

# Joint Research Centre (JRC)



IE - Institute for Energy  
REU - Renewable Energy Unit  
*Ispra - Italy*

<http://ie.jrc.ec.europa.eu/>

[http://re.jrc.ec.europa.eu/esti/index\\_en.htm](http://re.jrc.ec.europa.eu/esti/index_en.htm)

<http://re.jrc.ec.europa.eu/refsys/>

## Joint Research Centre (JRC)

### **GIS for Decision Support System**

Enhancing information for Rural Electrification  
in Africa (off-grid versus grid-connection, RES sources)



Katalin Bódis

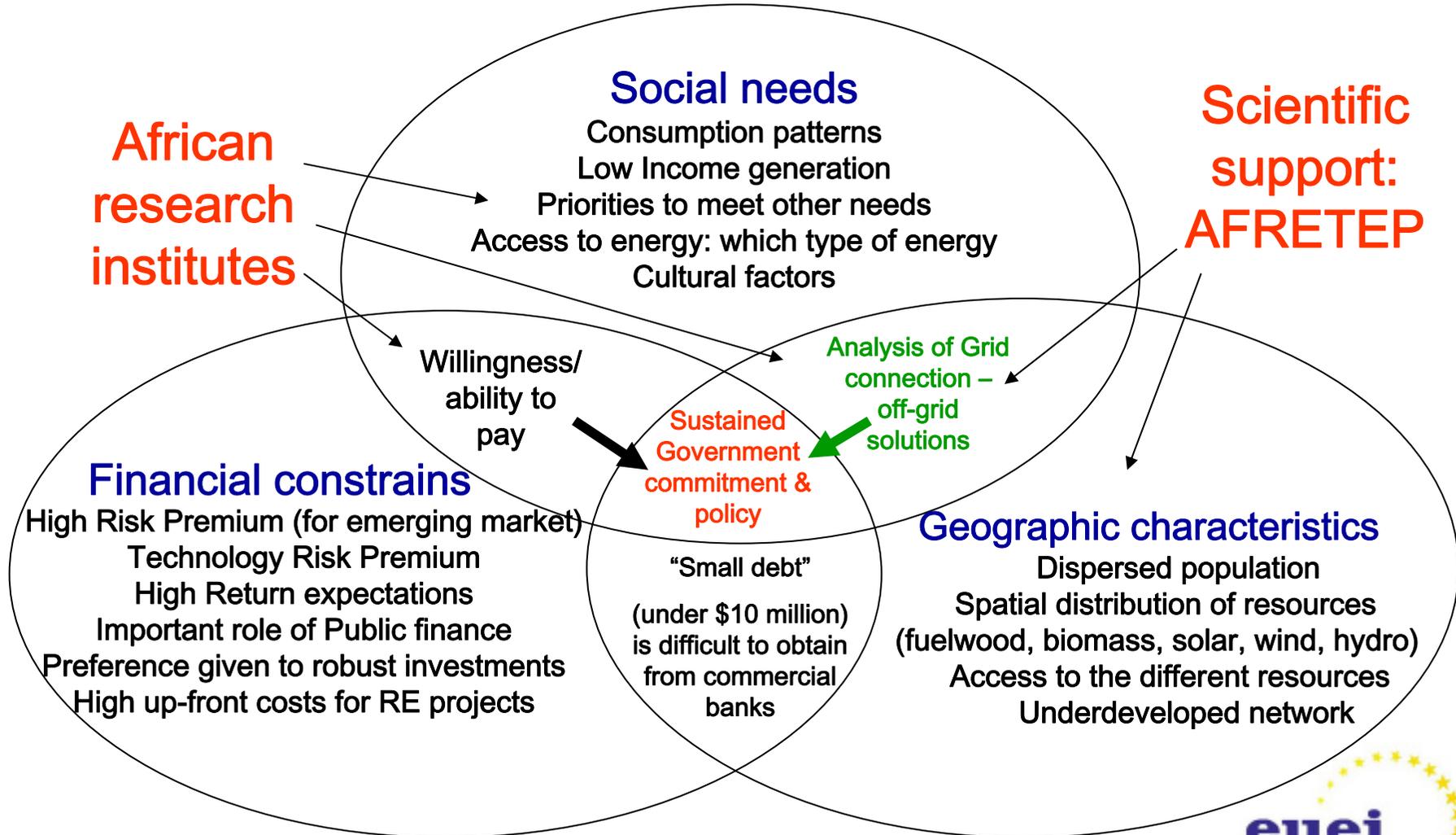
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# Conditions, barriers and points of intervention for Rural Electrification in Africa

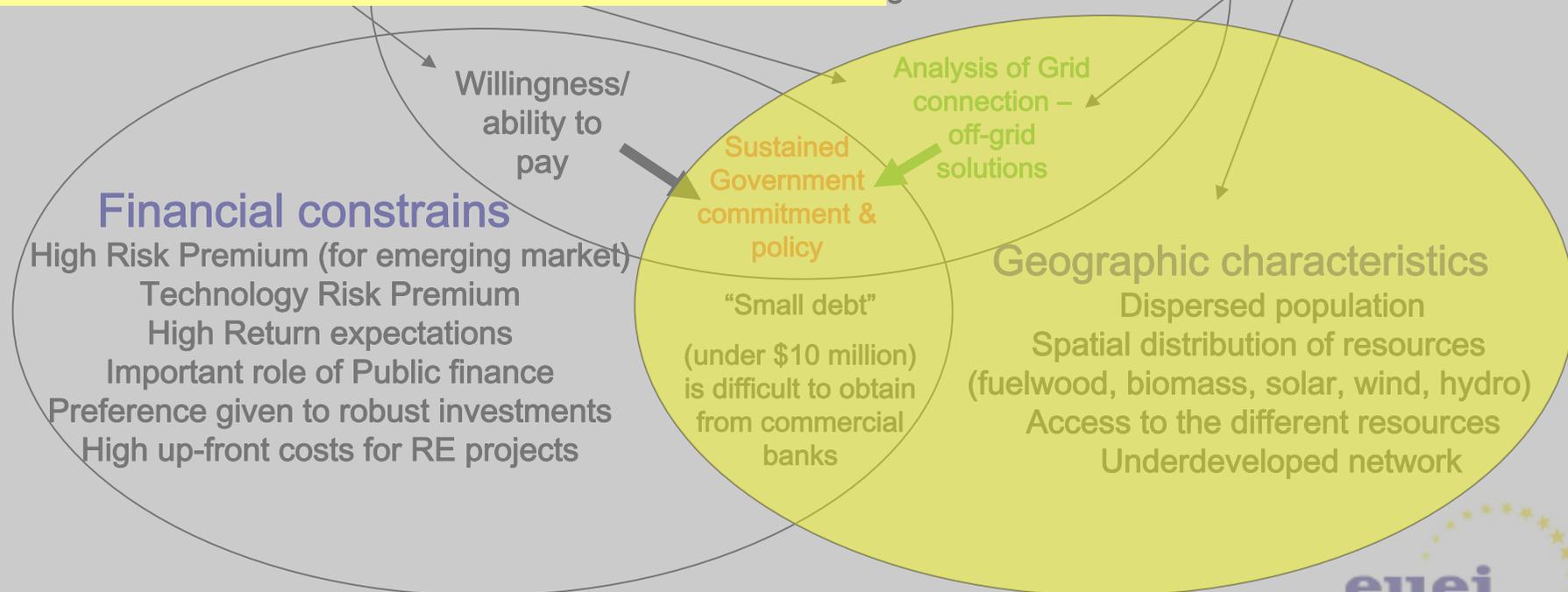


# Conditions, barriers and points of intervention for Rural Electrification in Africa

## Aims:

- Data mining, data collection;
- Development of a supporting geospatial data set;
- Spatial analyses;
- Optimization of distributed generation;
- Decision support.

Scientific support:  
**AFRETEP**



# Source African and Global Geospatial Data Sets

## Population

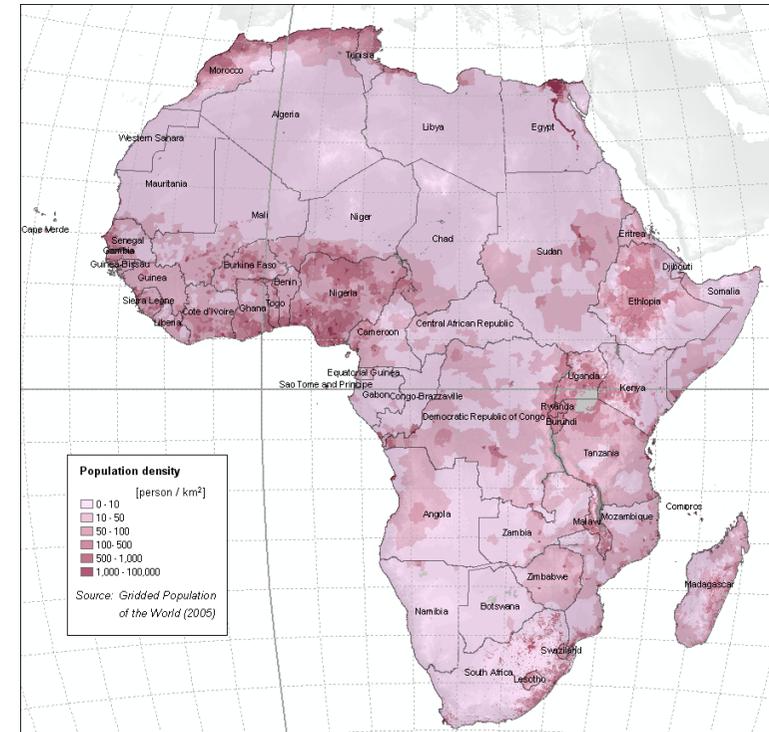
‘Gridded Population of the World: Future Estimates’  
[ref. 1. CIESIN, FAO, CIAT]

Source: <http://sedac.ciesin.columbia.edu/gpw>

Processed (projected, resampled) raster data representing the estimated number of population in each cell in 1 km resolution.

### Limitation of detailed GIS analyses:

- different size of units (administrative regions);
- smoothed concentration of population.



# Source African and Global Geospatial Data Sets

## Administrative boundaries and names

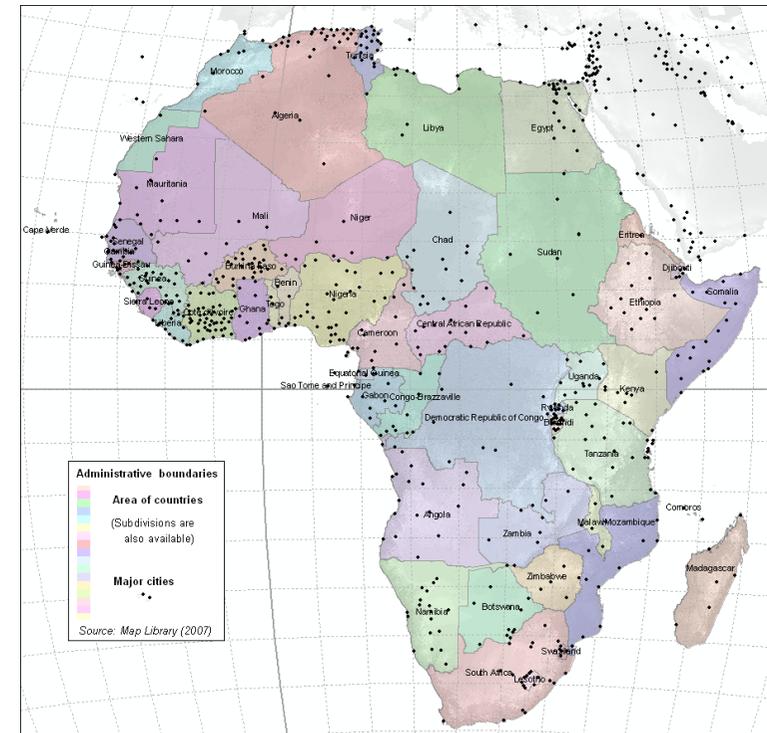
The geo-referenced data set of administrative units of the Map Library project  
[ref. 2. Map Library, 2007]

Source: <http://www.maplibrary.org/>

Processed (projected, LAEA) vector data

### Limitation of detailed GIS analyses:

- different levels of details;
- insufficient information about rural population.



# Source African and Global Geospatial Data Sets

## Populated places

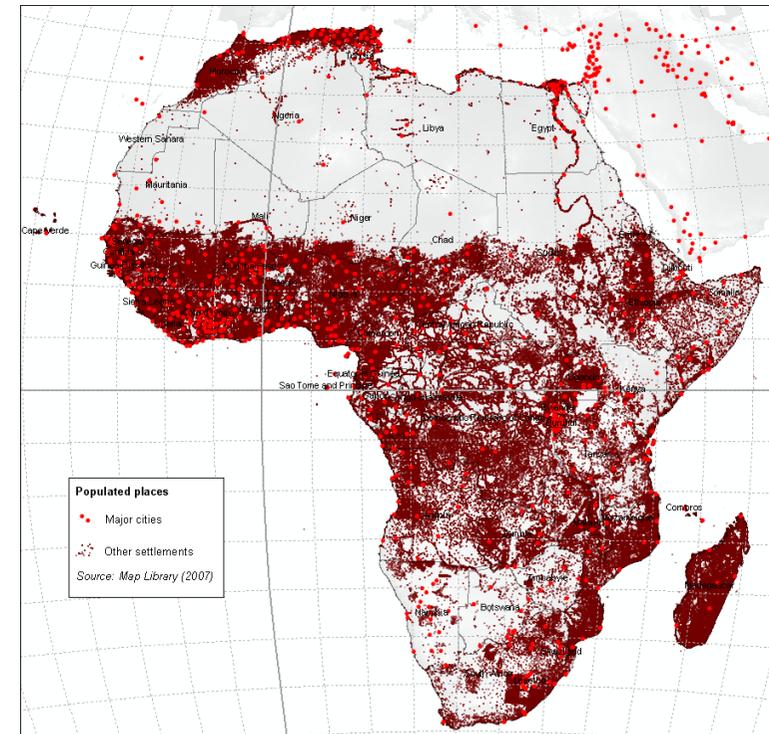
Locality and name of point objects (e.g. populated places, administrative centres, churches, schools, military bases) are available also from the Map Library data set, but without population information. [ref. 2. Map Library, 2007]

Source: <http://www.maplibrary.org/>

Processed (projected, LAEA) vector (point) data

### Limitation of detailed GIS analyses:

- no information about consistency;
- missing number of belonging population.



# Source African and Global Geospatial Data Sets

## Network infrastructure

GIS database of the Africa Infrastructure Country Diagnostic (AICD), [ref. 3. AICD, 2009].

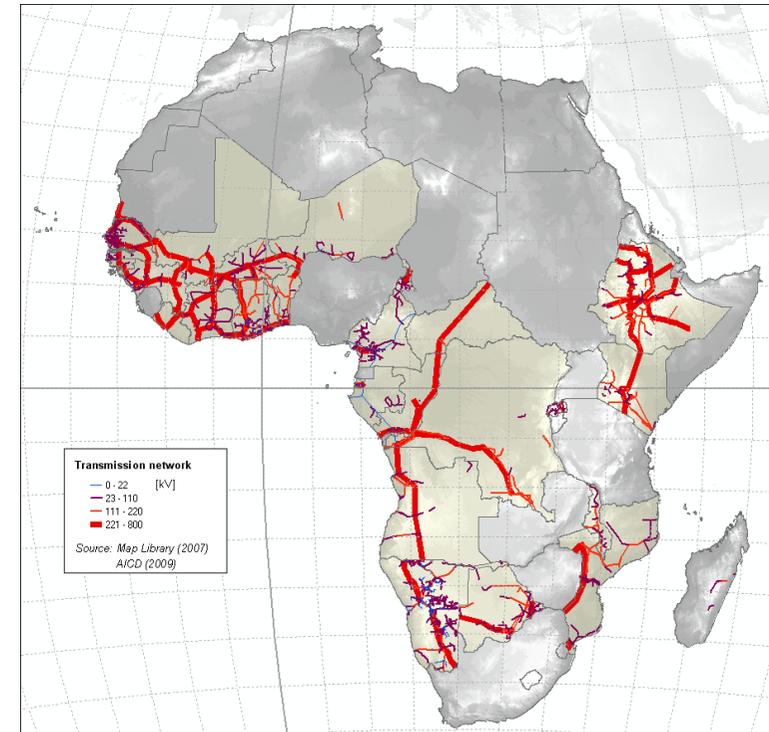
Two thematic layers from the AICD database:

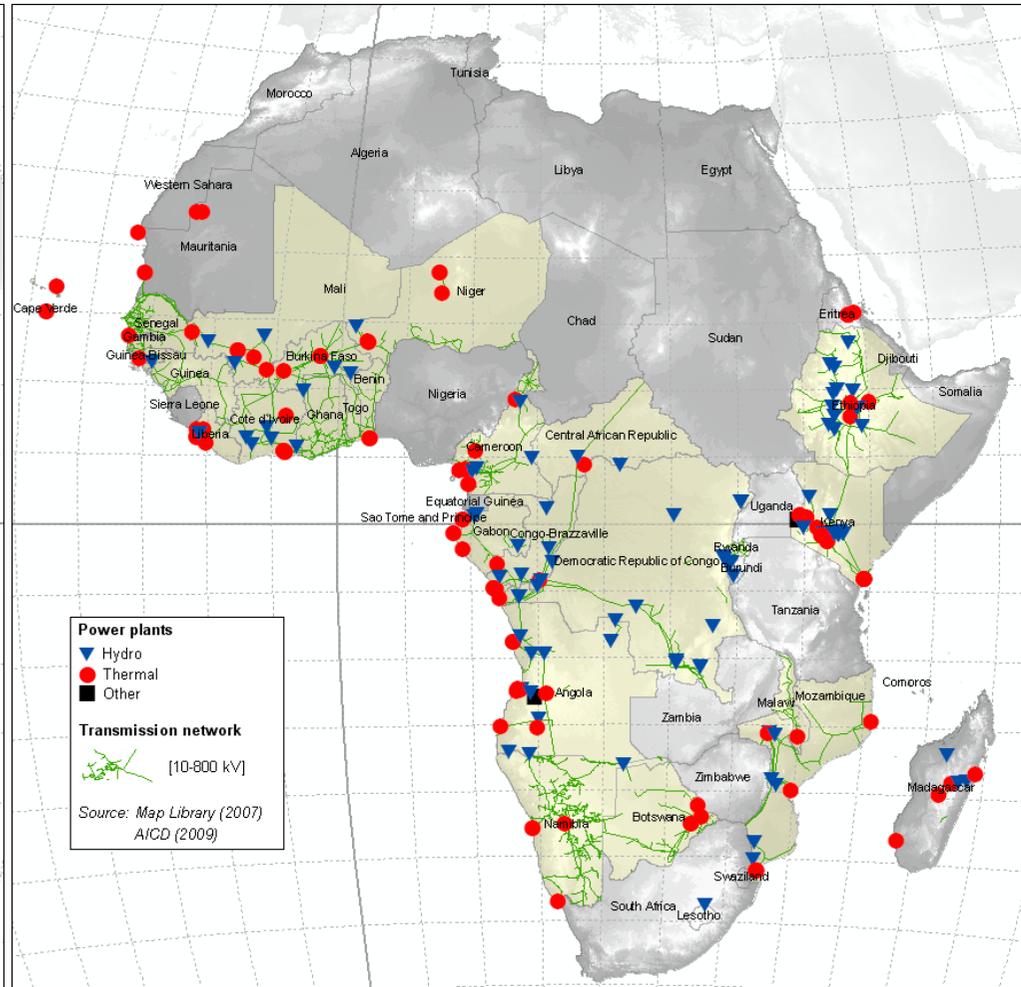
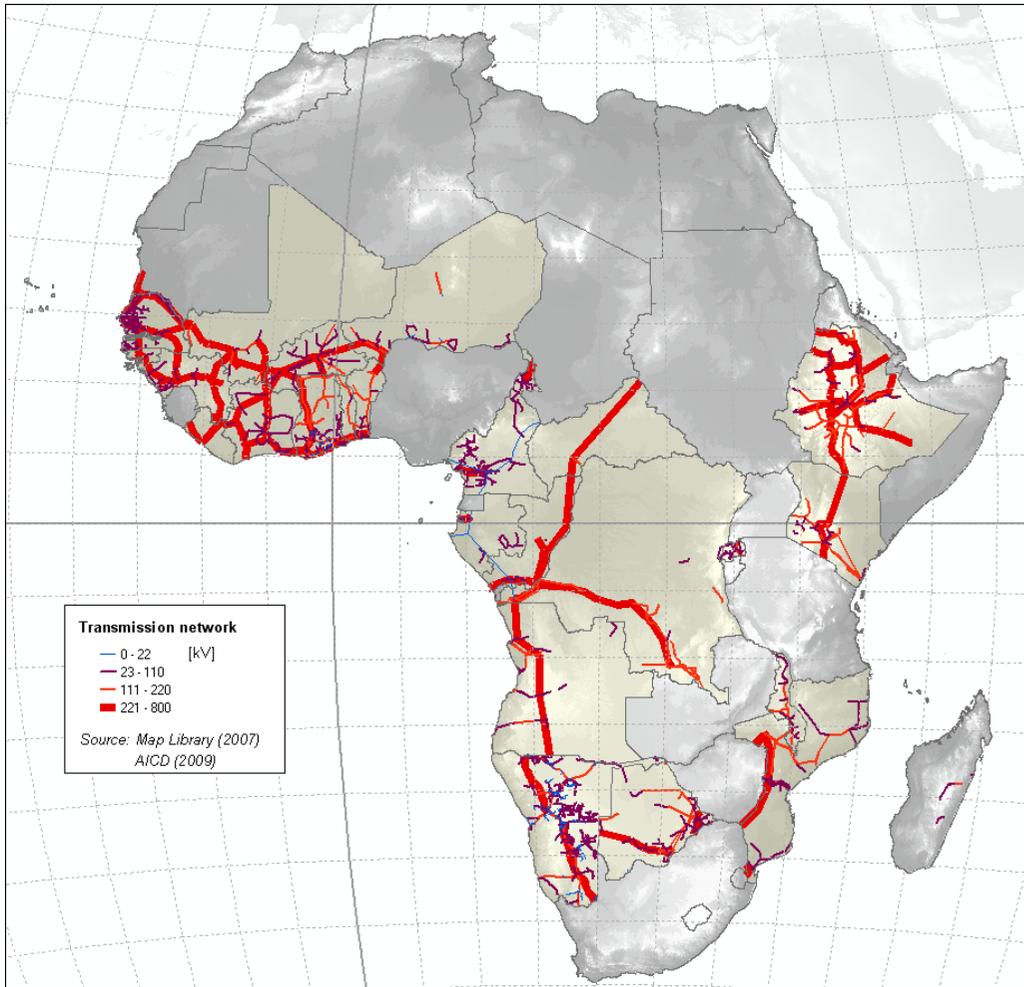
Power:        Power plants (point objects)  
                  Transmission network (linear objects)  
Transport:    Roads (linear objects)

Source: <http://www.infrastructureafrica.org/aicd/about>

### Limitation of detailed GIS analyses:

- no information about consistency;
- covers only 24 countries.





# Source African and Global Geospatial Data Sets

## Digital Elevation Model

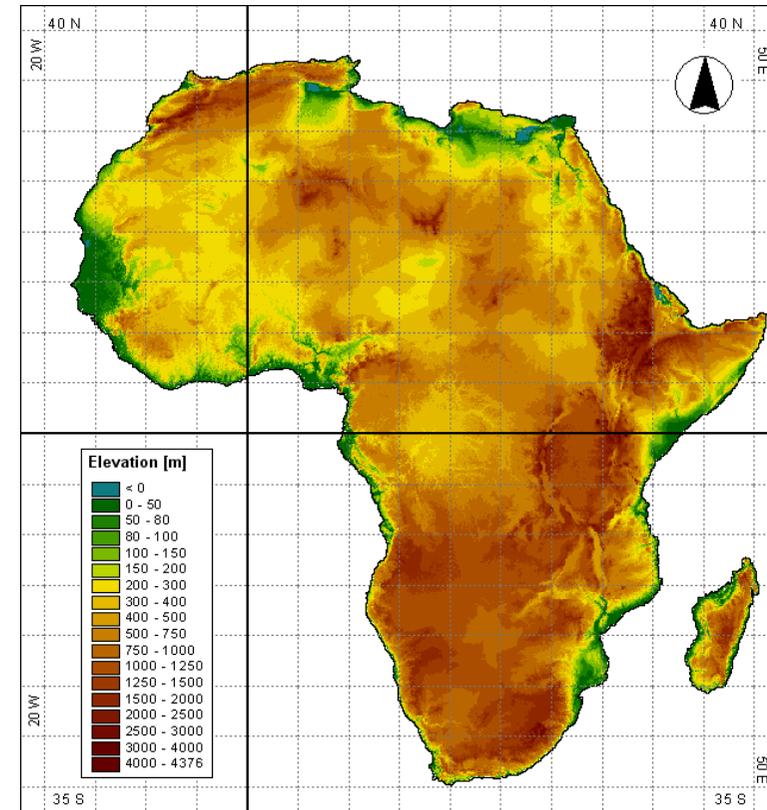
The Shuttle Radar Topography Mission (**SRTM**) obtained elevation data on a near-global scale (between N60 and S57 degree) to generate the most complete high-resolution digital topographic database of Earth [ref.4. Farr et al., 2007].

Processed (projected, resampled) raster data representing the elevation in 100 m resolution.

Source: <http://www2.jpl.nasa.gov/srtm/>

### Limitation of detailed GIS analyses:

- surface elevation including vegetation and other natural and artificial objects.



# Source African and Global Geospatial Data Sets

## Land Cover

Source: The Global Land Cover 2000 (**GLC2000**) database [ref. 5. GEM, 2003] that provides a harmonized land cover database covering the whole globe for the year 2000.

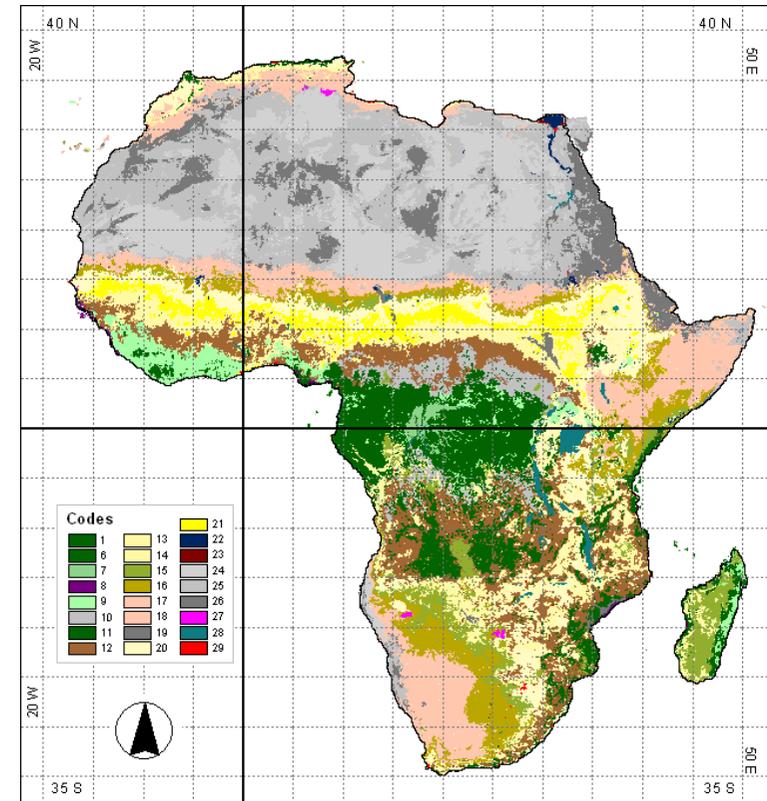
Processed (projected, resampled) raster data representing the vegetation in 1 km resolution.

Source:

<http://bioval.jrc.ec.europa.eu/products/glc2000/glc2000.php>

Limitation of detailed GIS analyses:

- its coarser resolution.



# Source African and Global Geospatial Data Sets

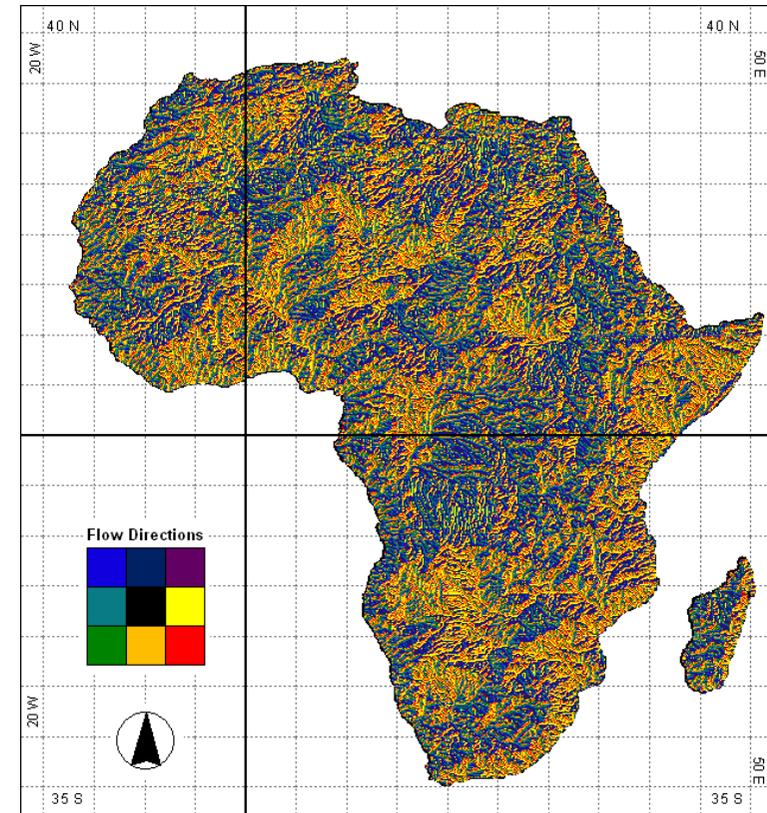
## Flow network

The SRTM-based source of flow or drainage network of African river basins has been developed for a data set for continental hydrologic modelling and flood forecasting [ref. 6. Bódis, 2009].

Processed (projected, resampled) raster data representing flow (discharge) directions.

### Limitation of detailed GIS analyses:

- its coarser resolution due to the source data.



# Common reference system – metric

## Projection and Coordinate System

Since the modelled area extends over several administrative regions and countries it was necessary to specify a common reference system.

## ETRS Lambert Azimuthal Equal Area

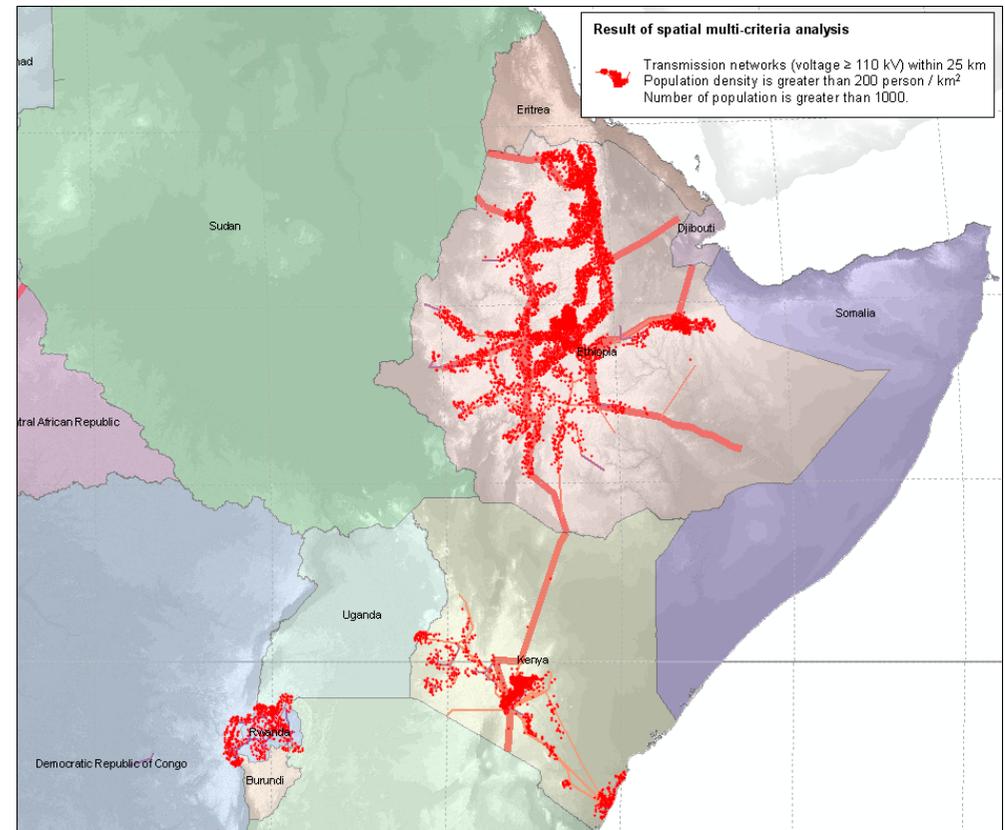
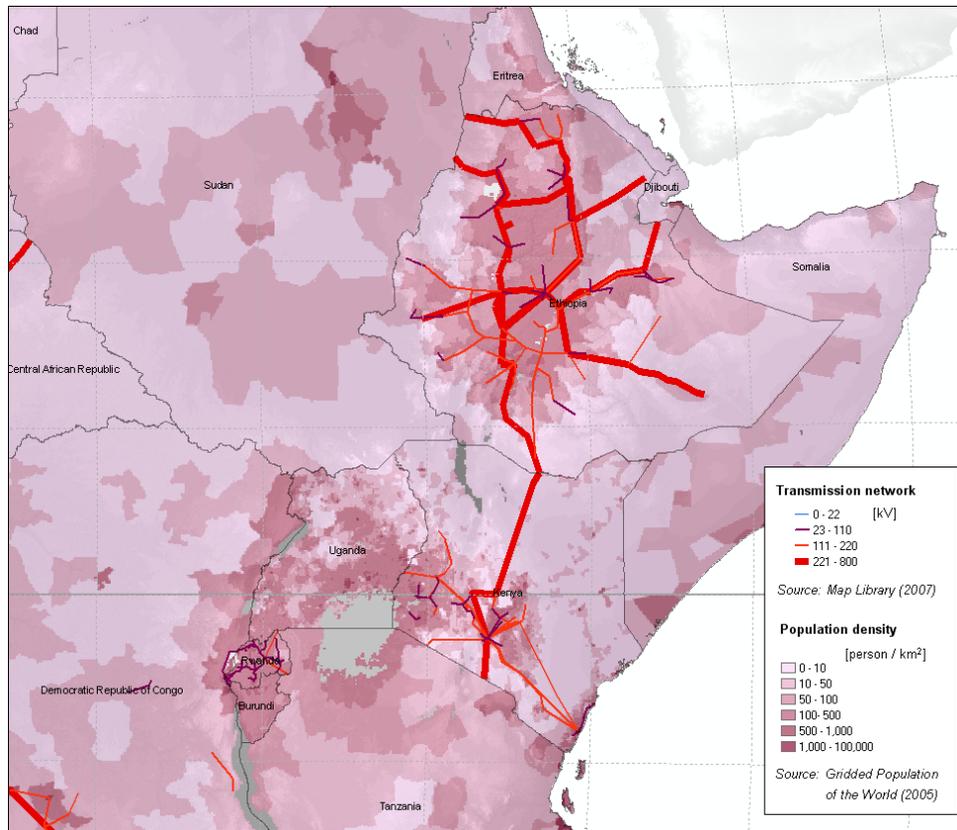
Projection Name:	ETRS_LAEA
Projection Type:	Lambert Azimuthal Equal Area
Spheroid:	GRS80
Datum	WGS84
Radius of sphere of reference:	6378137
Units:	meters
Longitude of centre of projection:	18° 00' 00"
Latitude of centre of projection:	00° 00' 00"
False easting:	4321000.0
False northing:	3210000.0

ETRS LAEA corresponds to the European standards [ref. 7. Annoni et al., 2001]

# Case study 1 - Multi-criteria analysis – country level

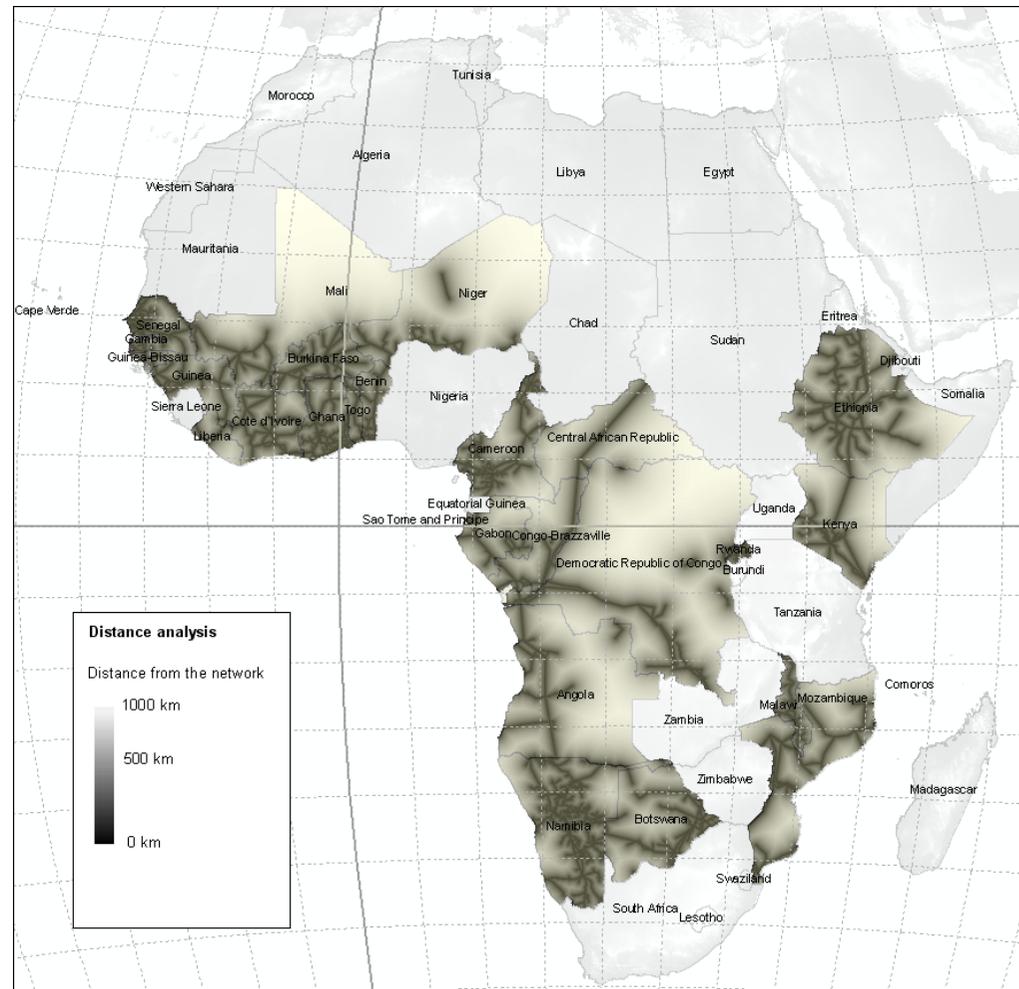
Population – high in number and density

Transmission network – within a certain distance

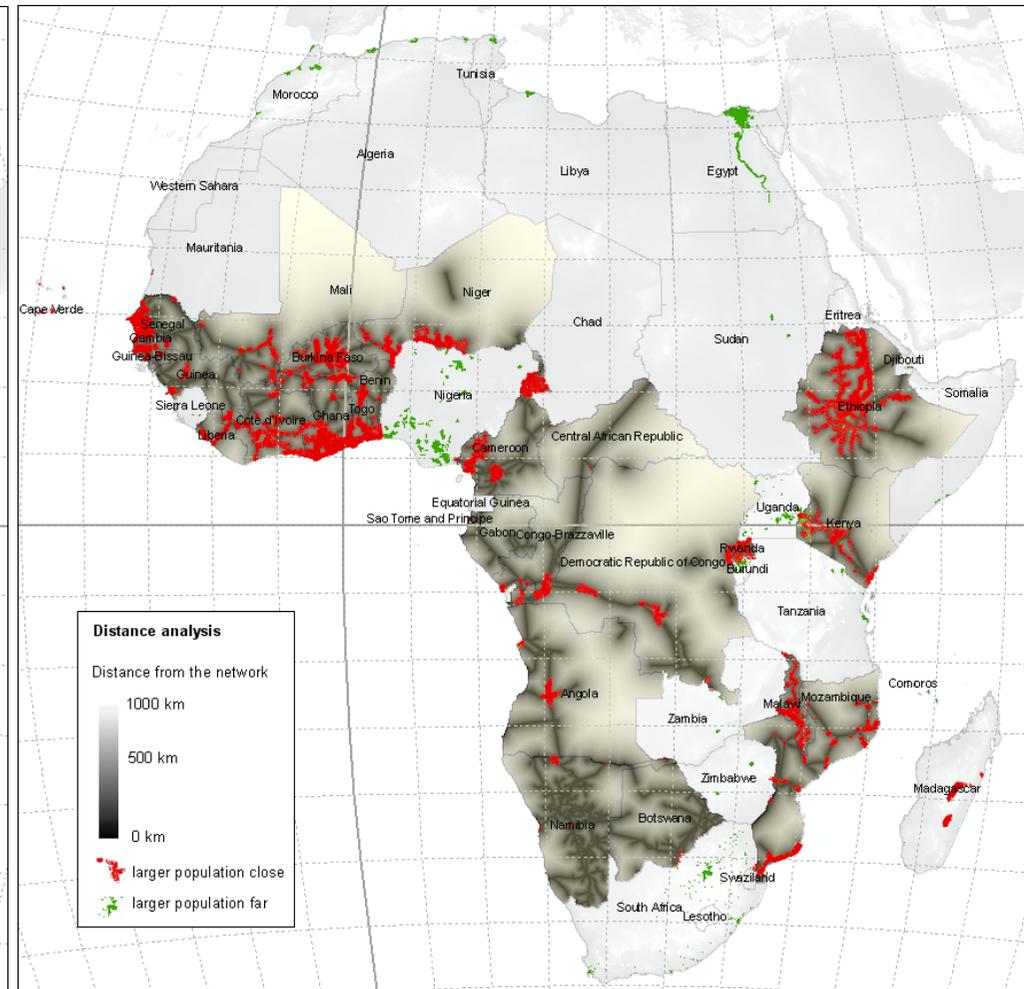


# Case study 1 - Multi-criteria analysis – continental level

## Distance analysis



## Population



# Case study 2 – estimation of potential extension of grid

Using

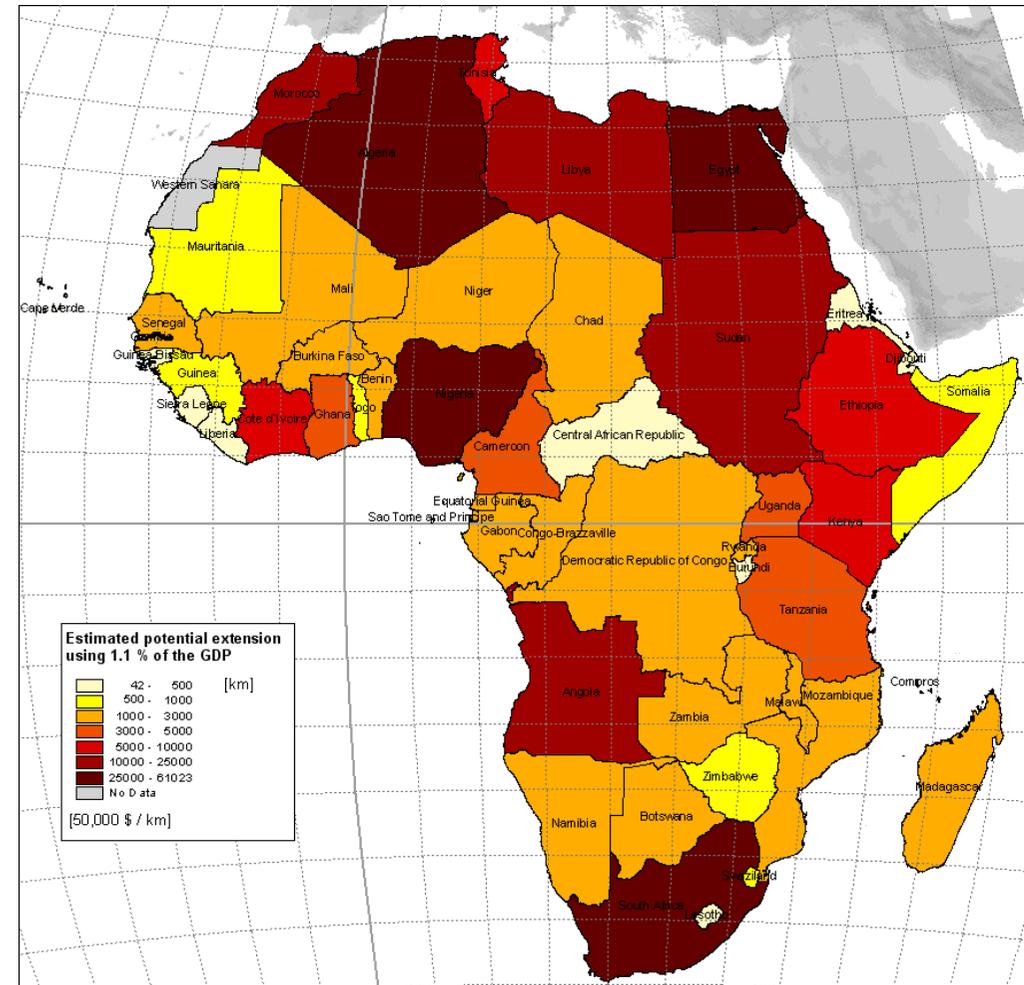
“best practice example” from World Bank,

- 95% of rural households enjoys access
- Within 15 years 70 million people connected

- National contribution ~ 5 % of GDP
- External support ~ 1.1 % of GDP

[ref. 8. Saghir, 2010]

Assumption: 50,000 \$ ~ 1 km medium voltage network



## FURTHER STEPS - QUESTIONS

- Do we follow a right and fruitful approach?
- Are there other geospatial data sets available on regional level?
- Are population-related data of rural areas available?  
(Following sectors: health, education, local government)
- What studies / analyses could support the development in the best way?

**Any comments / suggestions are welcome!**

# References

[ref. 1] Center for International Earth Science Information Network (CIESIN), Columbia University; United Nations Food and Agriculture Programme (FAO); and Centro Internacional de Agricultura Tropical (CIAT). 2005. Gridded Population of the World: Future Estimates (GPWFE). Palisades, NY: Socioeconomic Data and Applications, Center (SEDAC), Columbia University.

[ref.2] Map Library (2007)  
<http://www.maplibrary.org/library/sources.php>

[ref. 3]AICD (2009), Africa Infrastructure Country Diagnostic (AICD),

[ref. 4] Farr, T. G., Rosen, P. A., Caro, E., Crippen, R., Duren, R., Hensley, S., Kobrick, M., Paller, M., Rodriguez, E., Roth, L., Seal, D., Shaffer, S., Shimada, J., Umland, J., Werner, M., Oskin, M., Burbank, D. and Alsdorf, D. (2007) The Shuttle Radar Topography Mission, Reviews of Geophysics, Volume 45. RG2004, doi:10.1029/2005RG000183.

[ref. 5] GEM (2003) Global Land Cover 2000 database, *European Commission, Joint Research Centre, 2003*, Documentation and data URL: <http://bioval.jrc.ec.europa.eu/products/glc2000/glc2000.php>

[ref. 6] Bódis, K. (2009): Development of a data set for hydrological modelling. Input layers related to topography, channel geometry, land cover and soil characteristics of European and African river basins, European Commission, Directorate-General Joint Research Centre, Institute for Environment and Sustainability, Ispra, Italy, p. 80. EUR 24087 EN

[ref. 7] Annoni, A., C. Luzet, E. Gubler and J. Ihde (Eds.) (2001) Map Projections for Europe, European Commission, Directorate-General Joint Research Centre, Institute for Environment and Sustainability, Ispra, Italy, p. 131. EUR 20120 EN  
URL: <http://www.ec-gis.org/sdi/publist/pdfs/annoni-et-al2003eur.pdf>

[ref.8] Saghir, J. (2010) Energy and Development: Lessons Learned, Workshop, International Energy Agency, Paris