

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/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

IE - Institute for Energy

REU - Renewable Energy Unit

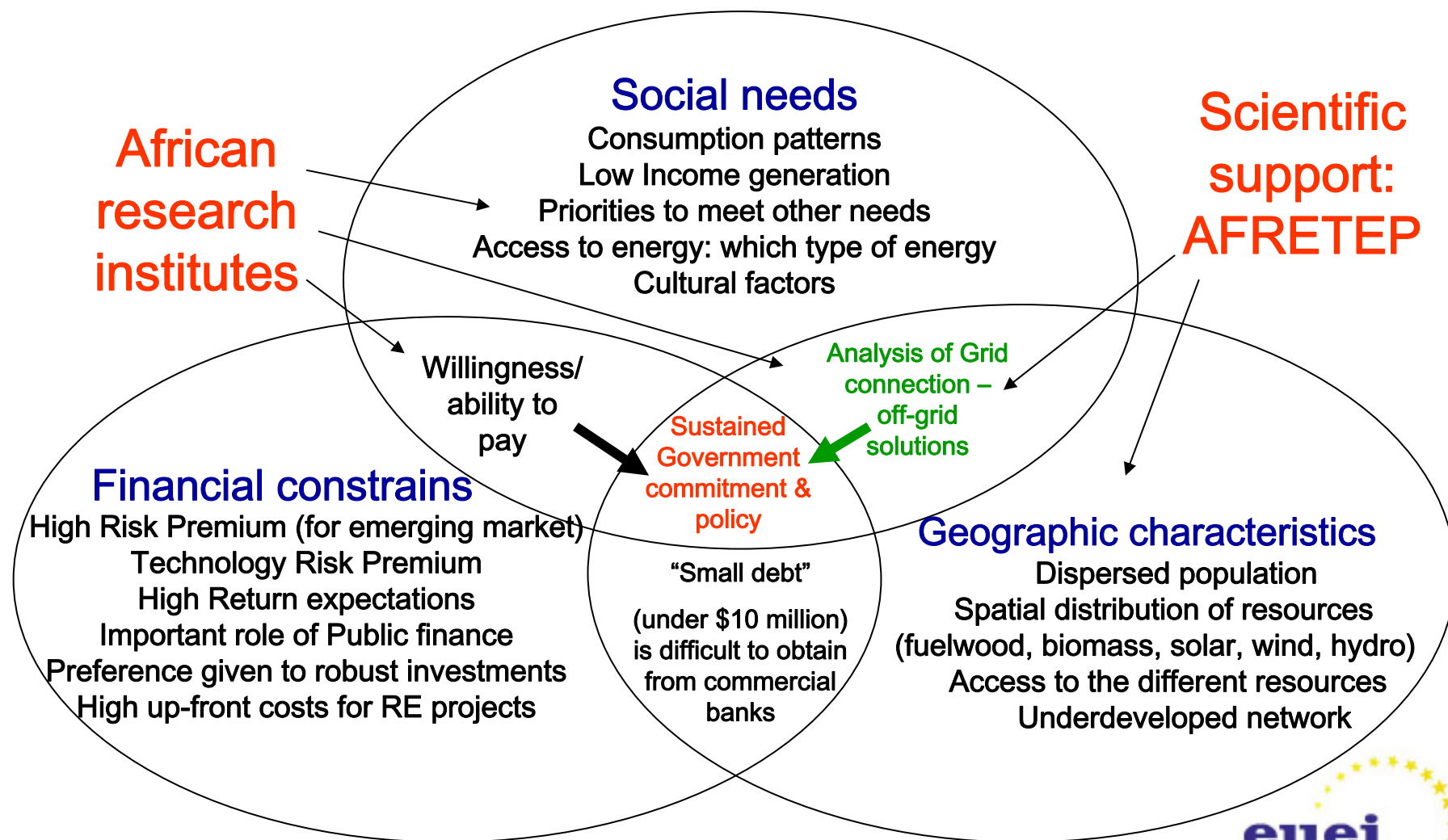
Ispra - Italy

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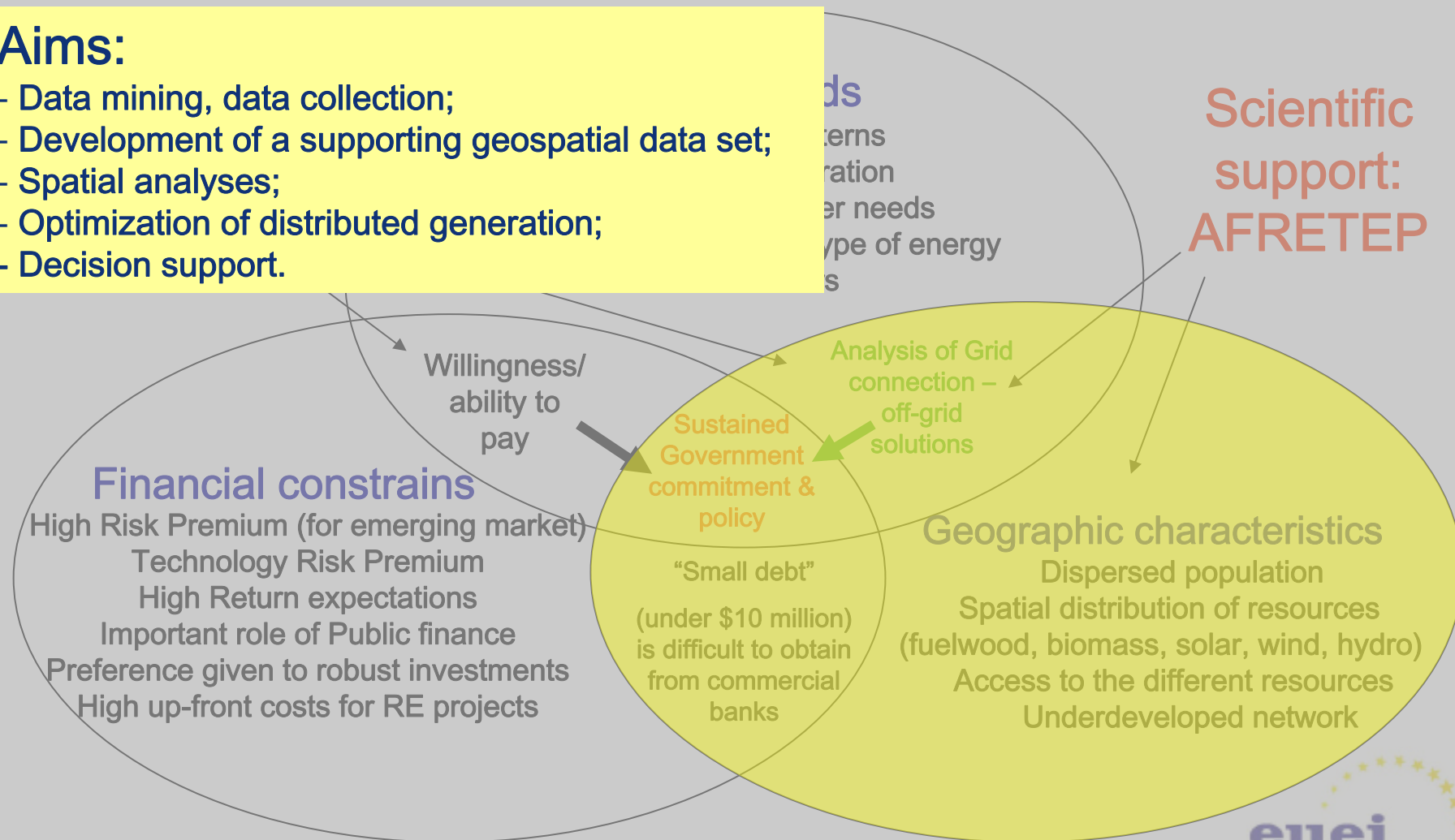
Conditions, barriers and points of intervention for Rural Electrification in Africa



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.



Source African and Global Geospatial Data Sets

Population

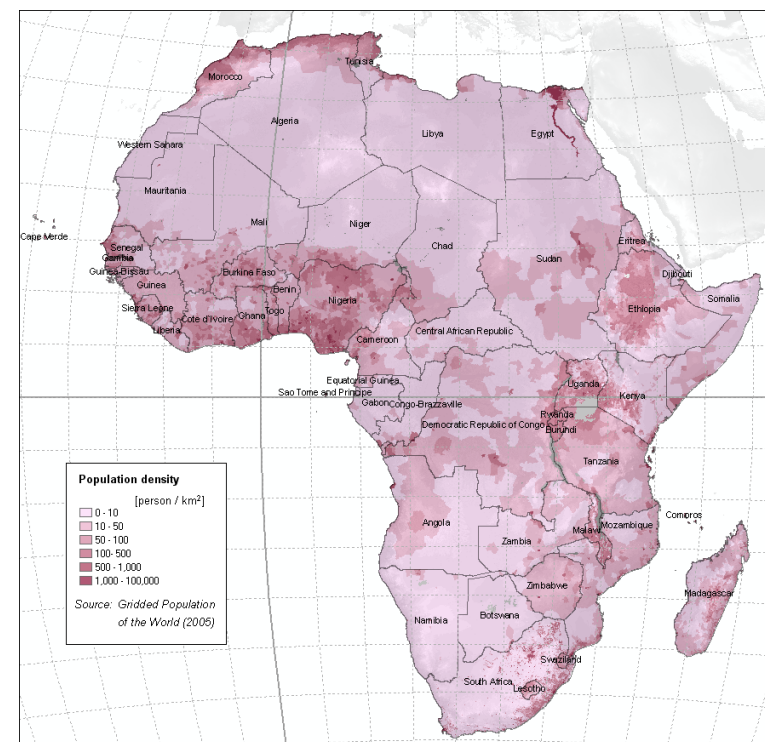
‘Gridded Population of the World: Future Estimates’
[ref. 1. CIESIN, FAO, CIAT]

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

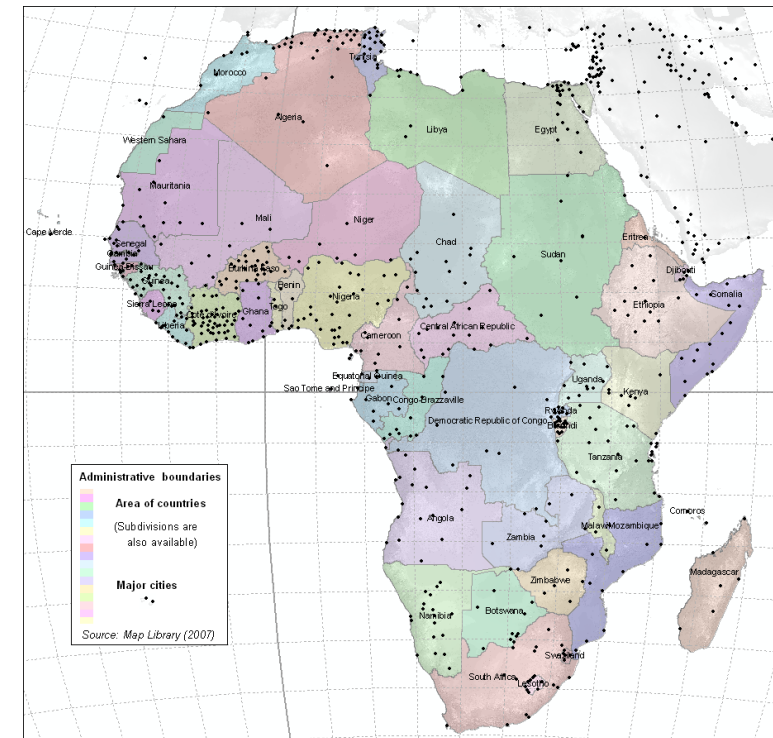
The geo-referenced data set of administrative units of the Map Library project
[ref. 2. Map Library, 2007]

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

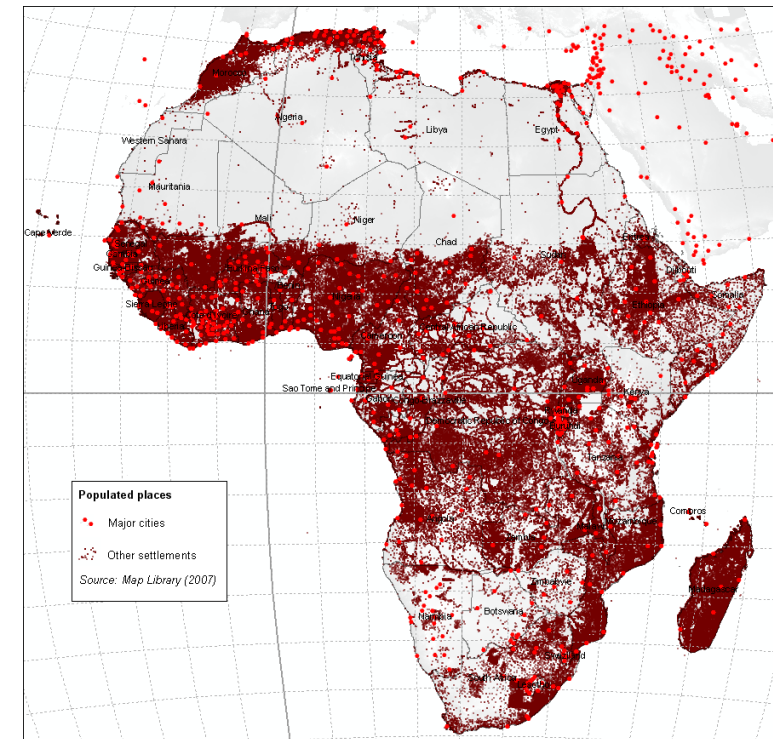
Locality and name of point objects (e.g. populated places, administrative centres, churches, schools, military bases) are available also from the Map Library data set, but without population information. [ref. 2. Map Library, 2007]

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].

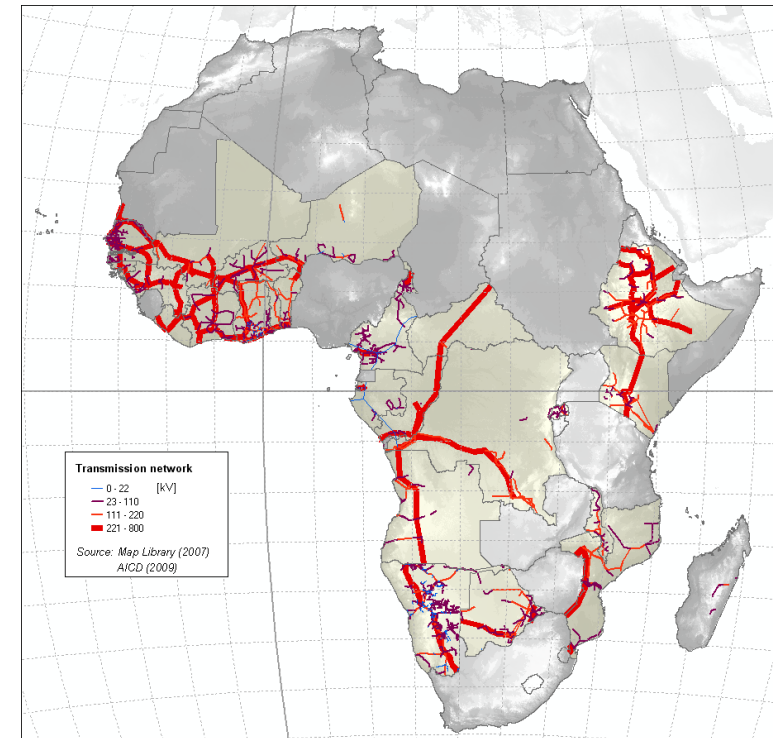
Two thematic layers from the AICD database:

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

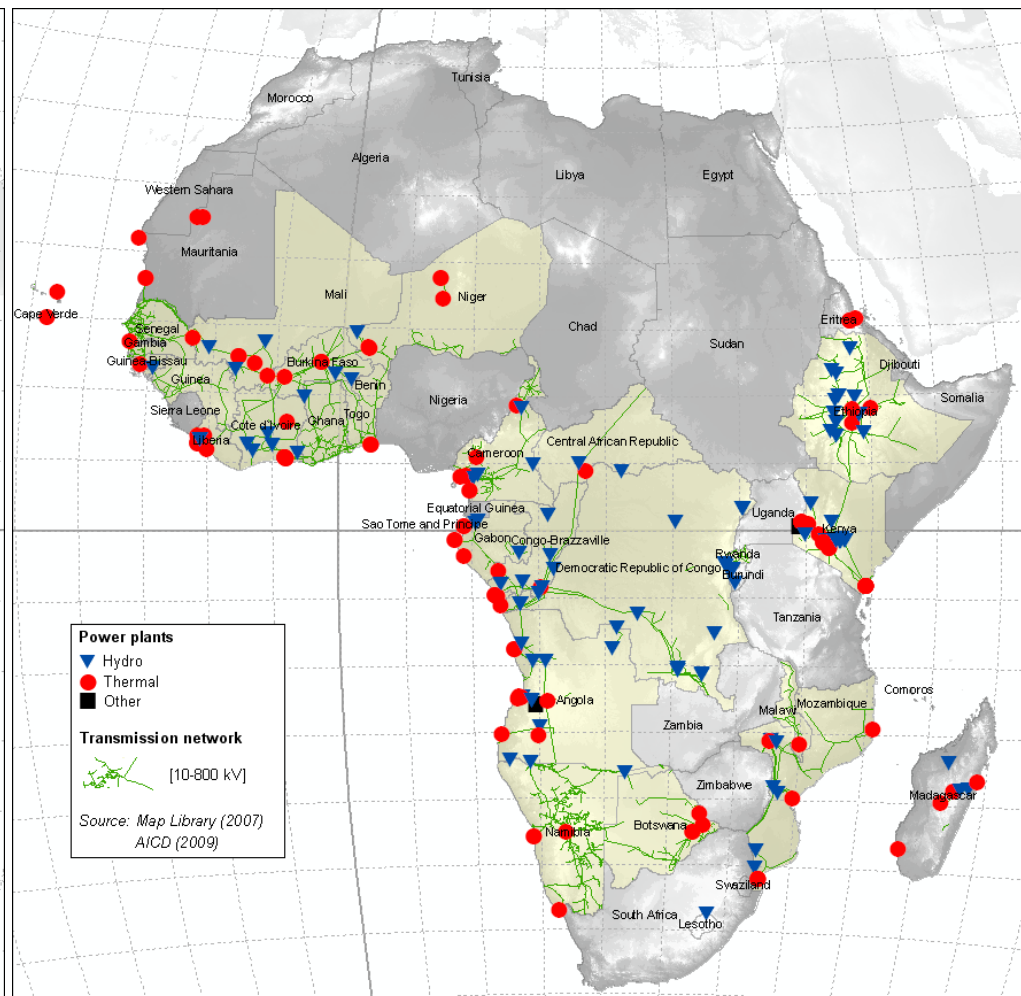
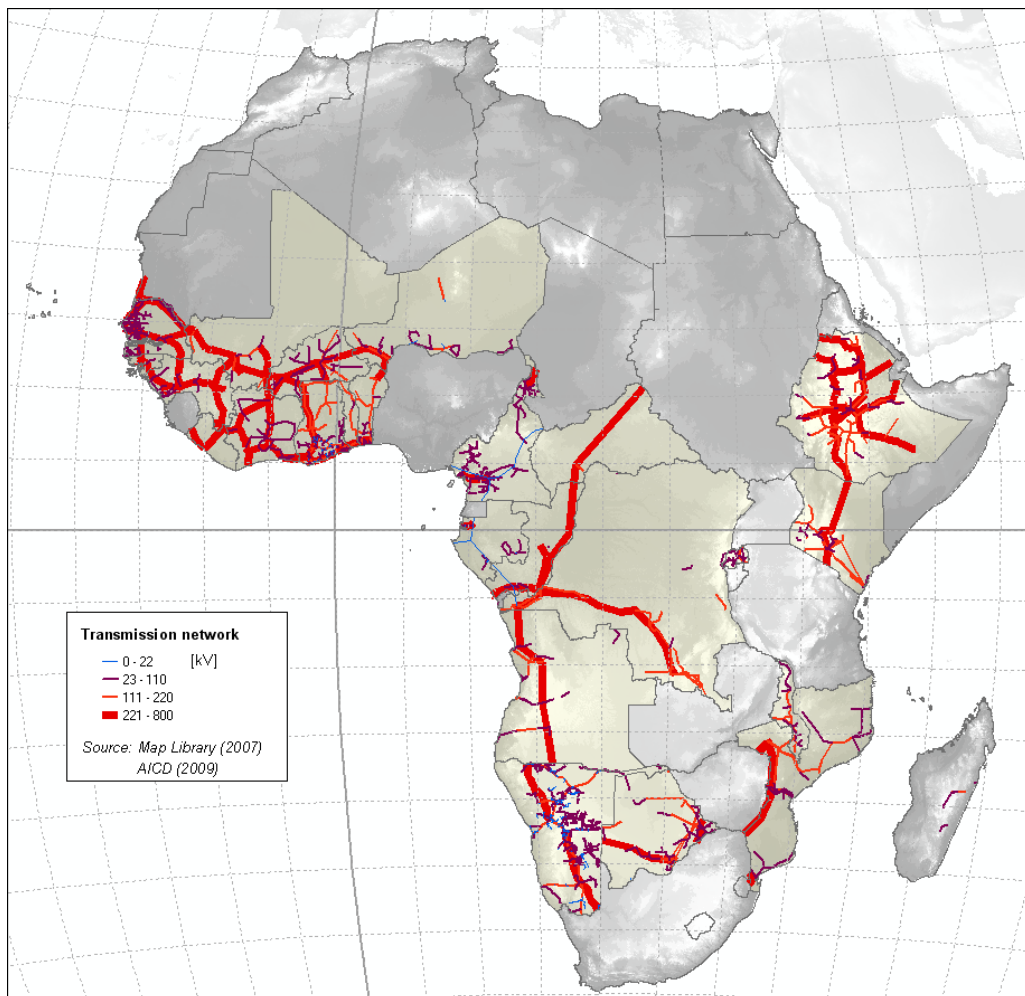
Source: <http://www.infrastructureafrica.org/aicd/about>

Limitation of detailed GIS analyses:

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



AFRETEP Meeting 31st May – 1st June 2010



Source African and Global Geospatial Data Sets

Digital Elevation Model

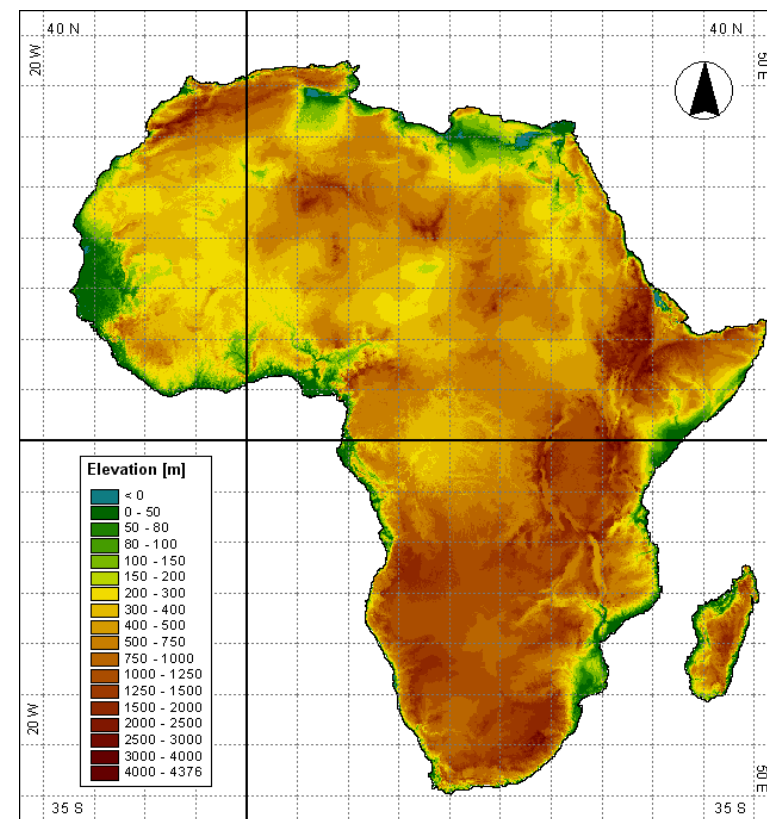
The Shuttle Radar Topography Mission (**SRTM**) obtained elevation data on a near-global scale (between N60 and S57 degree) to generate the most complete high-resolution digital topographic database of Earth [ref.4. Farr et al., 2007].

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.

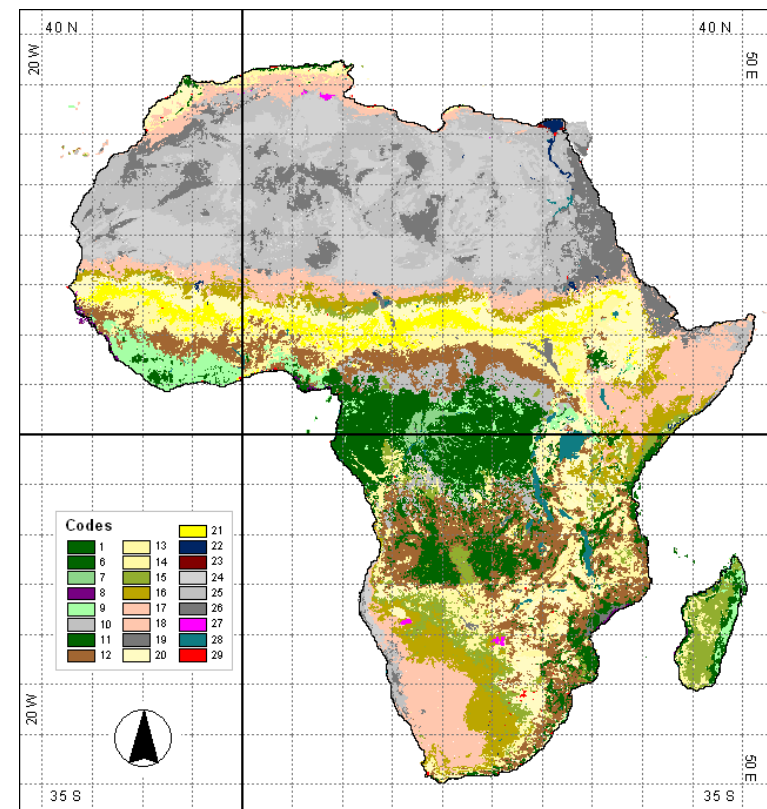
Processed (projected, resampled) raster data representing the vegetation in 1 km resolution.

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

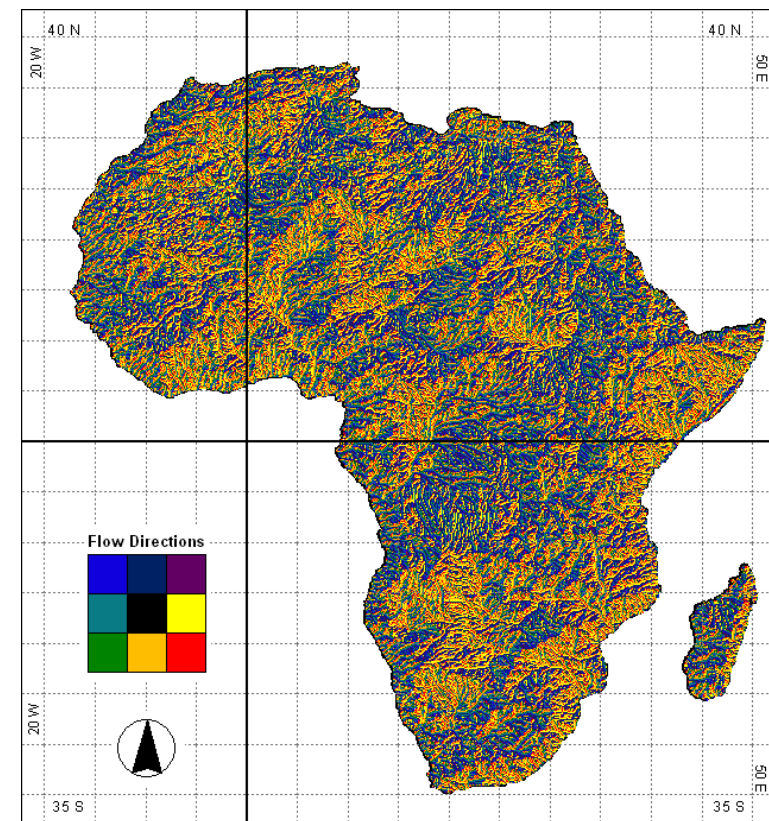
Flow network

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

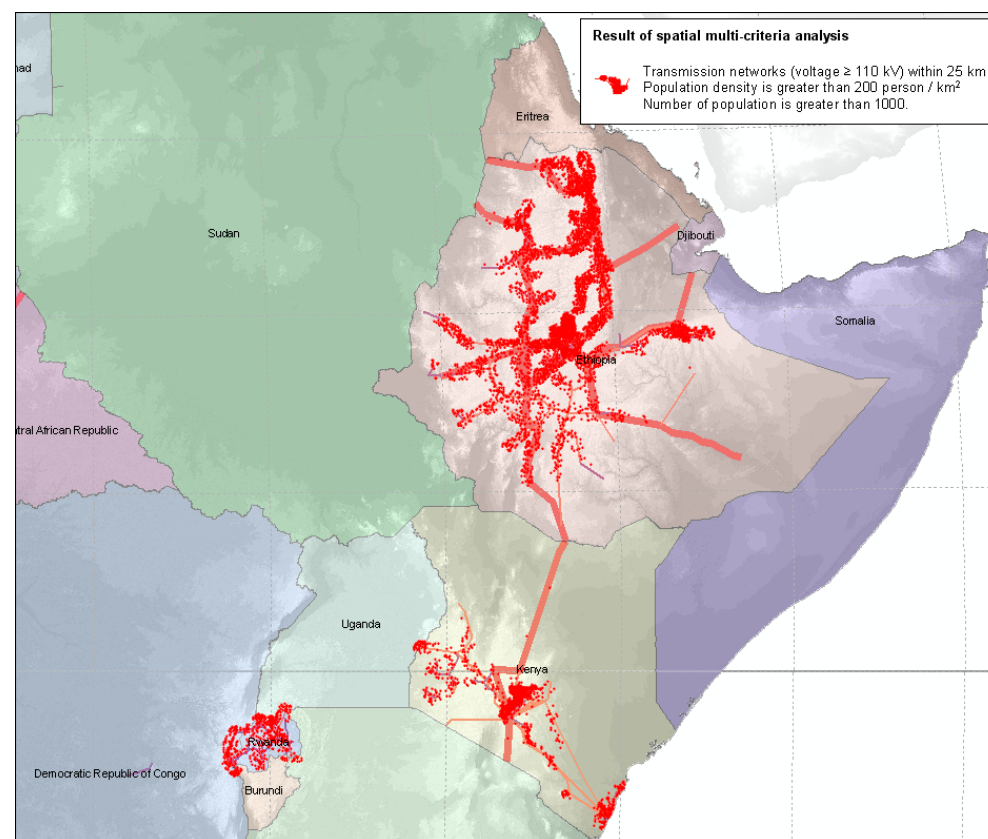
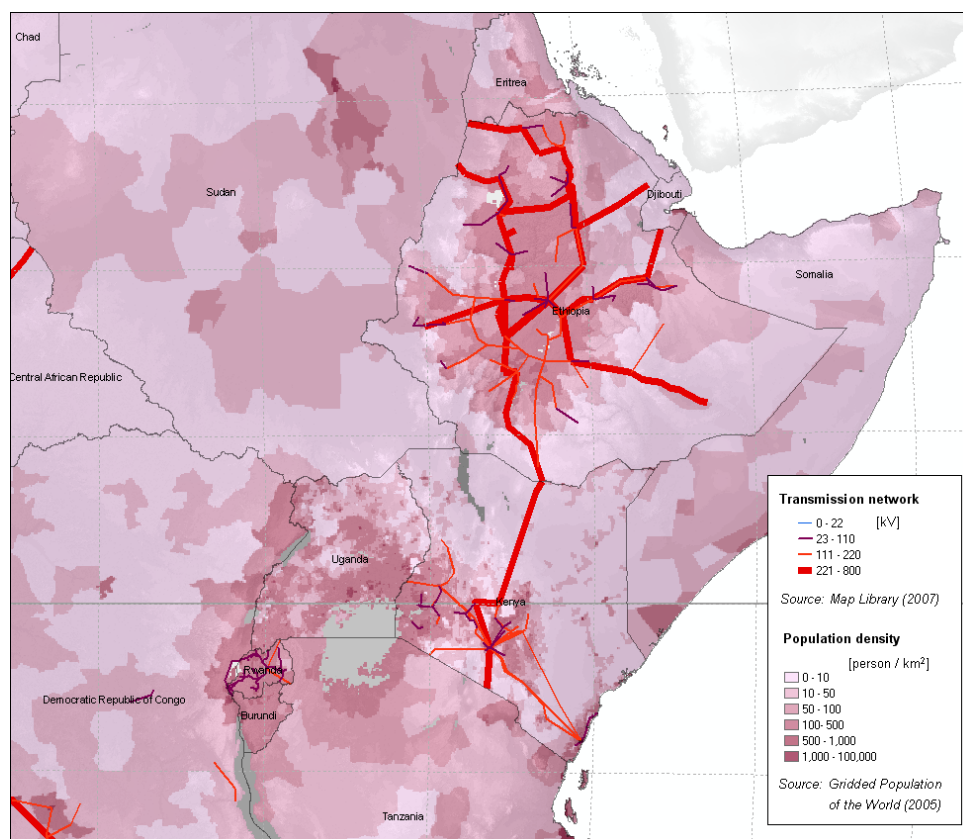
Projection Name:	ETRS_LAEA
Projection Type:	Lambert Azimuthal Equal Area
Spheroid:	GRS80
Datum	WGS84
Radius of sphere of reference:	6378137
Units:	meters
Longitude of centre of projection:	18° 00' 00"
Latitude of centre of projection:	00° 00' 00"
False easting:	4321000.0
False northing:	3210000.0

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

Case study 1 - Multi-criteria analysis – country level

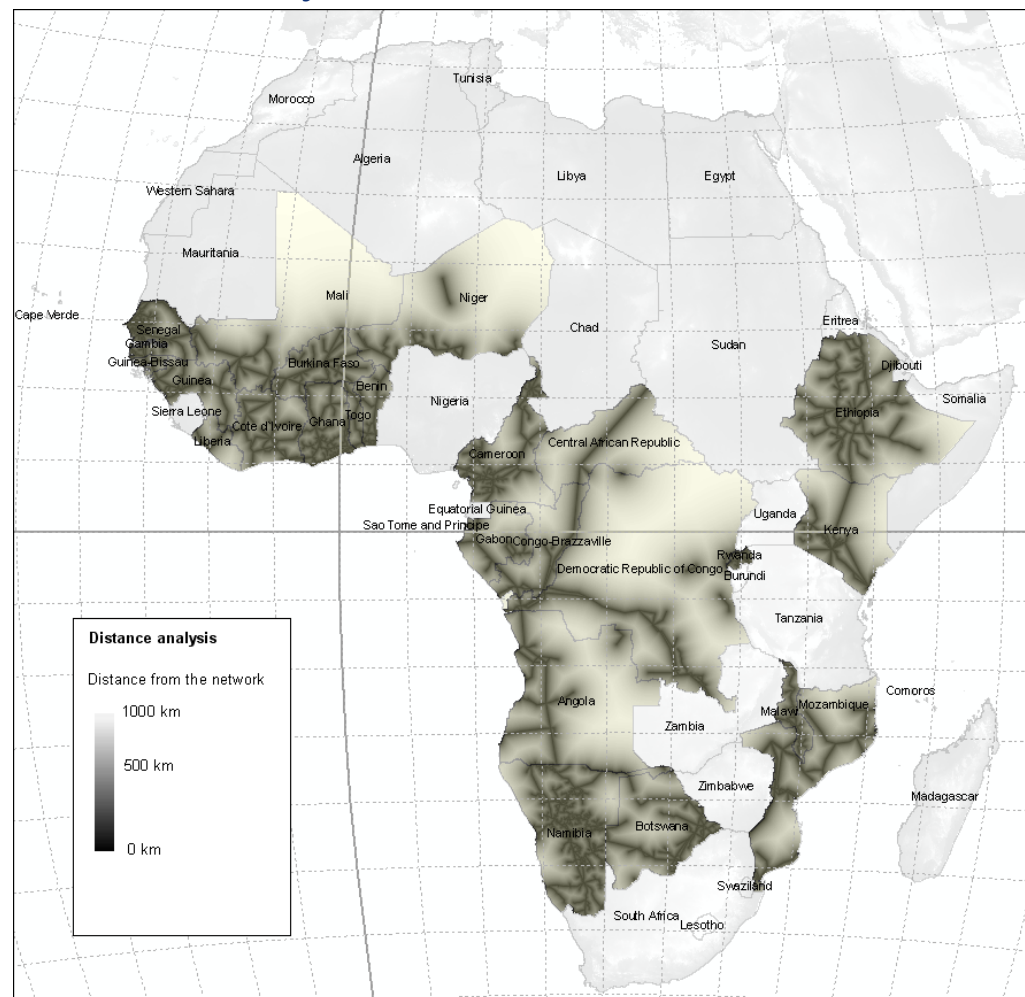
Population – high in number and density

Transmission network – within a certain distance

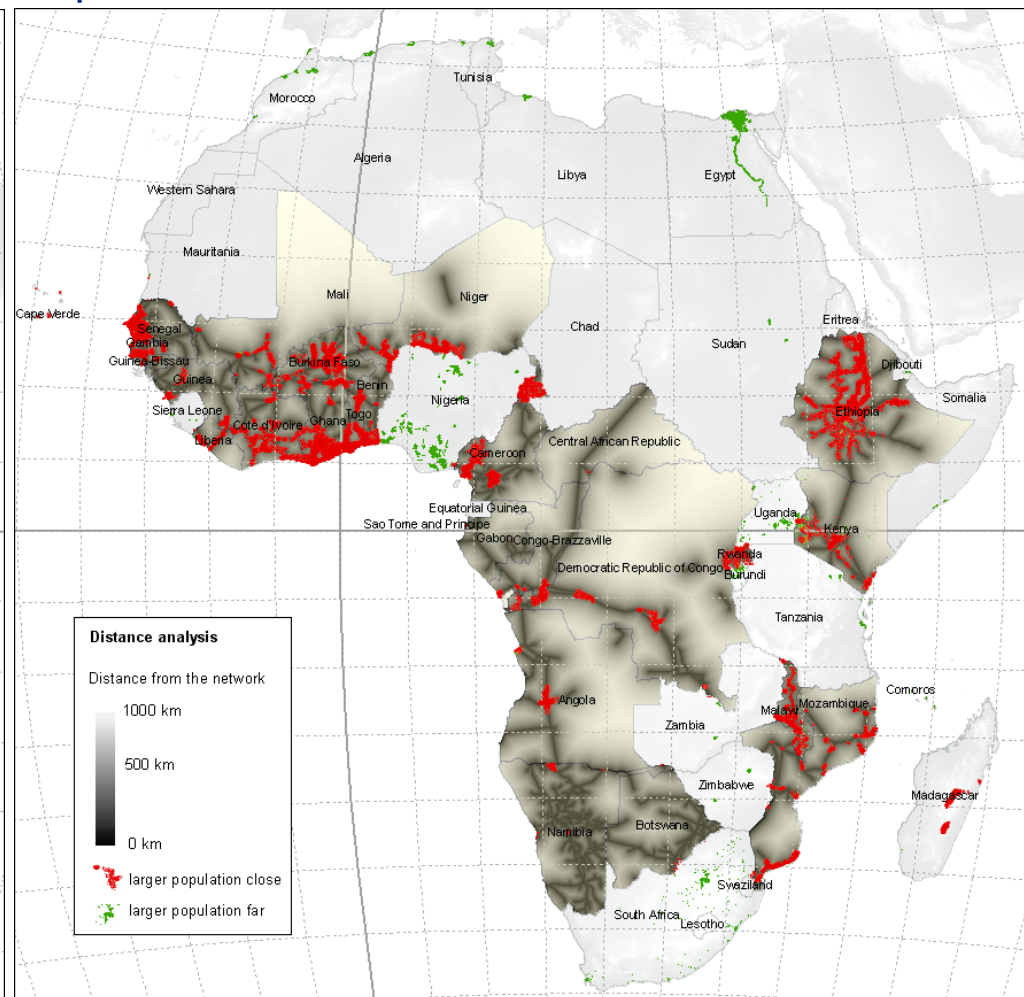


Case study 1 - Multi-criteria analysis – continental level

Distance analysis



Population



Case study 2 – estimation of potential extension of grid

Using

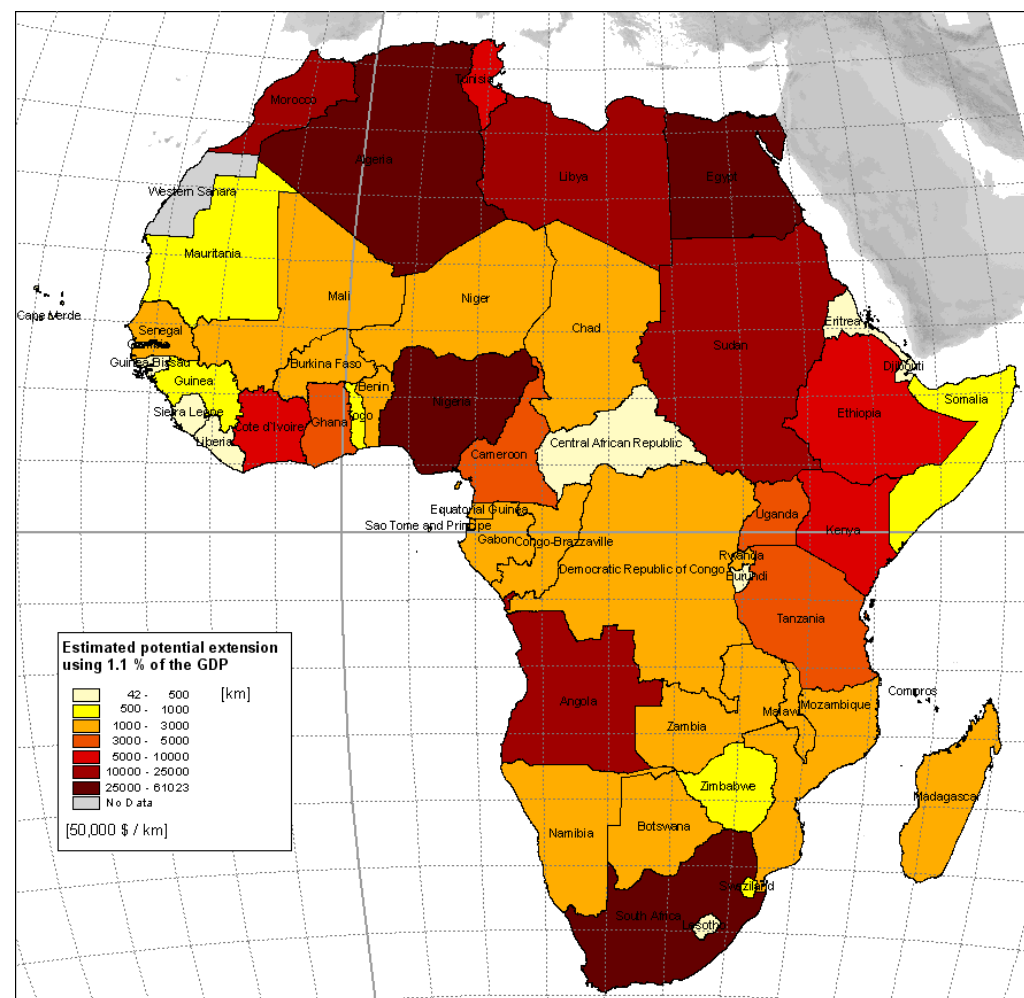
“best practice example” from World Bank,

- 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 (GPWE). 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