



ANYL4PSD
REGIONAL TEACH-IN ON
CLIMATE JUSTICE
12-13 MAY 2022

Renewable energies in Africa : orders of magnitude, opportunities & limits

African Regional online Teach-In
on Climate and Justice

12/05/2022



▼ Renewable energies : what are we talking about ?

- Renewable energy = **Energy that is renewed at least as fast as the speed at which it is used**
- What it includes : All what derives from **photosynthesis** (biomass...), from the action of the **sun** (solar irradiation), and from **natural cycles** (wind cycle, water cycle, marine currents...)
- What it does NOT include : Nuclear energy, Hydrogen, natural underground gas
- Wide differences between renewables on energy potentials, exploitation and collection systems

Renewable energy in Africa : what is at stake ?

01

Facing the depletion of **fossil resources** and transitioning towards a cleaner energy mix

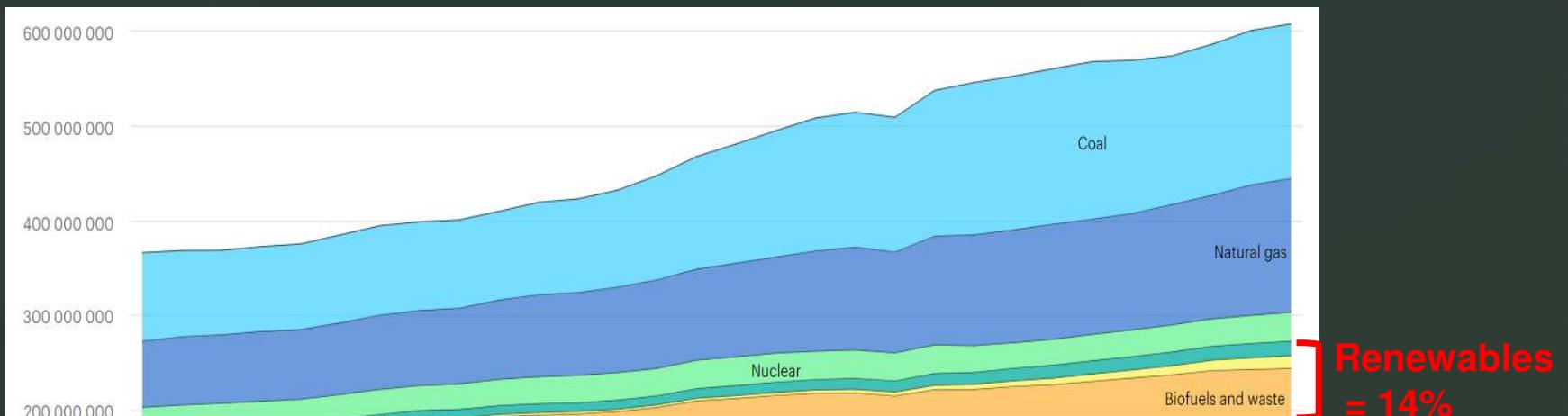
02

Ensuring a **sustainable energy** and **electricity supply** in the face of increasing **climate risks**

03

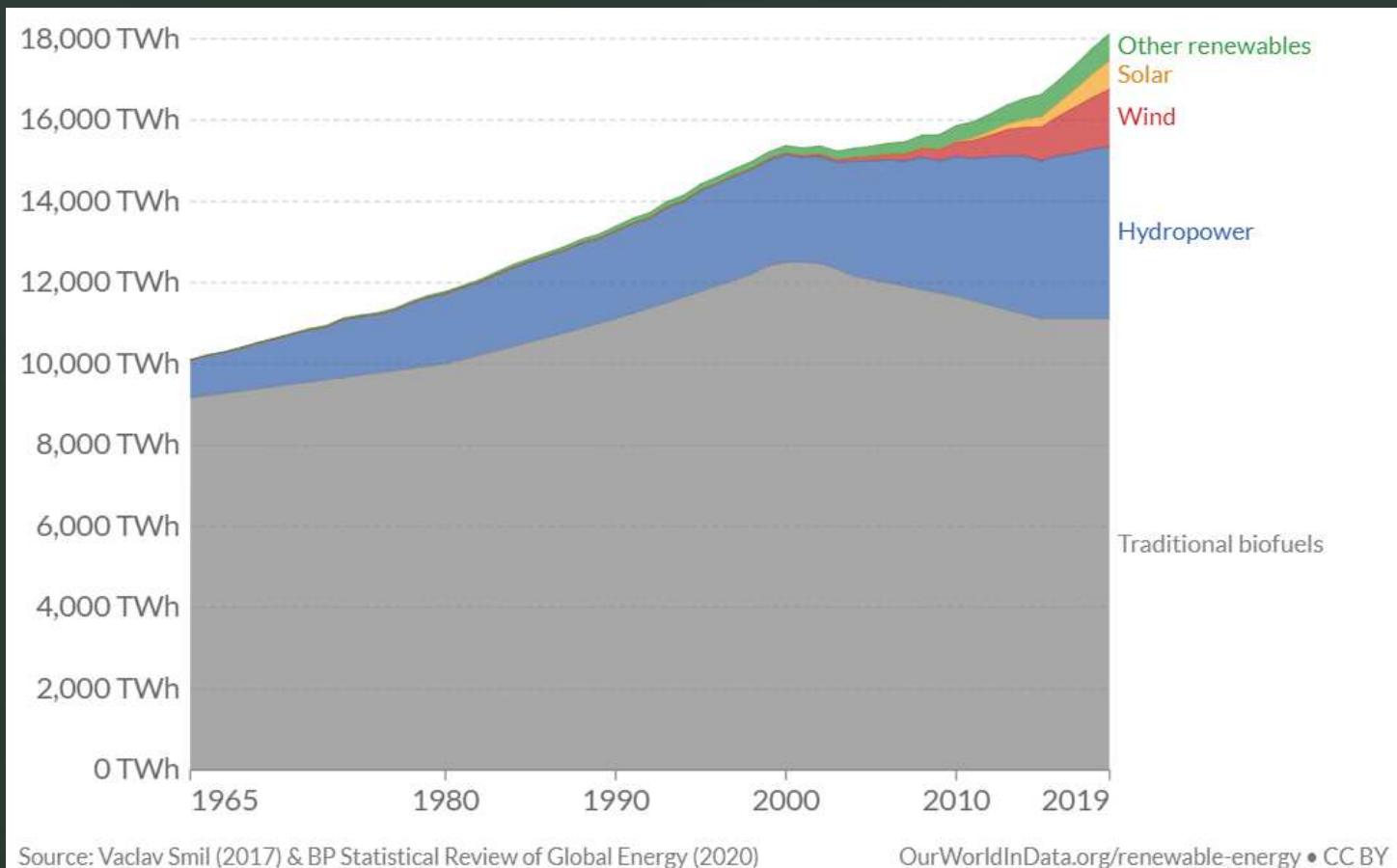
Building efficient renewable energy production systems that can **meet the demand for a 1.4 billion population** (and growing)

What is the share of renewables in the total energy supply ?



Total energy supply by source, World 1990-2019, in TJ (Source : IEA)

Which renewables do we use the most ?



Renewable energy consumption measured in terawatt-hours per year, worldwide

Biomass, the most widely used renewable

- **Fuelwood, forestry products, agricultural waste**
- Used as a **combustible** for **heat** or **electricity**
- Production and use mostly local
- Small scale substitute to fossil energies



Biovéa biomass plant, Ivory Coast (2024 project)

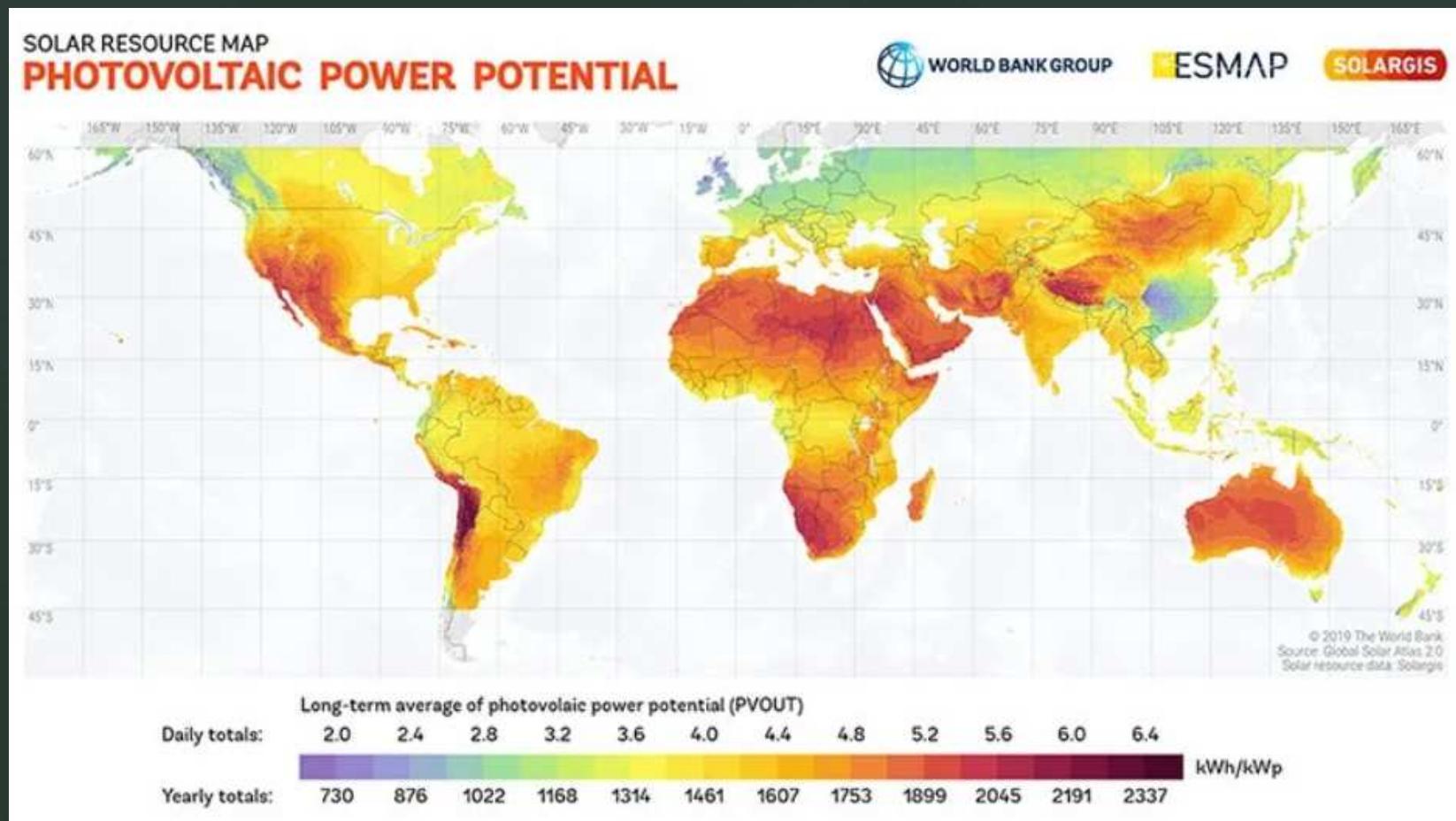
Hydropower, the controllable potential ?

- Most low-carbon electricity, fully controllable
- 15% of the continent's electricity mix
- Multitude of impacts : on biodiversity, on populations, on water resources...
- Africa holds 41% of the worldwide hydropower potential, but only exploits a small share of its potential
- Most dams are used for agricultural irrigation

The Aswan High Dam,
1/15th of Africa's hydropower



Solar power, the local high potential

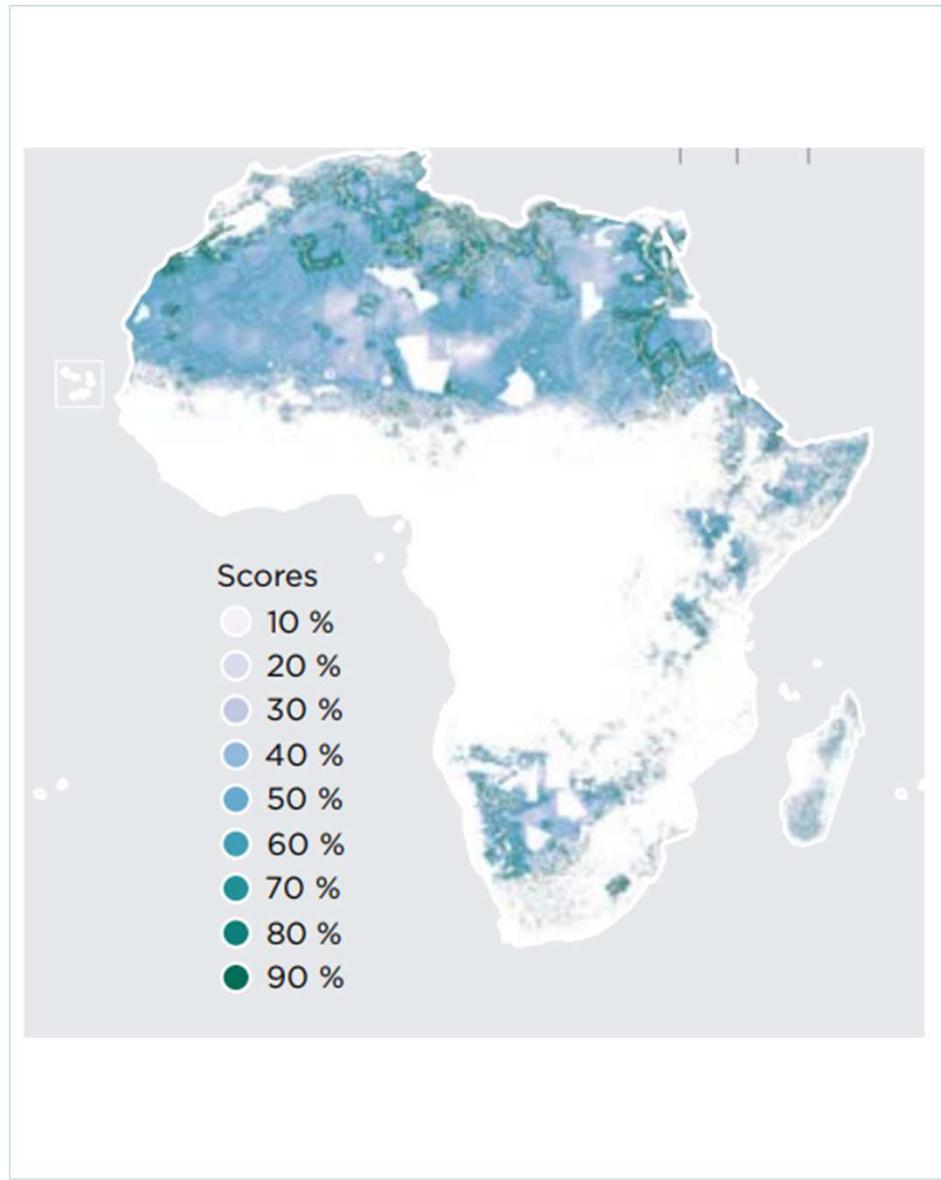




Kathu Concentrated Solar Park, South Africa

Solar power, the local high potential

- Most important electric capacity potential in Africa, with decreasing costs
- More **CO2-intensive** and rare **materials-intensive** electricity than other renewables
- Even more with the need for **electricity storage capacities**
- **Concentrated solar power** can be a viable option (used for heat and electricity)



Wind power, the limited impact source

**Areas most suitable for
the installation of wind
powerplants on an
industrial scale**

Wind power, the limited impact source

Low-carbon source of electricity, intermittent and with a lower load factor

A wind turbine can capture 60% of the wind's kinetic energy

Compared to solar power, wind power costs less

Need for a combination with controllable sources to ensure the stability of the system

Offshore wind turbines offer a more stable electricity supply but require more resources and have a bigger impact on ecosystems

Lake Turkana Wind powerplant, Kenya

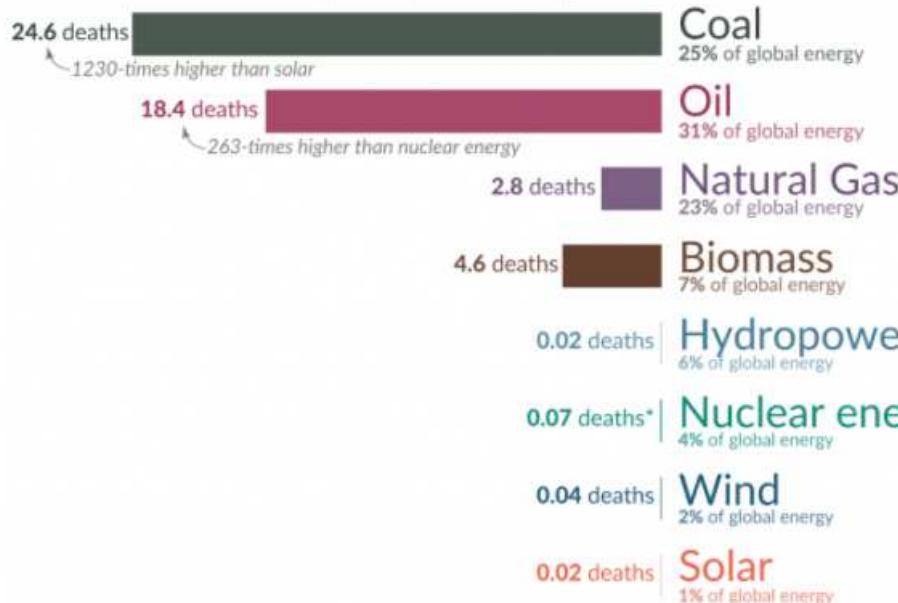


Are renewables the safest and cleanest sources of energy ?

Death rate from accidents and air pollution

Measured as deaths per terawatt-hour of energy production.

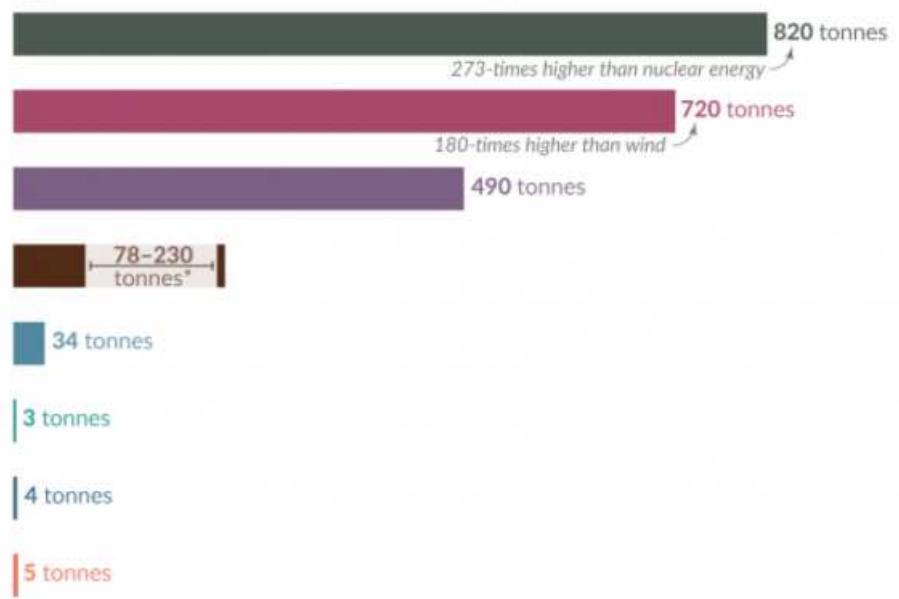
1 terawatt-hour is the annual energy consumption of 27.000 people in the EU.



Greenhouse gas emissions

Measured in emissions of CO₂-equivalents per gigawatt-hour of electricity over the lifecycle of the power plant.

1 gigawatt-hour is the annual electricity consumption of 160 people in the EU.



*Life-cycle emissions from biomass vary significantly depending on fuel (e.g. crop residues vs. forestry) and the treatment of biogenic sources.

*The death rate for nuclear energy includes deaths from the Fukushima and Chernobyl disasters as well as the deaths from occupational accidents (largely mining and milling).

Energy shares refer to 2019 and are shown in primary energy substitution equivalents to correct for inefficiencies of fossil fuel combustion. Traditional biomass is taken into account.

Data sources: Markandya & Wilkinson (2007); Sovacool et al. (2016); IPCC AR5 (2014); Pehl et al. (2017); BP (2019); Smil (2017).

OurWorldinData.org – Research and data to make progress against the world's largest problems.

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Range of material requirements for various electricity generation technologies

The hidden face of renewables : material costs

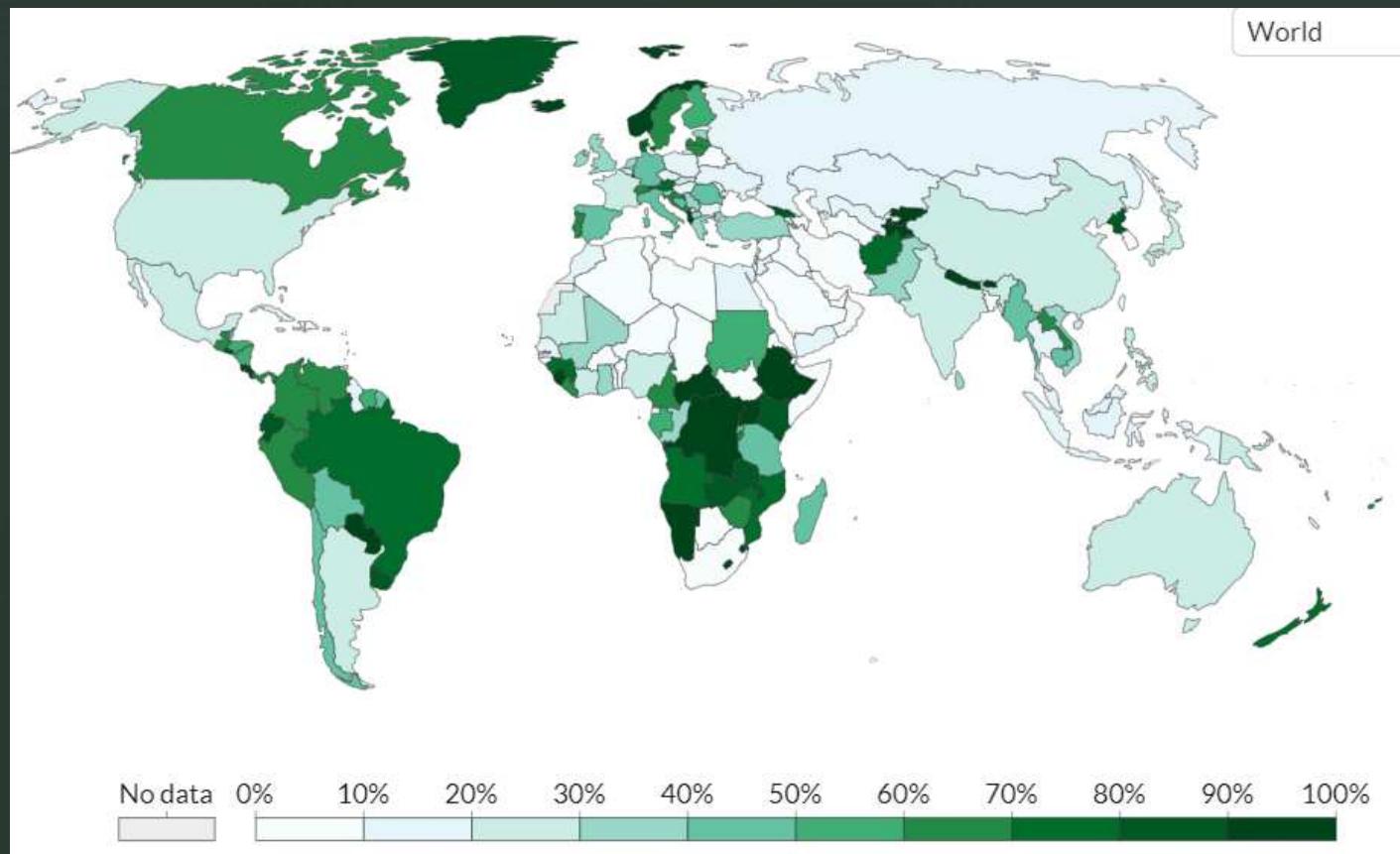
- Renewable energies = diffuse energies, needing complex capture systems that use a variety of non-renewable materials

Materials (ton/TWh)	Generator only				Upstream energy collection plus generator			
	Coal	NGCC	Nuclear PWR	Biomass	Hydro	Wind	Solar PV (silicon)	Geothermal HT binary
Aluminum	3	1	0	6	0	35	680	100
Cement	0	0	0	0	0	0	3,700	750
Concrete	870	400	760	760	14,000	8,000	350	1,100
Copper	1	0	3	0	1	23	850	2
Glass	0	0	0	0	0	92	2,700	0
Iron	1	1	5	4	0	120	0	9
Lead	0	0	2	0	0	0	0	0
Plastic	0	0	0	0	0	190	210	0
Silicon	0	0	0	0	0	0	57	0
Steel	310	170	160	310	67	1,800	7,900	3,300

Africa's renewable potential

- Evolving towards a 100% renewable energy mix before 2050, possible ?

**Share of electricity production from renewables in 2021
(hydropower, solar, wind, biomass & waste, geothermal)**



An autonomous renewable energy system, utopian ?

- Functioning of the overall energy system relies on fossil energies
- Producing with wind and solar power would make the system 10 times more expensive : **renewables aren't produced with renewables**
- Complexity of autonomy with lower energy return rates



► The solution : a mixed energy system

- Need to mobilize all renewable resources : wind, solar, wood and hydropower at the same time; so that controllable sources are combined with intermittent sources
- Need for more electrification of energy systems, and more efficiency and optimisation ; so as not to rely on fossil fuels entirely
- The International Renewable Energy Agency has stated that the share of renewable energies in Africa's energy mix could rise up to 50% by 2030, and **73% by 2050**

Order of magnitude : how much energy does Africa need ?

- Africa = **3%** of the worldwide annual energy consumption (4800 TWH)
- Total annual demand for electricity in Africa represents only 700 TWH, which equals to the production of **30 Aswan high dams and 320 turkana wind powerplants**, for instance.
- When comparing Africa's energy potential with Africa's energy needs, there is a much higher capacity to match its needs than anywhere else.

Conclusion

- Need to develop mutualized electricity distribution networks to minimize economic and environmental and maximize the resilience of territories
- Such centralized systems call on new governance mechanisms, with public institutions at the head of **new renewable energy production and distribution schemes**

