Cooperation between European und African Universites -

Capacity Buildung in the Field of Sustainable Energy

h_da

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1 Introduction

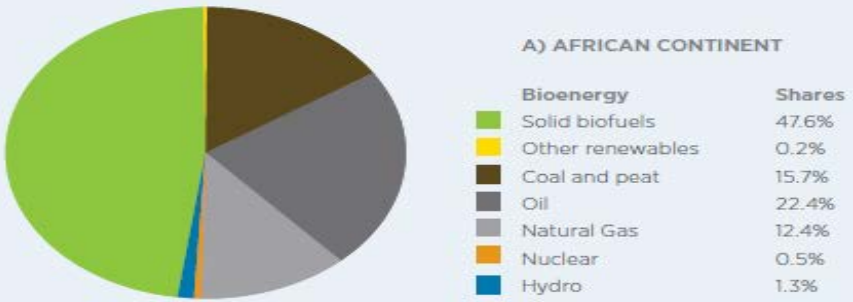
Regions of Africa

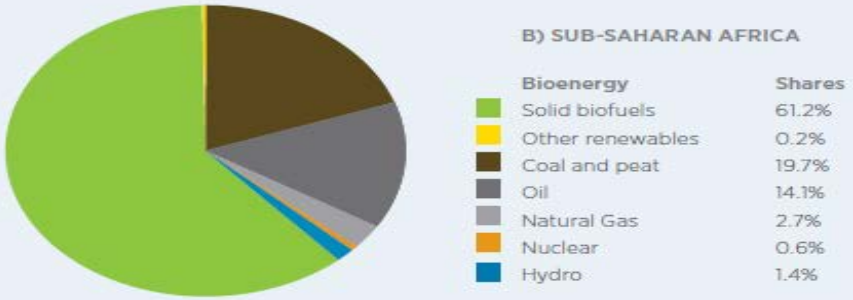
2. Energy Challenges of Subsaharan Africa

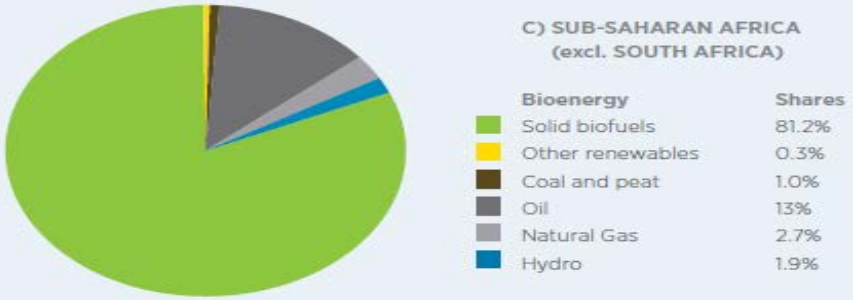
- Dependence on traditional biomass (firewood for cooking, warm water
- Small share of modern commercial energies (oil, gas, electricity)
- Energy poverty – **lack of energy services** like space heating, cooling, transport, communication,
- Lacking access to electricity (especially in rural areas)
- Unreliable power supply in areas with grid power (power cut, power shading)….making back up systems necessary

https://unstats.un.org/unsd/ENVIRONMENT/Energy.htm

Share of Biomass in TPES 2009



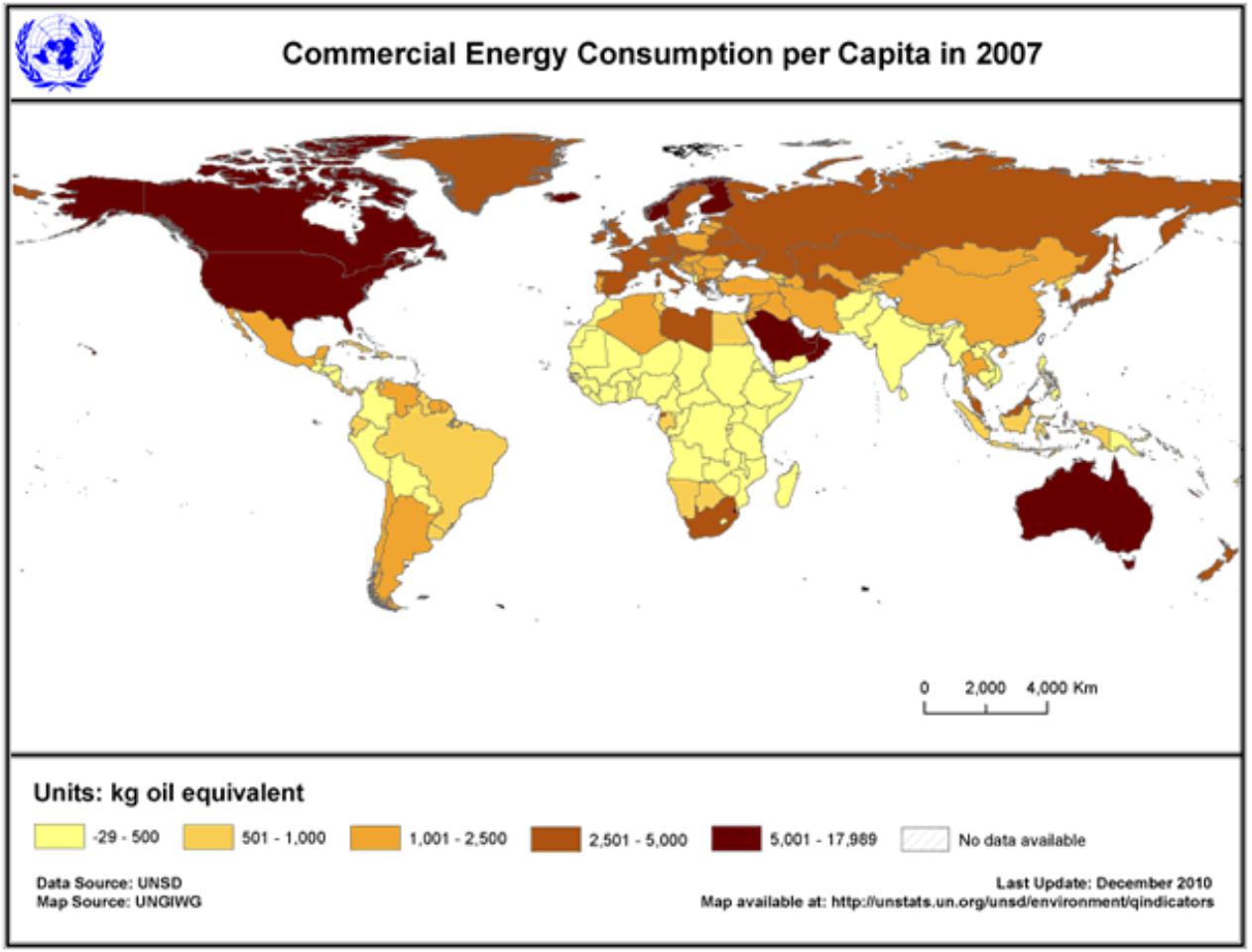




https://www.irena.org/DocumentDownloads/Publications/IRENA-DBFZ_Biomass%20Potential%20in%20Africa.pdf

Figure 1: Based on International Energy Agency (IEA) data for 2009. The charts show the shares of bioenergy in the total primary energy supply. (A) African continent. TPES: 673 Mtoe (28 177 PJ). (B) Sub-saharan Africa. TPES: 517 Mtoe (21 646 PJ) (77% of African TPES). (C) Sub-saharan Africa, excl. South Africa. TPES:372 Mtoe (15 575 PJ) (55% of African TPES. 72% of Sub-saharan TPES)

Commercial Energy Consumption per capita



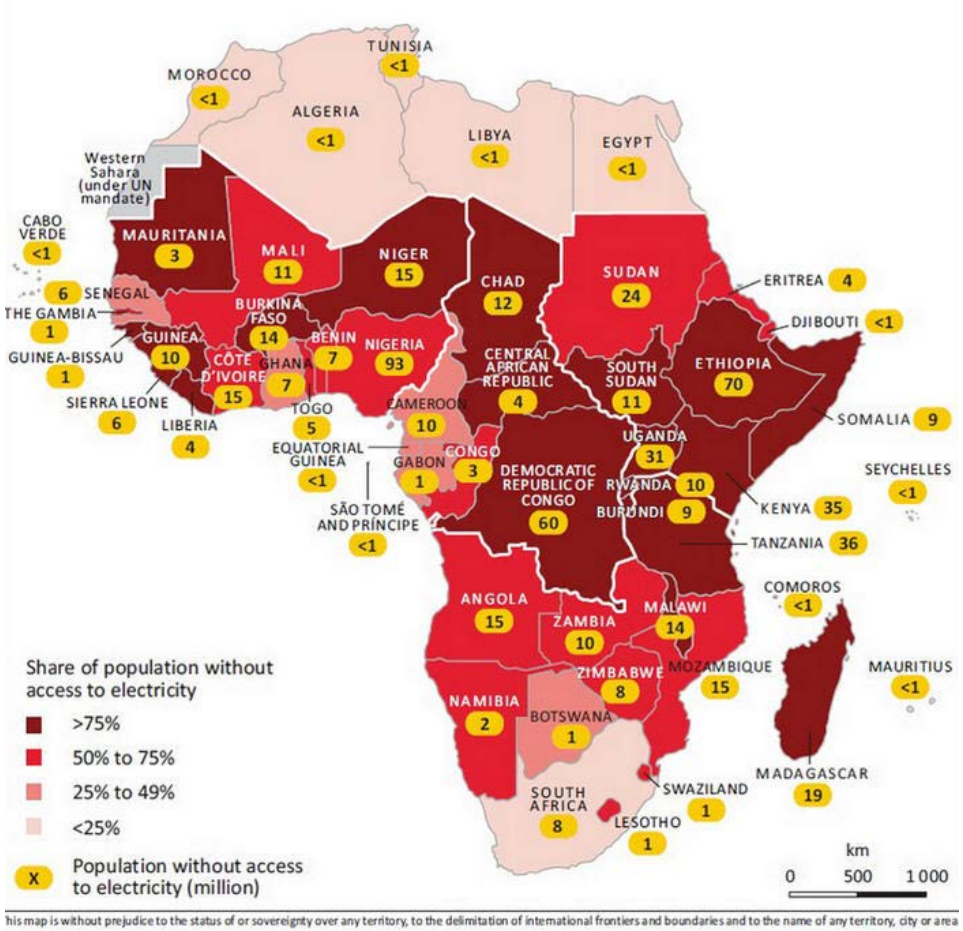
Electricity access in 2013

SOURCE: IEA, World Energy Outlook 2015

Electricity access in 2013 - Regional aggregates

Region	Population without electricity millions	Electrification rate %	Urban electrification rate %	Rural electrification rate %
Developing countries	**1.200**	**78%**	**92%**	**67%**
Africa	635	43%	68%	26%
North Africa	*1*	*99%*	*100%*	*99%*
Sub-Saharan Africa	**634**	**32%**	**59%**	**17%**
Developing Asia	526	86%	96%	78%
China	*1*	*100%*	*100%*	*100%*
India	*237*	*81%*	*96%*	*74%*
Latin America	22	95%	98%	85%
Middle East	17	92%	98%	79%
Transition economies & OECD	**1**	**100%**	**100%**	**100%**
WORLD	**1.201**	**83%**	**95%**	**70%**

2. Energy Challenges of Subsaharan Africa

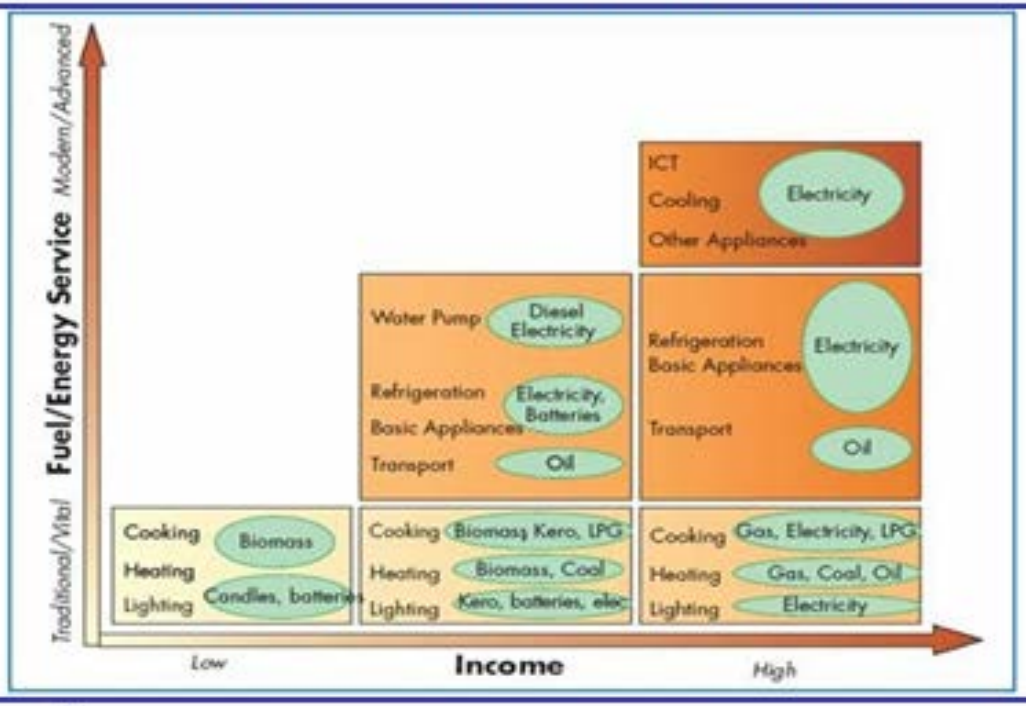


Energy Challenges of Subsaharan Africa

Central Africa:

- Low level of energy consumption /**energy services** (light, cooling, transport)
- Prevalence of Biomass
- Low effectivness (low useful energy); 10 – 15% efficiency
- Indoor pollution
- The increasing population let the demand for firewood grow
- In many countries use of biomass is **not sustainable**
  - **Growing population**
  - **Longer ways to more remote areas for firewood**
  - **Rate of Harvest > Rate of Biomass Growth**

Energy Ladder (source IEA, WEO, 2002)



Energy Resources of Africa

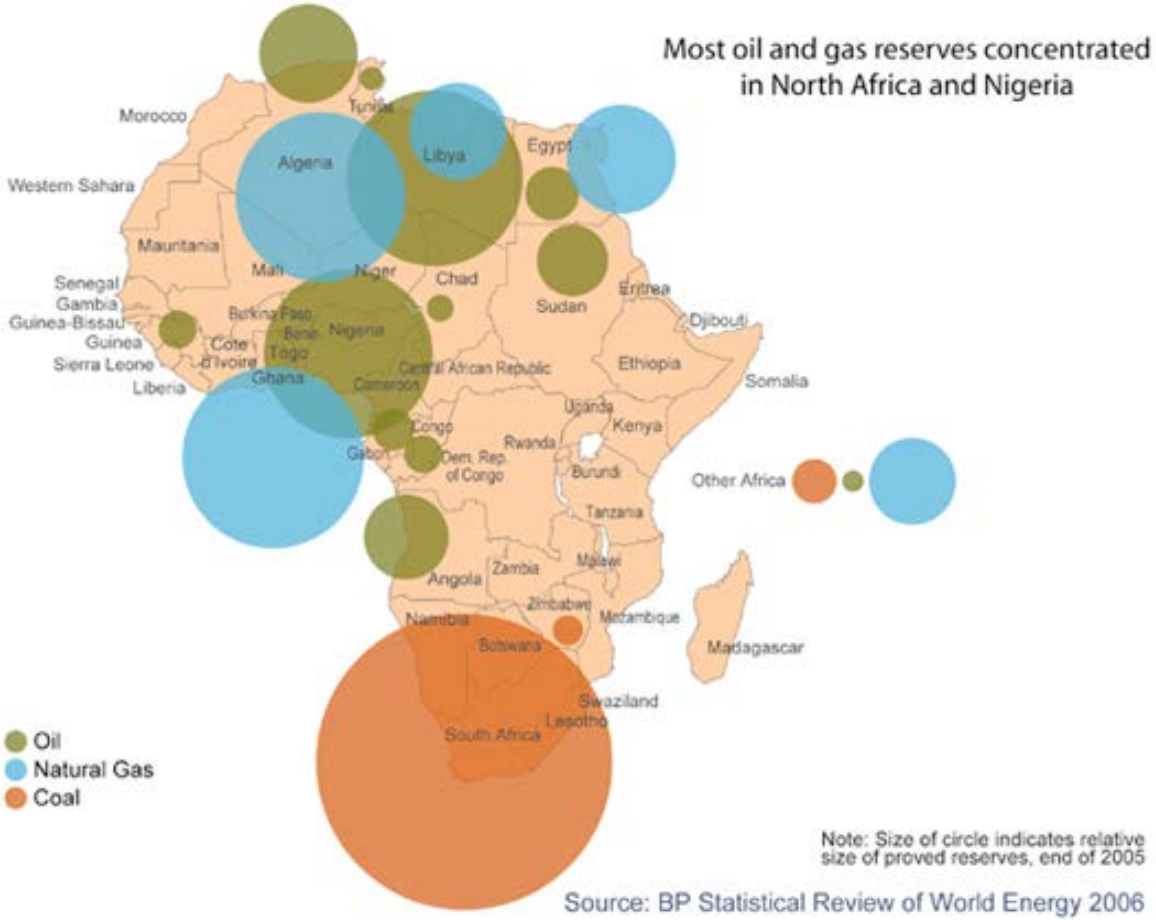
Is Africa lacking energy resources?

No, in general no.

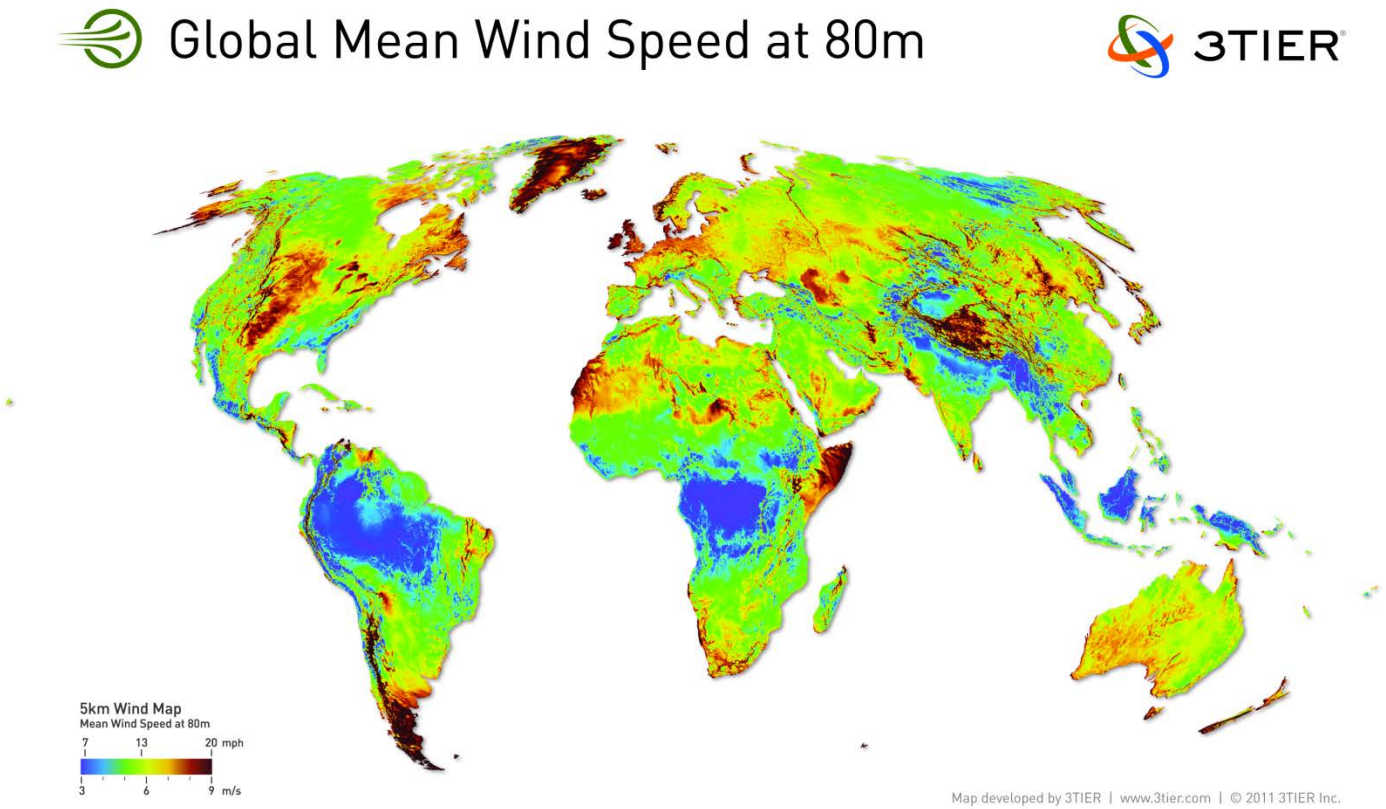
- Oil resources in North Africa, Nigeria, Angola…
- Natural Gas resources in North Africa, Mozambique, Namibia…
- Hard coal in South Africa, Zimbabwe, Botswana…
- Hydro power in the tropical regions (North and South of the Equator)
- Biomass resources in tropical regions
- Wind energy in coastal regions (Marocco, Namibia, South Africa…)
- **Solar energy everywhere**

Conclusion: Enough energy resources, Africa is Net Exporter of Energy

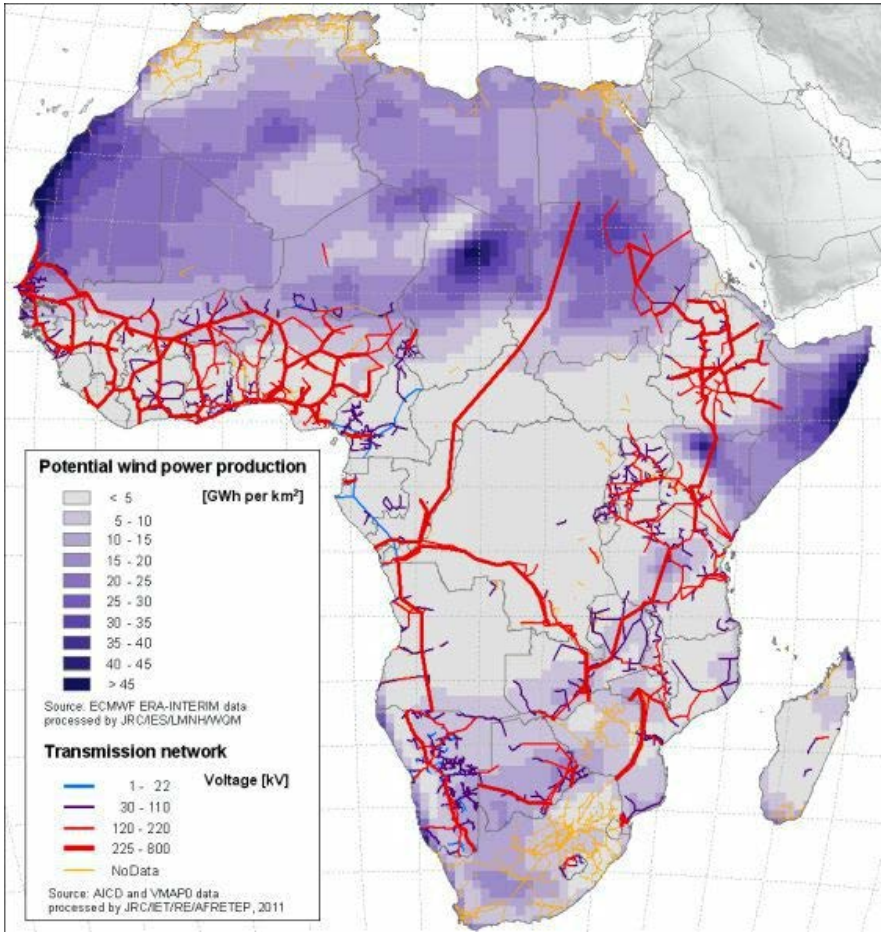
Fossil Fuel Resources 2006



Global Mean Wind Speed at 80m

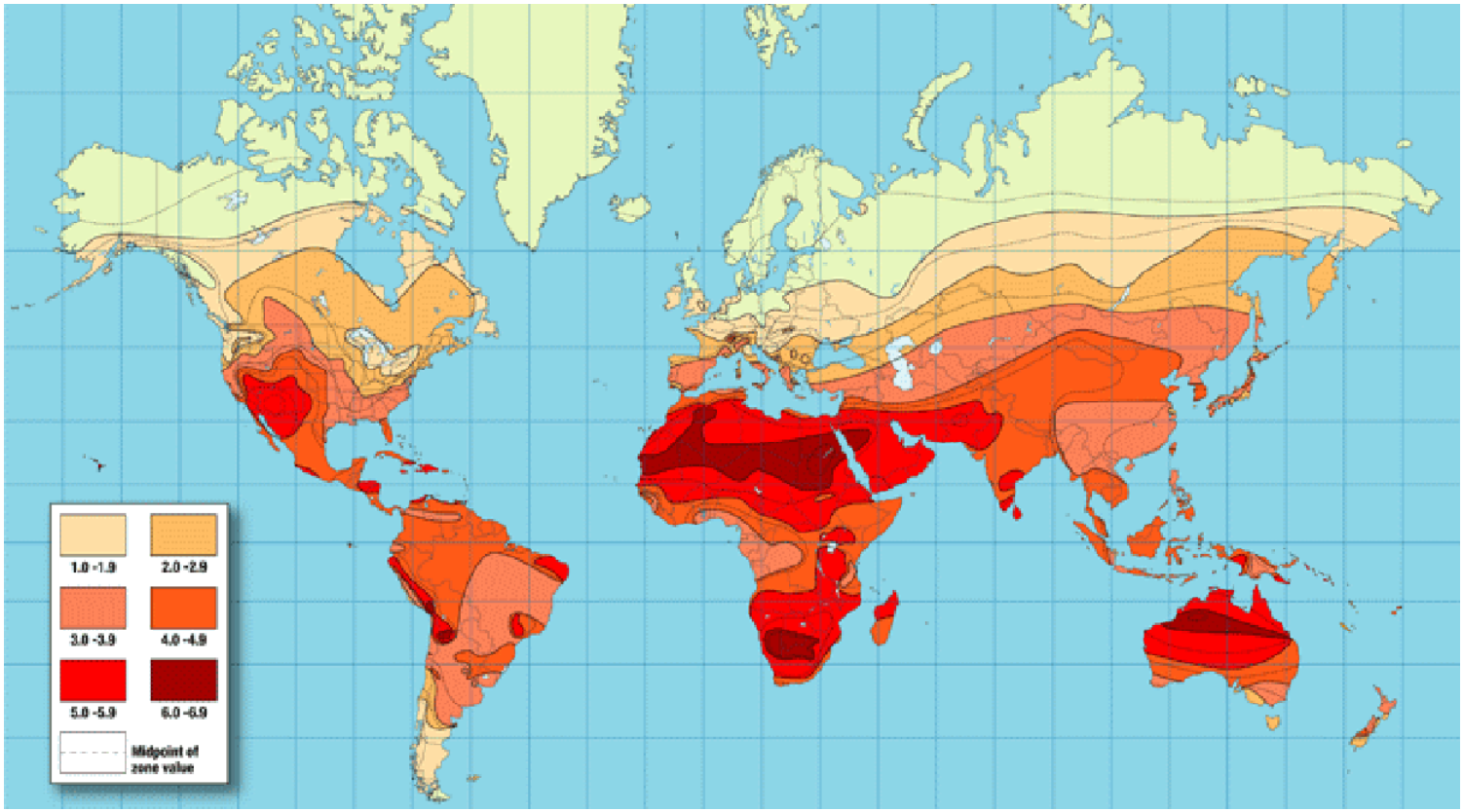


Potential Wind Power Production Africa



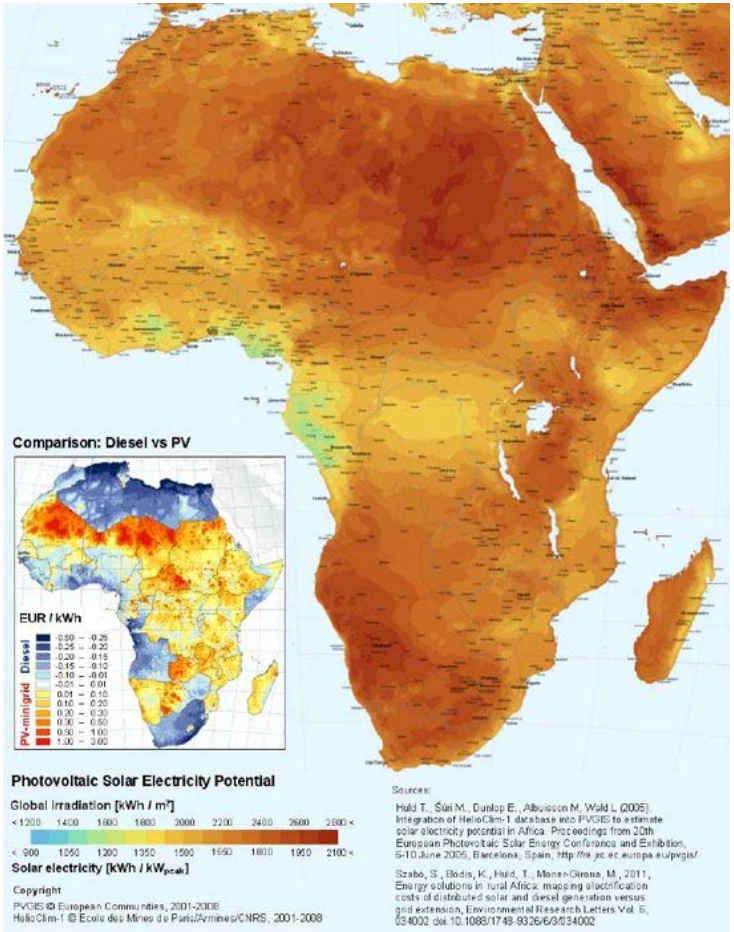
https://www.evwind.es/2016/06/27/the-dawn-of-wind-energy-in-africa-2/56727

World Solar Resources



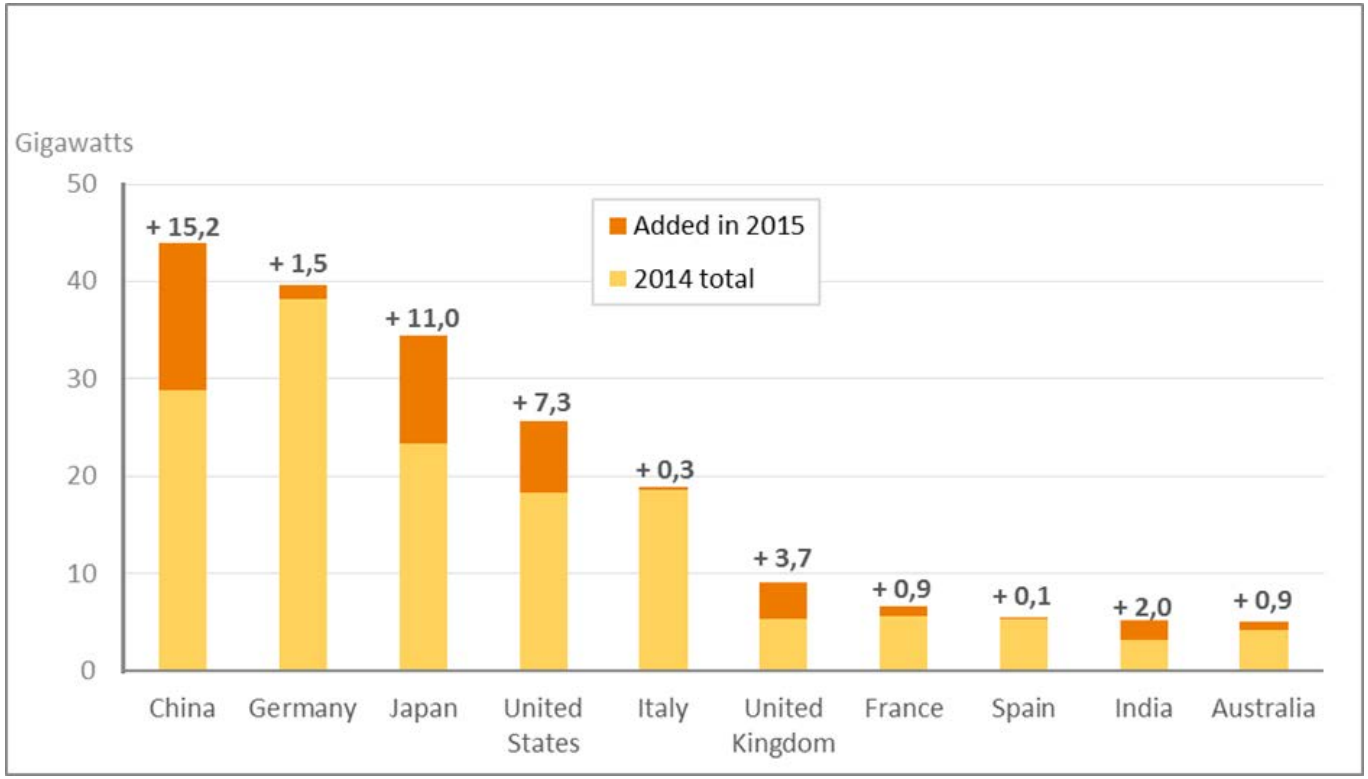
http://www.solafuture.co.za/news/south-africas-solar-resource-compared-to-the-rest-of-the-world

Africas PV Potential



http://environmentalresearchweb.org/cws/article/yournews/48639

Cumulative Solar Capacity and Capacity Additions in Top 10 Countries 2015



Obstacles for the use of PV in Subsaharan Africa

Why is the use of PV technologies booming around the world…but hanging behind in Africa?

- Higher Prices for PV (customs, lacking competition, transport…)
- Lacking incentives (tax credits, FIT, Portfolio Standards)
- Image as Second best electrification (Solar home systems)
- Lack of adequate PV investment schemes (high interest rates, lacking colaterals, banks not interested in small loans)
- Lacking qualitiy standards; poor quality

Project „Southern African Soustainable Energy Initiative“ (SASEI)

Target: Capacity Building in Higher Education Institutions in the Field of Sustainable Energy

- Including 4Universities
  - Namibia University of Science and Technology
  - University of Botswana
  - National University of Lesotho
  - University of Applied Sciences Darmstadt

  Funded by EU (at least on European university)

  3,5 years (Oct. 2013 – March 2017)

Target: Capacity Building in the Field of Sustainable Energy

What does it specifically mean?

- Inception meeting (Roadmap for 3 years; allocation of funds)

Stakeholder meetings in 3 countries, in the capitals with all stakeholders of the energy sector

- Representatives of the energy ministry
- **Regulator.....National Power Company (Grid company**)
- research organizations
- project developer, renewable energy firms…

What kind of Qualification does the country needs most?

- master or bachelor programs in Renewable/Sustainable Energy?
- joint master program or individual for each country?
- Technical Training Short Courses?

The team

Inception meeting at University of Botswana/Gaberone

University of Botswana

Namibia University of Science & Technology (NUST)

National University of Lesotho

Outcomes on 4 Areas

1. University Programs
2. Further Education; Technical Training Programs
3. Energy Data Base
4. Research

Solar Power Technologies and Markets

Solar Technology	Off-grid/on-grid	Useful energy	Rated power
PV Solar Lamp, PV Cooler, PV Pump	Off-grid	Light, Cooling, mechanical energy, communication	0 – 20 W
PV solar home system	Off-grid	Direct current for various purposes	20 – 300 W
PV back up system	Off-grid/on grid	Alternate power for various in-house purposes of firms	1 – 50 KW
PV small power generation (roof-top)	On-grid	Alternate power for in-house purposes of households and firms and the public grid	1 – 100 KW
Utility scale PV or CSP- plants	On-grid	Alternate power for the public grid	0,5 – 100 MW

Outcomes I: University Programs

Master of Sustainable Energy at NUST	√	√	√	√	√	√	√	√	
Bachelor of Engineering modules at UB	√	√	√		√				
Masters at UB	√	√	√		√				
Sustainable Energy short courses at NUL	√	√	√		√	√		√	
Master of Science in Sustainable Energy at NUL	√	√	√	√	√	√			

Outcomes II - Short Courses (Technical Training)

Learning materials for Short Courses (one week)

Provision of Short Courses on each Partner

Modules	Training Dates
1. Renewable Energy and Energy Efficiency	23rd – 28th Jan, 2017
2. Solar Thermal Systems	20th – 25th Feb, 2017
3. Solar PV Systems	20th – 25th Mar, 2017
4. Wind Energy	24th – 29th Apr, 2017
5. Energy Policy, Regulation and Environment	22nd – 27th May, 2017
6. Bio-Energy	19th – 24th Jun, 2017
7. Energy Economics, Finance and Project Management	24th – 29th Jul, 2017
8. Hydropower	21st – 26th Aug, 2017
9. Electrical Power Systems	25th – 30th Sep, 2017
10. Engineering Design for Rural Villages	23rd – 28th Oct, 2017

Outcomes III – Energy Data Base

- Reports on Energy Markets and Energy Legislation for all 3 Countries
- Check of Energy Data Availability
- Manual to improve the Energy Balance
- Introduction of Energy Planning Programs (LEAP – Software) in all 3 universities

Outcome IV - Research

- Annual Scientific Conferences (alternating in the 3 countries)
- Journal on Renewable Energy and Energy Efficiency
- Regional Platform of Knowledge Sharing
- Preparation of more joint projects (another EU application)

4. Conclusion

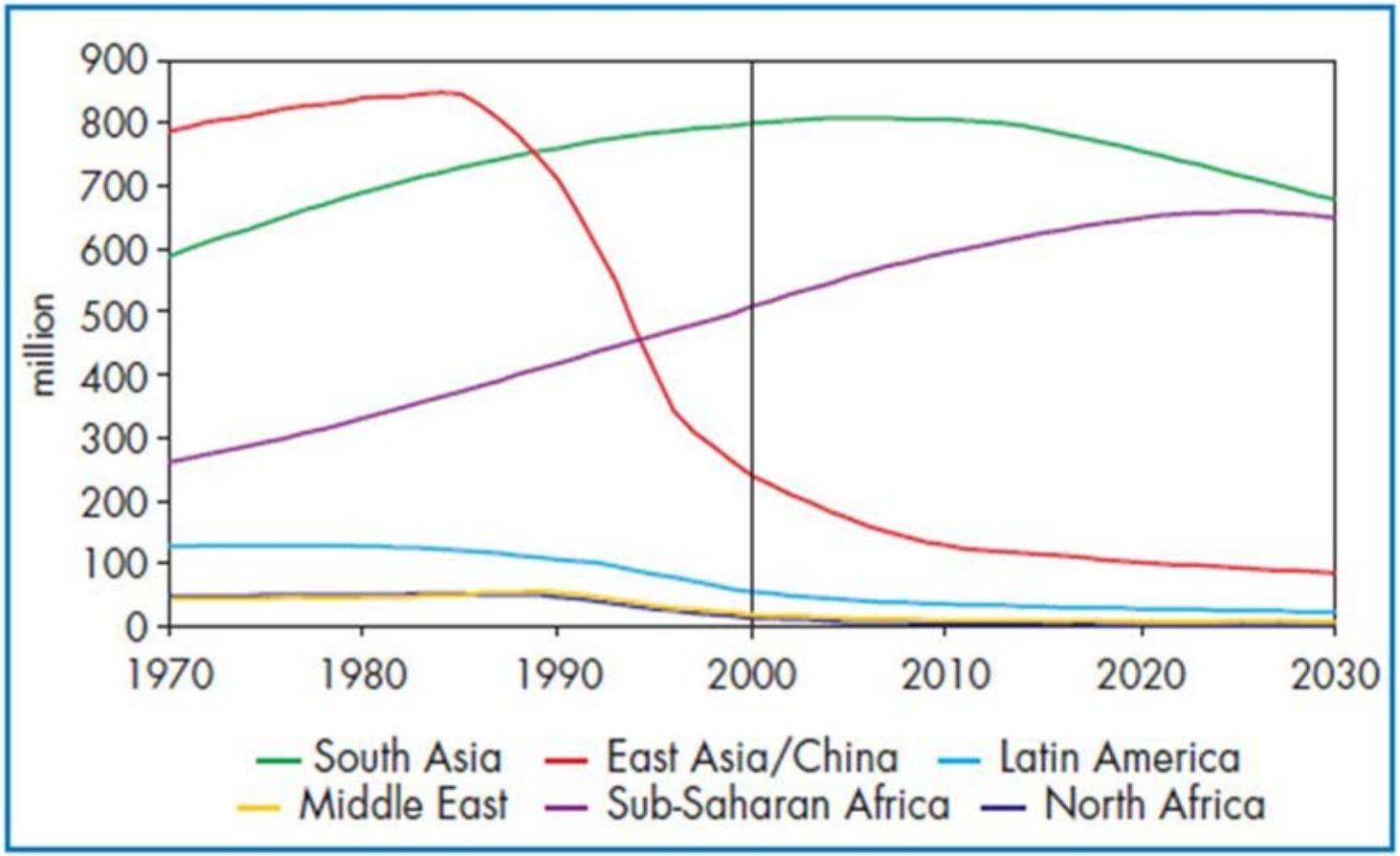
EU Interest as financing institution: Are the outcomes sustainable? - YES

- Journal
- Annual conferences
- Improved data based for political planning and energy research
- University programs
- Technical training short courses

Hope all this will help to speed up the development of markets for renewable energy technologies

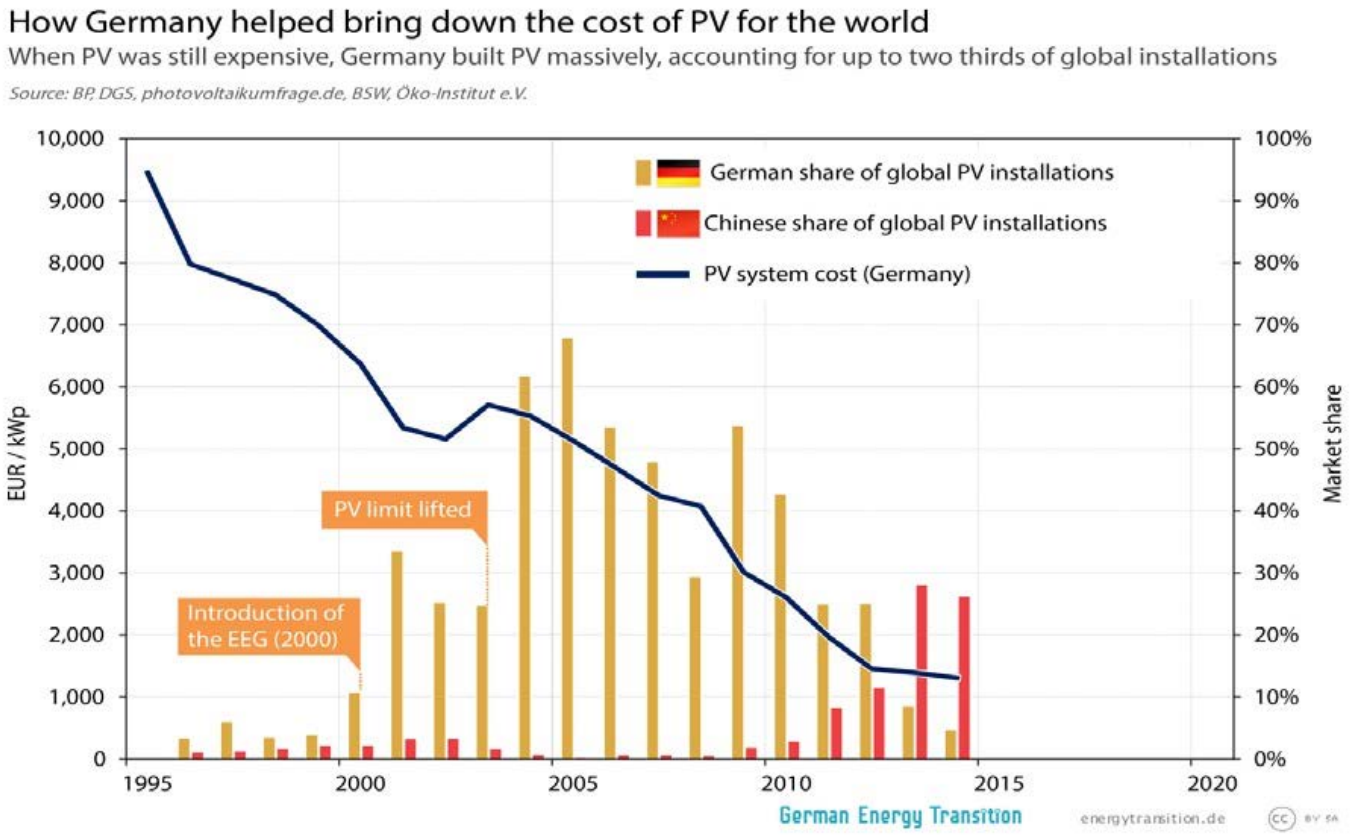
And encourage applied research projects

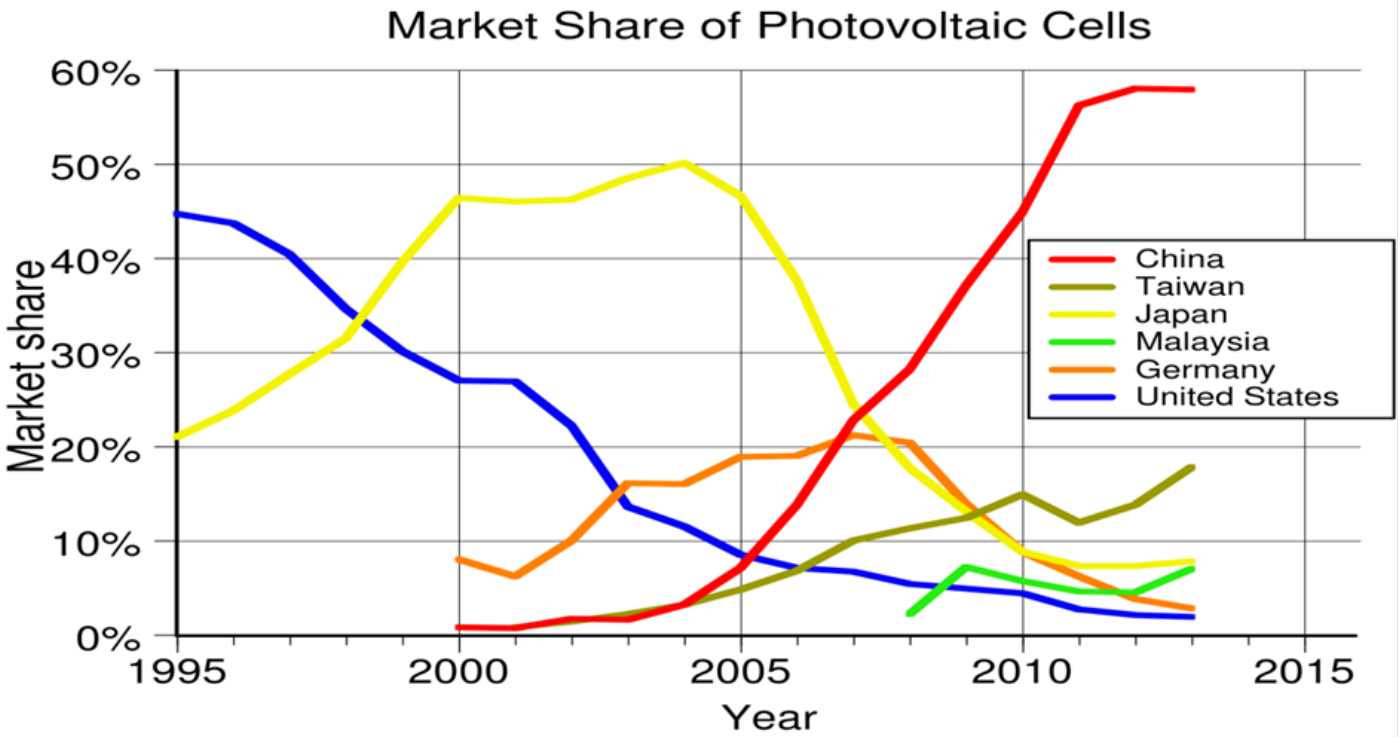
People not connected to the grid by regions – projection 2002



Source: IEA analysis.

Price drop of PV systems




Market Share of Photovoltaic Cells
60%
50%
40%
30%
20%
10%
0%
Market share
1995
2000
2005
2010
2015
Year
China
Taiwan
Japan
Malaysia
Germany
United States