Self-Powered Communities for Africa **Road Map**

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Introduction

Road Map (RM) generally links strategy to future actions and explicitly incorporates documents for the required human capabilities and technologies which are to be in place at the right time.

This RM is product – technology oriented. It includes planned for short and long term actions needed to implement the Self-Powered Communities for Africa along with assessment of key risks.

This RM serves as a guide during a journey, allowing the stakeholders involved (opinion and decision makers) to recognize and act on events that are represent their interests – i.e. Decentralized Electrification of African countries based on Renewable Energy Sources (RES) and operated under the Renewable Energy System (RES) rules.

This RM been prepared chiefly as a result of their three year-long initiative to better understand human and technology aspects, and differences between electrification processes in European and African countries.

The RM is addressed to the Africa Union (AU) and the European Development Fund (EDF). The AU, consisting of 53 African countries, was established on 9 July, 2002, and the AU secretariat as well as the Africa Commission is based in Addis Ababa, Ethiopia.

1. Business case

Presented RM is a general expression of needs and constraints of African families, communities, regions, and states considering any of the day technologies (organizational and technical) that are feasible for bringing in an added value.

RM distinguishes three levels of the ultimate beneficiaries: first: families, second: families in communities, and third: communities in regions and states. The ultimate beneficiaries at all three levels are represented by families (e.g. mothers taking care of lighting and coking; children taking care of education, and fathers taking care of a job, mostly like employees and/or micro entrepreneurs), and all of them together participating at African´s social life and economic development.

RM is built on three core key business components: first: business processes implementation skills, second: business organization knowledge, management and control, and third: understanding and maintaining business motivation.

RM respects three principles: first: to educate people in understanding value of electricity, second: electricity is a commodity with monetary value, and third: Renewable Energy Sources and Systems are the core point for rural and peri- urban communities.

Business case is not only about human and technology aspects; it also covers financial needs and constraints and business timing.

RM is build on an assumption that financial sources for decentralized electrification in Africa exist; what is missing is lack of good projects and start up processes with a potential to accelerate investing

money into more integrated functions (e.g. electrification and entrepreneurship) and into stronger motivation to assist natural synergy effect of growing and sustaining a business.

Time range of the RM operations is defined by two mileposts: first one is called "as is", i.e. what we now can see in Africa. The second one is called "to be": what should we see as a result at the end of a short-term planning period (5 years), at the end of mid-term planning period (15 years), and within the time for future growth population prediction, 2050.

2. Road Map environment

Around the world, a new forms of social (human) and technical (technology) changes are taking place. To address these processes the RM was concentrating on two key aspects: social, and technical.

2.1 Social aspects

Social aspects are based on the reality of the poverty around the world (e.g. www.lightingafrica.org, www.globalissues.org/, www.worldometers.info/ , and the book "The Fortune at the Bottom of the Pyramid" author C.K.Prahalad). The way out of this situation can be better understood (e.g. www.socialprofitnetwork.org), and solved by tools (e.g. www.project-impact.net). In many countries increasing numbers of people are moving to large cities (http://youthink.worldbank.org/issues/urbanization).

The world total population in 2011 is 7 billion and it will grow up, mostly in African continent. The population of Africa has grown to more than 770 million in 2005. We have found some predictions suggesting 2.6 times increase; to 2 billion by 2050 (including large migration from China, India and other countries to Africa).

Today, 3.3 billion people (more than half of the world's population) live in cities. In developing countries , 60 million people move into cities each year. This rate of movement is predicted to continue for the next 30 years.

Over the next 15 to 20 years, many cities in Africa and Asia will double in size. Most of these migrants will be living in slums in peri urban areas (in run-down areas of a city characterized by substandard housing and squalor and lacking in security). The rest will live in rural areas (e.g.http://en.wikipedia.org/wiki/Slum).

2.2 Target groups

The structure of target groups was presented by the World Bank Development Indicators (2008). For the purpose of this RM, the number of people living at different poverty levels can be split into two groups. The first one: the number of people with incomes less than $2(3) a day stands at about 2.6 billion, and the second one: the number of people with incomes between $10 (15) and $2 (2) a day is about 3.9 billion. In total: 6.5 billion peoples.

Target group for this RM are families in communities. A husband and wife, and four children are considered to be taken as one family, representing human capacity of one household (HH).

The household is the basic residential unit around which economic production, consumption, inheritance, child raising , and shelter are organized and carried out; for this RM a household is synonymous with family. There are many household analyses done in Africa. Different metrics exists,

and different metrics are used (http://www.africametrics.org/). Many articles on this topic were also written (e.g. households Cash Expenditure by Living Standards Measure Group).

The RM distinguishes three target groups:

1. Between 70% to 90% of African households (the actual percentage varies from country to country and from region to region) live in poverty (This total percentage consists of two subgroups: 1a: less than $2 (3) per day, and 1.b: between $2 (3) and $10 (15) a day),
2. African HHs with a capacity to form the middle class and rich households (more than $10 a day): represent the remaining variable from 10% to 30%.
3. Any households which have an interest to buy SPC products and services.

The RM works with three types of household's location:

a) In rural areas (households mostly located out off a power grid, with a capacity to produce power for its own consumption and later on with a capacity to sell the generated power to the central power grid)
b) In peri-urban areas (HH located mostly close to the urban power grid but with a little probability to be ever connected to the grid under the same regulatory standards like the cities are, is of ever be,
c) In cities (mostly equipped with a poor power grid and/or power price is too high for a househol and it is motivated to save money)

The RM identifies three technology drivers with strong integrated impact on African population:

I. Mobile phones: Number of mobile phones in Africa grows, now about 500 million people own them. Mobile phones support integration of functions, synergic effects in routine operations (in retail, services, manufacturing).
II. Financing operation: Original principles of trust in financial operations are taking place in communities, including control functions and sanctions when the rules are broken. The numbers of mobile phones for these specific financial operations (e.g. mobile banking, mobile shopping, and mobile "internal financial control" systems) not only grow but they are getting more sophisticated.
III. Phenomena of creativity: The natural sense of being creative is a typical feature of African population. This RM is build on the assumption that motivation to accept new technologies (e.g. electrification of African society) is based both on this natural creativity and economical incentives.

2.3 Technological aspects

The RM was addressing Renewable Energy Sources (RES). We were mapping renewable energy which comes from natural sources such as the Sun, biomass, wind, water, etc., and renewable energy implementation systems; integration of both the fossil and the green energy into one energy infrastructure.

More details are in (e.g. http://en.wikipedia.org/wiki/Renewable_energy). We were looking for the best RES http://www.teachers.ash.org.au/jmresources/energy/renewable.html). We appreciate the importance of the book by Henrik Lund: "Renewable Energy System, the Choice and modeling of

100% Renewable Solutions" and we have been concentrating on solar energy (e.g. http://en.wikipedia.org/wiki/Solar_energy).

Technologies have a restrictive impact on technique of life of any family throughout the world. Technological development (on technical and/or organizational basis) changes technique of life (e.g. when we compare a family's technical equipment for lighting, meal preparation, entertainment, etc. in Europe and Africa).

This RM works with an expectation that people who live in communities (in rural, peri-urban, cities), mostly poor but the rich as well will accept any new technologies (e.g. reliable delivery of drinking water , quality station lavatories, accessible mobile phone recharging services, etc.) if they are available and understood by them.

The RM deals with four key functions related to families living in African communities: food, health, education, and jobs. Mostly new technologies must be transferred to African countries, regions, and communities and into family lives in order to increase quantity and quality of all of these four functions. New technologies bring to the African market new products, and technique of life will improve in quality, and quantity (market power of the population will grow).

The RM accepts impact of new telecommunication industry on anybody who is living and/or working in Africa (e.g. mobile phones, computers, and internet). On the other hand there is a lack of electricity, poor quality of the existing central power grids build at the national levels, while a huge natural energy potential in RES - namely sun energy - exists.

Both qualitative and quantitative changes can't come true without electrification. The RM works with an assumption that to meeting the needs of families and of industrial development in Africa by power grid systems like those existing in Europe is impractical and a new decentralized electrification system for Africa has to be developed.

The RM is accepting a widely proposed solution for Africa, i.e. by making the use of RES: both the sources (mostly sun and bio energy) and the system (mostly of grid island systems).

Decentralized electrification for households (solar household systems), services (power recharging centers), job creation (selling the generated electricity to an operator of a central power grid), and new bio-energy technologies (e.g. for meal preparation - cooking: using biomass´ products instead of charcoal), development of new industries aimed at job creation (e.g. electrical motors, machines, appliances mostly of domestic production) are being mapped out as well.

2.4 Technical structure

Decentralized electrification will be based on the following key products:

1. Solar home system (especially lighting now widely recommended for African's household),
2. Solar systems for workshops, schools, hospitals, etc. ,
3. Recharging centers: for households, workshops, public services etc. ,
4. PV panels for customized application (street lighting, water pumping, irrigation, agriculture processes, special public services, etc.),
5. Thermal panels for application needs (heating, heat energy storing, etc.)

6. Thermal turbine system generating electric power by utilizing low potential heat (from 30 to 80 deg. C) accumulated in a water tank.
7. Other RES (biomass, garbage waste, etc. suitable for RES technologies, and other classical renewable sources: wind, and water streams.

Decentralized electrification units will be operating for:

a) Home off grid systems serving client´s demand:
   - e.g. one (two) lights, one radio, one mobile charging (basic package)
   - e.g. four lights, one radio, one mobile charging, one TV (expanded package)
   - e.g. four lights, video recorder, two mobile charging, TV, one refrigerator (deluxe package)

b) Public/private premises off grid systems serving client´s demand:
   - e.g. lighting and mobile charging for schools, hospitals, workshops (simple offer)
   - e.g. lighting, heating, batteries for mobile phones, computers, TV refrigerators, air-conditioning recharging (based on smart battery system services)
   - e.g. more complex off-grid (island) hybrid system (based on PV technologies and on thermal turbine technologies)

3. Road mapping

Road mapping operates on both the vision and the mission levels. Road mapping consists of data creation and data validity assurance process aimed at assist stakeholders' communication and their will to integrate more functions of human life and new technologies into stronger and sustainable business advantages.

RM's vision: To add value to the quality of life in rural and peri-urban areas in Africa mostly by investment in solar energy and building Self-Powered Communities and networking.

a) **Definition of RM:** We can look at Road mapping as "vector of activities" with value and trends being affected by internal and external influences. Road mapping is a chain of activities taking place between two points of time. The first one is called "as is" position. It defines sources (means) that have to be converted into point-of-time or a position called "to be" which defines sources (means) that should be transformed into a new quality. Chances from "as is" to "to be" are achieved by activities taking place "on the road" (e.g. business planning, ownership, architecture, monitoring, auditing, and financial review) were means (e.g. the know-how, skills, money, contacts) must be present. This road indicates key business characteristic and reflects stakeholder´s responsibility: i.e. to have all activities and risks related to them under control.

b) **RM and motivation:** Road mapping should be followed by decision making processes and any decision making process should be based on a vide consensus of stakeholders for the project to be "on the road" and sustains itself there. Stakeholders should be informed and motivated to participate.

RM Mission: To assist public and private sector **motivation** to build Self-Powered Communities and cooperate with African Research Centers and universities to add value to people in African by

building decentralized and sustainable energy supply system based mostly on Renewable Energy technologies.

a) **Business strategy and implementation tactic**: It was presented through active contacts: The first example: Participation at the African Union (AU) Research Grant (RG) programme, LOT 2 (for see the following text). The second example: Participation at the European discussion forum on the Green Paper, "EU development policy in support of inclusive growth and sustainable development".

b) **Business policy and business rules development**: This is the most critical issue and will come into place when: 1. Our team will win the AU RG, and/or 2. Our team will be invited by EU Commission to continue examining the best ways for implementation of the Green Paper objectives.

c) **Influencers and constrains identified by the road mapping**: We will recognize these specific aspects of business development and project success via monitoring at the lower levels. Working effectively with influences affects success of Strategic Feasibility Study and preparation of a Business Plan.

Data collection and road mapping performance: Currently, a large number of statistical data, prognostic and analytical studies are available. In summary, they offer a general picture of a potential for economic development in Africa and – subsequently – its energy needs. The problem is that this data and information is scattered throughout many sources and it is not easy to integrate them to fit the given objective. Therefore we have decided – based on the needs of the RM – for a procedure which uses just several basic data and puts them into context that will help us with the RM's objective, i.e. "To implement decentralized electric power generation for SPC in Africa". We used the following assumptions: Timeline, share of the population without access to electricity, an estimated need for energy consumption for one household.

a) **Timeline:** The past time period, 2005 – 2010; the current time period, 2010 – 2015; the future time period, 2016-2030,; and period for the population growth prognosis up to year 2050.

b) **Population:** In 2005, Africa had 770 million people. The 2015 estimate is 1 billion. Various prognoses for 2050 agree on 2 billion people to live in Africa.

c) **Households without electricity**: Based on the needs of the study we decided for the given range. 95% for the past period; 90% for the current time period; and 80% for time period. Remaining 5%, 10%, and 20 % respectively represent electricity generated in centralized power-generation facilities and distributed through the grid (mostly in metropolitan areas.)

d) **Output**: Estimated demand for electric power generating capacity per one household is 10 Wp for the previous time period and 40 Wp for the current time period. (For illustration, 10 Wp represents 1 light bulb and 1 radio; 40 Wp then 4 light bulbs, 1 radio, and one mobile phone charger.) This equipment has batteries supporting an extra 4 hours of operation.

Decentralized electric power generation sector: Under the assumption that in the past time period each household had to its disposal on average 10 Wp, Africa would need the power-generating

capacity of approximately 1,500 MWp. Similarly, assuming that at the current time period a household, on average, has about 40 Wp available, Africa would need about 6,000 MWp.

The RM is mapping out decentralized power-generating sector in Africa, i.e. that the every 10Wp or 40Wp per household is not delivered by a grid but by selling equipment which will ensure these outputs per household are delivered to these end users. On other hand, the need to cover the mentioned 1,500 MWp or 6,000 MWp in output would have been in Europe addresses using centralized power-generating capacities which would then deliver such energy to the grid.

In Africa, the mentioned needs of households lacking electric power can be delivered only by supplying the equipment which would then generate electricity, say with a help of solar energy.

For obtaining such solution it is necessary to create a wholesale and retail distribution network. A more detailed analysis will be part of the Feasibility Study for specific conditions in Ethiopia and Kenya and then in the Business Plan for a particular investment project into a SCP Factory.

RM is focused on the way which supports development of a domestic industry. It gives a preference to equipment delivered from factories built in Africa as opposed importing of individual components. In this way it presents to the AU as well as to individual member countries an input for building up their own industrial base for developments of power generation for Self-Powered Communities.

The RM, similarly to other activities which are aiming at deliveries from abroad and eventually also power generation from renewable sources, also keeps in mind opportunities for reducing CO2 emissions.

The RM emphasizes organizational and technical solutions of decentralized electrical system and addresses the issue of wastes which will accompany development of a domestic industrial base and wide utilization of decentralized sources of electric power in Africa (e.g. PV panels, cables, batteries, etc.) and to these systems connected electric appliances (light bulbs, radios, mobile phones, etc.)

4. Self-Powered Communities (SPC)

We are specializing in business knowledge transfer and business rule development in the area of Self Powered Communities. We are mapping out African communities that can be self-sustaining in all their energy needs and be strong in using Renewable Energy Sources (RES), and that should have a know-how and skill to operate their off-grid electricity system in Renewable Energy System (RES) regime. The RM envisions other opportunities for SPC as well (e.g. a potential of a SPC to be connected to the central, national power grid services, to a recharging center for other surrounding communities).

The RM identified a need to build Self-Powered Communities with help of Enterprise Architect and Financial Engineer.

Enterprise Architect Role: is to create entrepreneurship framework in Rural and/or Peri-urban Communities. Enterprise Architect will integrate Housing and Services, Renewable Energy Enterprises, Micro and Small Enterprises into one sustainable economical and social unit. He has to develop community master plan and assist entrepreneurs in community how to develop business plan and rules, and how to prove feasibility of proposed changes.

Financial Engineer Role: Financial Engineers role is to prove financial feasibility of any enterprises in Rural and/or Peri-urban Communities. Financial Engineer will have to distinguish between financial operations "on the Wall Street" and in any Rural and/or Peri-urban Community, He has to develop a financial plan and to prove its feasibility to Banks, EU founds, and to other financial institution. His role is to bring money to the community and to educate community people in positive cash flow and financial sustainability management, control and audit.

Enterprise Architect and Financial Engineer will assist Community Decision (Opinion) Makers to understand operations to "Access to know-how" and "Access to financing" for community development. Community Master Plan, Jobs, Education, Health and Food prioritizing, Entrepreneurs business plan and rules, Financial plans, Financial control and audit systems will help Decision (Opinion) Makers to have community social and economical sustainability under their control.

More detailed description was presented at the European Institutional Network Annual Meeting in Florence, Italy, organized by the Centre for the Development of Enterprise (CDE) Central Office in October 2009, and later on more developed in other activities (see section 5. Added value gained).

5. Findings

The RM identified following findings:

1.1 Decentralized electrification based on RES is a correct road for African´s households and micro entrepreneurs to survive existing trends, and the right road how to continuation of life and economical development of families and communities in various African´s regions and countries.

1.2 On one hand, Self-Power Communities represent the lowest level for consensus creation and decision making processes related to community development, while on the other hand they are the strongest force for the country's stability, improvement of social conditions , and economical growth at regional and states levels (e.g.: with a potential of guaranteeing sustainability of decentralized electrification program at any country in Africa).

1.3 Both programs of decentralized electrification based on RES and Self Power Communities represent the strongest argument for to identifying not always immediately apparent financial potential of Africa continent, and to tap motivation processes hidden in African´s families and in micro entrepreneurs.

1.4 All three finding mentioned above are changing traditional market operation between countries in Africa and elsewhere, including European business interests in Africa:

- There is no reason to import all technology segments of the decentralized electrification investment from abroad (e.g. new factories investment into RES technologies),
- There are feasible options to manufacture technologies directly in African. Activities implemented according to this RM initiate creation of a new industrial development and Pan-African industrial cooperation (e.g. development of new industries for SPC program implementation).

Added value gained

The RM authors identified a logical chain of activities aimed at:

a) Building of Africa – Europe networking: the RM process was open in 2009 by a close cooperation with CDE Central Office in Brussels and Local Office in Nairobi. It has been strengthen by our participation at the 2nd International Business Conference and Trade Fair in Nairobi, 2010.

b) Common Networking Research Application: the RM is a general framework of the 5P initiative to participate in the Africa Union Research Grant (AU RG), LOT 2 – Renewable and Sustainable Energy. Universities from five countries, two from West Africa (Guinea, Nigeria), and two from East Africa (Ethiopia, Kenya), and from the Czech Republic have been asked to react on the Open Call for Proposal – 2011 (for more details see the AU RG Application Form "Renewable and Sustainable Energy for Self Power Communities in Rural and Peri-Urban areas in Africa").

c) Investment activities: the RM is the first general and common document mapping investment opportunities in Africa related to decentralized electrification of rural and peri urban areas in Africa. It is mapping out validity and roles of the Self-Powered Communities (SPC) in a competitive, sustainable, and for development feasible environment of the contemporary life in countries of African, regions, communities, and families. The RM indicates inputs for follow-up investment steps important for building decentralized electrification reflecting the local needs: the RM relates to the Strategic Feasibility Study (SFS), and to the Business Plan (BP) of the SPC (PV) Factory (for more details see SFS and BP).

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