Developing new sustainable geothermal resources : a challenge for the East African countries

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1st African geothermal Conference Addis Abeba Nov. 26th

Energy is a key factor for developing East African countries

- Only 5% of the rural population and 40% of the urban population are connected to the national power grid
- Most of EAC plan to move from major mineral exporters to significant manufacturing operators reducing local unemployment
- For the next 15 years, a 6 to 8% increase of the EAC energy needs is forecast
- To address this problem, reliable, environmental friendly alternatives to classical energy resources should be prospected
- Out of these, geothermal energy has very good potential

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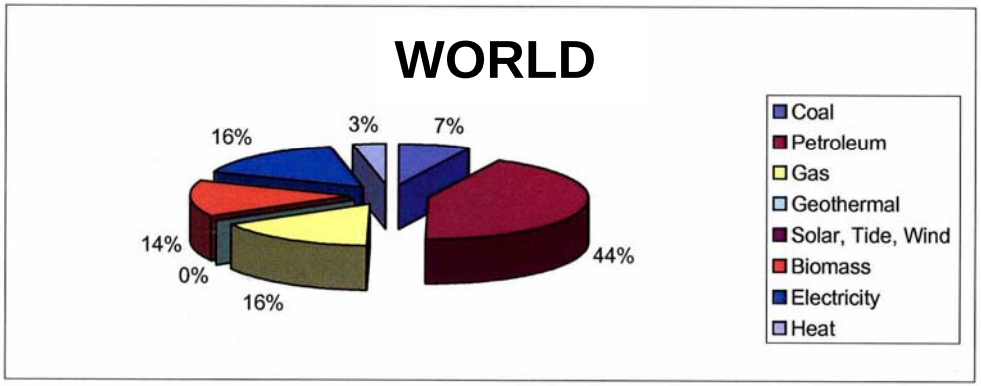
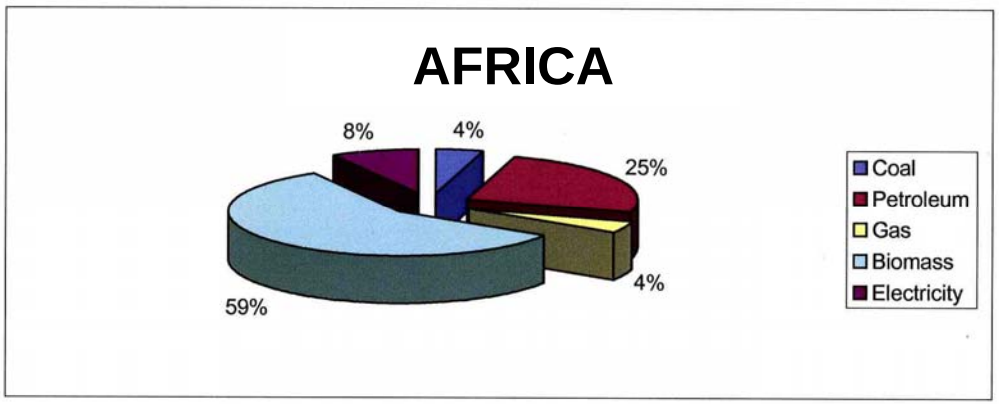
Comparison of energy consumption in the world and in Africa by commodities





Source: International Energy Agency.
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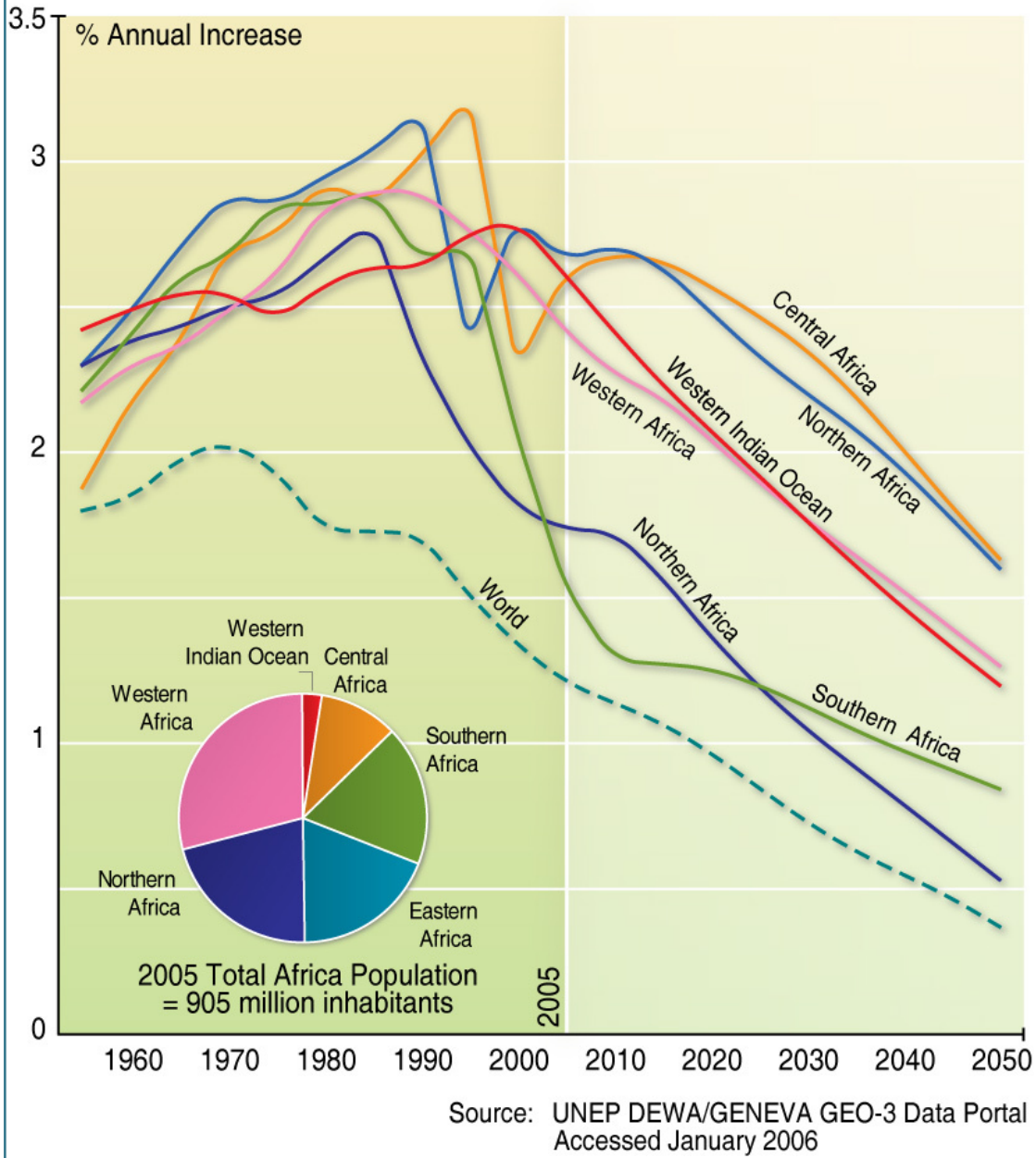
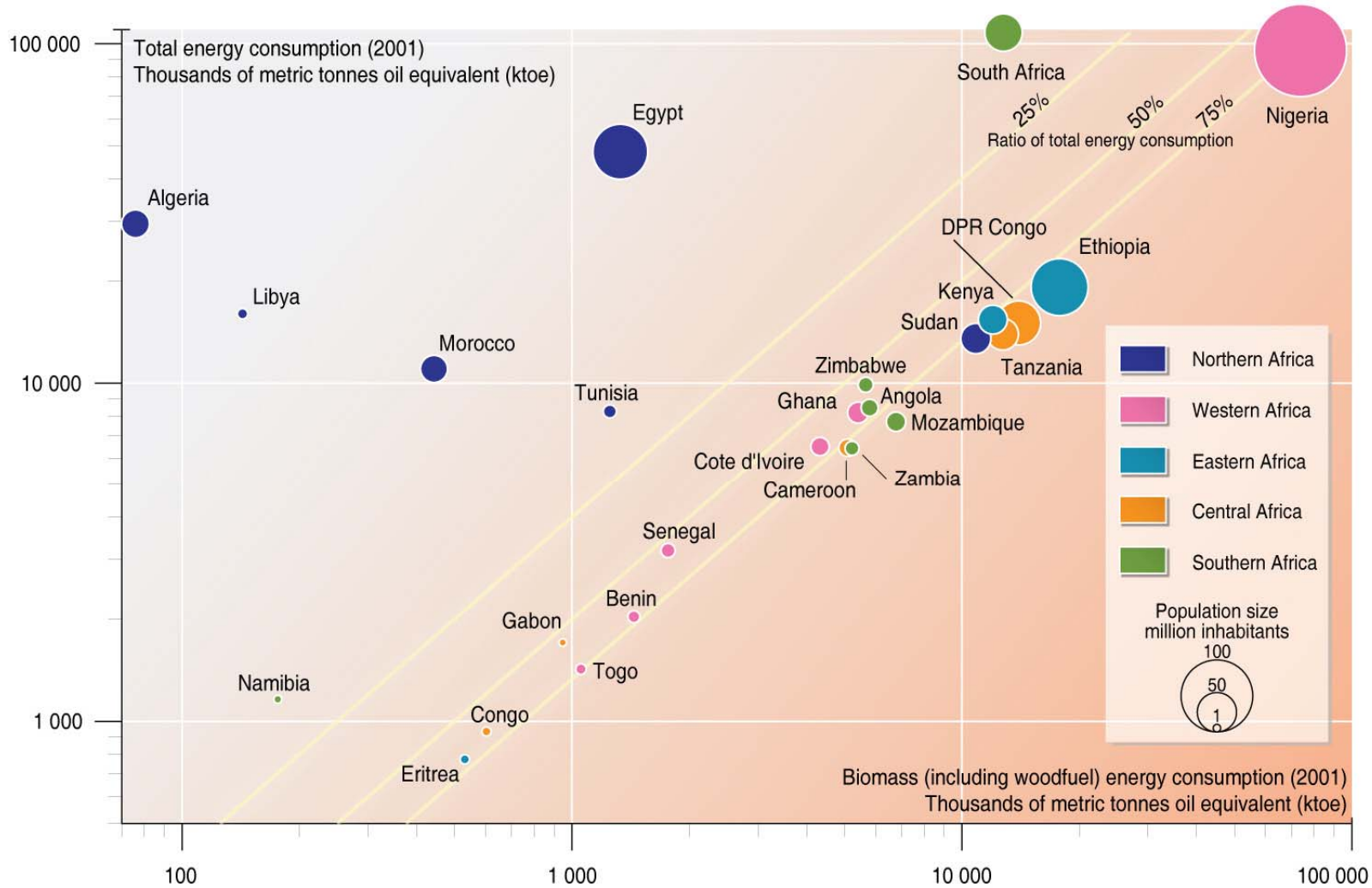


Source: UNEP DEWA/GENEVA GEO-3 Data Portal
Accessed January 2006

The average annual population growth of EAC will remain faster than the world average



Source: Earthtrends / World Resources Institute
Accessed January 2006

Total energy consumption in Ktoe

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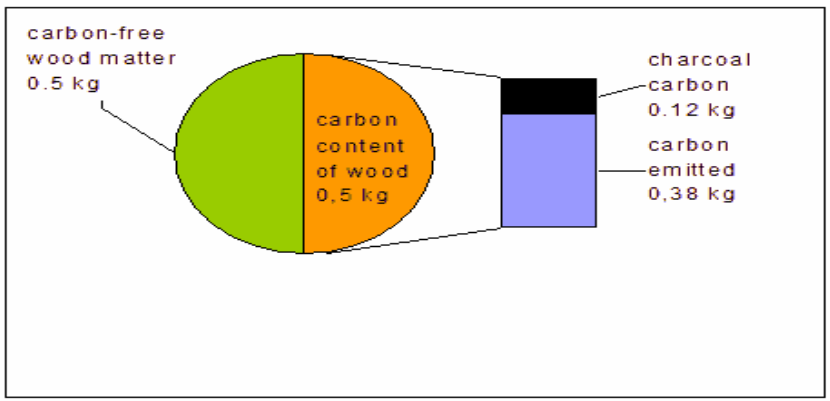
Immoderate use of biomass induces severe impacts on human well-being and natural ecosystems

- **Firewood burning for cooking causes respiratory diseases (indoor smoke)**
- **Artisanal charcoal manufactures loose an important part of the contained calories and emit substantial CO_2, cooking with charcoal uses more wood than cooking with firewood**
- **Ash farming by villagers destroys the biodiversity and sometimes lead to uncontrolled burning of the forest and villages !**
- **Increasing deforestation produces soil denudation that has decreased the soil fertility in numerous areas**



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Recently destroyed village in Northern Ghana by uncontrolled ash farming

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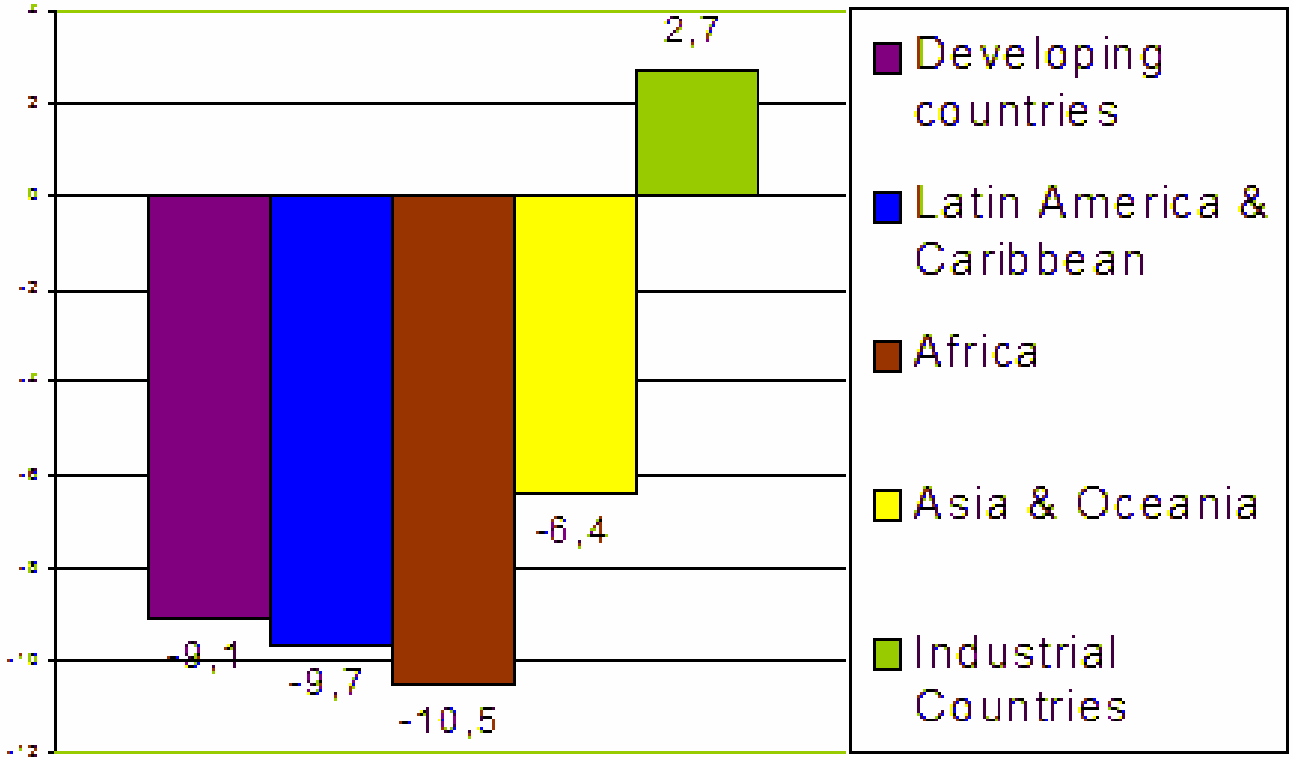
Figure 2: Change of wood surfaces between 1980 and 1995, according to "Africa Environment Outlook", UNEP 2002[3].



Moreover, the cost of the oil imports has been multiplied by 2 in the last 10 years !

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East Africa has a tremendous potential to develop untapped geothermal resources

- **The eastern and western branch of the Rift are the most favorable areas:**

- A thin continental crust faulted under a distensive regime since the Early Tertiary

- Mantle plumes leading to a very strong volcanic activity

- High rainfall on the rift shoulders with permanent lakes

- High heat flux in the crust

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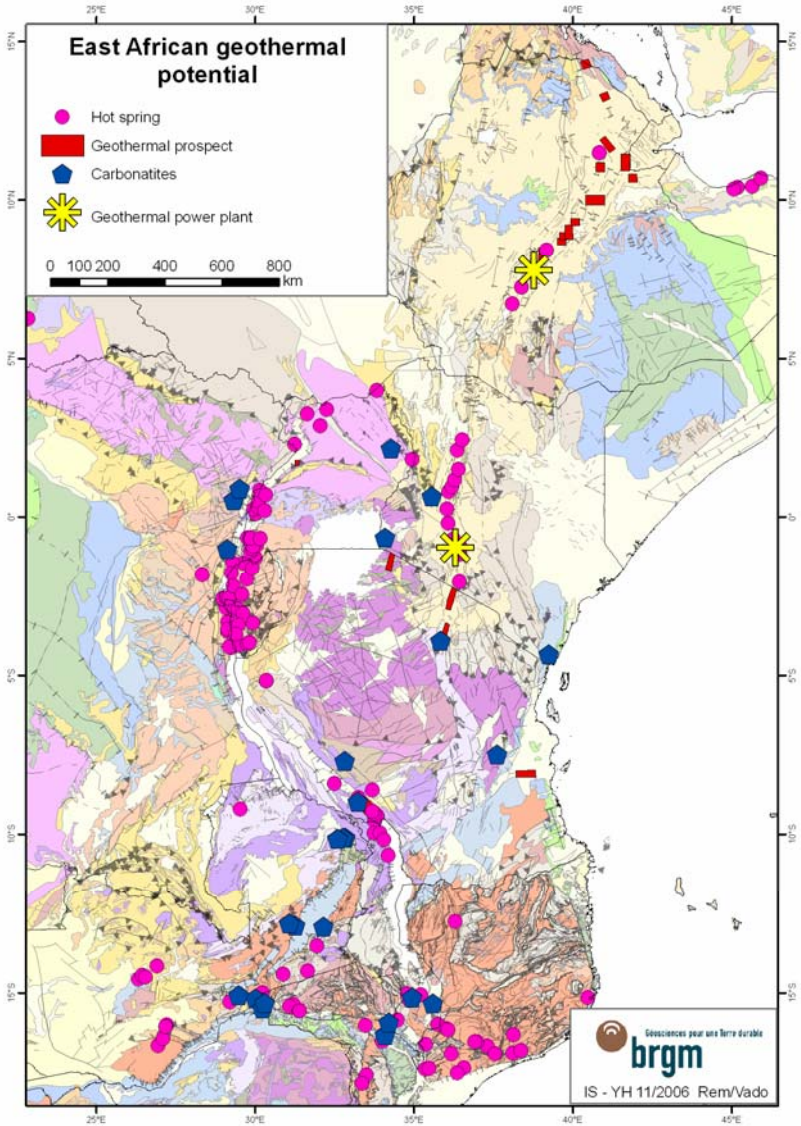

Extending over more than 3600 km, on both rift branches, numerous thermal springs are recorded

Total potential: > 7000 MW

Only two existing power plants: 65 MW

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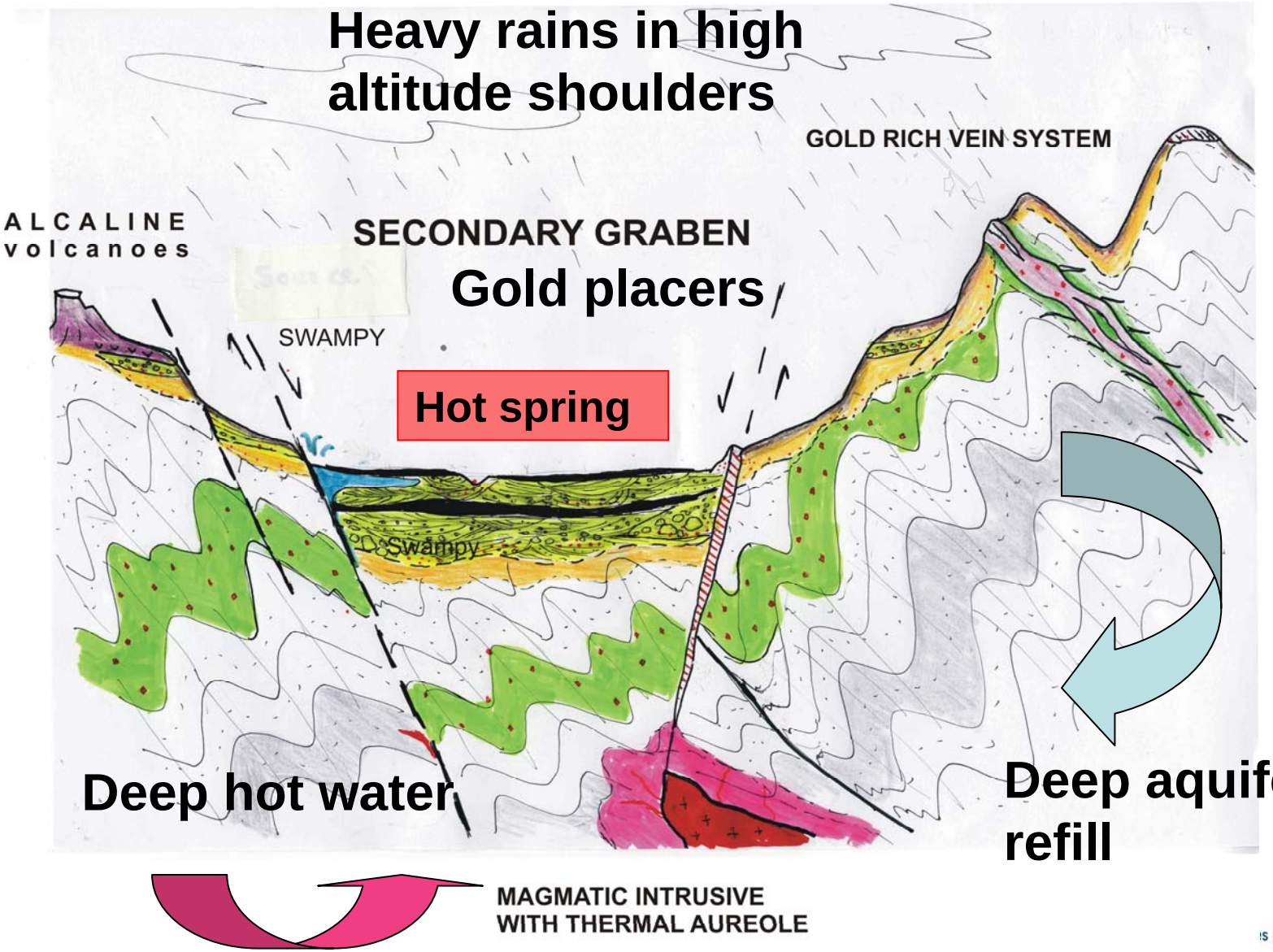

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Geothermal energy is a clean, sustainable energy but investment cost is high if high enthalpy is required

Installed power	Direct Investment cost	Producing cost*
World bank	(US $ / kWe)	(US c / kWh)
< 5 MWe	1600 – 3700	5.0 – 10.5
5-30 MWe	1300 – 2500	4.0 – 7.0
> 30 MWe	1150 – 2200	2.5 – 6.0
EEC	(€ / kWe)	(c€ / kWh)
15 MWe	2300 – 2400	5.5
30 MWe	1800 – 1900	4.5
55 MWe	1400 – 1500	3.7

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ENERGY	Affordability	Accessibility	Availability	Sustainability
Biomass	++	++	+	- -
Hydropower	+	+	+ -	+
Gas	+	-	+	+
Coal	+	+	++	- -
Nuclear	-	-	+	+
Geothermal	+	+	++	++

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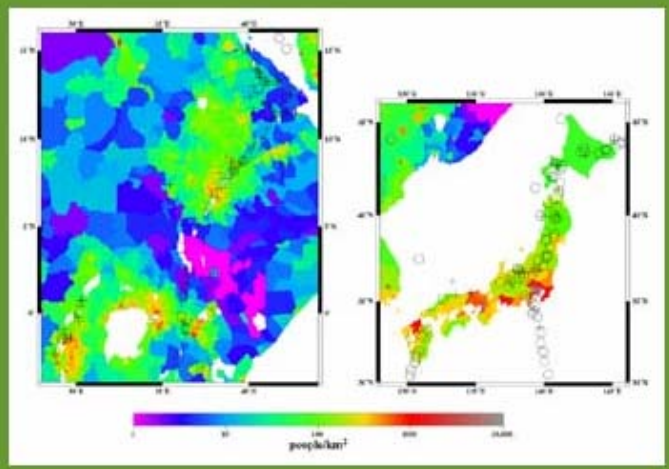
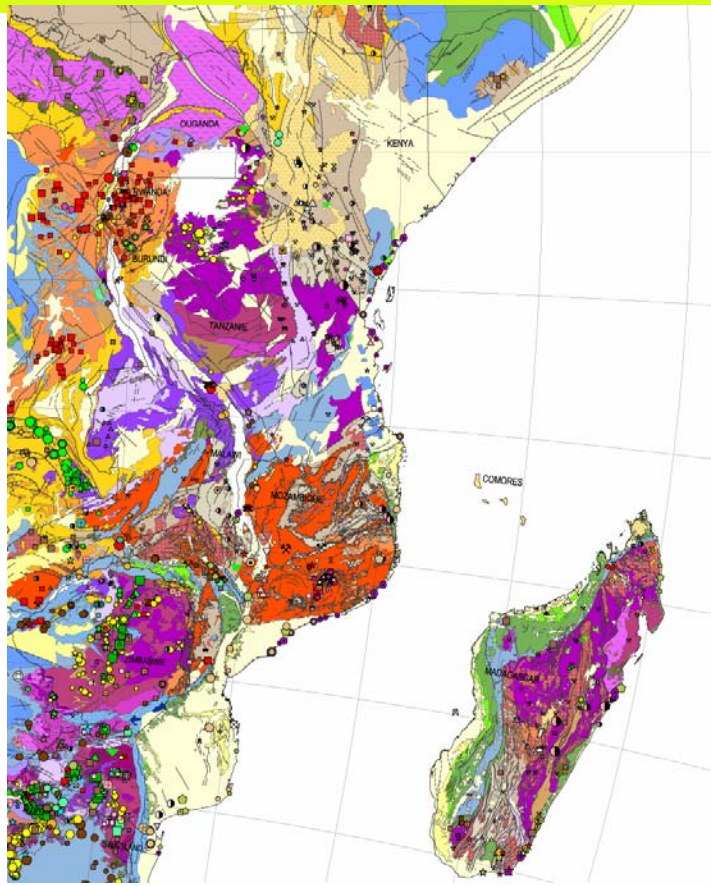
East Africa is one of the most crowded area of Africa (more than 100 millions people) and also, one of the most prospective area for various resources



Population of Volcanic Regions in East Africa and Japan



Au, Ag, Cu, Sn, W, Nb, REE, Diamond, PO_4,…

Epithermal gold has a very high potential

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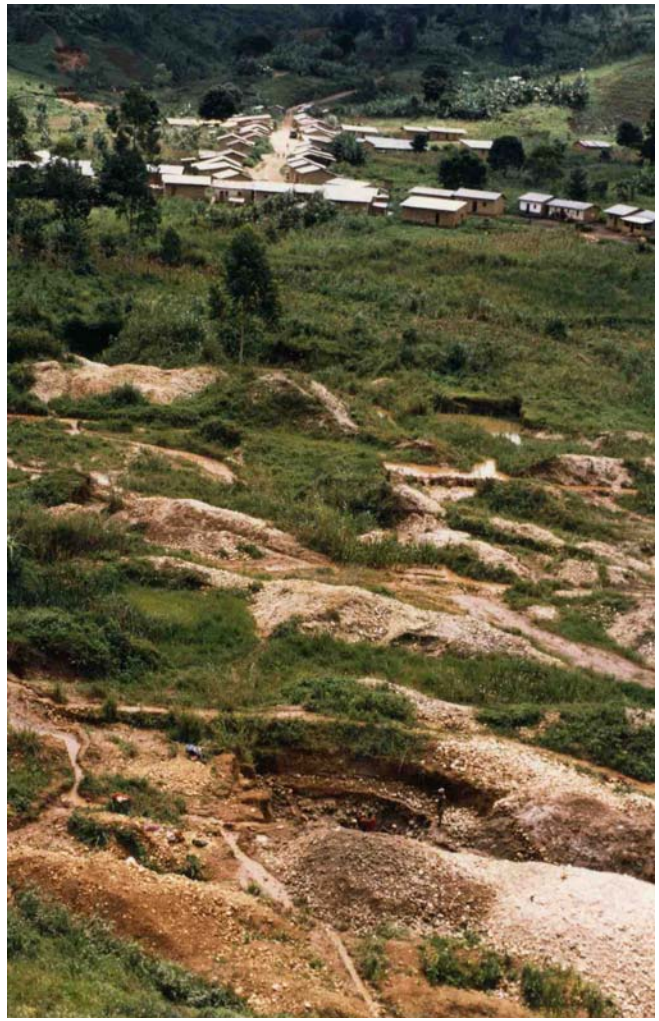
Developing new geothermal resources may boost local industries start up



Mineral development:

- **Primary carbonatite exploitation: for carbonate (cement), phosphate (fertilizer), niobium, rare earths production**
- **Travertine quarrying and polishing, natron, clay, zeolites extraction from evaporitic lakes**
- **Tiles, bricks, ceramics cooking, peat drying**
- **Strengthen and secure artisanal gold working (ventilation, rock grinding,…) and optimize ore recovery**

Processing industries: **sugar refineries, tea, coffee, peat drying**

Nutrition: **fish, shrimps farming**

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Additional benefits of the electric power from geothermal resources are numerous

For the local population:

Domestic lighting, cereal milling, cooking and watering
Avoiding time waste for water, wood harvesting etc..

For regional authorities:

Limit CO_2 emission and protect the forest, savanna ecosystems

Health safety (hospitals…)
Education (schools..)

Road maintenance (grinding)

To protect the wildlife sanctuaries: one of the major resource of EAC ! (ecotourism)

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How to raise the necessary funds ?

Public sources:

- **World bank, UNEP (GEF), UNIDO, BAD,**
- **Various bilateral cooperation**
- **Local governmental agencies, ministries, National power companies**

Private sources:

- **Future end users: private power companies, mining companies, water companies, railways, etc..**
- **Private foundations, NGO: WWF, Greenpeace,…**

And mutualize the drilling risk : insurance-banks?

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BRGM has the capacities for:

- Delineate the most prospective areas by using geological, geophysical, geochemical and hydrogeological methods and map the volcanic areas

- Model the geothermal reservoir at depth

- Carry out the geological and geochemical monitoring of the core and fluid samples during the well drilling

- Optimize the exploitation of the geothermal field in terms of production and duration

CFG Services has the technical expertise to:

- Assess the economic feasibility of a geothermal project

- Select the best place for drilling

- To drill the target and record the useful parameters

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The Bouillante geothermal 15 MWe power plant

Guadeloupe Island (French West Indies)

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