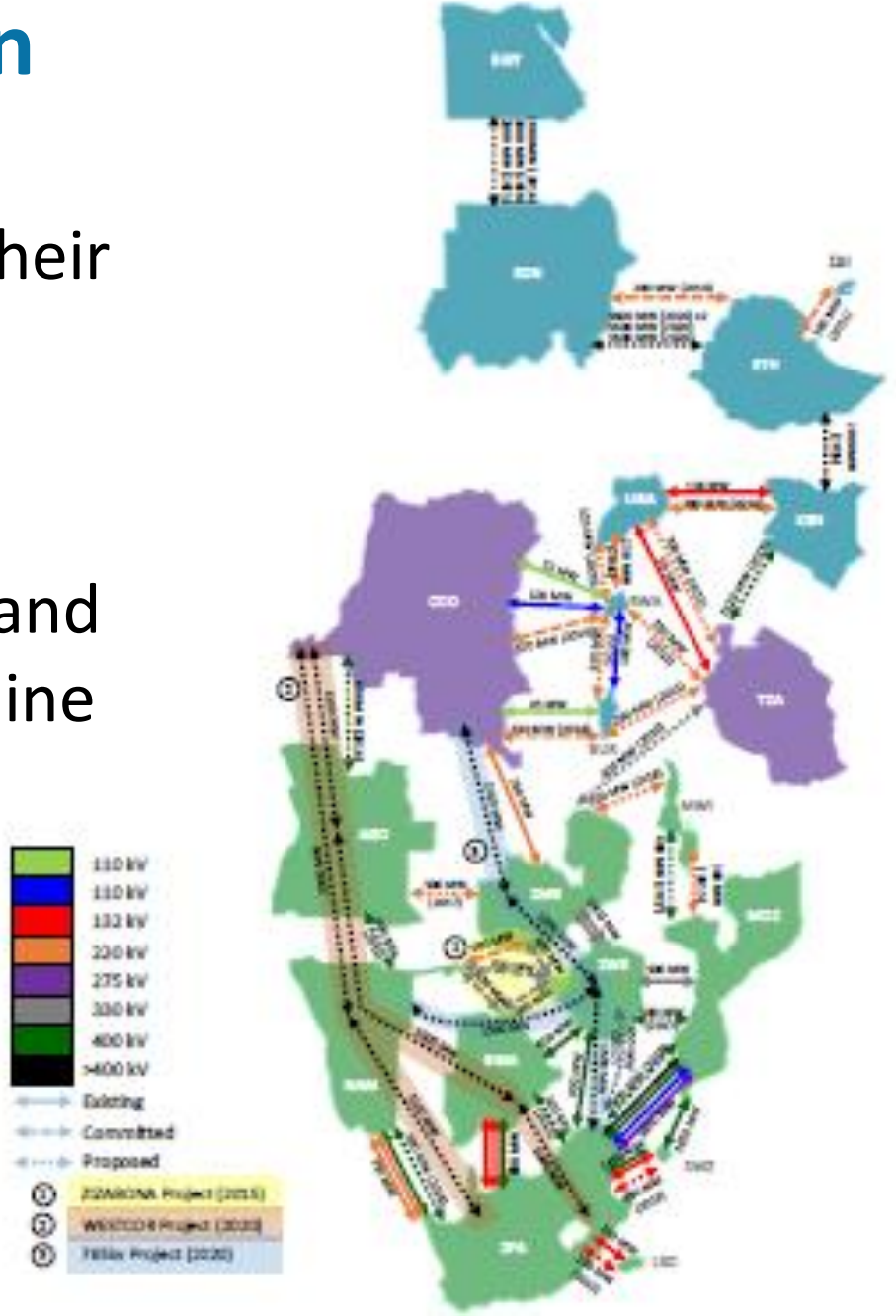
- RE database
- Power sector infrastructure database
- Software to analyze future power sector in 45 African countries

Consistent with regional master plans

The models are built on database of:

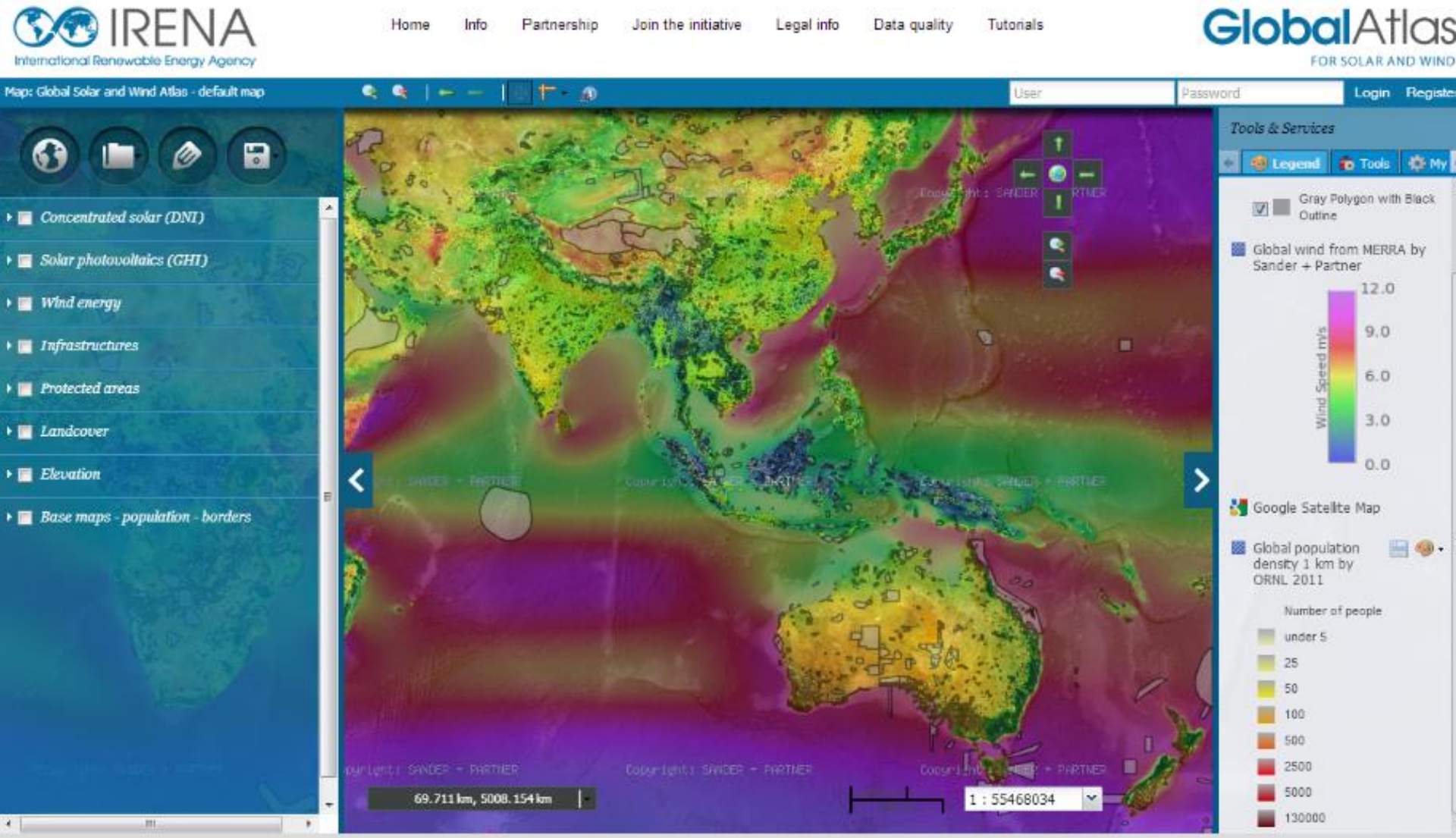
- Existing power plants and their retirement plants
- Existing international transmission lines
- All proposed power plants and international transmission line projects
- Regional master plans

- **Renewable Costing Data**
- **Global Atlas/Generation Potential Assessment**



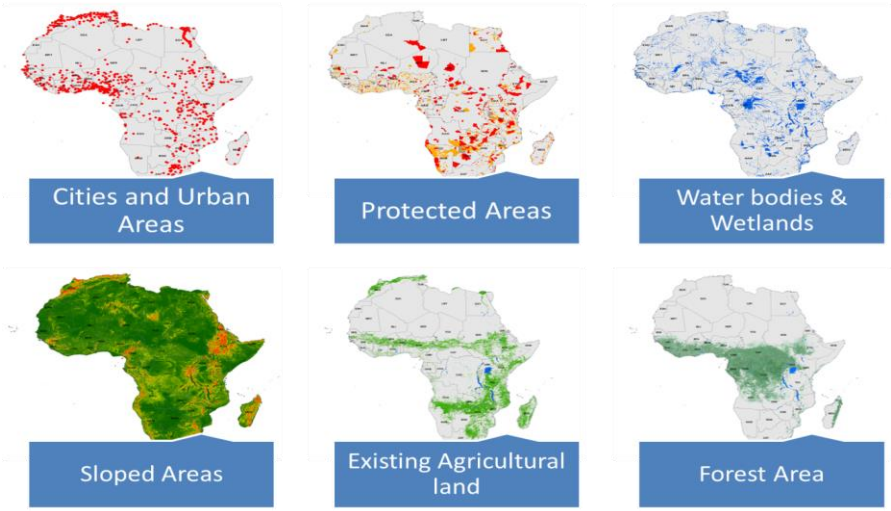
Analysing physical resource potentials from Atlas

IRENA
International Renewable Energy Agency



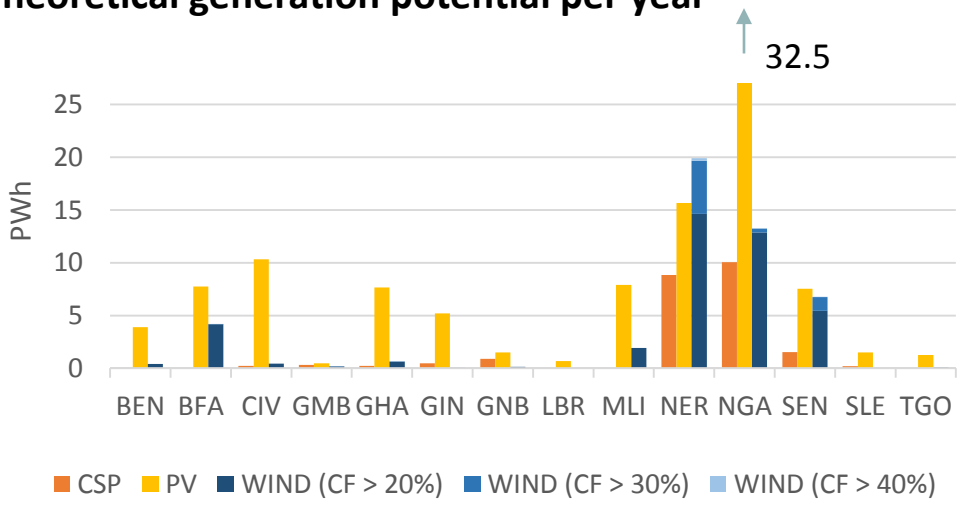
Generation potential assessment

- Resource maps (solar irradiation, wind speed)
- Land cover and topology maps
- Administrative boundaries



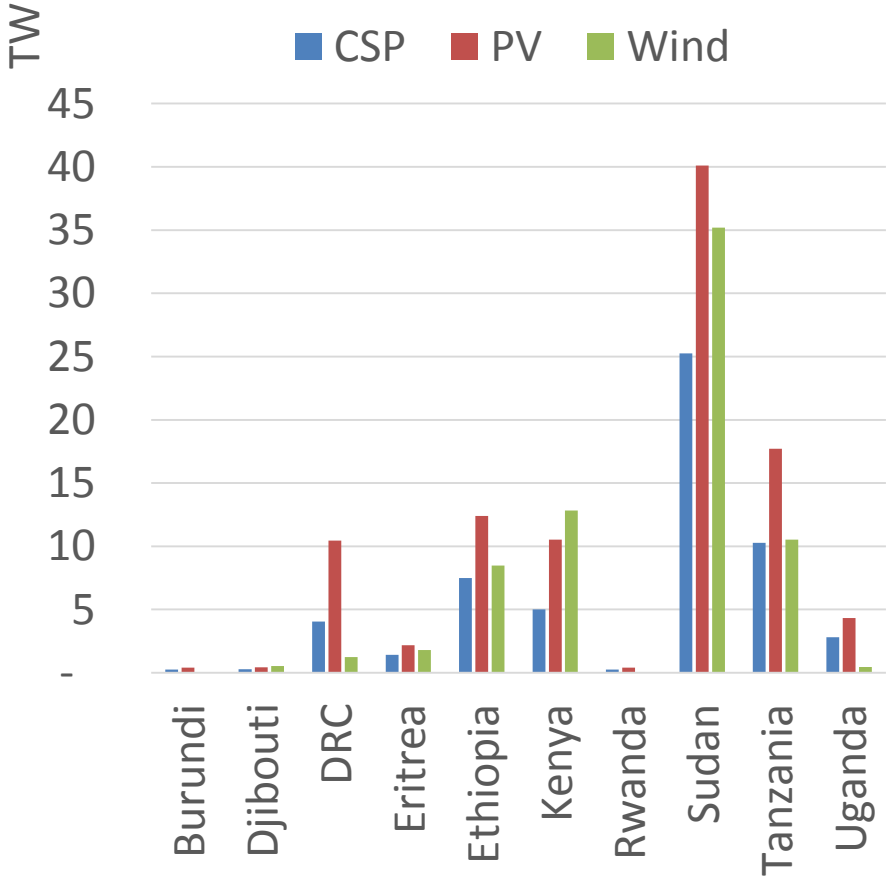
- Combine layers
- Define resource classes
- Extract country data

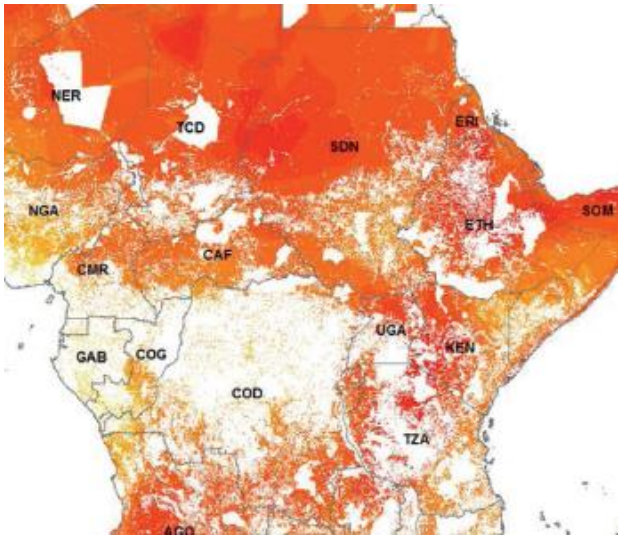
Theoretical generation potential per year

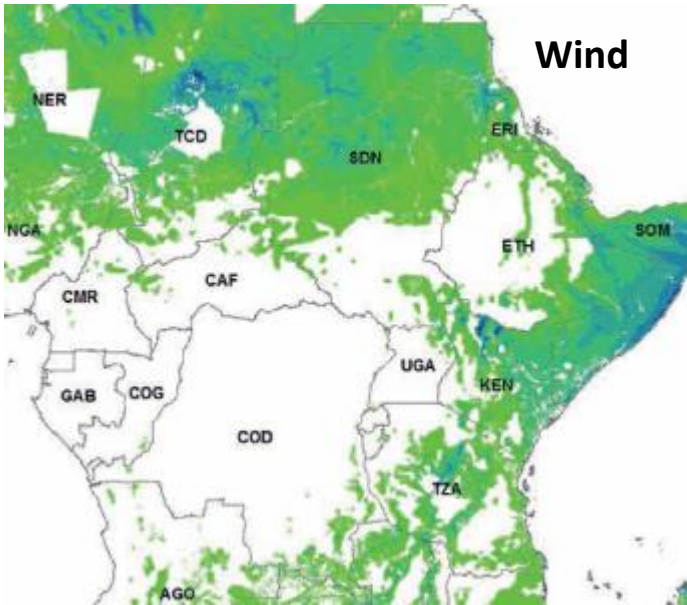


Theoretical generation potentials

Huge solar and wind potential, but unevenly distributed



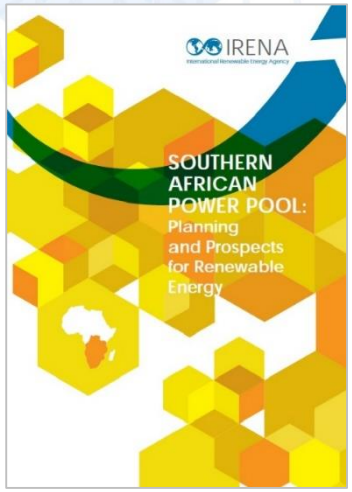


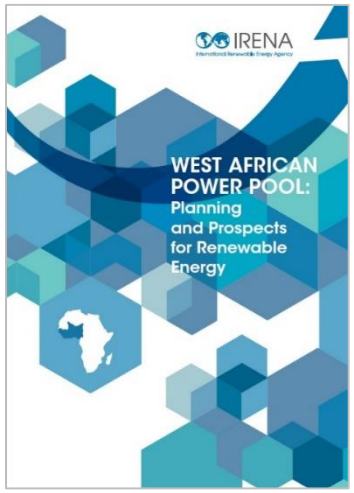


SPLAT outputs

- Generation capacity expansion
- Generation plan
- Transmission capacity expansion
- Electricity imports/exports
- Investments and operational costs
- Emission and waste
- etc.

5 regional analysis





Application of SPLAT tool

Policy scenarios based on the publically available information

- **Renewable technology cost reduction**
- **Impacts of regional trade**

Assess the investment needs

This serves as:

Starting point for developing regional prospects by inviting countries to validate the results

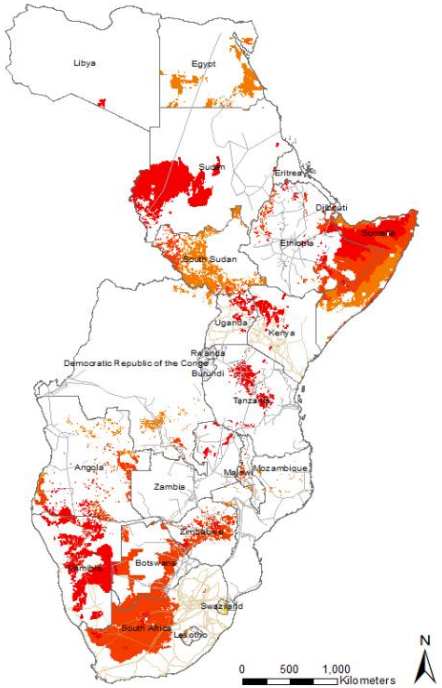
Starting point for country analysis by county experts

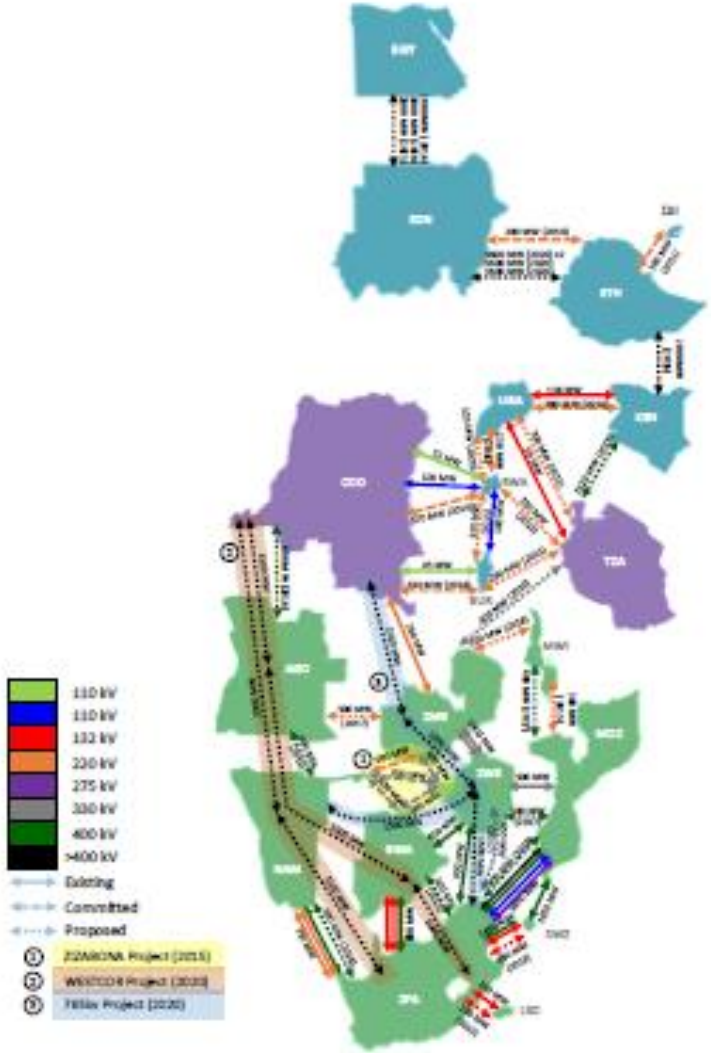
Project identification

- **Transmission projects**
- **Hydro projects**

- **RE projects?**

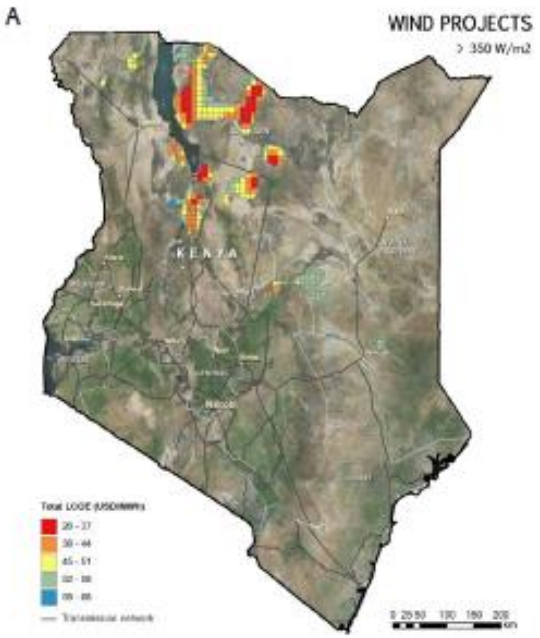
  → **Zoning approach**

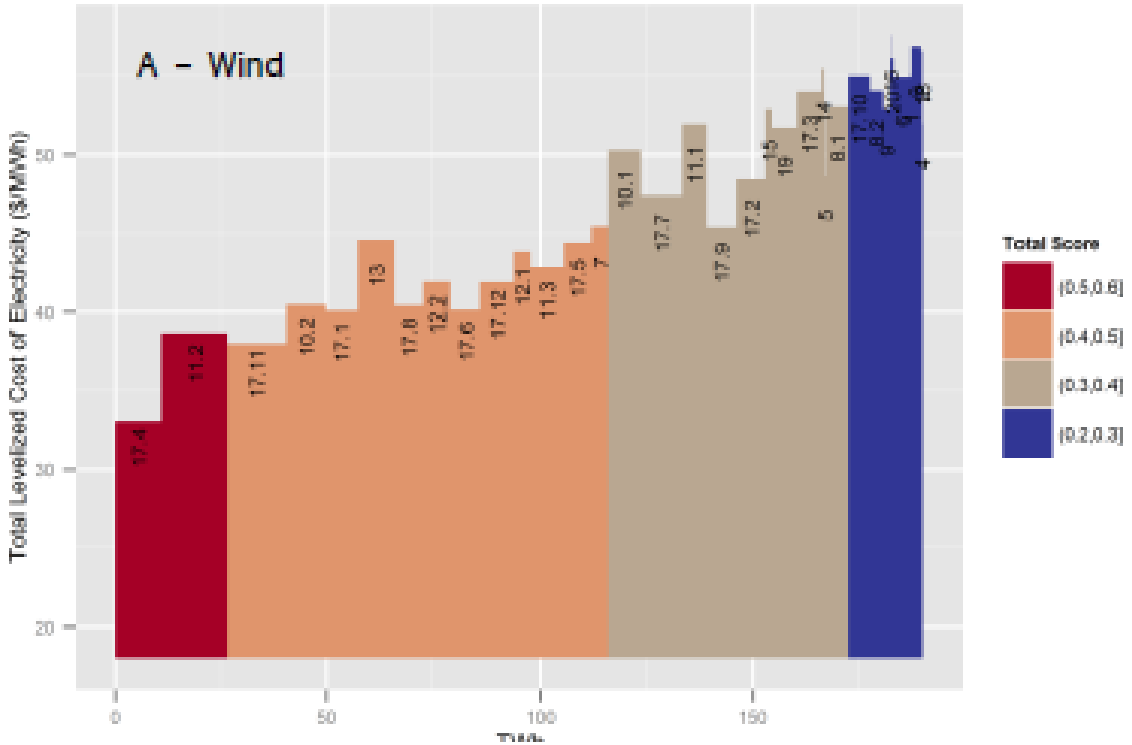




Project zone identification

Kenyan example





What is energy planning?

What are the tools used?

How we apply it in the African context

Sub-Sahara Africa: power sector

- Total installed capacity: 88 GW
- Only 31% of the population with access
- Universal electrification is decades (?) away
- Modern Energy consumption 1% of OECD levels*
- 80% of households rely on biomass for cooking
- 30 countries face regular interruption of services
- Interruptions cost 6% of turnover to the formal sector and as much as 16% to the informal sector
- State Owned Utilities inefficiencies cost 0.8% of GDP

Source: World Bank

Challenge: Investment Gap

- Currently, about **1-2 GW** of new installed capacity deployed a year. Africa needs 10-**12 GW**
- Access growing no more than **1%** per year in the last decade
- At this rate, less than **60%** of Africans will have electricity in their homes by 2030
- **Currently, $9-10 billion** invested yearly to provide first access to modern energy
- **Africa needs up to $40-50 billion** yearly for universal access by 2030

Financing shortfall of 80%

Current Investment Trend

Sub-regions	Avg. Yearly Investment ($B)	Cumulative Till 2020 ($B)
World Bank	1.5	12.0
Other MDBs	1.5	12.0
Emerging Financiers	2.0	15.0
Private sector	5.0	41.0
Total	10.0	80.0

Investments Needed

Sub-regions	Avg. Yearly Investment ($B)	Cumulative Till 2020 ($B)
Central Africa	2.0	18.0
East Africa	18.0	183.0
Southern Africa	12.0	123.0
Western Africa	9.0	95.0
Total	40.0	420.0

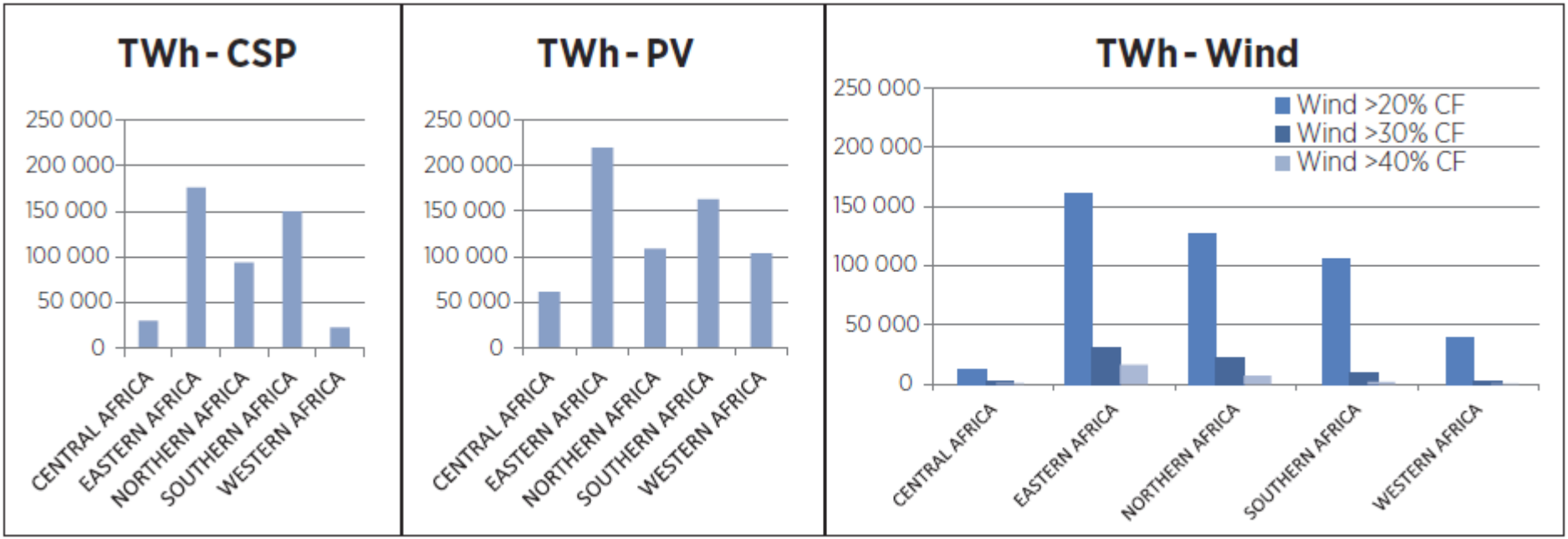
Source: IRENA, World Bank

African continent in 2030

- In 2010: 650 TWh, 140 GW
- In 2030: 1,800 – 2,200 TWh
  - 390- 620 GW

RE Resources

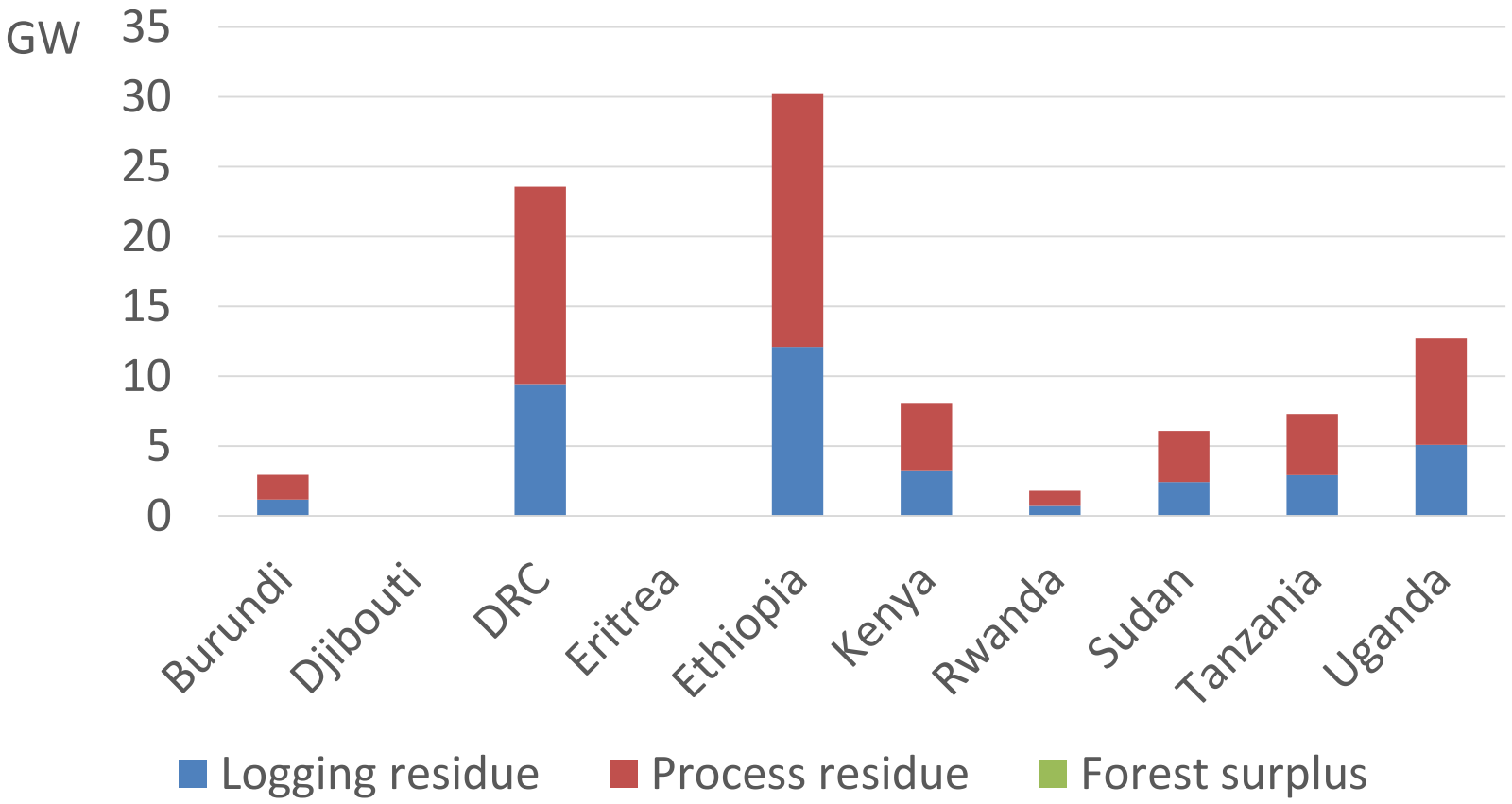
- Detailed GIS analysis shows abundant but regionally different RE power generation potentials



- Geothermal < 100 TWh/yr
- Biomass > 2 600 TWh/yr

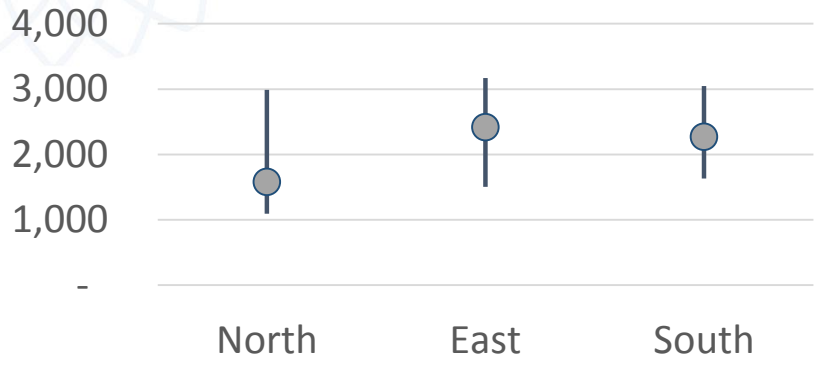
Biomass for power generation

Assessment of woody biomass potential for power generation

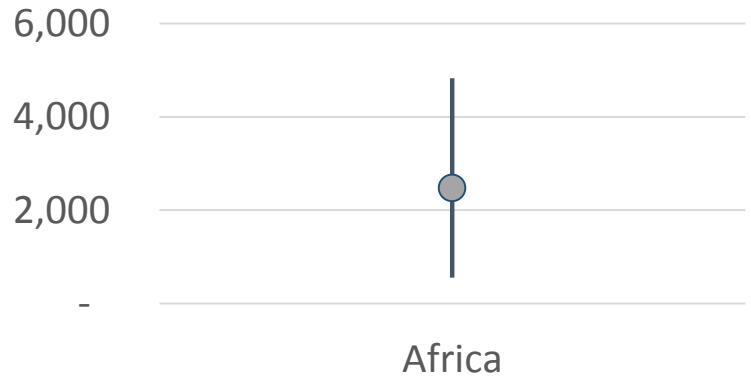


Investment costs ($/KW)

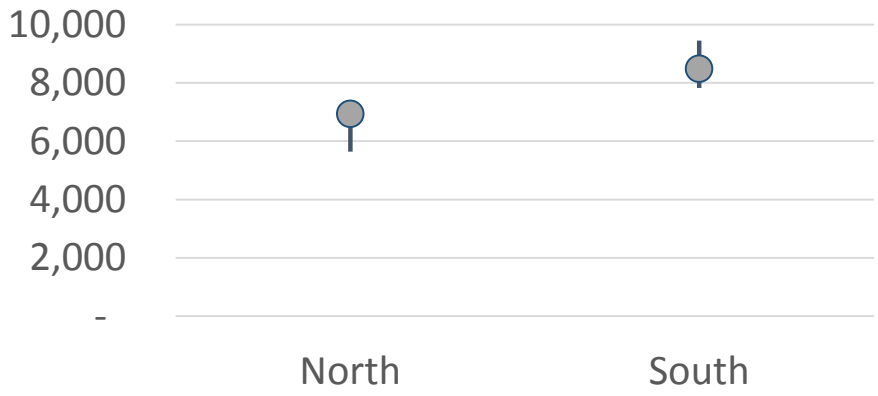
wind - 50 projects



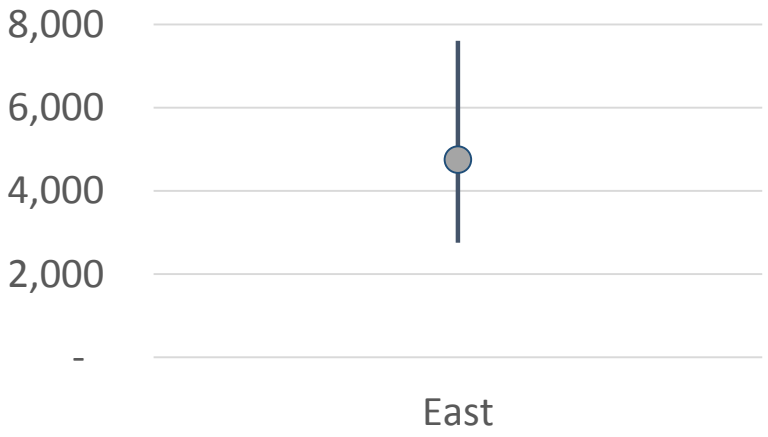
solar PV - 67 projects



CSP with storage - 17 projects

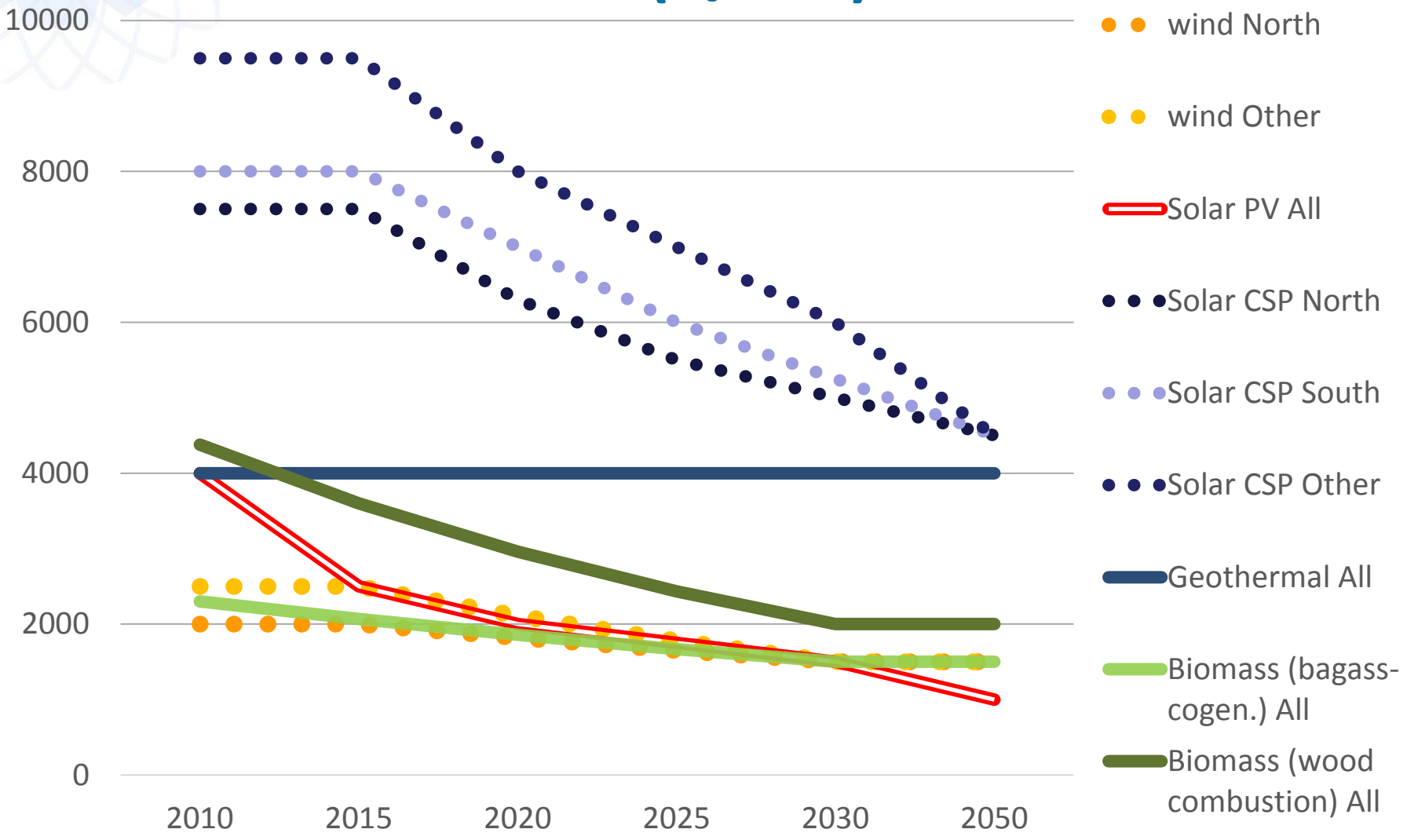


Geothermal – 7 projects



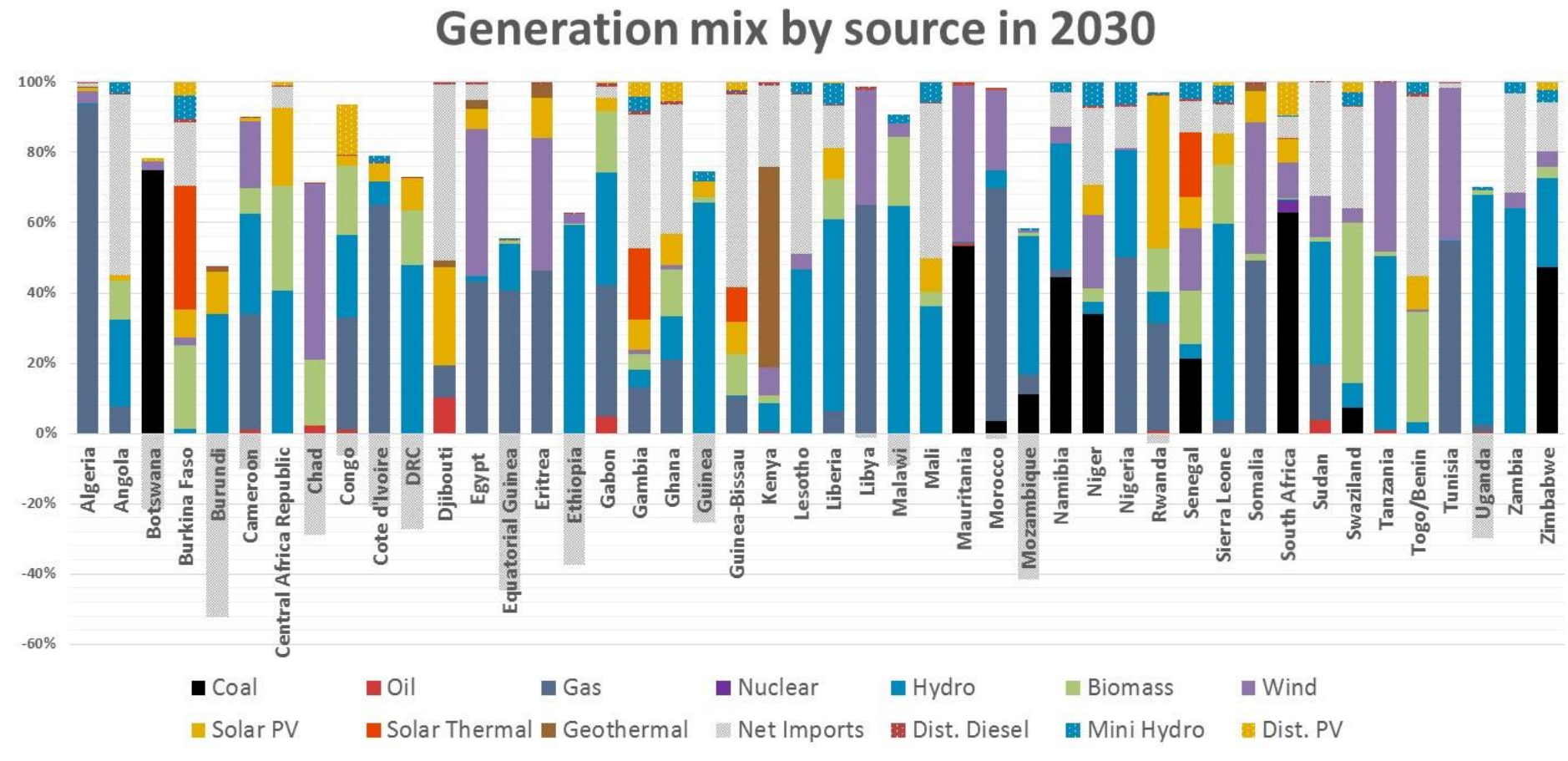
max min weighted average

Projected investment cost reduction for Africa ($/KW)



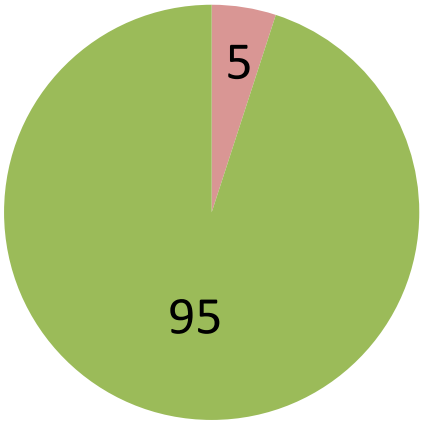
Continental prospects

RE share in generation: in 2011 **17%**
in 2030 **30-60%** depending on the policy setting
20-30% with no policy



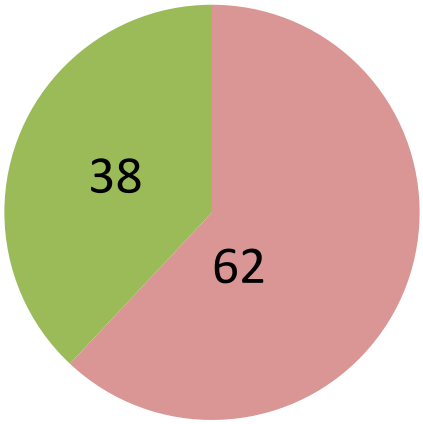
Prospects for decentralized generation for 2030

Southern Africa: Urban



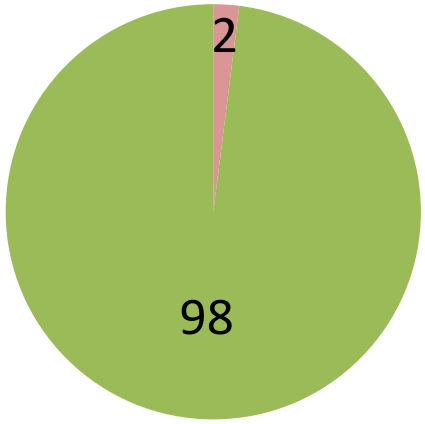
Range:
0-17%

Southern Africa: Rural



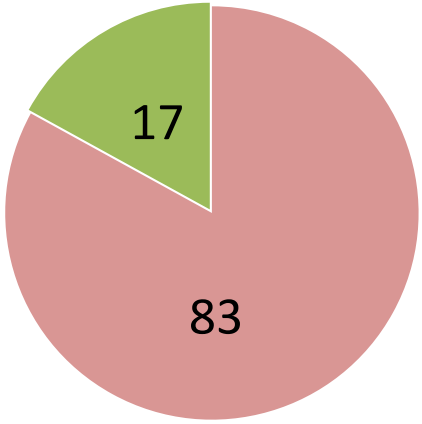
Range:
40-91%

Western Africa: Urban



Range:
0-9%

Westhern Africa: Rural

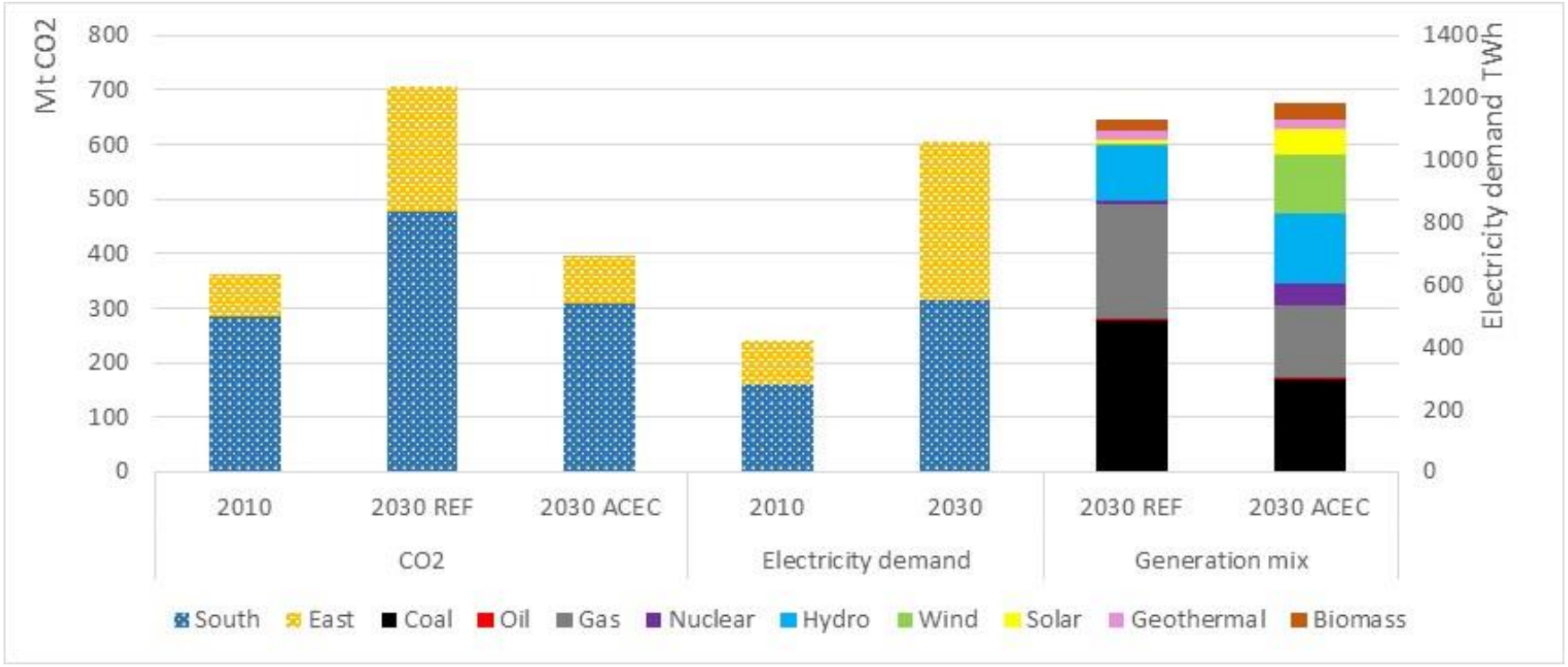


Range:
50-95%

Decentralized Centralized

ACEC impact assessment

- Demand is expected to **triple** by 2030
- CO2 emissions would be cut by **half**
- Share of RE would double under the ACEC scenarios



Conclusion

Energy planning capacity building

Abidjan in Nov 2012 with ECREEE

Johannesburg in Dec 2012 with SANEDI

Kigali in Oct 2014 with UNECA

Yaoundé in Sep 2014 with IAEA

Tunis in Mar 2014 with IAEA

IRENA's Roles

- Developing planning tools and methodologies
- Supporting planning study (Regional/national entity as a planner)
  - Providing access to statistics/data/tools/methodologies
  - Advisory service
  - Capacity building
- Conducting planning study using tools
  - Substantiate IRENA's propositions (e.g., CEC concept)

IRENA

International Renewable Energy Agency

Asami Miketa
amiketa@irena.org