Energy transition in (Subsaharan) Africa

Filip Černoch
cernoch@mail.muni.cz

Sub-Saharan Africa

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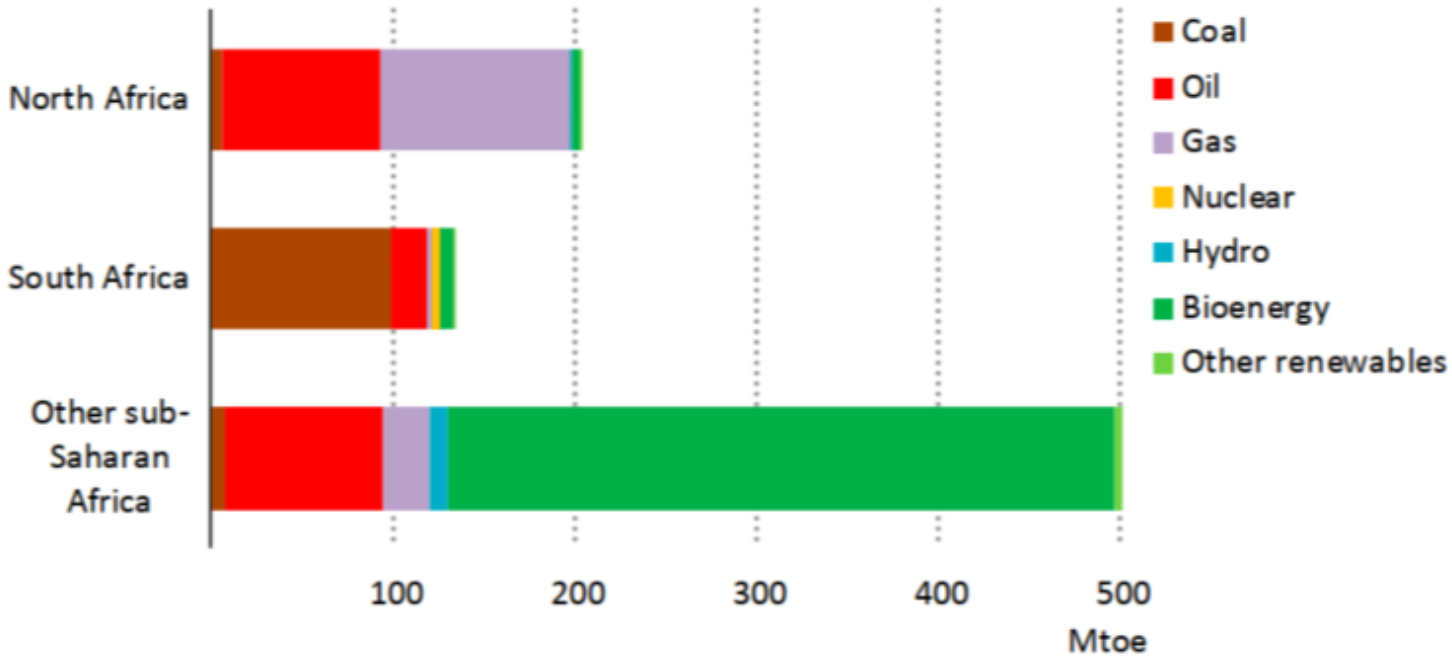
- If you were the head of your country during the late 1970s, what policies would you follow to minimize the impact of possible another oil shock on your country‘s economy?
- What options do the hydrocarbon producing countries of MENA region have to deal with the (possible) impacts of decarbonization? As you see it, which are more probable and which less? Why?

Context

Sub-Saharan Africa

- Region is rich with resources (both fossil and renewables) but poor with energy - accounts for 6% of global energy demand (3% of electricity), having 17% of the world´s population. 45% of that bioenergy. Over the past 30 years power generation per capita plateued.
- Solid biomass (fuelwood, straw, charcoal, dried animal and human waste) accounts for about 70% of final energy use in the region (80% with SA excluded).

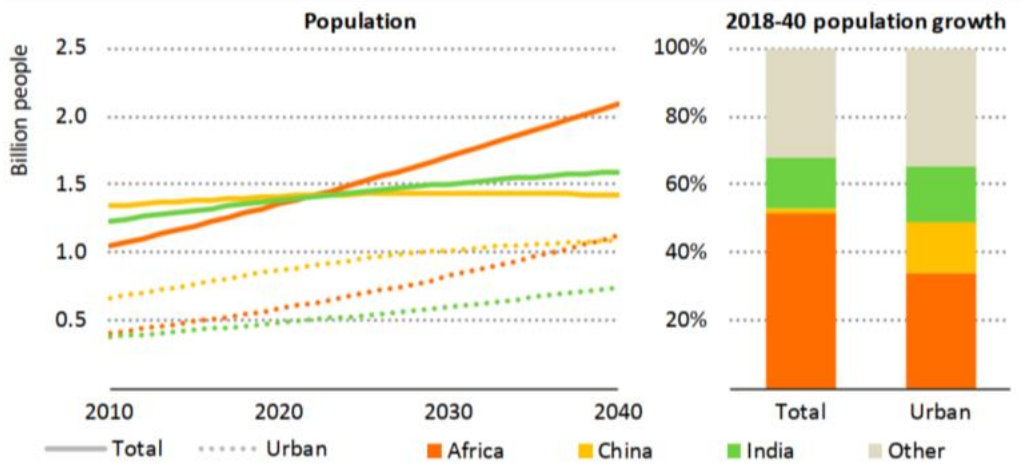
Total primary energy demand by fuel, 2018



Trends

1) Growing population

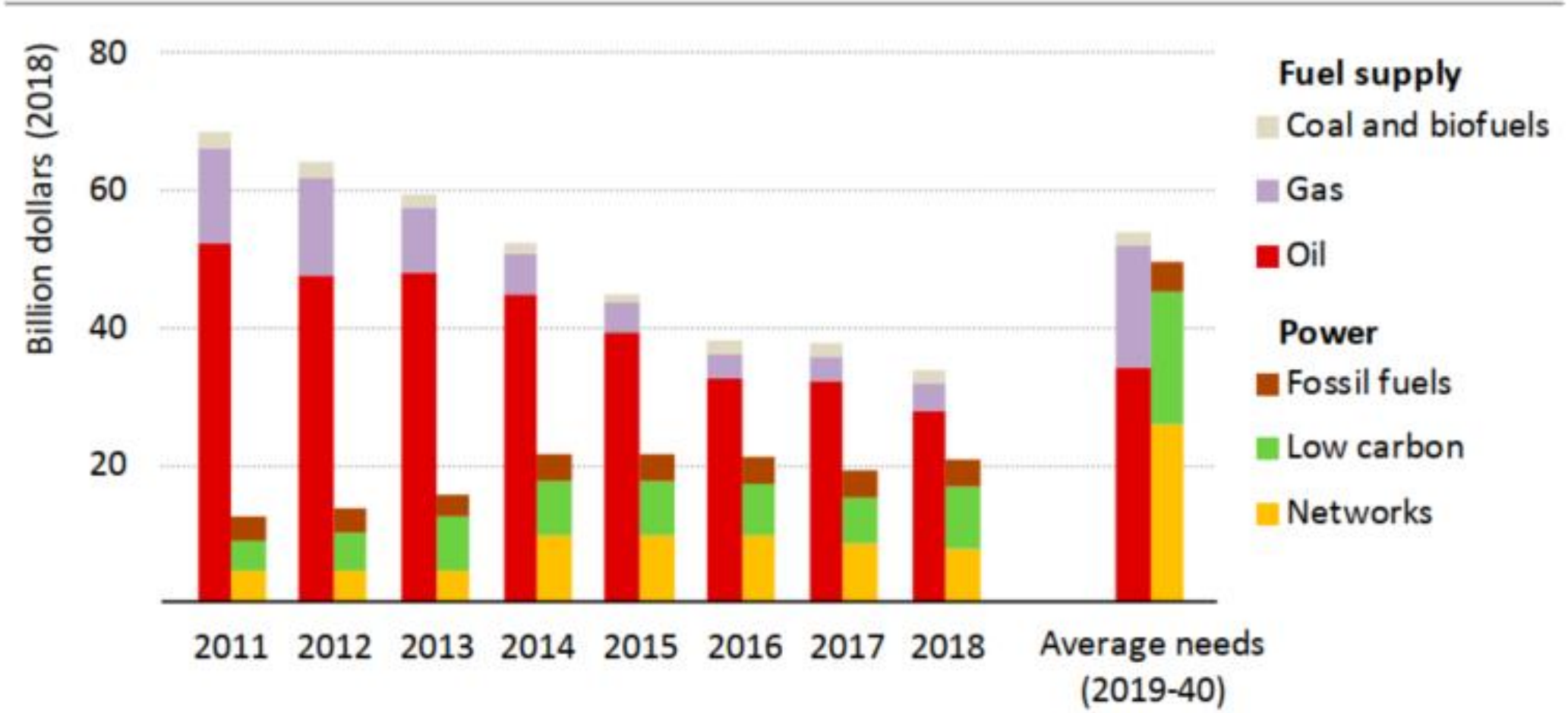
- Rapid population growth -180 million in 1950; 1.3 bn. in 2018; (expected) 2.2 bn. in 2050, and (expected) 3.9 bn in 2095.
- Urbanisation – by 2030, more than 50% of people in cities, by 2050 more than 60%. By 2040 about 580 additional million people in the cities.
- Potential advantage is growing working-age population (42% below 15 years). 40% of the population below powerty line.



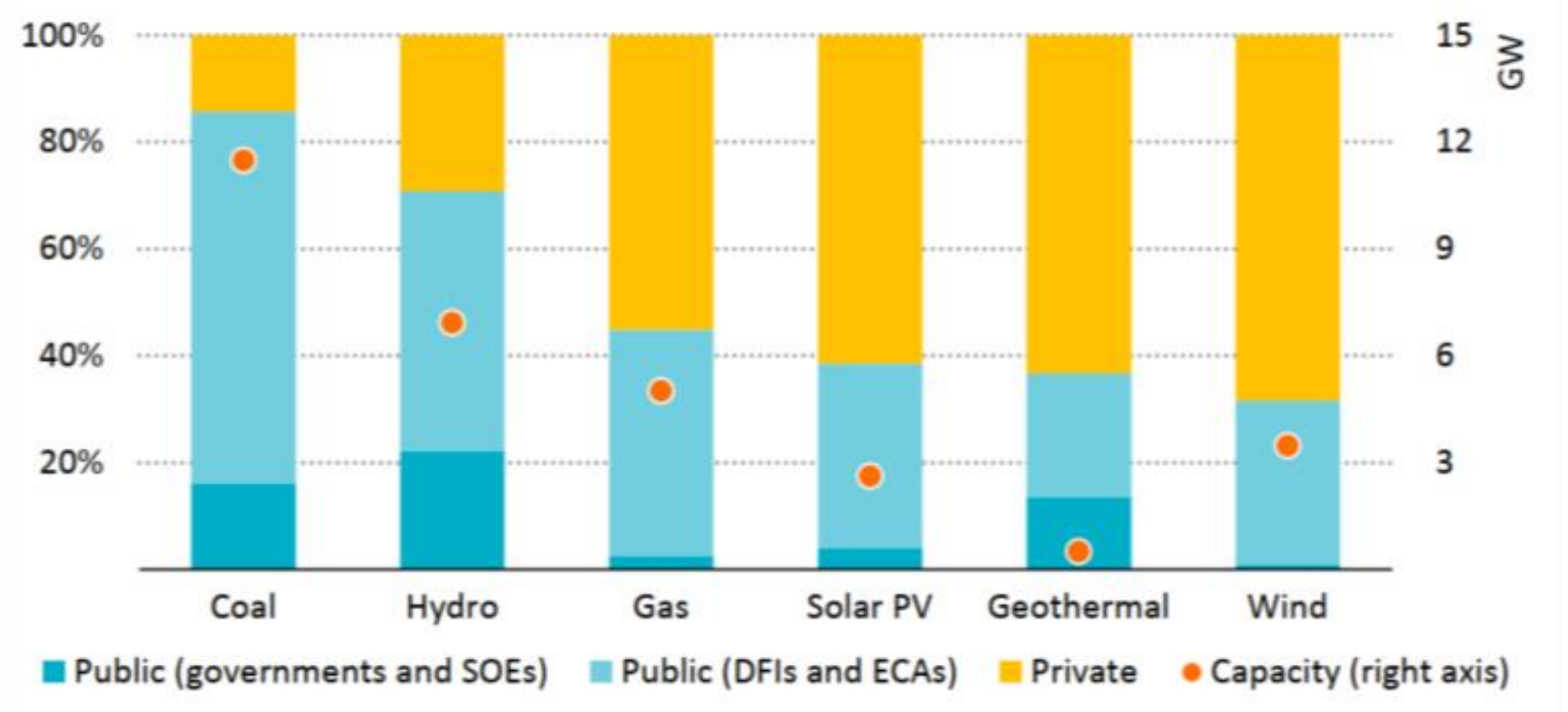
2) Investments and economy

- In 2018, around USD100 billion invested in energy sector = about 5.5% of the global total.
- The economy of the region is still smaller than that of Germany (sic). Agriculture 65% of employment, mining for export.
- Share of population living in powerty decreases while absolute number increases.
- Significant role (FDI, trade) of the EU, growing role of China (oil-related investments in Angola, Chand and Uganda, gas investment in Mozambique, or hydro in Ethiopia and Nigeria).
- Governance shortomings preventing foreign investments – low-quality institutions.

2) Investments and economy



2) Financing sources for power generation investment by share, type and capacity in sub-Saharan Africa, 2014 - 2018



2) China case – the new colonialism?

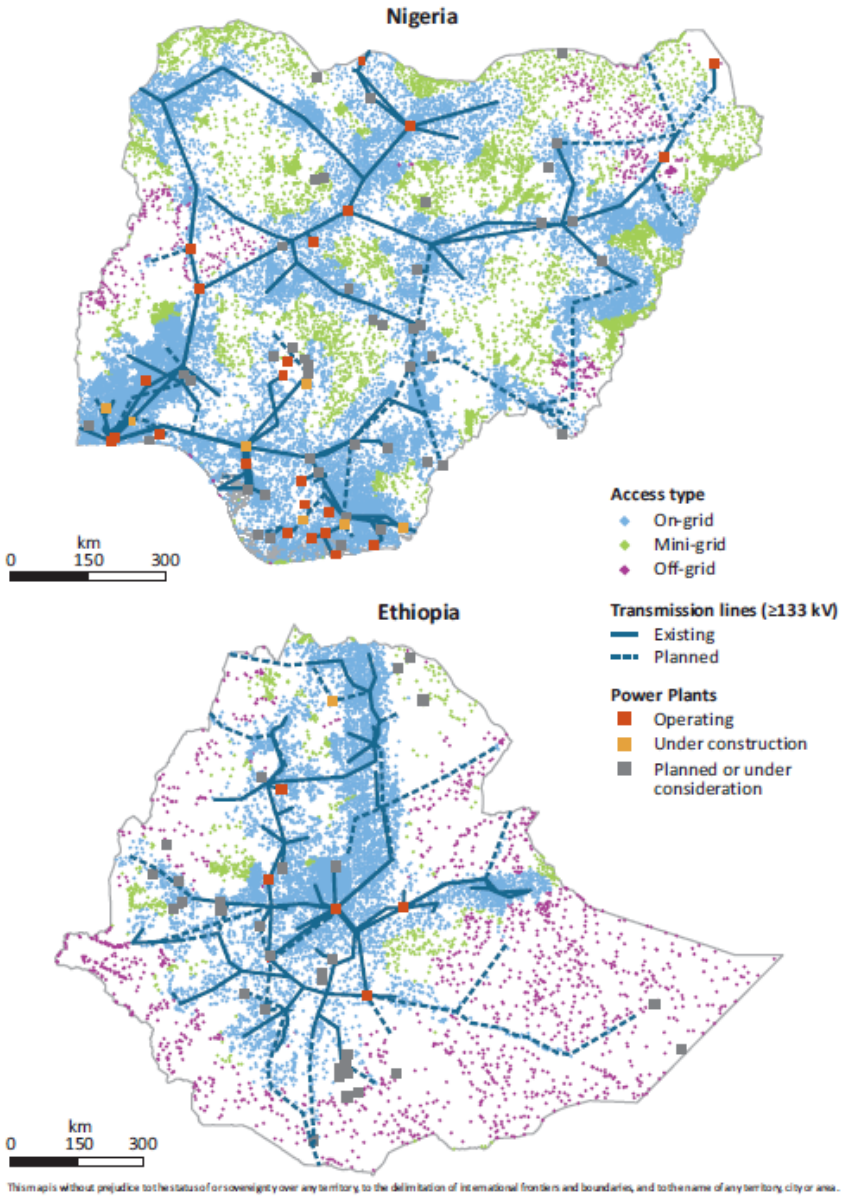
- Investments of USD 60 bn in 2015, around 10 000 Chinese companies operating in the region.
- Export of commodities, import of electronics and industrial goods. (Tecno – 25% of the whole smartphone market).
- Predatory loan practices or investments in infrastructure?
  - China lent at least USD95.5 billion between 2000 and 2015 – 40% for power generation and transmission, 30% for infrastructure.
  - Example of Djibouty – in two years from 50% to 85% GDP. Similar in Angola, Kenya…

3) Electricity access

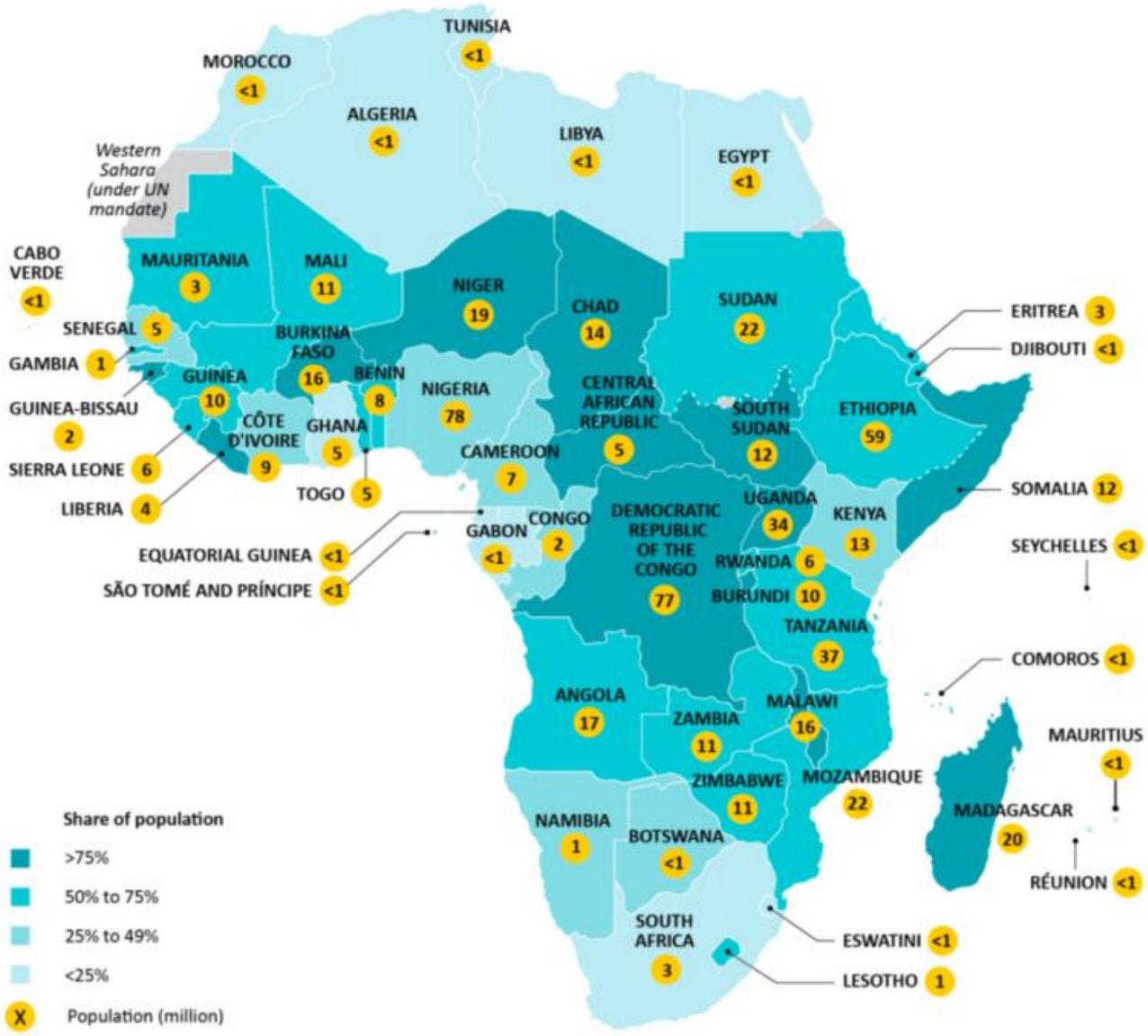
- In 2013 the trend of population growth outpacing electrification reversed. 45% electrification rate.
- In 2013 610 million people without elektricity, 595 in 2018. 80% of them in rural areas.
- Increasing role of renewables. Decentralized systems, off-grid systems?
- Still 530 million people in mainly rural areas without electricity by 2040.
- Reliable supplies of electricity essential economic development.
- Electricity prices very high by world standards, despite being often bellow the costs of supply (subsidies for oil).

- Electrification undermining development goals of clean energy and climate action?

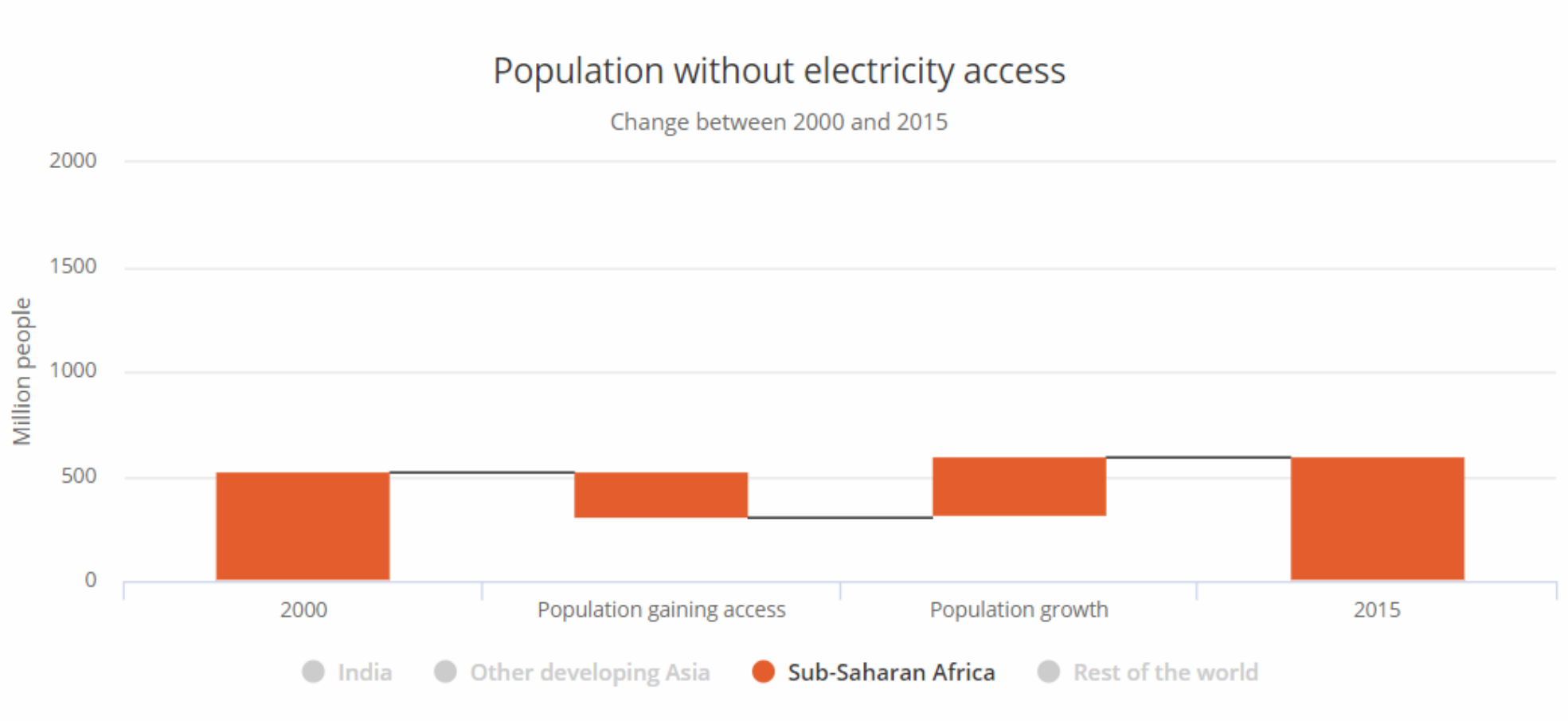
Figure 3.4 ▷ Optimal split by grid type in Nigeria and Ethiopia, based on anticipated expansion of main transmission lines



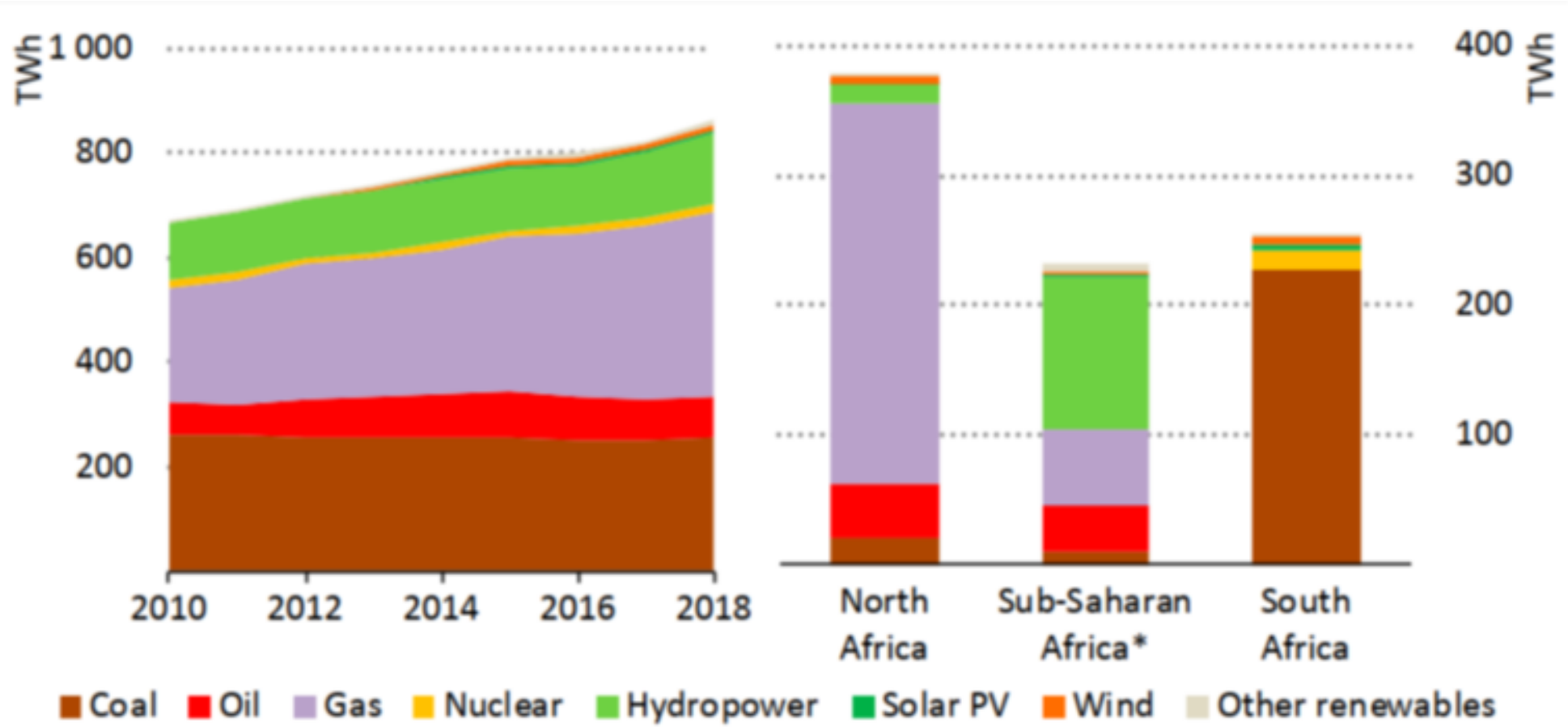
3) Population without access to electricity, 2018



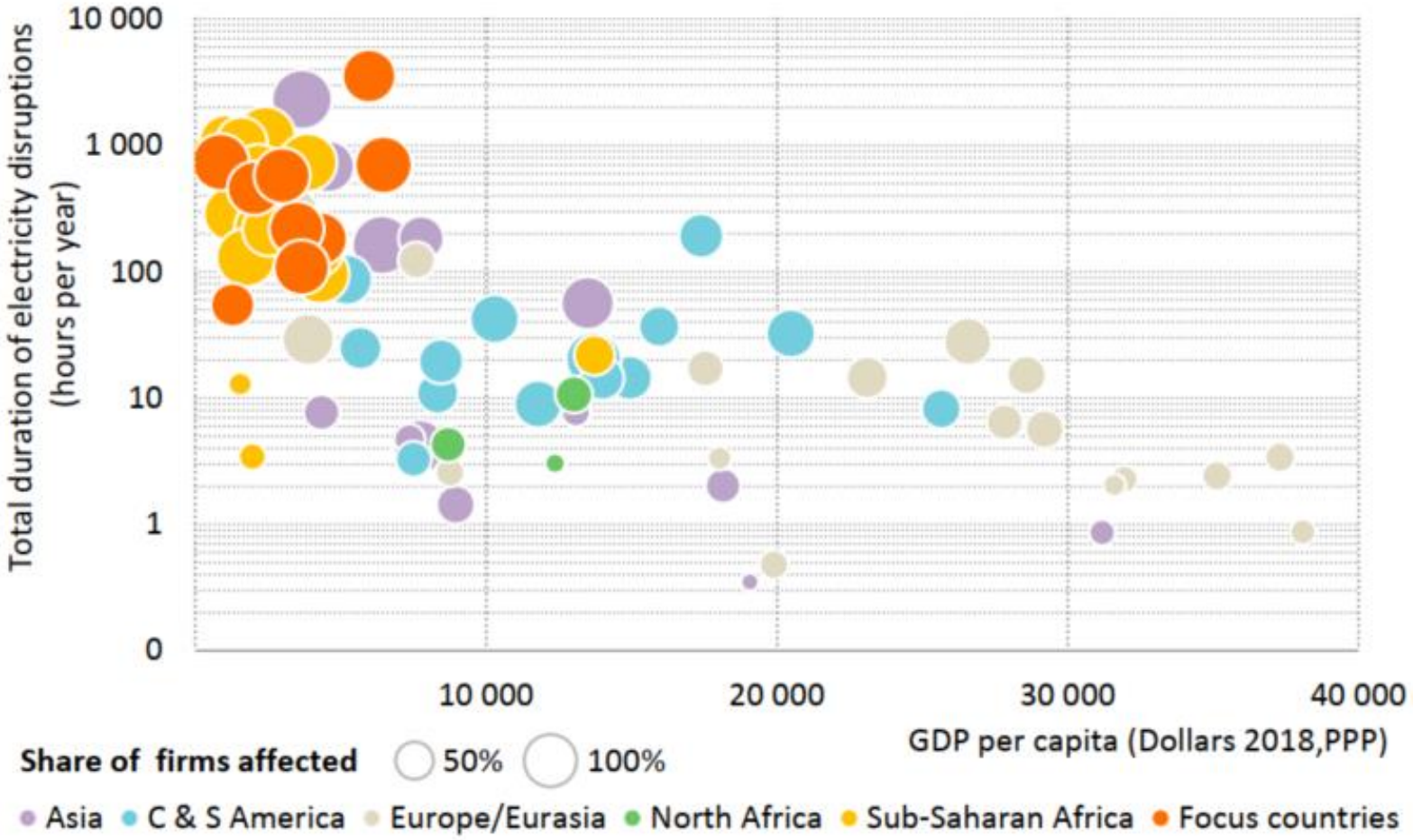
3) Access to electricity



3) Electricity generation by fuel, 2010 - 2018



3) Electricity outages and GDP per capita in selected regions, 2017



3) Diesel generators vs. PV units

- Diesel generators used to back-up the (unreliable) grid – outages for 6% of the time on average, in some countries (Nigeria, Guinea, Central African Republic) much higher figures.
- Nigeria the largest African importer of the generators, spending almost USD 22 bn. for fuel only (5bn above the price of electricity).

4) Clean cooking

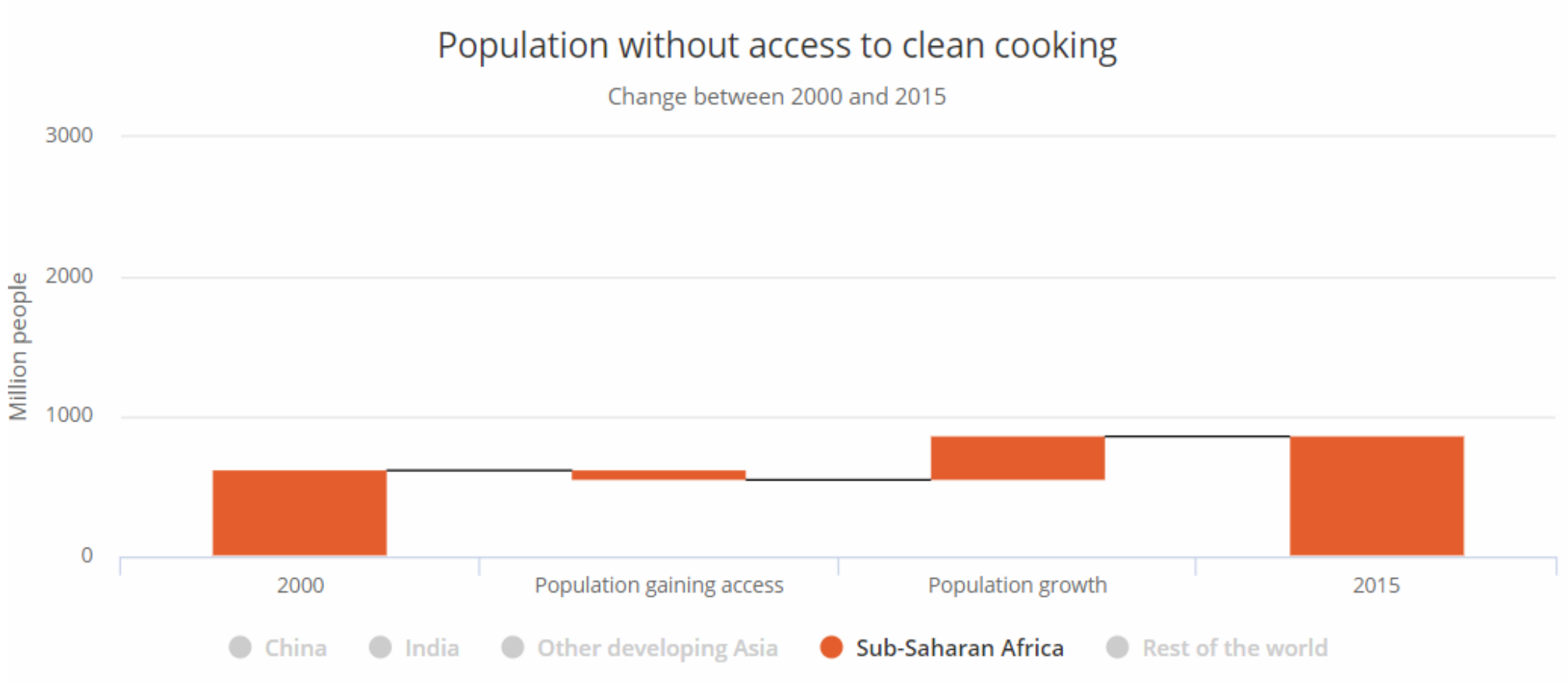
- Between 2015 – 2018 increase from 15% to 17% population with access to clean cooking. 900 million without.
- Clean cooking – health and environmental improvements, economic opportunities for women.
- 500 000 premature deaths due to the household air pollution.
- 6% of people using kerosene. Deforestation for charcoal for cities. Increase in LPG.

2) Biomass in cooking

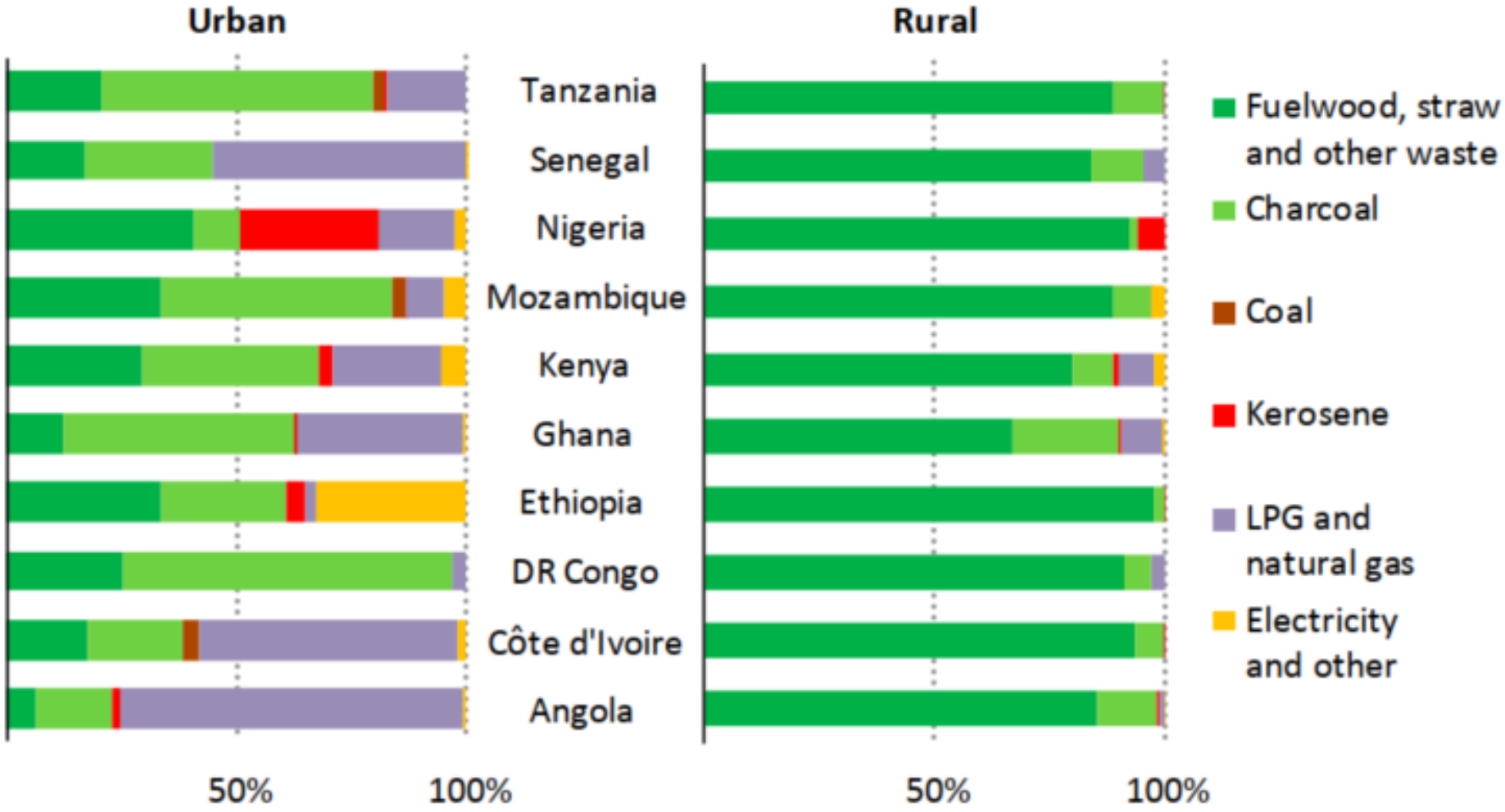
- Solid biomass (fuelwood, straw, charcoal, dried animal and human waste) accounts for about 70% of final energy use in the region (80% with SA excluded).
- Cooking primarily.
- Environmental consequences, health effect.
- Policy actions and wood scarcity may encourage usage of LPG and more efficient cookstoves, but 650 million people still cooking with biomass in 2040.

	Investment cost ($)	Efficiency	Daily hours for cooking	Consumption per household (toe/year)
Traditional cookstoves				
Charcoal	3 - 6	20%	2 - 4	0.5 - 1.9
Fuelwood, straw	0 - 2	11%	2 - 4	1.0 - 3.7
Alternative cookstoves				
Kerosene	30	45%	1 - 3	0.1 - 0.2
LPG	60	55%	1 - 3	0.08 - 0.15
Electricity	300	75%	1.2 - 2.4	0.07 - 0.13
Biogas digester	600 - 1 500	65%	1 - 3	0.07 - 0.14
Improved cookstoves:				
Charcoal	14	26%	1.5 - 3	0.4 - 1.5
Fuelwood	15	25%	1.9 - 3.8	0.5 - 1.6

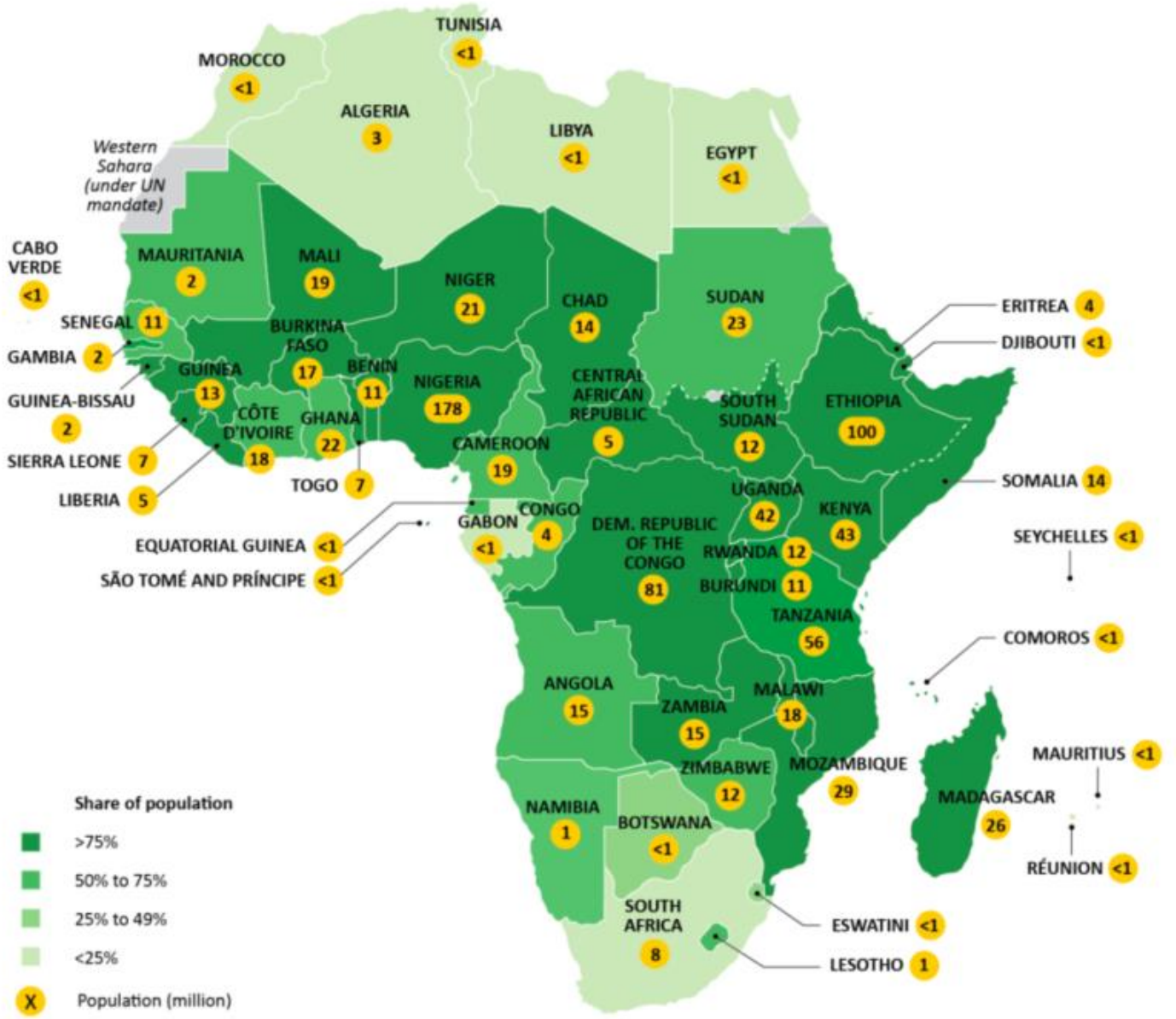
4) Clean cooking



4) Main fuels used by household for cooking, 2018



4) Population without access to clean cooking, 2018



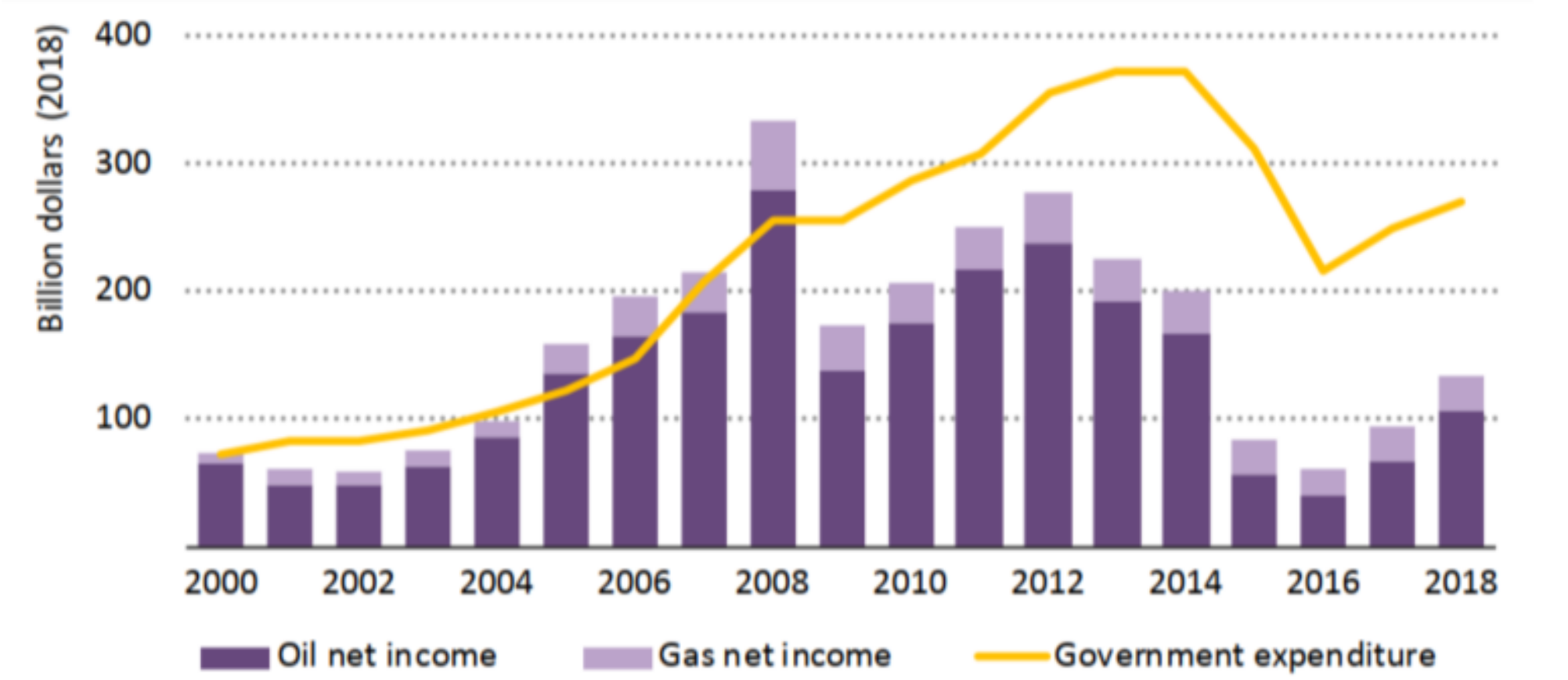
5) Hydrocarbon resources

- The whole continent (incl. North Africa) around 450 billion barrels of technically recoverable oil (about 7% of the world). In subsaharan Africa ¾ of reserves in Nigeria and Angola.
- Natural gas used sparcely – about 5% in energy mix. 100 tcm (13% of the global total) of recoverable natural gas, often flared (1/3 of the whole production). Plenty of new discoveries, prospecs of increased consumption. Nigeria, Mozambique, Tanzania. Expensive infrastructure needed.

= estimated 120 bn. tons of coal (less than 1% of world reserves) in the southern part of the continents, lack of exploration and data. SA, Mozambique etc.

= Uranium resources in Namibia, Niger, SA (20% of world reserves).

5) Net income from oil and gas production and government expenditure in top-ten producers in Africa



5) Nigeria and its oil

- Angola is overtaking Nigeria as the largest sub-Saharan oil producer.
- In Nigeria, regulatory uncertainty, militant aktivity, oil theft (bunkering) in the Niger Delta compromise production.
- Oil theft estimated at 150 kb/d plus oil spills due to sabotages (= 14% of output) – lost revenue of more than USD 5bn/y. Situation getting better in the last years.
- Nigeria as a rentier state – largest economy in the region but several key human development indicators (education, life expectancy) on the regional average.
- https://www.youtube.com/watch?v=KagZ76EXU_I

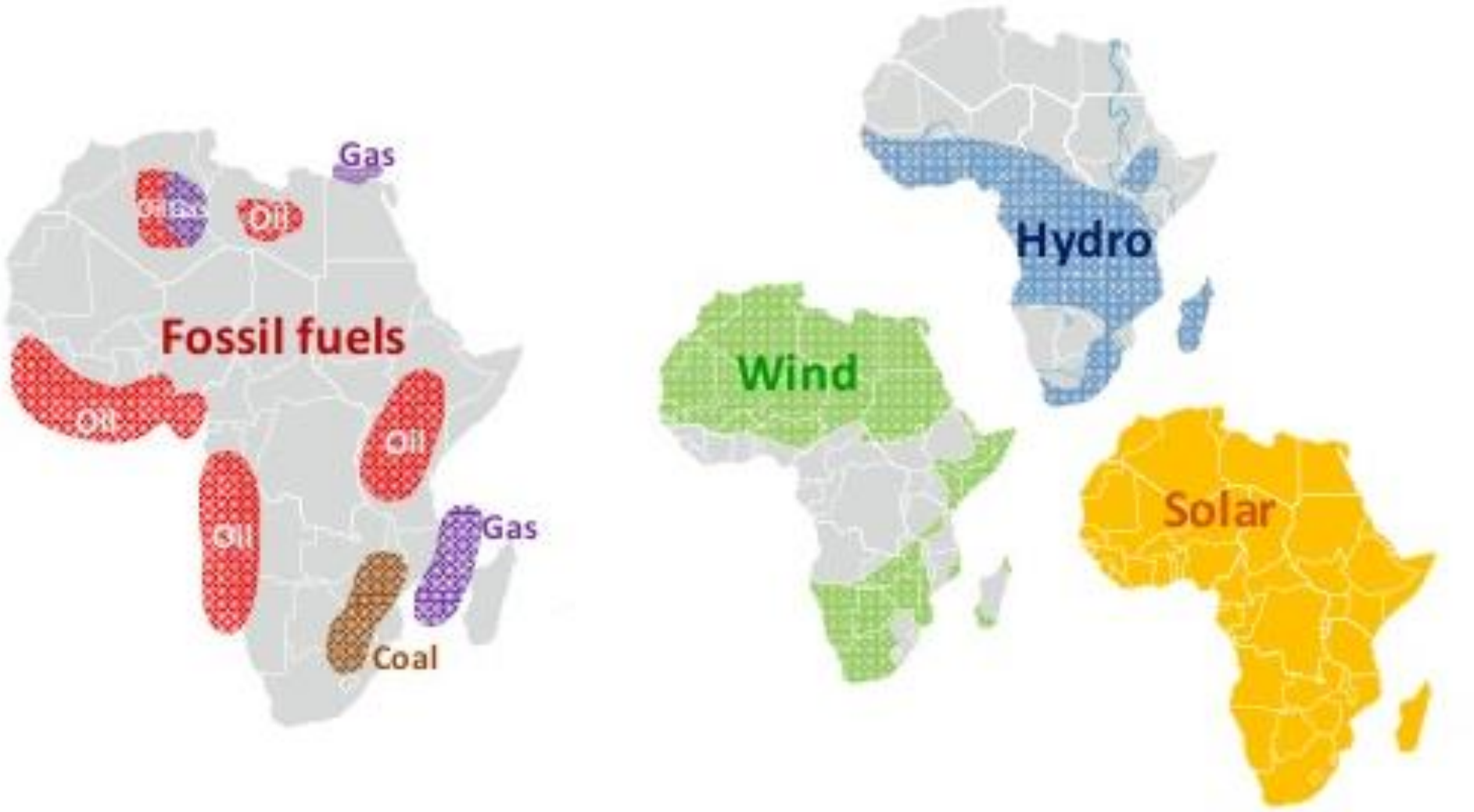
5) (Energy) resource curse?

- IEM outlook 2019:
  - Growth 3.2% in 2019, 3.6% in 2020.
  - Non-resource-intensive countries expected to growth nearly three times faster (at 6.0%) than oil exporters (at 2.1%) and other resource intensive countries (2.7%).
- Africa's resource producers remain among the least diversified economies in the world, and their economic prospects remain tied to the volatile movement of global commodity prices.

6) Renewable sources

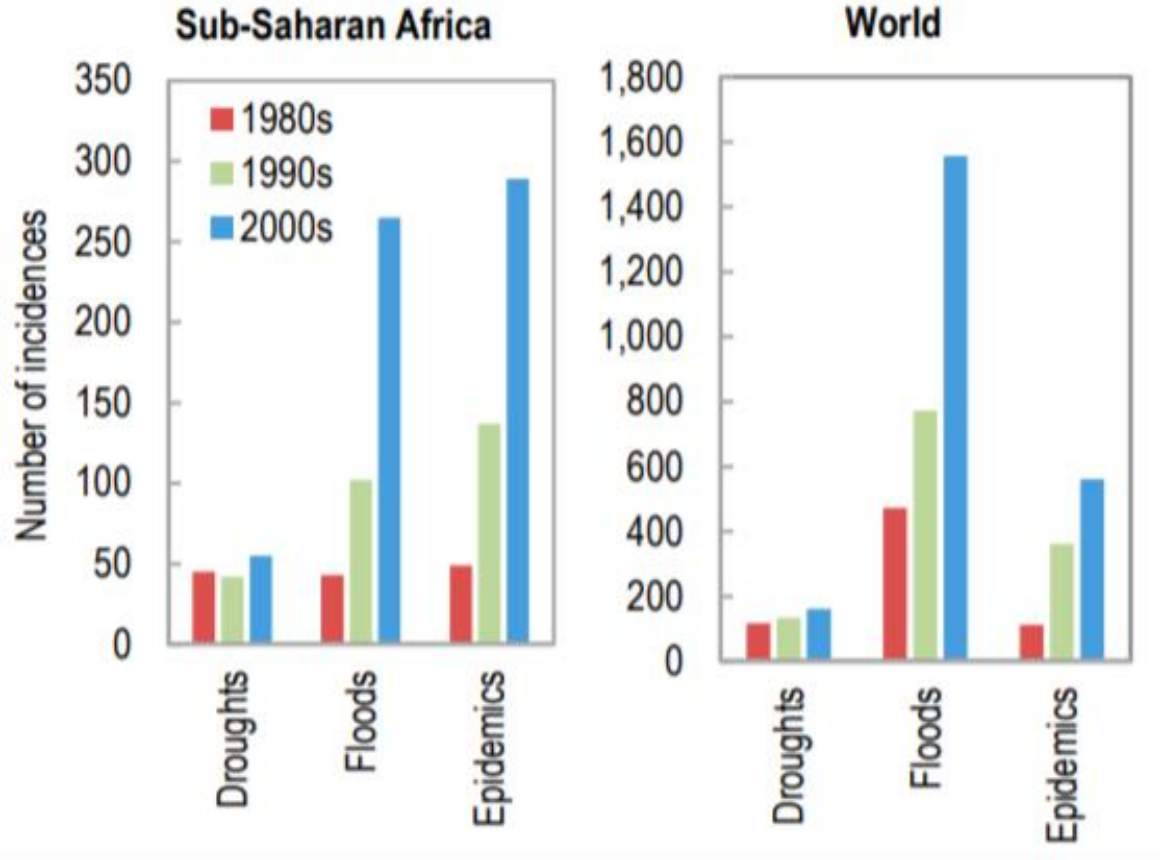
- Development limited by financing, underdeveloped grids and infrastructure, uncertaint policy environment.
- Around 4 GW of solar PV added between 2010 and 2018.
- Total of 35 GW of hydro capacity across Africa. 60% of investments between 2010 and 2015 from China.
- About 5.5 GW of wind total.
- Bioenergy – 60% of primar energy use.

6) Renewable potential



7) Climate change impact

- More than 680 million (more than half of the population) in areas where cooling is needed.



Incidences of natural diseasters, 1980s-2000s

Crossroads

(Centralized) fossil fuels vs. (decentralized) renewables

- What energy pathway to take?
- Centralized/traditional sources need centralized governance.
- Decentralized/renewable sources provide energy, but - could economy be built on decentralized/renewable sources?
- Leapfroging – example of telecommunication.

Sources

- World Population Review (2018): Sub Saharan Africa Population 2018.
- IEA (2014): Africa Energy Outlook.
- IEA (2017): Energy Access Outlook 2017: From Powerty to Prosperity.
- Hafner, M.; Tagliapietra, S.; de Strasser, L.(2017): Energy In Africa: Challenges and Opportunities.
- Oxford Institute for Energy Studies (2018): Electrifying Africa.
- IMF (2019): Regional Economic Outlook: Sub-Saharan Africa.

Average elektricity losses in power systems, elektricity demand served by back-up generators, and share of hours of elektricity supply lost to outages, 2018