PECC Auckland Seminar
Henri Boyé

Opportunities for renewable and carbon free energies

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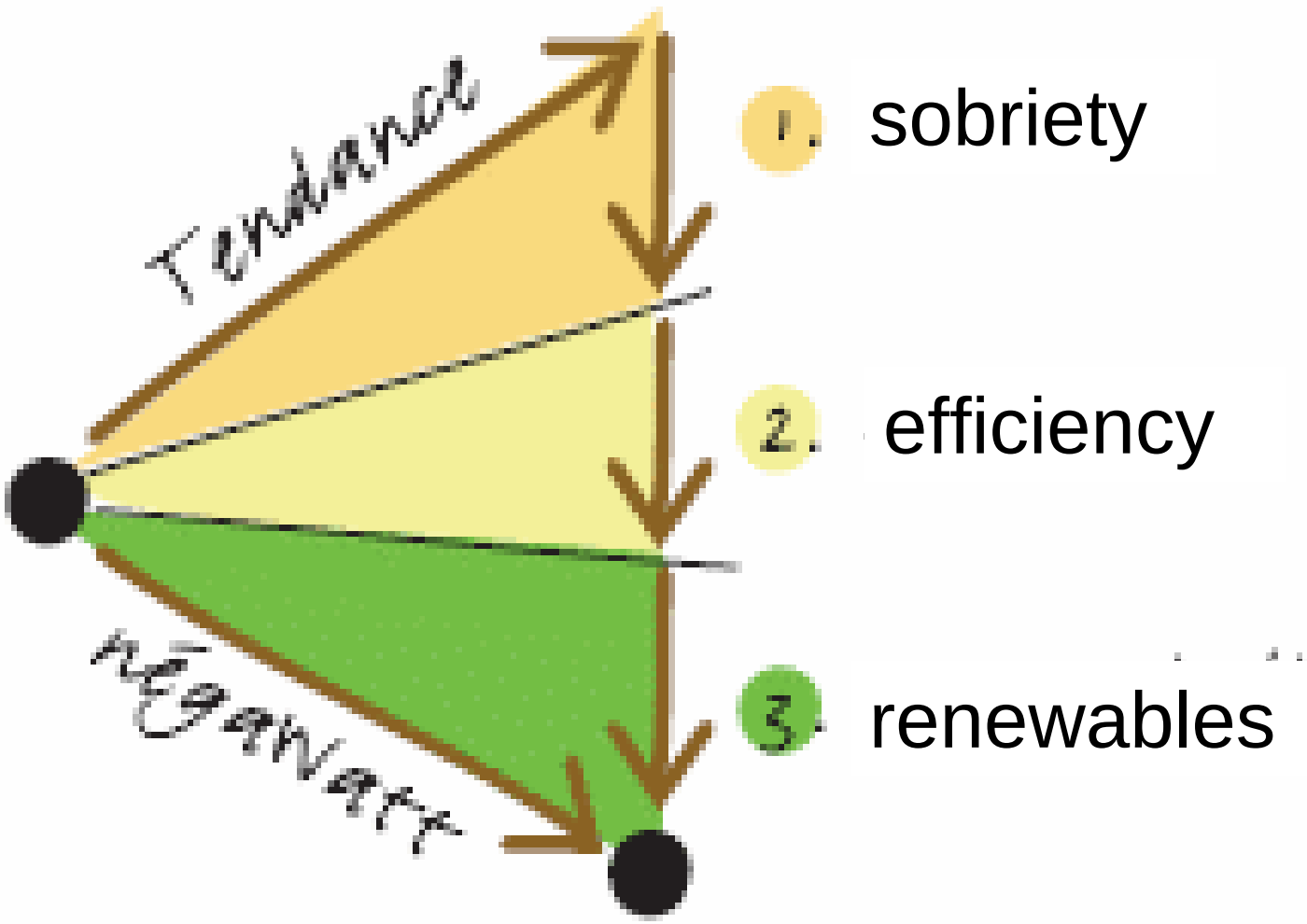
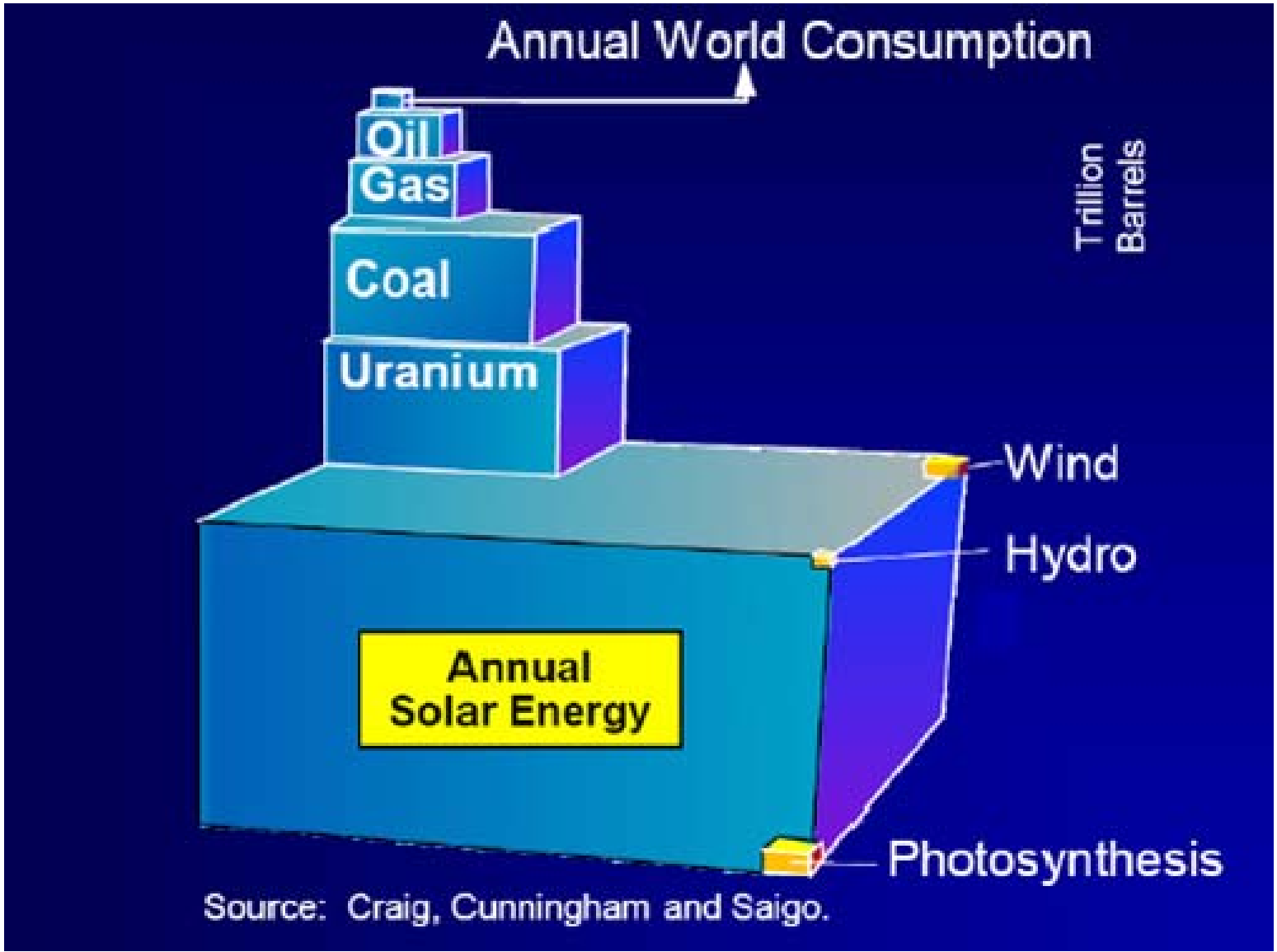
The negawatt scheme



Primary *Renewable* Sources

- Fusion reaction *burning* the Sun
- Tidal friction *slowing* planetary motion
- Radioactive *decay heating* the earth's core
- Many secondary, derivative *resources*
  - Solar radiation driven wind and hydro
    - Wind-driven ocean waves
  - Solar-driven biomass

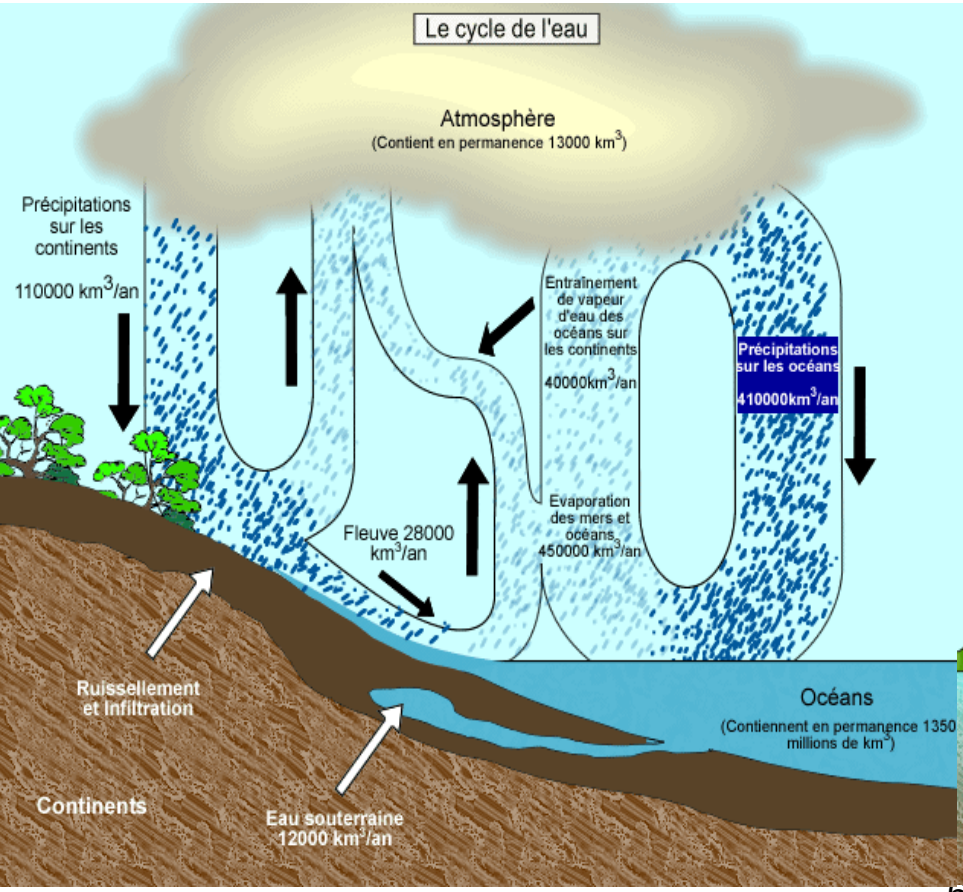
Annual Solar energy

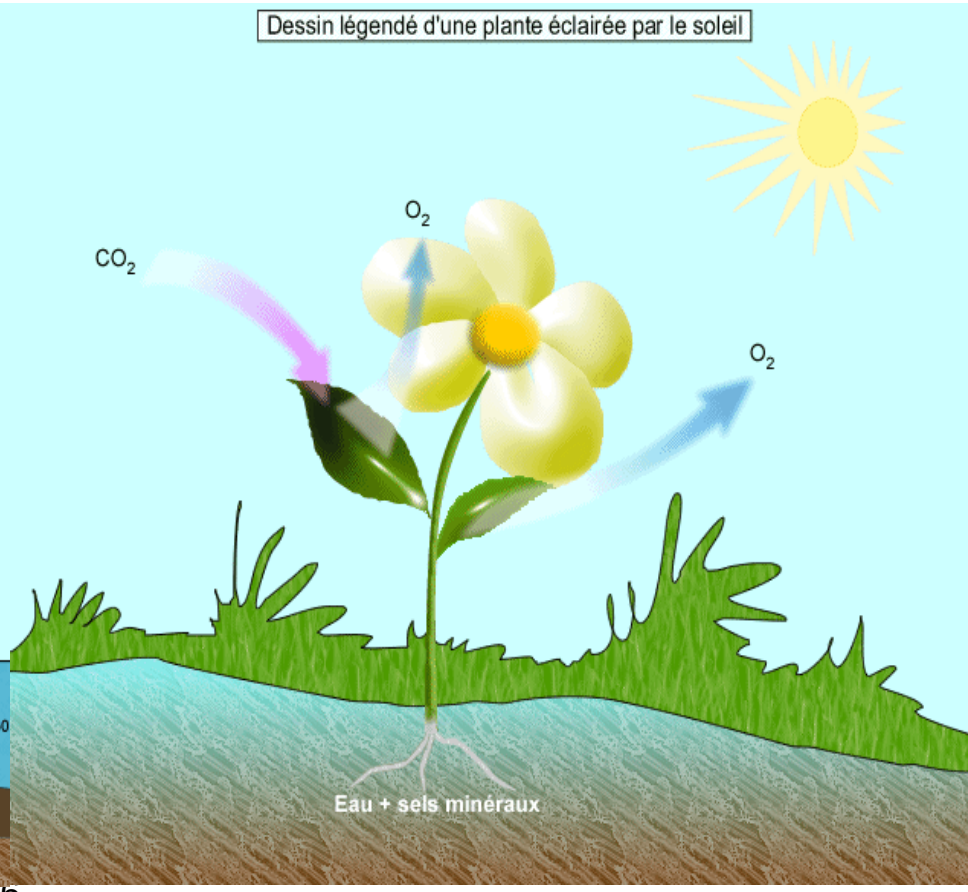


Derivative renewable Resources

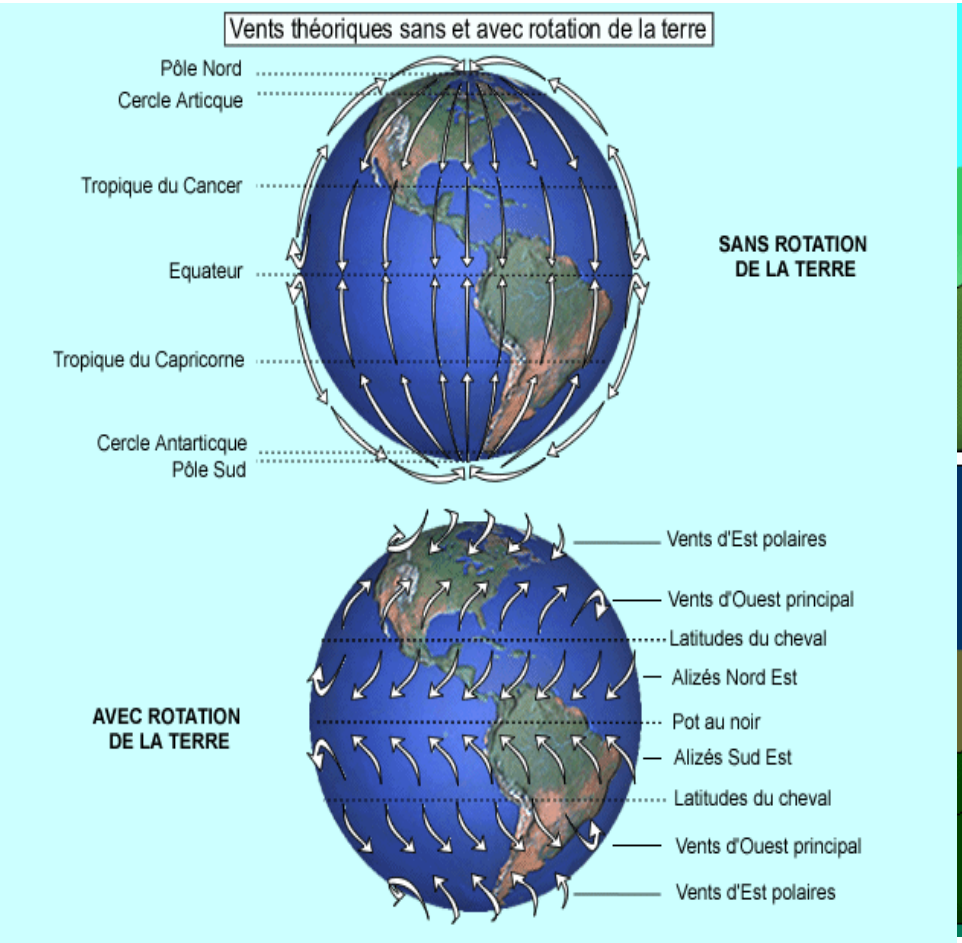
- Sun, PV, thermal, CSP
- Wind
- Ocean waves
- Biomass photosynthesis
- Hydro (rivers)

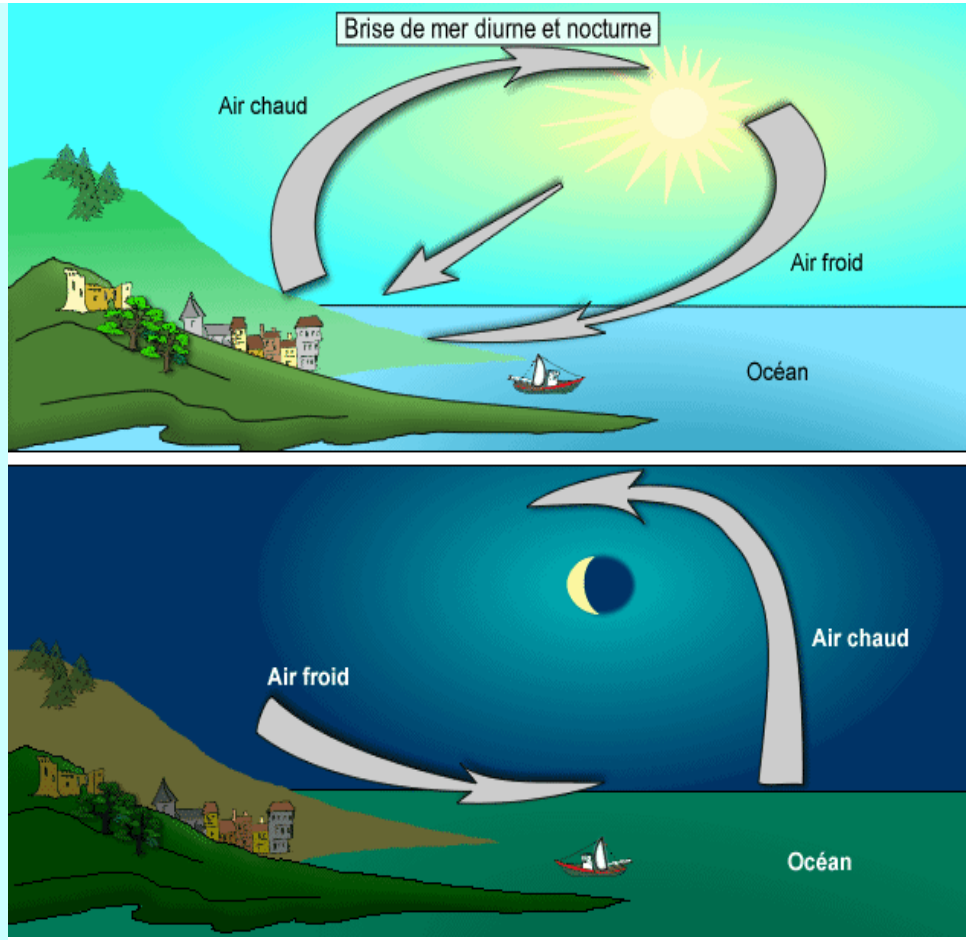
Sun Energy, Source of Hydropower, source of biomass growth



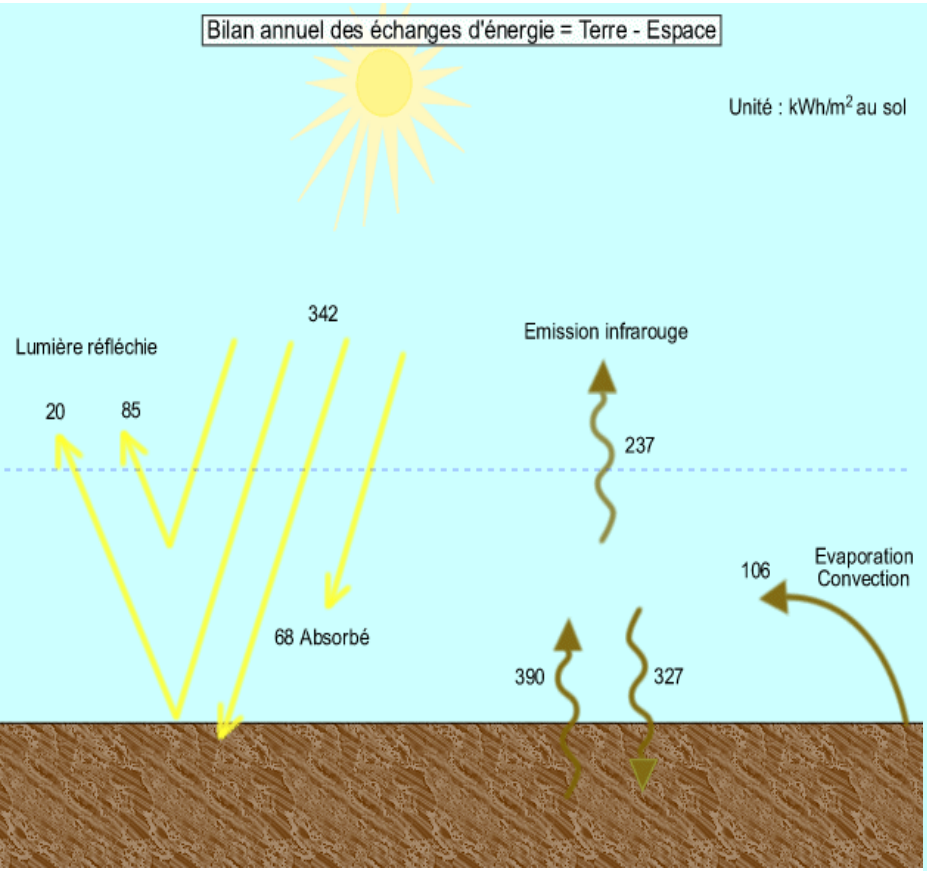


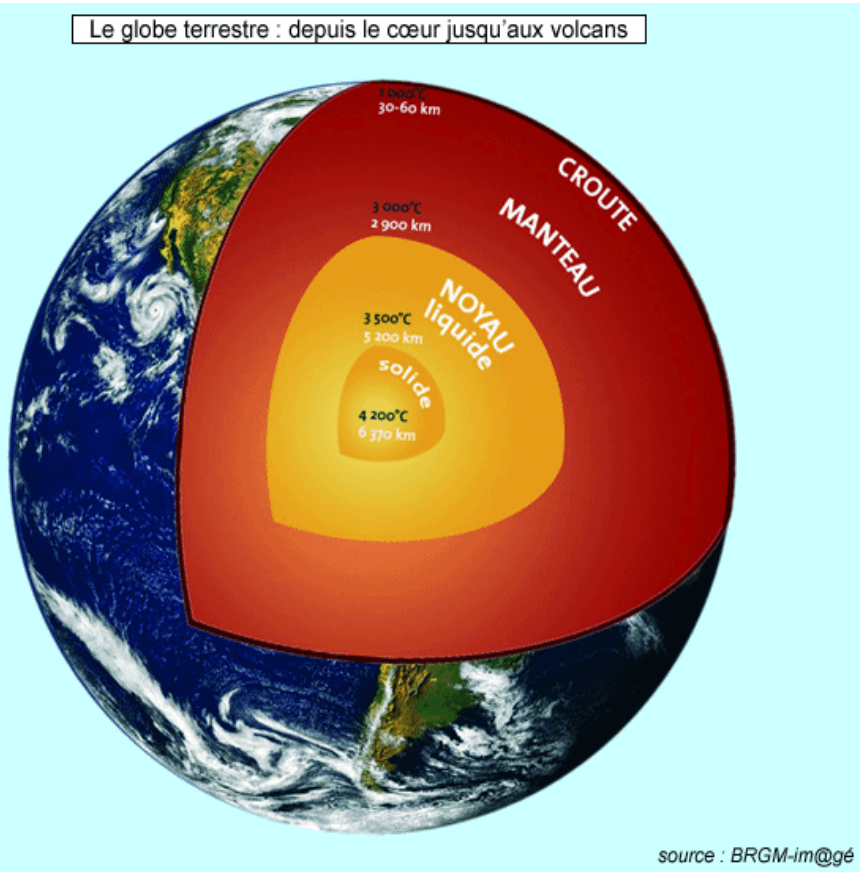
Sun Energy source of Wind Energy



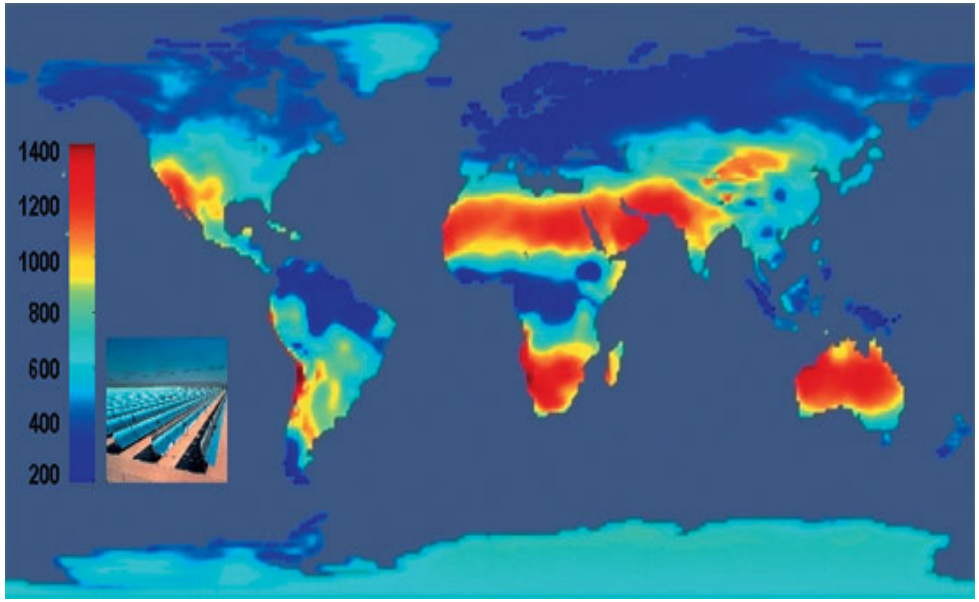


Two big sources ot renewable energy
two nuclear reactors
Sun = fusion, Earth Core = fission





Solar thermodynamic



Solar thermodynamic

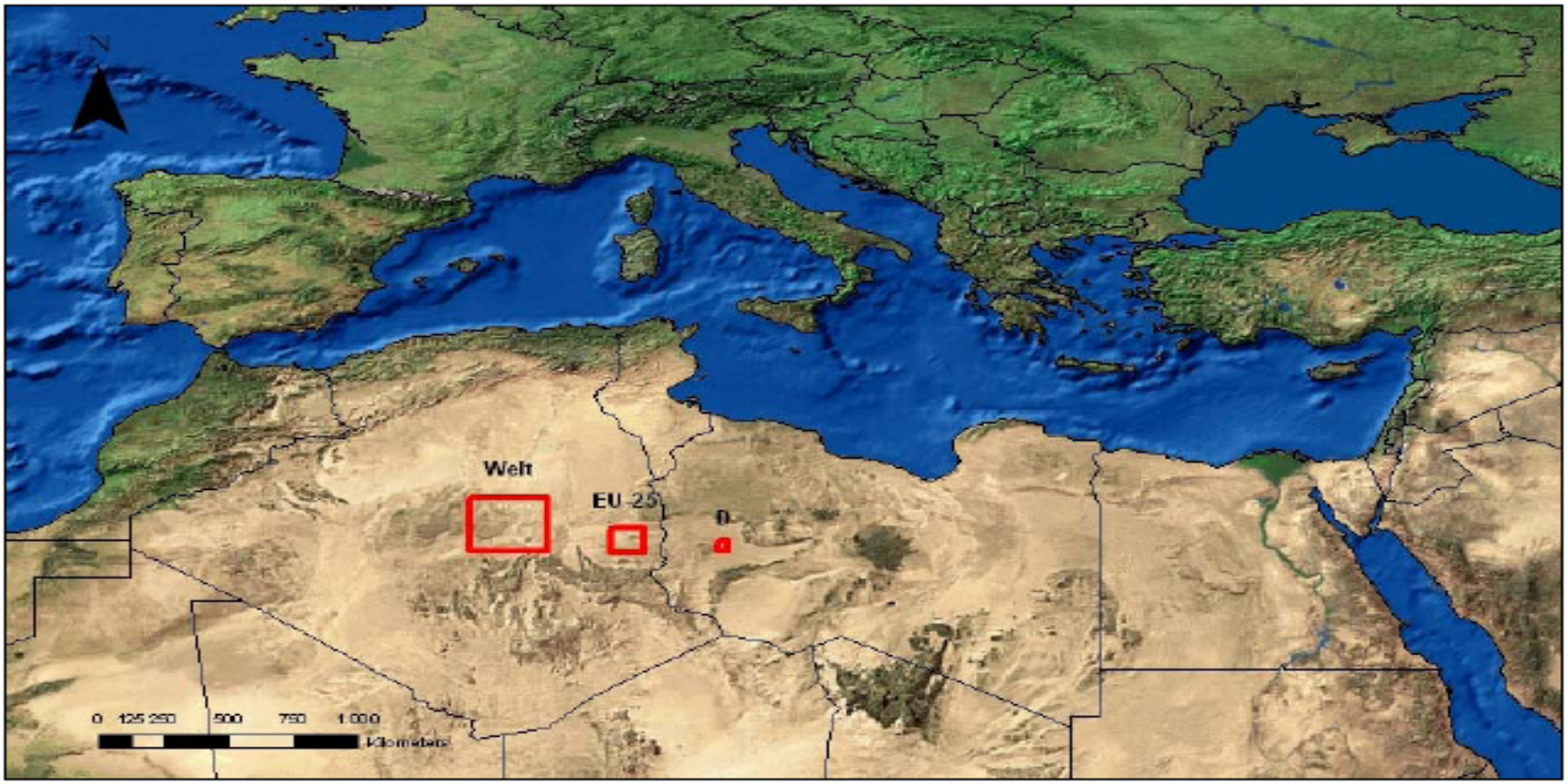
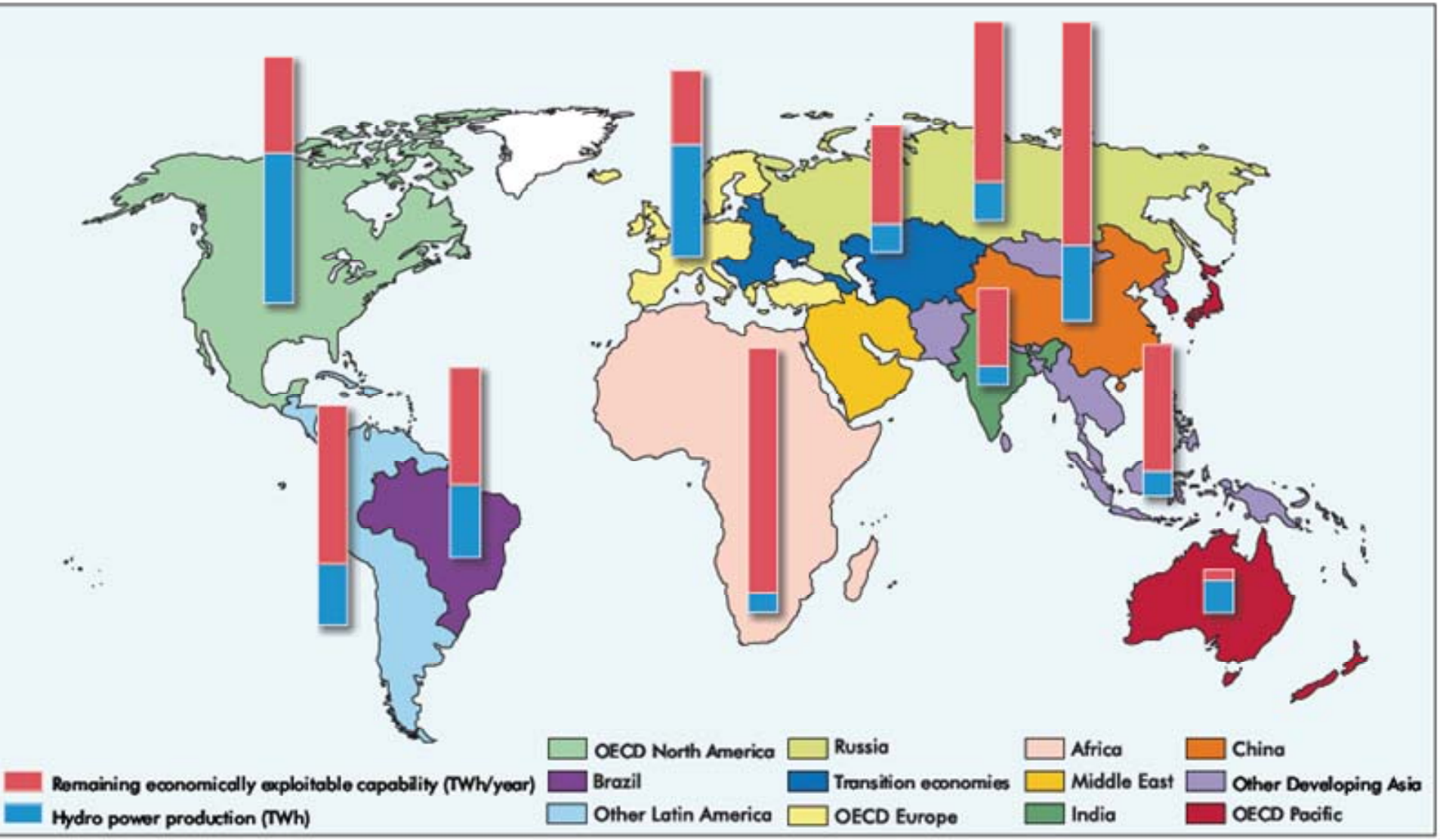


Fig. 12: Theoretical space requirement to meet the electricity demand of the world, Europe (EU-25) and Germany (Data from DLR, 2005).

Hydro Generation

- Resource is the product of rainfall, catchments area, and vertical head
- A power resource that has evolved with technology for centuries
- Simple, well understood conversion of potential energy into mechanical and then electrical power

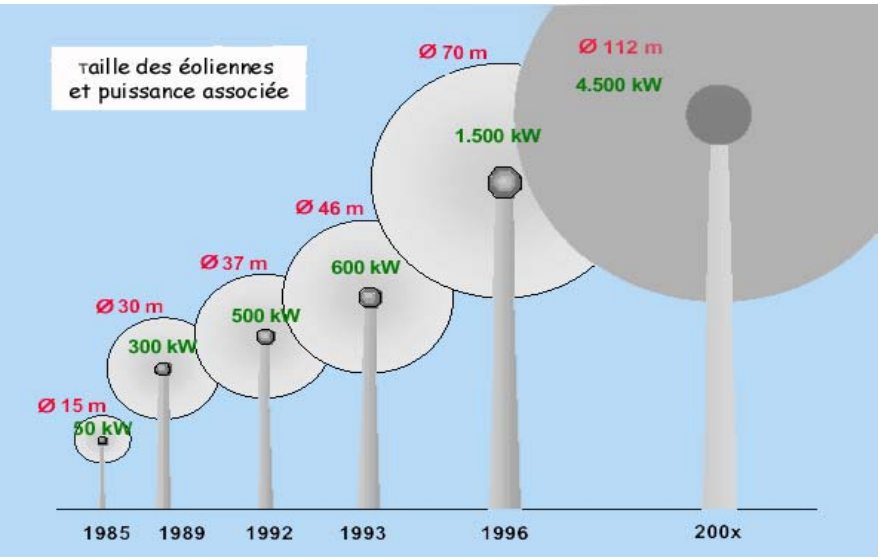
World Hydro Potential

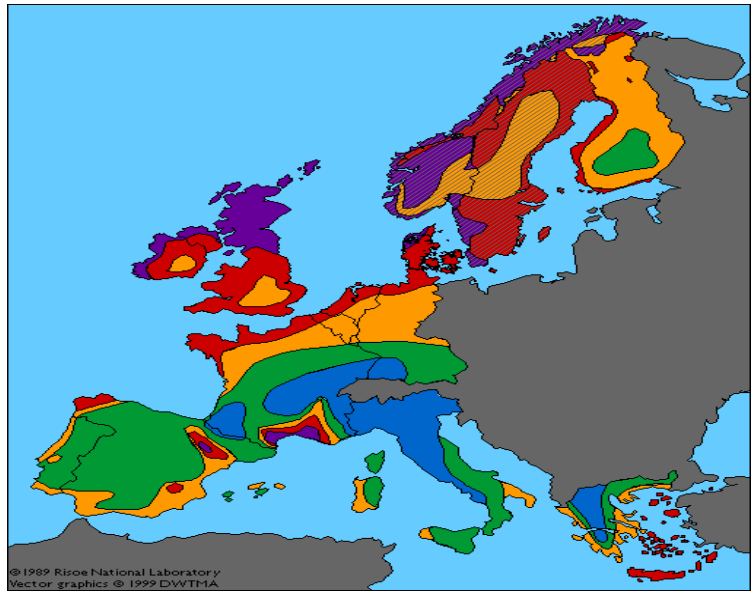


Wind Energy Resource

- Velocity and density (1.2 kG m^{-3}) determine kinetic energy
- Power is proportional to the cube of the wind speed and the density of the air
- Velocity increases with height above ground owing to ground or water shear stress (wave energy!)

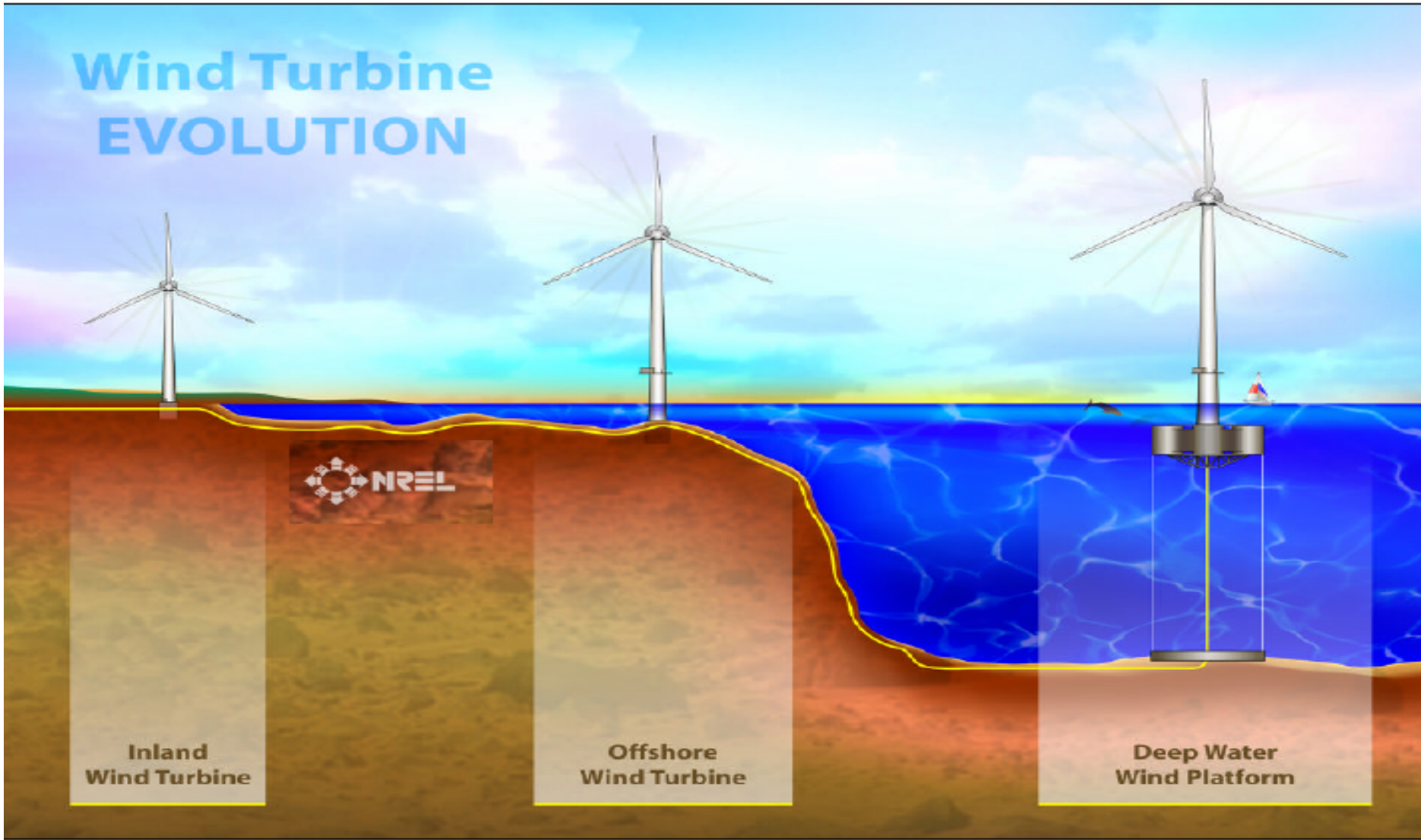
Wind Energy





	m/s	W/m²	m/s	W/m²	m/s	W/m²	m/s	W/m²	m/s	W/m²
	>6.0	>250	>7.5	>500	>8.5	>700	>9.0	>800	>11.5	>1800
	5.0-6.0	150-250	6.5-7.5	300-500	7.0-8.5	400-700	8.0-9.0	600-800	10.0-11.5	1200-1800
	4.5-5.0	100-150	5.5-6.5	200-300	6.0-7.0	250-400	7.0-8.0	400-600	8.5-10.0	700-1200
	3.5-4.5	50-100	4.5-5.5	100-200	5.0-6.0	150-250	5.5-7.0	200-400	7.0-8.5	400-700
	<3.5	<50	<4.5	<100	<5.0	<150	<5.5	<200	<7.0	<400
			>7.5							
			5.5-7.5							
			<5.5							

Wind turbine evolution



Offshore Wind Energy

Wind in Morocco The site of Koudia Al Baïda

European Commission, IRESMED
– Henri BOYÉ

The wind farm of Koudia Al Baida

– Henri BOYÉ

Royal Inauguration
by King Mohammed 6

Rural electrification by PV in Morroco Temasol

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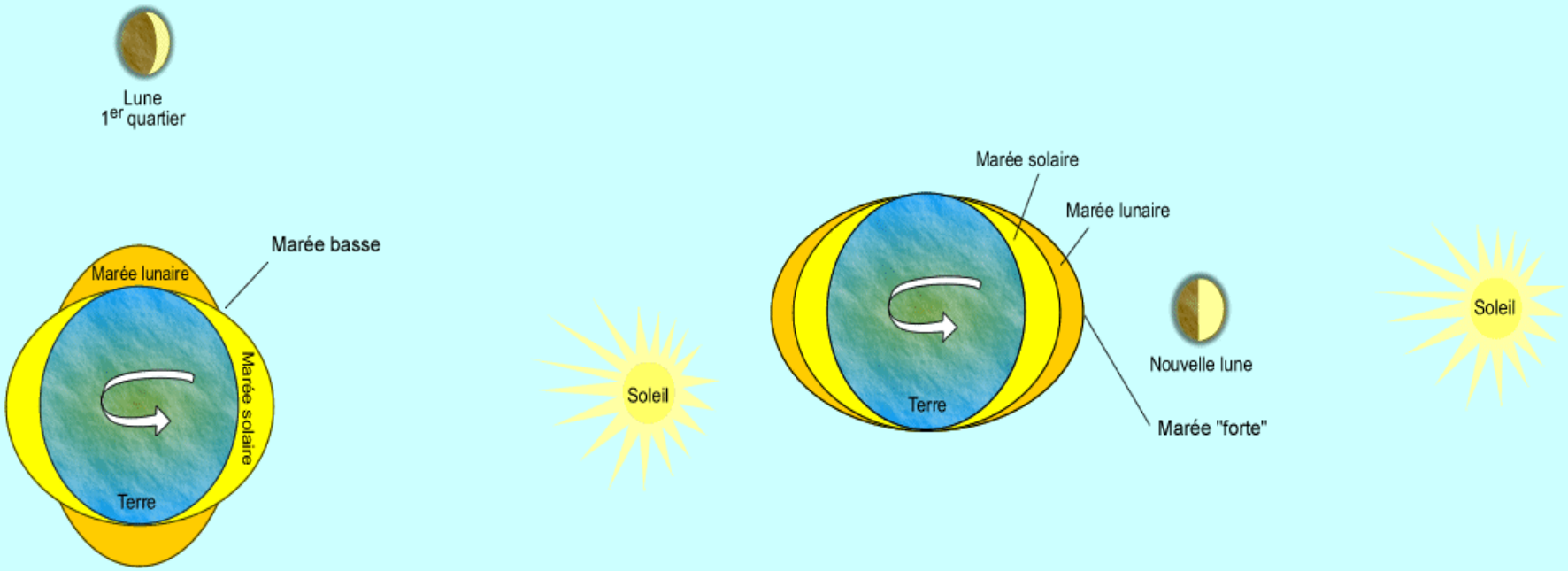
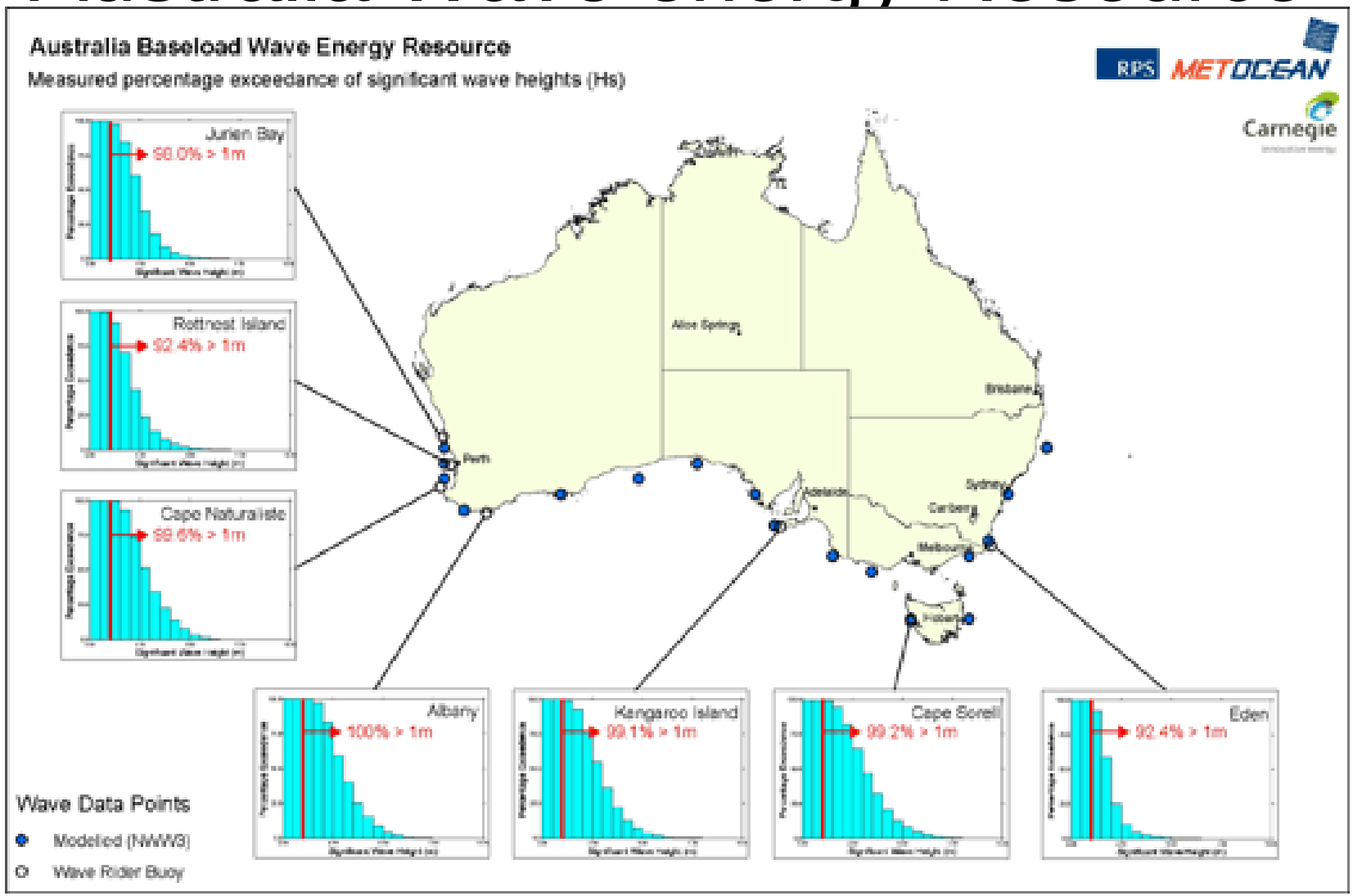
Tide energy

High tide

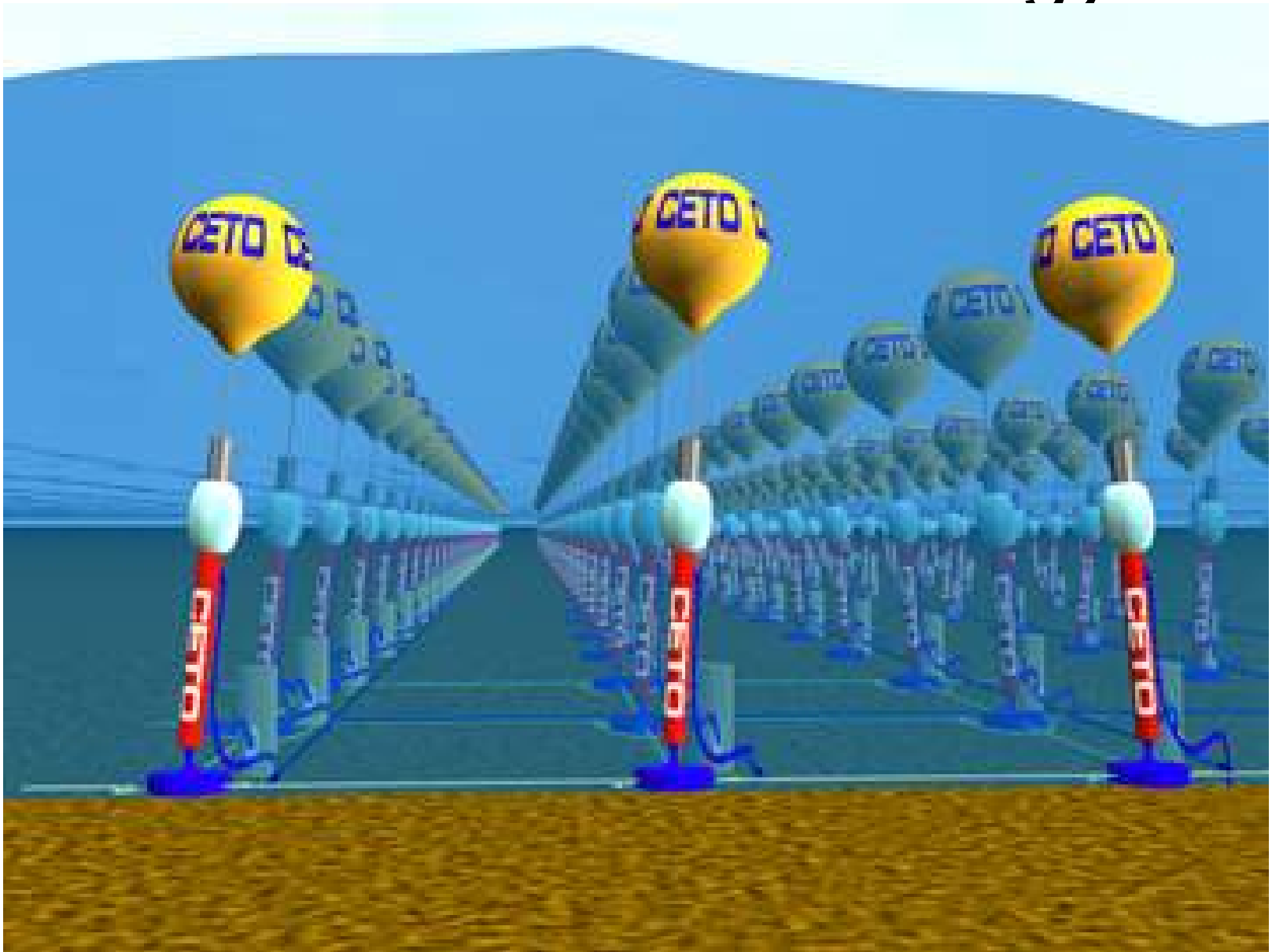
Low tide



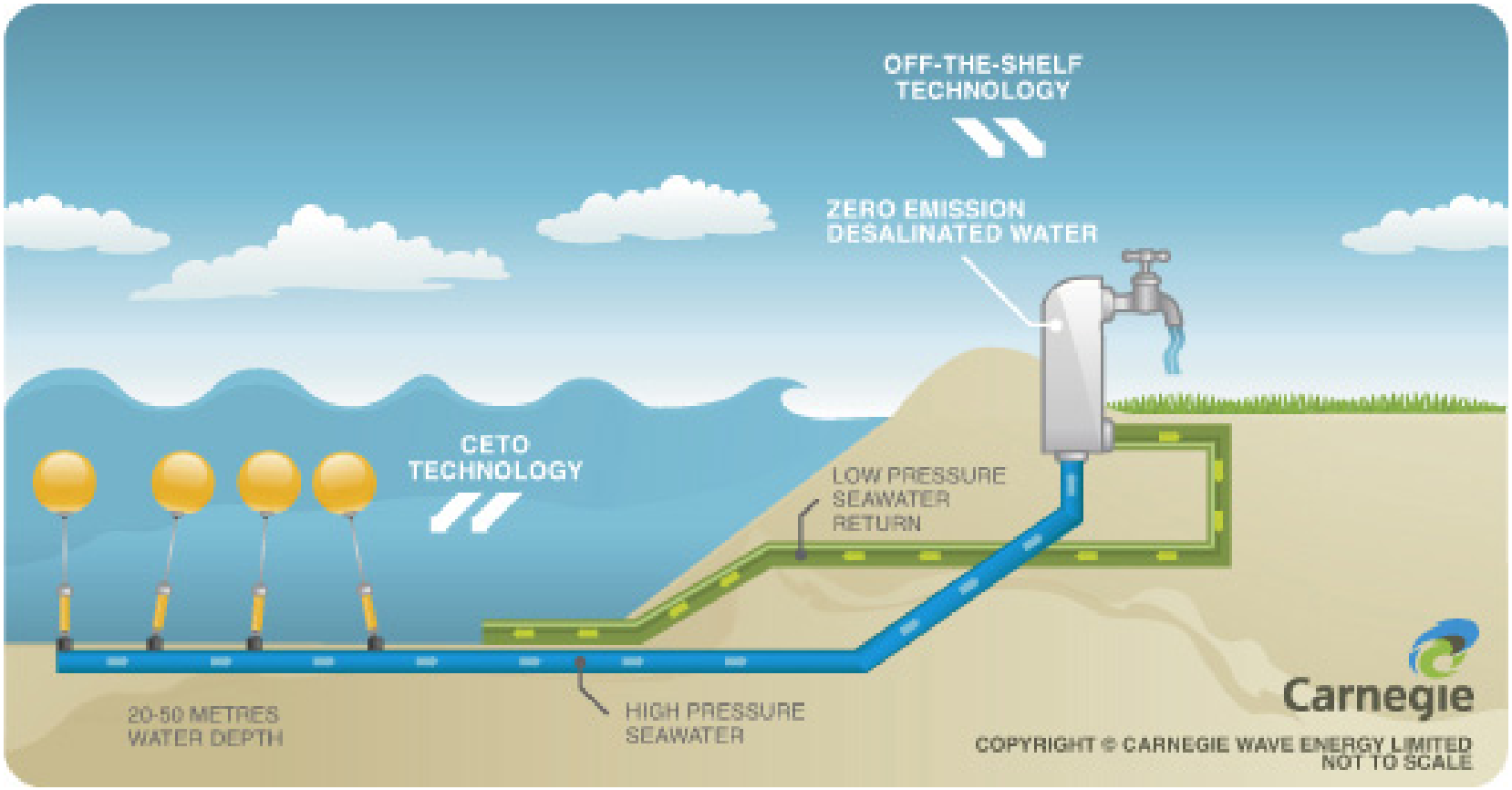
Australia Wave energy Resource



Ceto Wave technology



Ceto Wave technology



The Mediterranean Solar Plan

Union for the Mediterranean

Objective of 20 GW of RE by 2020

Photovoltaic

- Mono-crystalline
- Thin-film
- Concentrated PV

Concentrated Solar Power

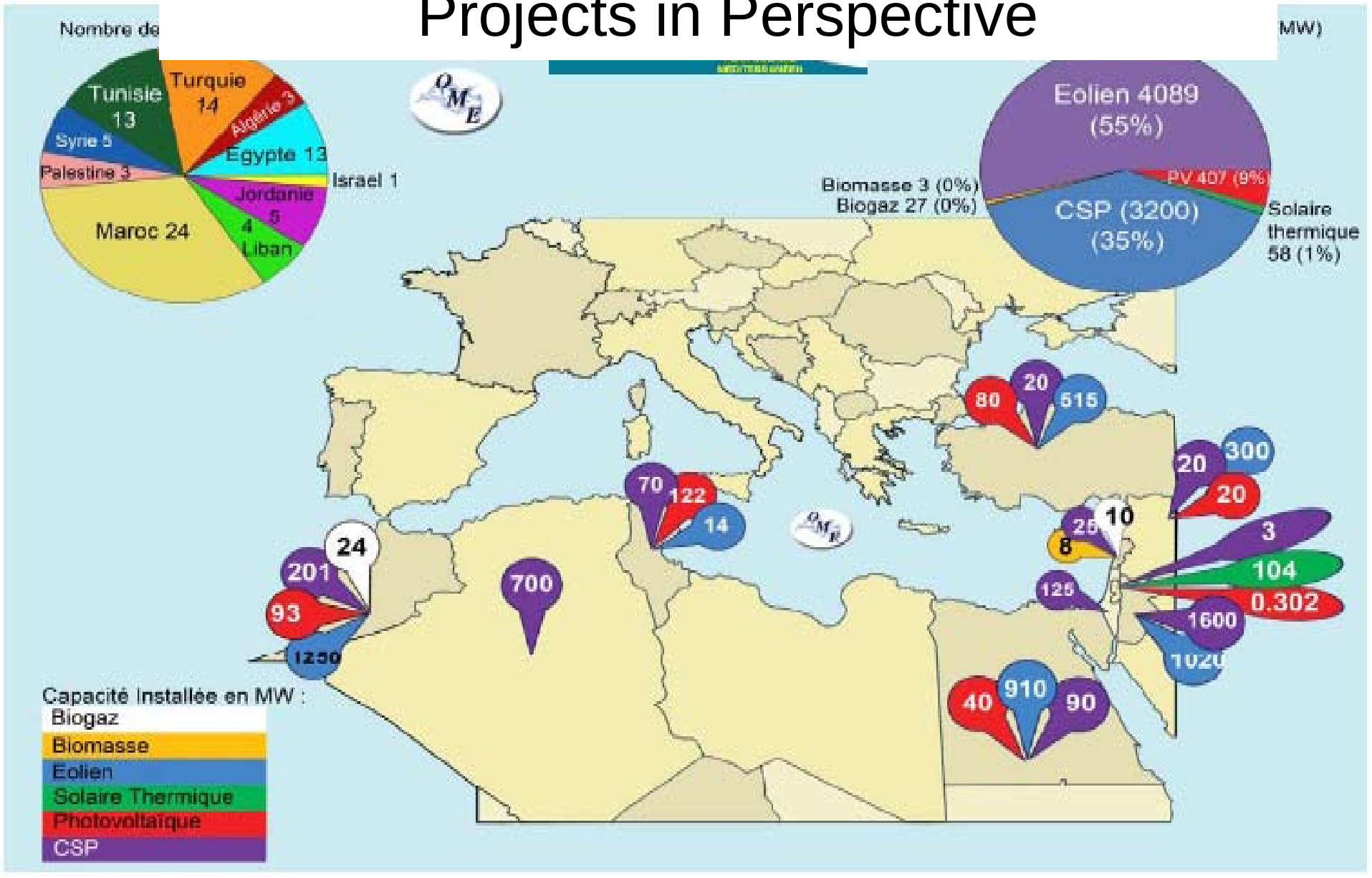
- Parabolic troughs
- Power tower
- Linear Fresnel

Wind

Solar, Wind, + biomass, geothermal, etc.

The Mediterranean Solar Plan

Projects in Perspective



Obstacles to overcome

- Technology and Cost of RE
- offshore wind energy, PV,
- Social acceptability
- impacts on electrical networks
- Management of intermittent ressources
- Environment: CO_2, polluting emissions, fauna, flora, water …
- mobilisation of the biomass ressource
- Compatibility with reduction of consumption

Conclusions

- Linked with energy efficiency, a huge potential in renewables, with always local adaptation
- Short term: biofuels derived from food agriculture in transports, biomass , solar and geothermal for thermal uses , wind and hydro for electric power
- Medium/long term : ligno cellulosic biofuels, offshore wind, deep geothermal, solar PV and CSP.
- Research & development : technology for generation and management of intermittent energies
- Time is necessary, commitment, progress and will