

**Renewable energies are available almost everywhere that people are**

**Geothermal** – large resources where continental plates meet ('hot rocks')

**Wind** – highest speeds in mid-latitudes, North and South

**Waves** – most west facing coasts in mid-latitudes

**Tidal energy** – widely distributed along many coasts

**Solar** – almost unlimited availability in some parts of Africa but also in the Americas and parts of Asia

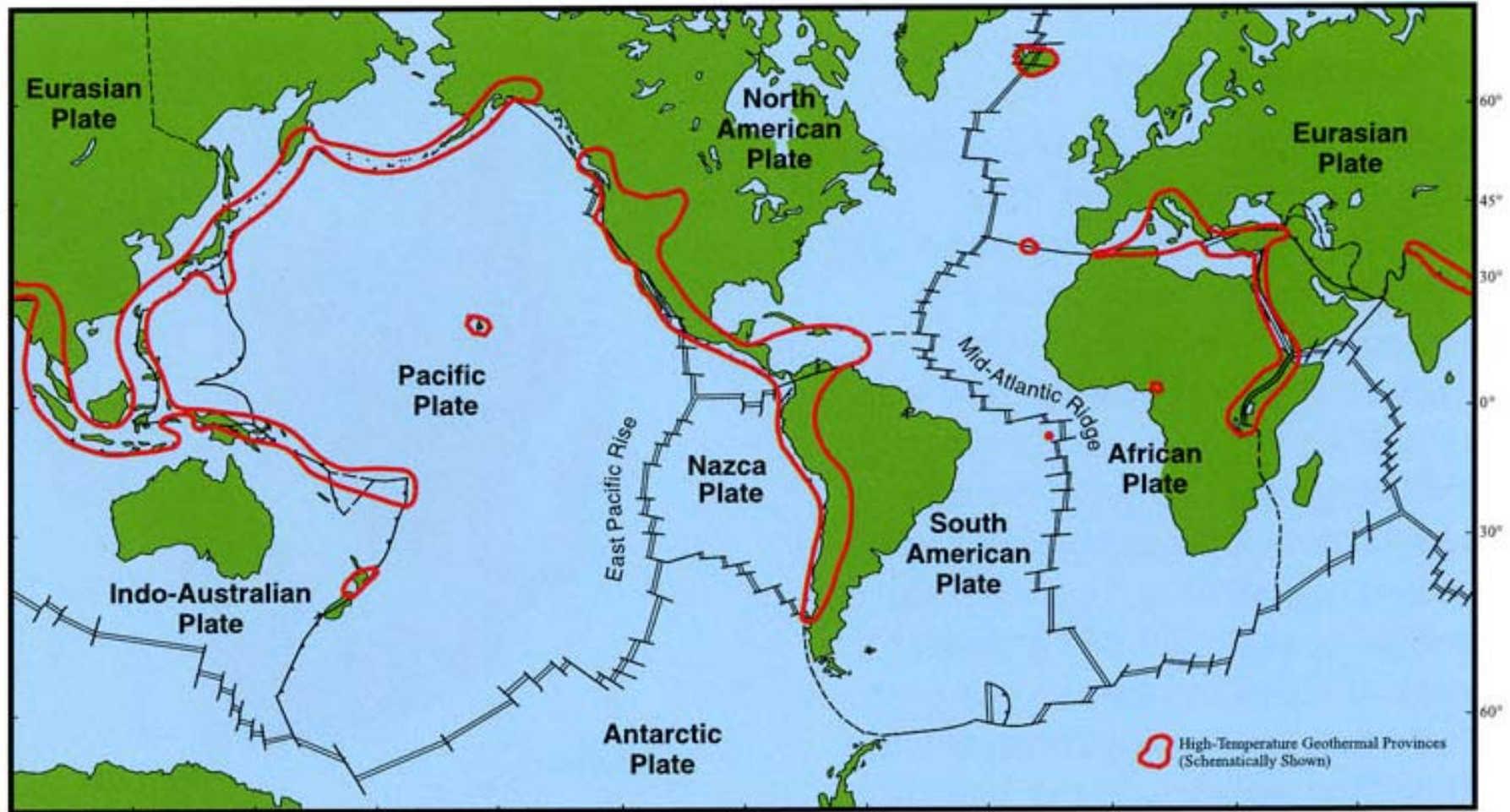
**OTEC** – relatively few locations, typically atolls and other islands

**Biogas** – any region with good water availability and high land productivity

**Hydro-electricity** – often already in use, but some expansion possible

## High temperature geothermal provinces

(active areas shown in red)



Source: Earth and Geoscience Institute, the University of Utah

## Olkaria Geothermal Plant, Kenya



## **Olkaria**

35 MW – \$100m

Current expansion completed late 2009

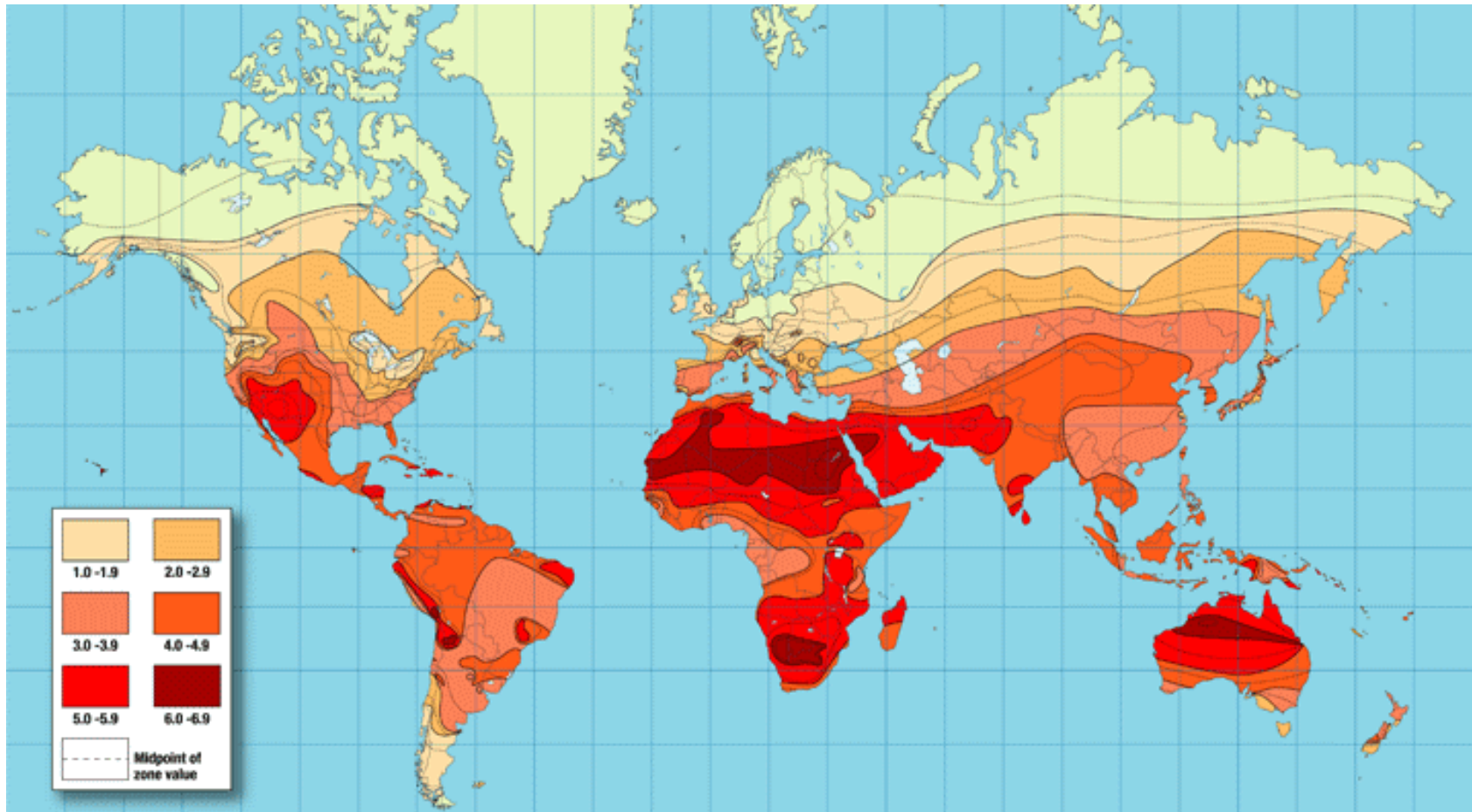
Kenya is 75% hydro at the moment, exports power, but surplus is rapidly falling. Geothermal important addition.

Other places with installed geothermal include Costa Rica.

Geothermal said to be Kenya's best energy resource ([www.power-technology.com](http://www.power-technology.com)).

# Solar radiation

(strongest sun in areas shaded red and dark red)



## Installing PV at Gobabeb research centre, Namibia





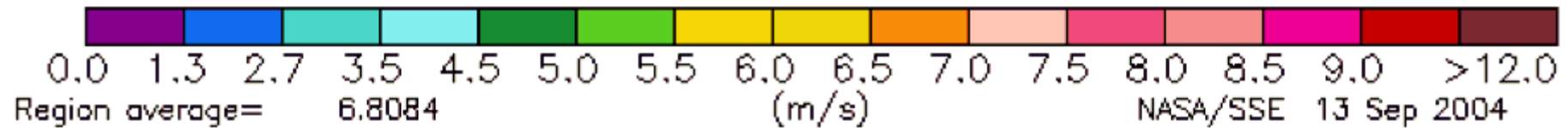
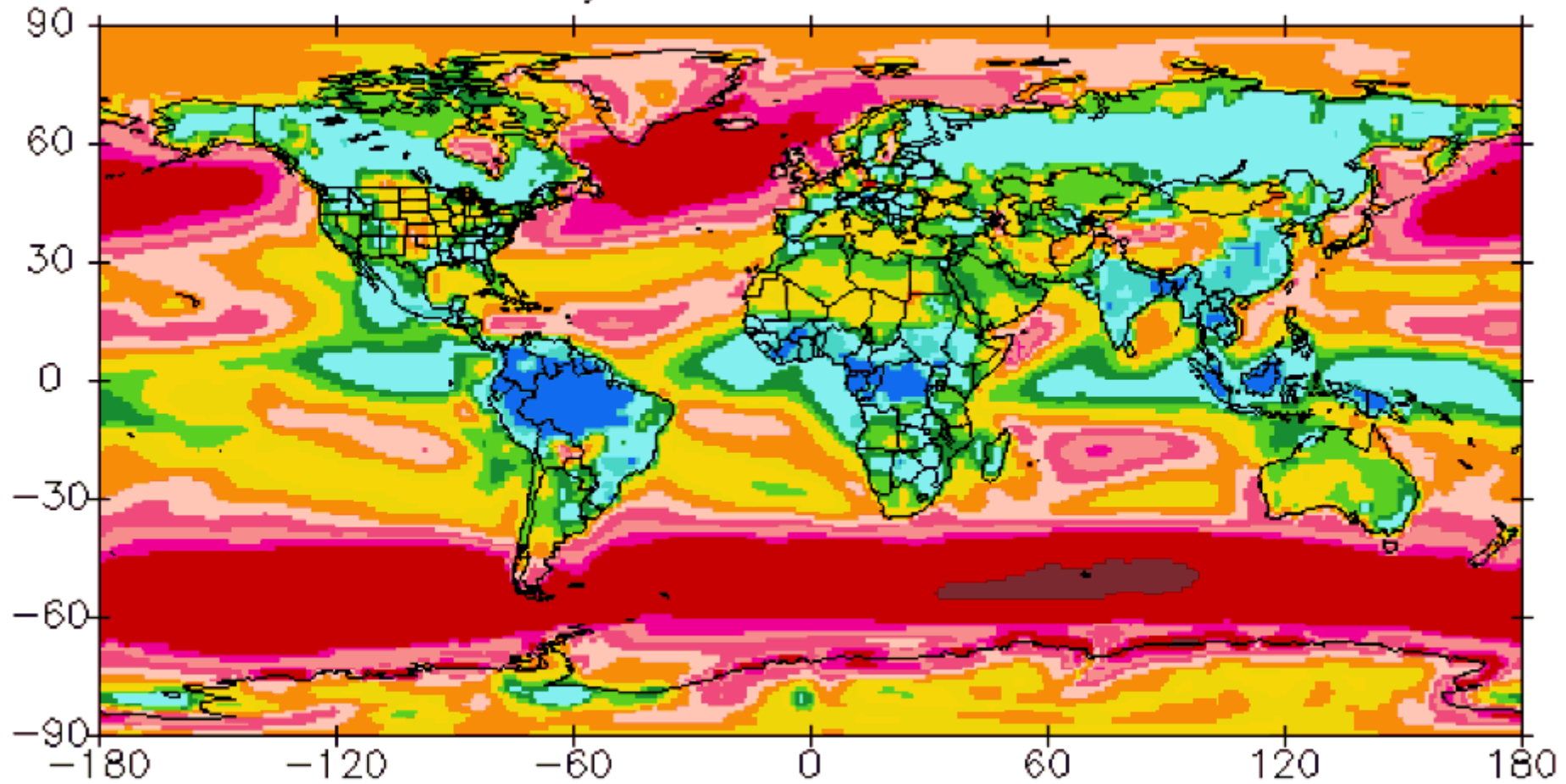
Namibia has some of the best sun in the world.

Can make electricity locally in most of the towns and cities.

The photograph is of a large desert research station powered by PV panels.

# Global wind resource

Annual 50m Wind Speed  
July 1983 – June 1993





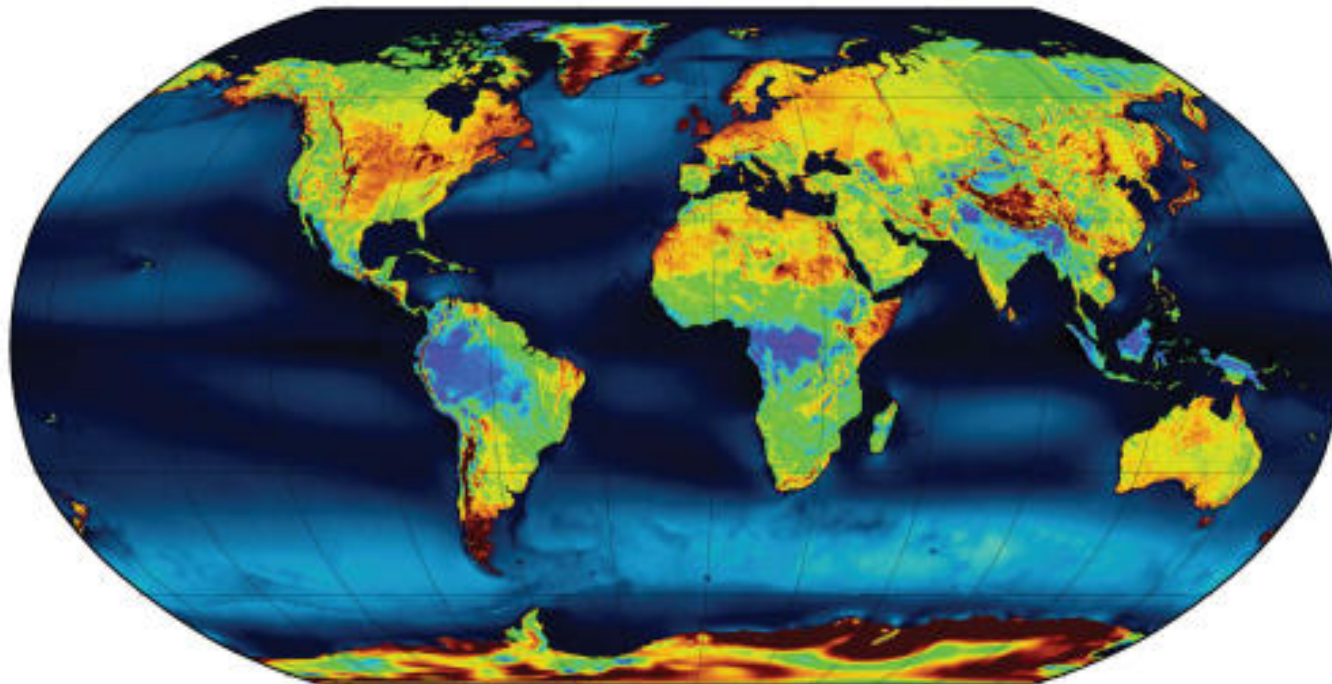
# World wind speed map

(highest average wind speeds over land are dark red)

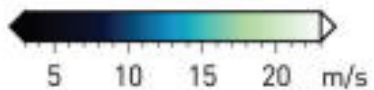
## 15km Global Wind Map at 80m

Mean Wind Speed for 2005  
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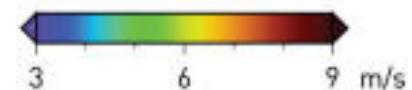
developed by  3TIER



Wind speed over water



Wind speed over land





**Wind farm at Comodoro  
Rivadavia, Argentina**

## Wind farm at Guanacaste, Costa Rica



Costa Rica is developing wind rapidly en route to its carbon neutrality target by 2020.

Has good wind resources, but few turbines at the moment because, like Kenya, has used existing hydro plants.

## Worldwide biogas availability – plant in India



Methane from rotting of manures and any organic matter.

Provides cooking fuel and lighting in over 20m homes in China.

Can work at domestic scale or in much bigger plants for whole villages.

Needs water supply and, ideally, plentiful supply of manure and waste biomass (eg sugar cane residue).

Any country can use this for heat or for making electricity at a wide variety of scales.



**Almost all developing countries have access to one of more sources of renewable energy. Examples include:**

**East Africa** – geothermal ('hot rocks'), solar

**Central America** – wind, biogas

**Southern south America** – wind, geothermal, waves, hydro

**Southern Africa** – solar, waves

**East Asia** – wind, geothermal, biogas

**Small islands** – wind, solar, OTEC

**West Africa** – solar, biogas

**Indian subcontinent** – wind, solar, biogas, geothermal