Stakeholder alignment: Key to enable renewably powered electric mobility on island states - a Caribbean island state case study

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ABSTRACT

Renewably powered electric mobility is an ideal fit for the Caribbean islands potentially providing numerous benefits – ecologically as well as economically. However, progress of transitioning the islands' energy and mobility systems is slow. A joint project between the Energy Unit of the Government of Saint Vincent and the Grenadines, GIZ, and Siemens AG with support of GEF UNDP PACES developed a common understanding of a large set of stakeholders regarding the structures needed for the introduction of renewably powered electric mobility on Saint Vincent and the Grenadines. The aim is to transition from 100% fossil to 100% electrically driven mobility and at the same time from 85% fossil to 100% renewable electricity generation – the pursued stakeholder alignment approach and the transition roadmap could serve as an example and blue print for other Caribbean islands.

INTRODUCTION

Numerous trends are changing business environments and will together allow cities, regions and countries to completely transform their power and mobility systems towards renewably powered electric mobility [1]. Among these trends are decreasing costs (e.g., for renewable power generation and batteries), increasingly available products (e.g., charging solutions, electric cars) and Internet of Things (IoT) technologies for coordinating distributed systems. The commonly seen roadblock of range anxiety is not a problem on small islands. Among other reasons, this makes Caribbean islands predestined to front-run this transformation, which may provide numerous benefits, e.g. reduction of emissions, new job creation, and reduced dependency on fossil fuel imports.

The Energy Unit of the Government of Saint Vincent and the Grenadines (SVG) in collaboration with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and Siemens AG with support of the Global Environment Facility/The United Nations Development Programme - Promoting Access to Clean Energy Services (UNDP PACES) project, have executed a joint project to get a common understanding of the structures needed for the introduction of renewably powered electric mobility on SVG. For this project, Siemens designed a stakeholder alignment approach, which was applied to a strategy planning workshop. This paper describes the technical feasibility of renewably powered electric mobility, explains the stakeholder alignment approach for overcoming transformation barriers and gives insights from its application to SVG with the intention to provide helpful examples and inspire other island states to intensify their endeavours to introduce sustainable power and mobility systems.

KEY ENABLERS FOR RENEWABLY POWERED ELECTRIC MOBILITY

Photovoltaic, wind and geothermal power plants, electro-chemical batteries, electric cars and charging solutions are technologies, which are today available as products at continuously decreasing costs. When combining them to achieve renewably powered electric mobility systems an increasing complexity is created with the challenge of matching fluctuating electricity supply (with fluctuations increasing with increasing penetration of variable renewable energy) with fluctuating electricity demand (with fluctuations increasing with increasing use of electric cars). Besides, renewably powered electric mobility leads to additional challenges, such as allowing drivers to recharge their vehicles at public charge points to realize their intended trips without organizational hassle, provide reliable and easy-to-use payment options, or correctly billing large numbers of transactions. To facilitate required solutions, interfaces among involved stakeholders and their respective assets (or things) must be defined and implemented using Internet-of-things (IoT) technologies to enable all actors (e.g., utilities, charging station operators, vehicle owners) or even their respective assets (or things) to negotiate according to defined preferences and organize the conditions of when and where to charge which car at which power, and adequately paying power producers. This complexity might seem daunting. However, the required infrastructure can be assembled using readily available power management and charging infrastructure operation systems. Thus, technologically, pieces of the puzzle are available to build renewably powered electric mobility systems.

STAKEHOLDER ALIGNMENT APPROACH

Despite the described trends and available technologies enabling the transition towards renewably powered electric mobility island systems and the huge benefits that can be expected for Caribbean island states, the transformation progress on Caribbean islands is slow. One important reason is that power and mobility systems are complex and involve numerous stakeholders (e.g., DSOs, GenCos, fuel importers, service station operators, car dealerships) with diverse incentives. The transformation requires significant investment, but will lead to an overall beneficial situation for society, but not necessarily for all involved players: a case of positive externalities or in other words a diffused benefits problem [2].

To address this problem, we developed a 10-step workshop-based stakeholder alignment approach for achieving a joint vision and transformation roadmap to kick-off the necessary transformation strategy process:
1. Alignment of a joint vision
2. Transparency on stakeholders' objectives
3. Alignment of key objectives
4. Development of ideas on future value creation opportunities and business models
5. Prioritization of business opportunities
6. Development of a stakeholder interaction matrix
7. Derivation of business ecosystem
8. Design of future business ecosystem
9. Design of possible initiatives for system transformation
10. Definition of key performance indicators for transformation success measurement

We applied the approach focusing on the island state of SVG as a case study with a workshop in SVG in 2017. As a result of the workshop, more than 20 stakeholder organizations (e.g., government organizations, private sector organizations, NGOs) have expressed their support of the underlying idea to develop the current system into a more sustainable and economic business ecosystem revolving around the transition of the mobility and power sector. The island can draw advantage from its manageable size to bring all key stakeholders together in a streamlined process and move quickly to turn into one of the first islands with efficient electric transportation on a large-scale serving as a role model for its neighbors.

THE CASE OF SAINT VINCENT AND THE GRENADINES

Electric mobility is an ideal fit for the Caribbean islands and particularly for SVG as it may provide numerous benefits, such as positive environmental effects, and less dependency on imports [3]. Since SVG has an abundance of indigenous (renewable) energy resources such as geothermal power, solar, and hydro power, it has the possibility to draw on clean energy sources for the electric mobility system of the future. With the limited battery range needed to commute on the island, electric mobility is an ideal fit. Additionally, electric vehicles could act as flexible load and benefit the grid operation by supporting the integration of non-controllable variable renewable resources [1].

Even though a number of roadblocks hindering the transition of the mobility and power system have been identified during the stakeholder workshop, SVG has the potential to rapidly develop electric mobility. It could still develop into a front-runner country in the Caribbean region. The front-runner has an advantage in establishing numerous additional local businesses, such as car dealerships to act as an e-car-dealer-hub for the Caribbean, which creates local jobs, improves purchasing power and leads to increased tax revenues. To achieve that, decisive and well-coordinated actions need to be taken.

Development of a shared vision and key objectives

The stakeholders have been asked to give their inputs into what their vision for SVG with electric mobility was during the first day of the Stakeholder Alignment Workshop. In general, all stakeholders agreed on a vision for a future of 100% electric mobility on SVG and expressed their common interest in moving forward ambitiously.
GIZ and Siemens received inputs on mobility aspects and power system aspects on the long-term vision imagining the islands in around 20 years from today and in intermediate steps. GIZ and Siemens consolidated the input into one joint vision, which was discussed, adapted and aligned during the second day of the workshop. The final vision is illustrated in Figure 1.

	Mid-Term Vision (till 2025)	Long-Term Vision (~ 20 years)
Power System Aspects	60-70% of the power mix is renewably generated (geothermal, hydro, and solar)	100% renewable energy based electricity system
Mobility Aspects	At least 10% of the vehicles on St. Vincent and the Grenadines are electric vehicles (~ 2000)	Saint Vincent and the Grenadines is the leader of electric mobility in the Caribbean region
	Sufficient charging stations in place	No more imports of fossil-fuel-vehicles
	Maintenance and recycling infrastructure is available	

Figure 1: Vision for renewably powered electric mobility

The joint vision of all stakeholders was further broken down into more specific objectives that can be achieved via the transition of the mobility and power system of SVG. In a first step, objectives were defined in four separate groups of more homogenous participants. In a second step, these were aligned among all stakeholders into one joint set of objectives.

The identified and aligned objectives were then ranked by their importance to the stakeholders, which resulted in the following 10 key objectives:

1. Reduce emissions from transport (climate protection)
2. Efficient and affordable transport/reduce costs
3. Attract global climate financing and investment
4. Generate revenues from new business models/job creation (e.g., recycling, maintenance, etc.)
5. Increase the local purchasing power
6. Green economy and eco-tourism image for increasing touristic attractiveness
7. Improve air quality (health)
8. Increasing the share of (indigenous) renewable energies
9. Reduce dependency on fossil fuel imports
10. Maintain tax revenues from individual car purchases/usage

Development of business models and aspired business ecosystem

To achieve the successful transition of the mobility and power system of SVG, a mix of interacting business models within a well-defined political and regulatory framework is required. In analogy with nature and biological systems, such a complex system of interacting organizations can be seen as a business ecosystem. Within the project, business opportunities were identified and evaluated. Additionally, future interactions of important stakeholders were discussed and drafted into an aspired future mobility and power business ecosystem for SVG. A set of candidate initiatives supporting the transition process and possible key performance indicators to measure the transition progress were also developed.
For providing the people of SVG with services around electric mobility and to achieve the defined key objectives 17 value creation opportunities or ideas for new business models were identified as follows:

E-Vehicle Import and Sales; E-Vehicle Maintenance and Services; E-Vehicle Training academy; E-Vehicle sharing operation; E-Bus fleet operation; Export e-cars to other islands (E-car hub for the Caribbean); E-Vehicle fleet operation (e.g., for logistics operations); E-Taxi fleet operation; E-Ferry fleet operation; E-Vehicle energy billing; E-Vehicle infrastructure as a service for other islands; Battery Recycling Company for the region; 2nd Life Battery usage for PV-Systems; Operation of the public charging network; E-Vehicle charging via private network; E-Vehicle park & charge reservation service; E-Vehicle preferential parking access.

During the workshop these business model opportunities were presented and discussed regarding their importance for a successful transition of the mobility and power system of SVG to achieve the mid-term vision. Thus, they were evaluated regarding their implementation priority in two steps: first, in the short-term (within 3 years) and second in the medium-term (within 9 years).

The first step in drawing the current business ecosystem is the creation of a stakeholder interaction matrix (see Figure 2). The aim of the matrix is to identify important interactions among stakeholders and to allow an identification of necessary or possible new interactions in the future business ecosystem. The matrix is structured in a way that for each stakeholder - structured into public sector and private sector - interactions are presented in the form of values that can be provided by one stakeholder (row of the matrix) to another stakeholder (column of the matrix) following the logic presented in the following figure. Guiding questions to fill the matrix are:
1. What can a stakeholder give to others?
2. What does a stakeholder need from others?
3. Which forms of values appear in the interactions?

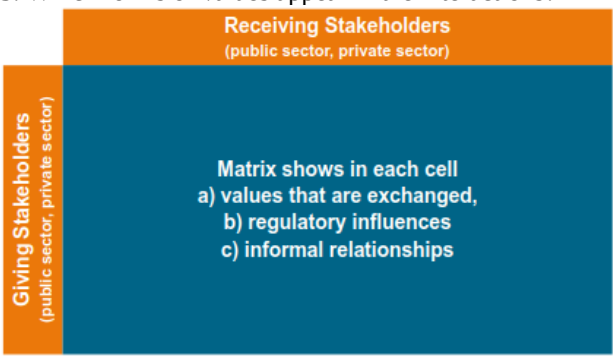

Figure 2: Stakeholder interaction matrix concept

Interactions are an exchange of values, which can be money, energy, tangible products, intangible values (e.g., trust, planning reliability). The different types of values are also called value currencies.
By analyzing the interactions among stakeholders and considering the main business models and roles in a future business ecosystem, Siemens created an initial draft of today's business ecosystem with most relevant stakeholders and policy interactions and a possible future ecosystem around renewably powered electric mobility.

The initial ecosystem serves as a starting point to further drive the development of an aligned and more detailed business ecosystem vision of key stakeholders of SVG. This will enable the government, the people, and the key organizations to actively shape the future of their mobility and power system to achieve the vision and objectives as defined in the stakeholder alignment workshop.

The modelled ecosystem showed that the aspired transition of the mobility and power system of SVG leads to a decline in importance of some existing roles (e.g., fuel importing companies or conventional diesel-based electricity production). This will also lead to decreasing tax revenues as it is also the case for vehicle import taxes, if incentive mechanisms targeting the import of electric vehicles will be implemented. However, it is important to set the

political and regulatory framework in a way that the transition leads to the development of new business opportunities, which will appear as new sources for tax revenues, such as charging station operation, e-vehicle maintenance services, renewable electricity producers, and new fleet operators. The sum of created value by all these new business activities should be larger than the created business value in today's system, which should then also lead to an increase in tax revenues. Thus, the aspired business ecosystem should not only lead to a more climate-friendly system for SVG, but also to a more economic and financially sustainable system. The analysis showed that, especially fleet operators, can play a pivotal role in a future business ecosystem by transforming capital expenditures of Vincentians into operational expenditures and creating roles with many business interactions among business players. For illustrating the way of representing business ecosystems, the following figure provides a small clipping of the aspired business ecosystem (see Figure 3) showing two new roles (e-vehicle training, e-vehicle maintenance and services) with intangible (training) and financial value currency streams (course fees, tax).

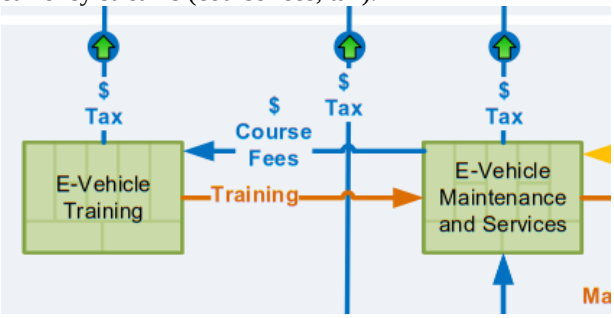

Figure 3: Exemplary detail of the business ecosystem map

The business ecosystem can support constructive discussions among key stakeholders of the country and should be further developed while the path towards the future system matures.

Results of the stakeholder alignment approach

All stakeholders have expressed their support of the underlying idea to develop the current system into a more sustainable and economic business ecosystem revolving around the transition of the mobility and power sector. The island can draw advantage from its manageable size to bring all key stakeholders together in a streamlined process and move quickly to turn into one of the first islands with efficient electric transportation on a large-scale serving as a role model for its neighbors.

In order to move forward rapidly, the following decisions need to be taken:
1. Agreement to start an integrated planning project for electric mobility in SVG (strategy design phase);
2. Decision on which entity will take the lead for the project (e.g., the Energy Unit) and which entities will contribute (e.g., ministries and NGOs);
3. How can the key factor for the success of the planning project, i.e. clearly expressed support by the government and an active involvement by all key stakeholders (as was initiated in the workshop) be maintained and nurtured.

The stakeholder alignment project showed that electric mobility is capable of acting as a catalyst in the transition of SVG towards a more independent, economic and sustainable country. Additionally, it can support the touristic attractiveness of the island and thus, contribute to one of the island's main sources of income. In conclusion, a well-structured transition towards IoT-enabled electric mobility can bring SVG to the realization of the vision of a mobility and power system that will sustainably improve the country's economic situation and lead to an energy system that is based on 100% renewable energy sources.
Siemens and GIZ cast the workshop results into a high-level roadmap to provide a structured starting point into the strategy design phase. This roadmap together with a collection of possible business models, an aspired business ecosystem map, suggested initiatives and possible key performance indicators equip the stakeholders for working on the details of the strategy.

The roadmap is presented in two views (see Figure 4). The activity view provides an overview of the initiatives or activities that are recommended for the different phases, whereas the resulting situation view provides a glimpse of the situation at the end of each phase, if recommended activities had been conducted. The situation considers both mobility and power sector aspects. The status quo of today's situation summarizes main activities that have already been started or are ongoing. It shows that SVG has already begun its journey with first steps towards the vision of a 100% renewably fueled electric mobility future. After the next step of the above described strategy design phase, the time span towards the defined mid-term vision in 2025 has been split into two strategy implementation steps pre-filled with recommended initiatives that need to be further detailed in the strategy design phase. As reaching the mid-term vision will already be an ambitious endeavor, the time after 2025 was only sketched as an additional outlook. The main goal of the current high-level roadmap to SVG is to provide a starting point for the strategy design phase.

CONCLUSION

Current trends, such as an increasing variety of available electric cars, decreasing battery prices and growing capabilities of IOT technologies for solving complex near-real-time problems, such as coordinating fluctuating supply with fluctuating demand or billing thousands of small transactions can be used to drive the transition of SVG into a more sustainable, economic and independent country. A vision and roadmap towards a renewably powered e-mobility future have been generated with the inputs and direction of key SVG stakeholders. A business ecosystem has been outlined showing how stakeholders can contribute and benefit in the future transportation

sector. The details of this transition are in the process of being further fleshed out. However, it is already clear that SVG can benefit in multiple ways including increased government tax revenues, new business model opportunities, increased employment and improved energy security through the use of indigenous renewable energies. SVG has been provided with a key and fundamental starting point to become a front runner in electric mobility in the Caribbean. The Government of SVG continues on track to transitioning the electricity sector to renewable energy, e.g., through the initiation of a geothermal production drilling project. The transition process in the mobility sector is progressing with ongoing strategy design and implementation, e.g., through detailed development of policies for the promotion of energy efficient and low carbon vehicles and preparation of a national appropriate mitigation action (NAMA) including the introduction of electric vehicles and charging stations.

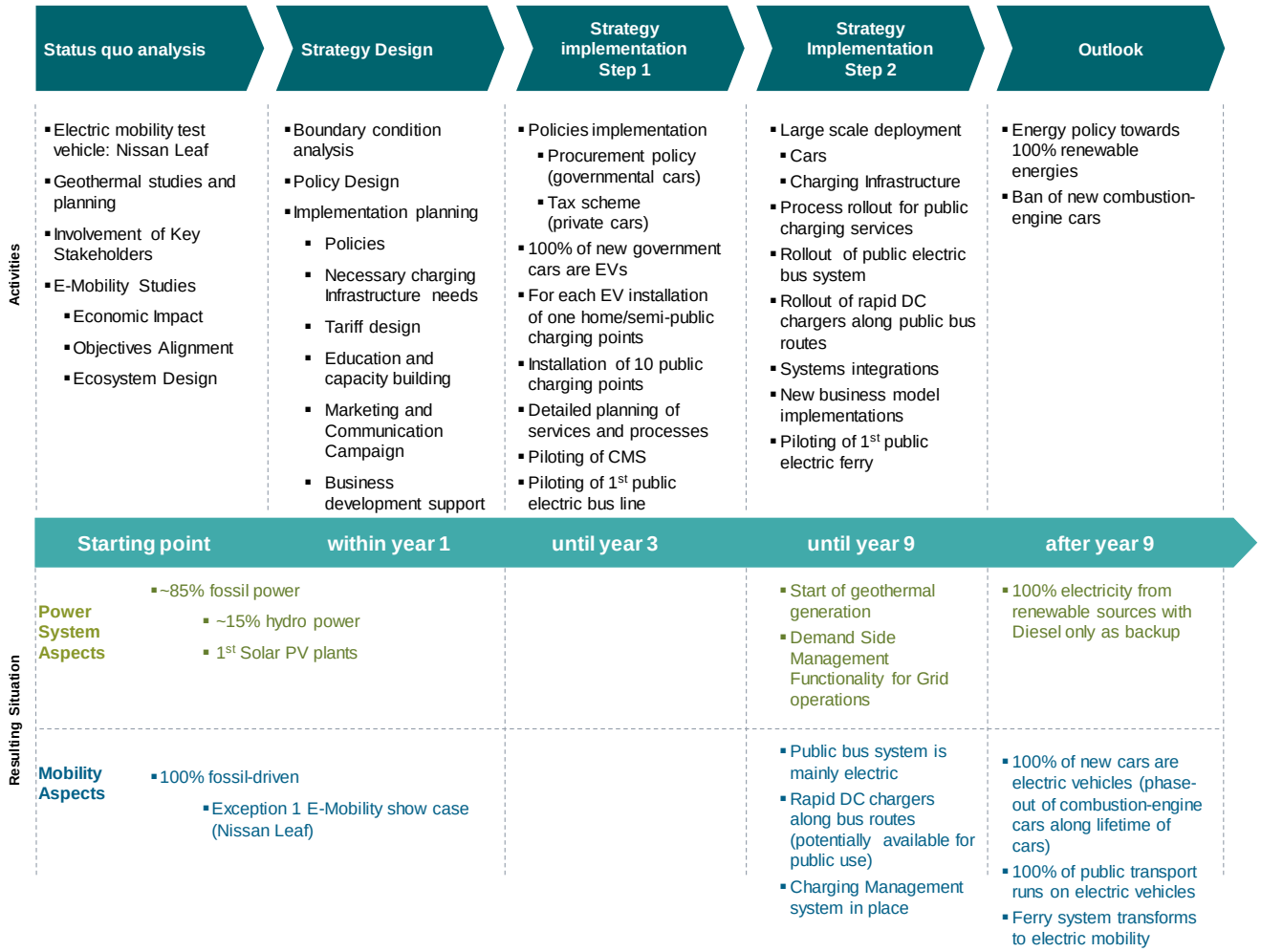

Figure 4: Roadmap for SVG with activity view (top) and depiction of the resulting situation (bottom)

ACKNOWLEDGMENTS

The presented case study is based on a project that was funded by Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH and supported by the GEF / United Nations Development Program PACES project.

REFERENCES

[1] M. Engelken, B. Römer, M. Drescher, I. Welpe, A. Picot, 2016, "Comparing drivers, barriers, and opportunities of business models for renewable energies: A review", Renewable and Sustainable Energy Reviews, vol. 60, 795-809.

[2] B. Römer, P. Reichhart, J. Kranz, A. Picot, 2012, "The role of smart metering and decentralized electricity storage for smart grids: The importance of positive externalities", Energy Policy, JEPO, vol. 50, 486-495.

[3] S. Shaw, D. King, 2016. Economic Impact of E-Mobility Transition in St. Vincent and the Grenadines – Final report. URL: http://energyunit.gov.vc/energyunit/images/pdf_documents/Economic_Impact_of_Emobility_Transition_in_SVG.pdf