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Self-Powered Communities (SPC)

Zdenek Chalus,¹ Robert Miller,^{2*} William J. Penn,^{3*} F. S. Caluyo^{4*}

¹ Prague Project Portfolio Planning Platform for Renewable Energy Sources (5PforRES)
110 00 Prague, Czech Republic

² Prague Project Portfolio Planning Platform for Renewable Energy Sources (5PforRES)
141 67 Berlin, Germany

³ Environmental Financial Advisors LLC, Block Island, RI 028071, USA

⁴ Mapúa Institute of Technologies, School of Electrical, Electronics, and Computer Engineering
Intramuros, Manila, Philippines 1002

*robert.miller@5pforres.eu; *wjpenn@earthlink.net; *fscaluyo@mapua.edu.ph

ABSTRACT

This paper examines opportunities for renewable energy (RE) technologies in improving quality of life (QL) for people in developing countries and regions. They all have natural sources of energy (sun, water, wind) while many of them have lack enough food, health care, education and jobs. We present a concept of Self-Powered Communities (SPC), which provides comprehensive socio-economic solutions to development based on decentralized electrification using locally available renewable sources of energy. The overall desirability of such approach and successful outcomes also rest on the fact that the SPC concept also leads to building up of local infrastructure and manufacturing and service industries.

One of the key components is a systematic focus on sustainability of operation of projects based to a significant degree on effectively cultivated community-based motivational mechanism assuring projects' long-term success, i.e. something which tends to be lacking in significant percentage of economic development projects.

SPC solutions arise from the following fundamental assumptions: electricity (e) creates jobs; water (w) is one of the key resources in any economic development as it is a necessary condition for life; and materials (m) are mirrors of quality of life and forward-looking community. It is so, for example, when a renewable bamboo with little or no waste is used instead of plastics which pollute the environment.

We distinguish four criteria: Benefits (B), Opportunities (O), Costs (C), and Risks (R), Quality of Life (QL) is expressed (measured) by the ratio (B&O)/(C&R). In the context of the above argument we have to accept not only (B&O) indicators but we have take care about other: primarily the costs (C) and risks (R).

In general concept, we use the following synergy equation: $QL \Rightarrow (e) \& (w \& m)$



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It is then evaluated by (B&O)/(C&R) indicators. Symbol => indicates consensus-making processes in changes in QL.

In practice, we are focusing on SPC solutions for tropical and subtropical countries and regions in Sub-Saharan and East Africa and the ASEAN countries. We specify three drivers (e, w, m) for social and economy growth (see the above QL).

At the 2013 ICSET conference we present SPC Pilot Project in the Philippines. This Pilot Project is described in the SPC Blueprint. The goal is to assist decision makers in securing financing for implementations of SPC portfolio of projects. We prefer business approach to dissemination of best practices and international transfer of know-how concerning RE technologies and organizing of large socio-economic development projects with effective use of motivation techniques with end-users.

Key Words: *Self-Powered Communities; Decentralized Electrification; Project Portfolio.*

Introduction

The Asian Development Bank:

*“Energy poverty is one of the most pressing issues of this century. It’s a problem of technology, infrastructure, economics, culture, and politics – and it impacts over a billion people in the Asia-Pacific region alone. Solving this problem requires solutions from **the top-down and the bottom-up** – everything from global finance to village-level technologies. The partnership was formed specifically to build platforms for cooperation, exchange, innovation, and project development in this area. We’re bringing together key stakeholders from business, finance, government, and NGOs for a singular purpose: to drive action.”*

Objectives:

- To provide access to electric power as the 21st century’s basic human right by implementation and dissemination socio-economic development projects using the Self-Powered Communities (SPC) approach,
- To add value to rural and peri-urban communities by their effective participation in decentralized electrification based on renewable energy sources which delivers electric power on 24/7, year-around basis.

This paper presents specific experience of project initiators/integrators (1 and 2), an advisor for financing of environmental projects (3), and local universities focused on research and education (4).

International team of the 5Pfor RES in cooperation with the Embassy of the Philippines in Prague and partners from public and private sector in the Philippines and with others has prepared a working document serving advocacy of the proposal to prepare, implement, and evaluate the Self-Powered Communities (SPC) Pilot Project in the Philippines.



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SPC methodology

The SPC methodology distinguishes three levels: 1. SPC Concept: presents core ideas and principles; 2. SPC Model: creates alternatives and selects priorities; 3. SPC Project: proposes single project and/or project portfolio. All three levels have their own project life cycle in the project portfolio (SPC Solution). The role of the SPC Methodology is to serve a competitive, sustainable, and development-encouraging environment for complex solutions initiated by decentralized electrification of a specific region. In implementation phase of a project we distinguish bottom up and top down approaches:

Project portfolio – top-down approach: The Blueprint advocacy: We assume that Sorsogon province will ask investor for about \$30 mil for the SPC Pilot Project. 5PforRES' role is to facilitate advocacy process and to assist the Sorsogon province.

Single project - bottom-up approach: Solar power plant with 1MWe output in St. Magdalena.

We propose SPC Concept, Models, and Projects to open international dialog on how to improve quality of life of very many people around the world, possibly a majority, i.e. over a half of its total population of 7 billion. An almost universally presents cause and effect and points out to poverty and limits to possible adding of value. Poor families and potential entrepreneurs certainly poses specific desires and internal motivation to improve their lives yet to identify, channel these essential forces toward assuring sustainability of socio-economical development project tend to be too often the ultimate challenge and weaker point of otherwise well thought-through and implemented projects.

Energy and Renewable Energy Sources

The Sun is an energy source with the capacity to satisfy needs of any SPC in the world. Renewable Energy Sources (RES), represented converted energy from the Sun, offers development of new lifestyle for communities based on decentralized power production, smart electricity usage, and personal ownership.

Our solutions and projects are mostly solo and mixed units in capacity above 100 kWe using solar PV, solar thermal, biomass-gas, biomass-steam, hydro-energy, wind, geothermal energy and energy accumulation (hydro-potential, battery) including of diesel generator (as a reserve solution). Any SPC - in order to be competitive and sustainable - should accept the fact that decentralized electrification represents a commodity with monetary value.

RES is a subject of interest to many countries throughout the world. The Philippines are no exception. An entire range of opportunities to use RES for most of the rural and peri-urban areas exists. Individual technologies are available and proven in real-life applications. The focus is on usefulness, effectiveness, and efficiency of individual applications and their combinations.

SPC Infrastructure Investment and Absorption Capacity



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SPC needs basic physical and organizational energy structures for the serving households, public facilities and enterprises in urban, peri-urban and rural areas. These structures (based on renewable energy sources) are services and facilities necessary for achieving operational sustainability of a local system electric power infrastructure. SPC infrastructure capital investment can be generally defined as a set of interconnected business components (process, organization, motivation) that allow access to electricity (e) to a broad spectrum of target groups.

Local energy infrastructure investments are divided into three groups (based on their specific location/placement):

- In specific parts of buildings (e.g. for air-condition's operations during day using solar PV electricity)
- In waste management facilities (e.g. for electric power generated by using bio-gas)
- River basins in rural areas (e.g. water retention and hydro-power generation).

SPC capital investments into electric power infrastructure prefer decentralized solutions, focused on small (micro) grid electric power generation/distribution, and can have the capacity to serve central energy infrastructure grid as well.

Absorption capacity of a Self-Powered Community reflects its acceptance of energy independence and effective use of electricity. SPC absorption capacity reflects business environment and degree of the ability to make economic operation of capital improvements in electric power generation and distribution sustainable.

The Blueprint

The international team of the 5PforRES with partners from public and private sector in the Philippines, and with other partners has prepared an open document, the Blueprint for advocacy of implementation of Self-Powered Communities (SPC) Pilot Project in the Philippines.

The Blueprint examines the opportunities for a broadly-based increase in electric power generation in the Philippines with impact on the main drivers of socio-economical development. The analysis is thus looking into synergy effects.

The Blueprint emphasizes synergy effects for two drivers derived from having access to electricity: water retention as an economic value and a pre-condition of life sustainability, and economical use of (construction) materials (new and used) for a higher quality of life in rural and peri-urban areas.

Analysis

The analysis uses inputs from international organisations, central and local governments, local sources and years of professional experience. The validity of inputs is subjected to verification throughout the Blueprint Advocacy. Analysis is focused on:



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- Identifying the key drivers for sustainable growth of and improvement of quality of life (QF),
- Application of socio-economic dimensions of the Self-Powered Community (SPC) solutions for decentralised electrification projects,
- Emphasising of the need of achieving consensus in cooperation via Public Private Partnerships (PPP),
- Summing-up characteristics of Renewable Energy Sources (RES) for decentralised electrification,
- Examination of quality of information concerning decision making about financing of electric power infrastructure,
- Evaluation of absorption capacity and competitiveness of projects using the SPC approach,
- Identifying effective approaches to sustainability, utilisation, and effectiveness of capital improvement investments into SPC projects.

Assumptions for analysis:

- Accessible databases and information sources are sufficient for preparation of the Blueprint for decentralised electrification based on RES as it represents a feasible solution addressing fundamental socio-economical needs of communities in rural and peri-urban areas.
- Effects of synergy of SPC solutions are available if project implementation is done with effective motivation, active involvement and – therefore – a real consensus of all key stakeholders.

Syntheses

The synthesis is focused on presentation of simple SPC solutions for the Philippines based on the findings in the Analysis section and it also presents the justification and reasons behind the SPC Pilot Project proposal. The conclusions of the Synthesis are tested in the Blueprint Advocacy process. The syntheses is focused on:

- SPC Methodology,
- Consensus, Decision Making and Business Rules,
- Macro Cash-flow Model, SPC Pilot Project, Blueprint Advocacy,
- 100kWe Model, and Drivers of Quality of Life,
- Services Model (SPC Utilities and SPC Factories),
- Financial Tools,
- Public Procurement, BOCR pre-Assessment

Assumptions for syntheses:

- Sorsogon province is the reference sample for preparation and advocacy of the Blueprint.



- The Blueprint advocacy is a suitable tool to use in order to demonstrate feasibility of SPC solutions during the process of decision-making concerning SPC Pilot Project preparation and implementation.

Proposal

The proposal of the Pilot Project follows-up on the letter of intent (LOI) signed by Governor of the Sorsogon province and the 5PforRES. Visits to the Sorsogon province and the assistance provided by the Mayor of St. Magdalena were instrumental to the process of identifying a sample, a “province unit” with one million inhabitants. The proposal is focused on:

- Description of the Pilot Project,
- Pilot Project Infrastructure, Financing and Management,
- Pilot Project Portfolio for the Province Unit,
- SPC Utility and Workshops,
- Project Portfolio (100kWe) - Value of Synergy,
- Pilot Project Financial Framework,
- Example of Global Statistical Survey of the SPC Concept,
- References

SPC Pilot Project addresses the electrification needs of rural and peri-urban areas – both on and off-grid. It introduces small power plants (100kWe) based on renewable energy sources with the capacity to generate and deliver electric power 24 hours/7 days a week/year around with an acceptable price, reliable service and with sustainability over the entire SPC project life cycle. Feasibility of the Pilot Project depends on SPC Utilities delivering their day-to-day services reliably and on Revolving Loan Fund providing sustainable financing. The SPC Pilot Project should be a core subject of the Blueprint advocacy.

Of critical importance is understanding of what “Value of Synergy” means in specific details. It is especially so due to the fact that impacts of such details on the final outcomes might not be always readily apparent. Therefore at a barangay level we are looking at and examining opportunities for synergy effect generated by three previously described – drivers (e, w, m).

No.	Recommended Workflow for the Blueprint	2013
1.	The final agreement on the Blueprint start up (signed LOIs between Sorsogon province and 5PforRES, and between MAPUA Technology Institute and 5PforRES)	January
2.	Discussion of the Blueprint Theses with international team of 24 experts from the Philippines, Hong Kong, USA, and the Czech Republic	February, March
3.	The Blueprint preparation (inputs, data collection, key innovative segments (drivers, synergy, procurement) and development of financial models)	January, April



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4.	Completion of the Blueprint draft: its distribution to the consulting team for comments; preparation for the Blueprint Advocacy	May
5.	The Blueprint Advocacy of the two key issues: the SPC Concept for the Philippines and the Pilot Project preparation; implementation, and evaluation (central and local governments, banks, financial institutions, private sector partners)	June, October
6.	Research work in the provinces, municipalities and barangays by the Mapúa Technology Institute and local universities	June, October
7.	The final version of the Blueprint modified as the result of feedback from the Advocacy; its presentation to all partners in the Philippines and then at the Sep. 30 – Oct 1, 2013 ICSET (International Conference on Sustainable Environmental Technologies) in Manila	September, October
8.	Decision on the SPC Pilot Project's Financing	TBD
9.	SPC Pilot Project preparation, implementation, evaluation	

Financing for capital investment

The Blueprint serves as a basis for focused discussion among and with banks and financial institutions about cooperation in a syndicated co-financing scheme (e.g. the Asian Development Bank, the World Bank, the Development Bank of the Philippines, the Korea's Official Development Assistance, the European Development Fund, and other banks and financial institutions).

The Blueprint offers Business Motivation Model (BMM) to financing institutions to facilitate their interest to finance preparation, implementation and evaluation of the Pilot Project. The global financial framework (international financial institutions and other organizations, private investment capital), and financial sources of the Philippines (public budgets, local banks, funds and private capital) perceive the SPC-based project as a great opportunity.

The Blueprint analyses potential for financing for both the SPC Concept and the Pilot Project. The SPC Concept proposes a network (cluster of products) leading to financing of a small (up to 100kWe) modular electric power generating and distributing system which is to serve the needs of decentralized electrification of communities with an ambition to be an energy independent and have a sustainable operation independent of energy markets. The Blueprint demonstrates feasibility of project portfolio financing for SPC Projects in the Philippines and proposes Pilot Project financing using specific example of the Sorsogon province.

The Blueprint presents two views: preparation and implementation of the Pilot Project and its justification. This approach allows us to apply multi-functional views when looking at technical and financial solutions. The Pilot Project for the Philippines is presented with the understanding that it can be replicated in other parts of the country as well as in other countries.



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Therefore, we have invited more banks and financial organizations from the public and the private sectors to participate in Blueprint advocacy. We intentionally put the Pilot Project into multi-function positions with the objective to seek synergy effects.

Availability of financing

The Blueprint operates with standard and frequently used financial tools (grants, loans, venture capital) and on the SPC side a mechanism of a revolving loan funds is introduced. We do not see the required financial resources as a simple addition to the cost linked to generation of the certain amount kilowatt hours of electric power but we work with additional measurable indicators. The objective is to implement targeted (revolving) financing for mid-time frame (20 to 30 years.)

Financial Sources and Tools: Most of the banks love – for good reasons - financing of energy sector projects. The objective is to have “smart” public procurement aimed at building a particular country’s own energy infrastructure and to do so at an acceptable price. Revolving Loan Fund (RLF) is a good instrument for financing of such effort. The Blueprint proposes to found a RLF as a smart tool at the Provinces governance level with a professional assistance from a strong Philippines banks (e.g. Development Bank of the Philippines). This the most pragmatic way how to operate bottom up approach for electric infrastructure services; how to get, increase, manage, control, protect and motivate real cash flow for sustainable development.

Selected instruments of financing should – above all – fit the best to all parties involved. Selection of instrument of financing reflects how mature the partnership in the project being prepared is. Selection and application of a particular instrument of financing also predetermines what financial settlement is to take place after the project is completed (e.g. project’s construction phase and its transition to production stages).

For RLF is characterized by periodic repayment schedule (monthly, quarterly or semi-annual), consisting of equal principal payments plus interest. Another feature of the RLF are the annual operating expenses: cost of capital (donor’s ROI) plus administrative expenses, plus contribution to loan loss reserves. However, unlike grants, the RLF generates loans, and the borrowers back into RLF must pay them. The objective is continuing issuance of new loans. Therefore, it is imperative that the administration of the RLF undertakes due diligence analysis in underwriting and monitoring the loans.

The benefits to the donor institutions are two. First, they are funding a portfolio of infrastructure loans, which may be too small for a direct loan, and portfolio of loans diversifies the risk to the donor. Second, the RLF has an annual Revenue Cash Flow (loan interest plus loan repayments), which repays the donor over time as opposed to a grant, which will never be repaid.

Administration of the RLF has to verify that borrowers have economic and financial capacity to repay a loan over the repayment schedule. Loss on a loan diminishes the original capitalization of the RLF. There are some unwritten criteria, which should be considered important. A Revolving Loan Fund (RLF) is a sustainable mechanism to finance SPC



Infrastructure capital projects. RLF is a suitable instrument of financing which not only maintains the its initial amount available to financing and at the same time has the flexibility to respond to borrowers' degree of financial obligations by modifying terms of loan payback.

Blueprint advocacy

This approach allows us to apply multi-disciplinary and multi-functional approach including technical and financial solutions. It is expected that the Pilot Project for the Philippines might be subsequently applied in other countries. Therefore we have invited other – non-Philippine – banks, financial and non-financial organizations and suppliers of technology, and others to join us in the Blueprint advocacy efforts. Implementations and dissemination of results: 5PforRES is an initiator of a “bottom up” or ”top down”-structured SPC pilot project and pilot project portfolio:

- a) “Bottom up” approach represents a single pilot project: we are considering investing private sources into building, operating and transferring over a pilot \$2m 1MWe-solar power plant. 60%-75% of the investment value will be paid back after final inspection takes place and at the latest after 1 month of operation of the solar power plant. In parallel, we are looking for a small grant (\$0.1 - 0.2m) to local universities to perform – together with the 5PforRES - evaluation of absorption capacity of the SPC Concept. Of critical and fundamental importance is to assure that SPC Clients (electricity buyers, villages and towns) develop strong interest and will understand “synergy” in order to participate effectively in the projects and be able to guarantee their sustainability.
- b) “Top down” approach represents a pilot project portfolio: we are acting in advocacy of a SPC pilot project portfolio for a region (about one million inhabitants) of sub-tropical and tropical countries of the South-East Asia, the Pacific, and Sub-Saharan Africa. The \$30 m project portfolio is focused on mixed use of RES modular units tapping into the existing grid, or initiating a demand for construction of new micro-grid technologies including energy storage solutions. The Blueprint is presented and discussed with local authorities and financial preparation stages and project portfolio evaluation costs should be included in the total budget of the pilot project portfolio.

Pilot simple project implementation in process

Detailed specification:

- Local partner: Mayor Gamos, St. Magdalena
- Electric cooperatives: SORECO
- Private partners: 5PforRES, s.r.o. Czech Republic (integrator) and IRES s.r.o., Slovak Republic (investor).
- Financial Institution: ADB

Partners to operate/maintain the system: Private partners will establish the Pilot SPC Unit, a "SPC - St. Magdalena Unit" in cooperation with the municipality of St. Magdalena. Issue to be addressed: land lease, specific SPC services, and jobs for local population.



We suggest proceeding in three stages:

- The first one is 1MWe PV solar power plant within the central power grid of Luzon
- The second one is an expansion 0.5-1.0 MWe in the same locality (including investment into local grid and in a battery system). We propose to split the 2nd stage into a solar PP investment and the local grid and battery system. Local grid and battery system must be investment of the municipality, specifically of the SPC - St. Magdalena Unit.
- The third stage opens the door for mixed RES solutions of decentralized electrification.

The objective of this bottom-up approach is to evaluate implementation of the SPC project:

- The first stage can be implemented without any restrictions. We could start working on the indicative contract.
- The second stage needs to be driven by the municipality. They must declare their interest not to be completely dependent on the central power grid of Luzon, and to open door for decentralized electrification (a relevant local power cooperative must participate). The municipality will need financial assistance from the ADB (for a study which is a part of the SPC Pilot Project - see the Blueprint, and for investment into the local grid and battery system). There is an opportunity for St. Magdalena to get a grant (stimulating subsidies) from the ADP (part of the top down approach).
- The third stage should be used as practical evaluation of the top-down approach. Financial mechanism of the project portfolio should be flexible and carefully controlled. The third stage should be also seen as a test of future financial operations.

Other authorities: the Philippine Economic Zone Authority, Board of Investment, and others. We should open the opportunity for foreign investors to participate in the Philippines rural program via incentive programs. The national authority should guarantee the purchase price of electricity in \$/kWh to assure economic operation of the power plant; such contract has guaranteed purchase price for 15-30 years. In parallel, we are looking for a small grant (\$0.1 - 0.2m) to local universities to perform evaluation of absorption capacity of the SPC Concept together with the 5PforRES team.

Implementation of pilot portfolio project

The Pilot Project's stages are calculated for a sample of population about one million inhabitants in an investment costs of multiple of \$10m. For the Sorsogon province the Blueprint proposes the following costs: preparation stage - up to \$1.0m; implementation stage up to \$30m; and evaluation stage up to \$0.5m. The preparation stage is planned for 2014. Implementation and evaluation stages are planned for three years. The Pilot Project should be completed and evaluated before the end of 2017.

Detailed specification:

- Local partners: province and municipality of St. Magdalena
- Electric cooperatives in Sorsogon: province has Electric Cooperatives SORECO
- Private Partners: The Norwegian Embassy in Prague was asked for Norwegian



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Development Fund participation

- Financial institution: ADB; request to the Korean Official Development Assistance was made via Korean Embassy in Prague and inquiries were also presented to the Centre for Enterprise Development (CDE) and the European Development Fund (EDF).

The Blueprint is at the Advocacy stage, coordination of involvement of all partners is a task of the Sorsogon province. 5PforRES and the Mapúa Technology Institute of Technologies are ready to discuss specific financial structure with the government of the Sorsogon province:

- Proposal and implementation of micro Cash Flow Analysis by using actual data barangays in the Sorsogon providence as a sample of the in project portfolio (e.g. the second and the third stages of the St. Magdalena single project),
- To determine the number of household in all barangays included in the project and estimate the average daily kWh usage by each one
- The above data will allow us to determine the required size/capacity of electric power generating and distribution system based on renewable energy (solar and other technologies)
- Estimation of the capital costs of the electric power generating and distribution system
- Development of a pro-forma capital sources and uses cash flow analysis
- Sources of capital will determine the structure of a loan coming from the revolving loan fund (RLF) that we propose to be established
- To develop a pro-forma operating sources and uses cash flow analysis,
- The uses will be the estimated annual O&M costs of the system for power generation and distribution plus the debt service on RLF loan
- The sources would be the annual electric user fees which equal the annual uses,
- Finally, we can then convert annual user fees into the cost per kWh and then determine the average electric costs (monthly, quarterly or annually) per household

This methodology can be in the end applied to all projects in project portfolio for the Sorsogon province.

Conclusion

Thank you for the opportunity to introduce you the Self-Powered Community (SPC) Concept based on RES pilot projects in the Philippines.

The QL => (e) & (w & m) equation has a solution based on practical implementation of synergy effects which are generated by coordination of decentralized electrification with capital investments into management of water resources and new use of traditional materials (such as bamboo) fitting the needs of decentralized, “island” electrification taking advantage of locally available RES.

We demonstrated the feasibility of the SPC approach using the Blueprint which can be



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found at <http://www.5pforres.eu/download/blueprint-final.pdf>. The Blueprint serves as the basis for testing of pilot projects in specific environment of a municipality, St. Magdalena, and a province (Sorsogon).

We are looking forward the presentation and discussion as well as follow-up communication with the 2013 ICSET participants.

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*) William Penn:

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- Executive Director, Clean Water Finance Agency, Providence, RI, USA, The agency manages \$70 million Revolving Loan Fund which is financing waste water and drinking water infrastructure systems throughout Rhode Island. 1990 - 1994