A NEW FRAMEWORK FOR INFRASTRUCTURE PLANNING

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ABSTRACT

A successful infrastructure strategy requires a strong alignment among the utility providing services around infrastructure and the participants consuming these services for value creation in this energy 'ecosystem'. To avoid trial and error in achieving this alignment, a new approach to modeling and planning the interaction of the participants within the energy ecosystem, including the utility, is presented. This approach uses energy as the common value flow amongst ecosystem entities, maps other value flows to the relationships between entities, and enables mutually beneficial relationships, thereby increasing value generation within the community energy ecosystem.

INTRODUCTION

Technology advancements like decentralized energy resources and digitization enable energy infrastructure to regain a driving role in enabling economic, social and environmental value. Therefore, it is time for utilities to get back to their roots and drive infrastructure to enable increased prosperity in their communities.

In this sense, a successful infrastructure strategy requires a strong alignment among the utility providing services around infrastructure and the other participants consuming these services for value creation in this energy 'ecosystem'. To avoid trial and error in achieving this alignment, a new approach to modeling and planning the interaction of the participants within the energy ecosystem, including the utility, is needed. As a consequence, energy-based services can be seen as an abstraction of current infrastructure and this would open up new degrees of freedom for the community to exploit energy efficiency potentials and improve energy productivity. Consumers would be strongly engaged in the plan because these services would help them create value, instead of relying only on utility subsidies, which would require continuous changes to the contracts between supplier and consumer.

An integrated utility transformation and community energy plan would align the efforts of the utility and the community to achieve the common goal of empowering communities to drive economic, social and environmental value (see Figure 1).

The outcome of such a planning process is an integrated utility transformation program and a community energy plan that serves both the utility and the community to overcome the diffused benefits problem in a new and unique way, and ensures that the plans are actionable and fundable.

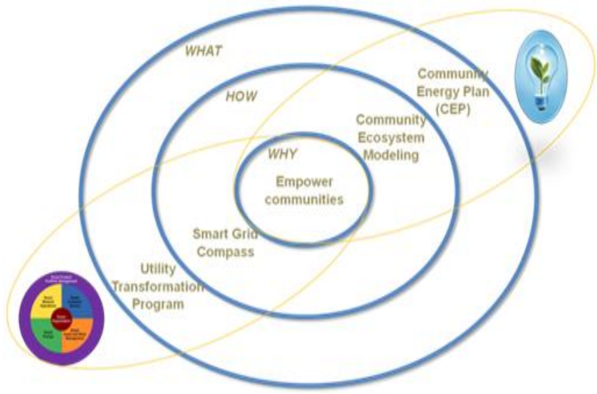

Figure 1 – Integrating Utility Transformation and Community Energy Planning

SIEMENS SMART GRID COMPASS

Systems and solutions at local electric distribution utilities are often commissioned with well-defined expectations and are installed in order to address particular problems. However, when it comes to transition towards a smart grid, utilities face a profound paradigm shift. No single product or solution turns a legacy grid into a smart grid or a 'utility of the future'. In the smart grid space with its high complexity and massive interdependencies, focusing on a single product for a single problem often does not work well. Business cases focused on one problem or objective often become negative and are not able to justify the required investments.

In today's paradigm, the process of finding and leveraging synergies between different technology investments has become a key success factor for smart grid implementation programs. Although a plethora of technologies and products are available in the market, their complex features, described in dense jargon, make it unclear how synergies can be realized in real-world application or in a sequential implementation program.

To address these challenges, Siemens has developed the Smart Grid Compass® approach.
The approach is comprised of four modular phases: Orientation, Destination, Routing and Navigation, with a view on six functional domains of a distribution utility's business as follows:

- Smart Network Operations
- Smart Customer Service
- Smart Asset and Workforce Management
- Smart Energy
- Smart Organization
- Smart Product Portfolio Management

The first key goal of the Siemens Smart Grid Compass® is to support the internal alignment of the utility through alignment of objectives throughout the company to create or strengthen a shared vision across departments and mobilize the entire organization around this unified vision.

The second key goal is to provide a structured set of programs and projects that will transform the utility into an organization capable of driving increased prosperity in its community. This community prosperity goal is what ties the actions of the transformation program to community energy planning initiatives, described next.

COMMUNITY ENERGY PLANNING

Community energy planning takes varying forms in various geographies, jurisdictions and regulatory regimes. The goals of community energy plans are primarily to improve energy efficiency, reduce greenhouse gasses and drive local sustainable energy initiatives within the community. The intent is to quantify energy consumption in the community and use this data to prioritize initiatives and efforts to achieve the stated energy goals and lead the community towards a defined energy vision [2,3].

Approaching these goals from a community point of view is intended to drive action in the form of energy generation and consumption related initiatives, but the authors found that it potentially leaves many opportunities for enhancing community competitiveness unaddressed and untapped. Ensuring the local utility is at the table and that they are in the process of pursuing their own vision of a utility of the future to support the community enables the utility to be at the forefront of community economic, social and environmental development.

The outcome of such a planning process is an integrated utility transformation program and a community energy plan that serves both the utility and the community to overcome the diffused benefits problem in a new and unique way, and ensures that the plans are actionable and fundable. The diffused benefits problem appears in situations when a potential action/investment is socially desired because the sum of benefits for all players outweighs required costs, but the investment is omitted because for every single player private benefits do not outweigh private costs. This challenge of widely distributed benefits among numerous players can be mastered through the use of cooperative business models, which can be identified using our presented approach.

FRAMEWORK

The framework originated by placing the utility at the intersection of technology and human values, in the manner in which utilities were originally created. The long-term planning requirements of utilities, however, are often at odds with the often short-term and rapidly evolving demands of the modern economic system. So positioning the utility's technological and human values-based origins alongside the demands of the organizations that consume the utilities services leads to a framework wherein the community's energy needs can be anticipated and met by the utility while the energy ecosystem is used as a platform for achieving the community's objectives.

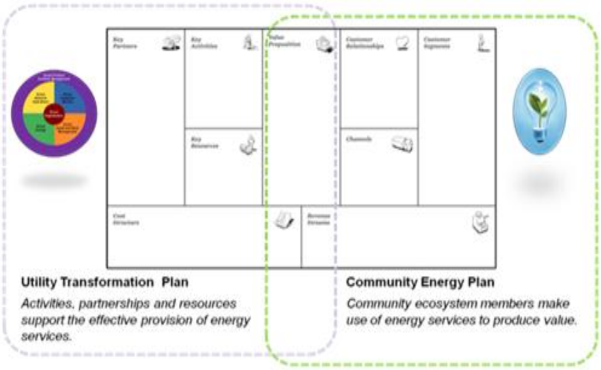

Figure 2 - Driving New Business Models Based On Energy Value Propositions

By integrating established methods like Siemens's Smart Grid Compass and Business Model Canvas (see Osterwalder et al: Business Model Generation), we have created a new modeling framework to capture energy-based interactions in the ecosystem of a community. In the third step of the method outlined below, we use this framework to identify opportunities for energy services and related value propositions (see Exhibit 2). This allows both utility and consumer to understand the added value generated, and therefore supports the effective definition and evaluation of potential new energy services and avoids misalignments. These new energy services can be focused around static and dynamic energy efficiency measures to fulfill government funding requirements of a community energy plan as required for example in Ontario, Canada.

METHOD

The method consists of three steps. The steps are conducted in a facilitated workshop setting designed to stimulate multi-stakeholder conversations around community energy. While the central objectives in conventional community energy planning are widely known, the present method is designed to extend the discussion beyond energy flows and inventories into a holistic discussion centered around higher order objectives in the economic, social and environmental space. At the centre is the utility, as both a participant in the discussion and as a stakeholder in the outcomes. And while the community energy plan may be a required outcome of such a discussion, the value to the community is in the planning itself, with outcomes generated long before the plan is published as stakeholders are motivated to act in concert and start to think in cooperative business models. The steps outlined below can be taken as the first phase in the process of design thinking, namely empathize, define, and ideate, a method of idea synthesis espoused by several leading business thinkers.

Figure 3 shows the steps in the method.

ENERGY INVENTORY

In the first step, organizations operating within the ecosystem are classified in an overall community energy ecosystem ontology. Groups of similar organizations form entity types with shared attributes. The key attributes that differentiate amongst entity types in the energy ecosystem pertain to energy and include the overall energy profile, including types and quantities of energy consumed, peak power demand, energy uses (e.g. process heat, space heat, lighting, mechanical), and any amounts of shiftable load.

This categorization of entities into types serves to highlight the nature of energy use within the community. In doing so, recognition of the unique needs of the various entities is brought to the forefront.

In parallel with the entity classification discussions, an energy inventory of the community can begin. Often this information exists to some degree; municipalities are increasingly required to report on energy consumption and a breakdown of energy consumption by organization type is often mandated to ease comparison across municipalities. But the value of the inventory extends beyond the flows of energy and into potential secondary discussions around the origins and history of the entities, their uses of energy, and a broader inquiry into the role of the entity in the context of the modernization of the utility and the community.

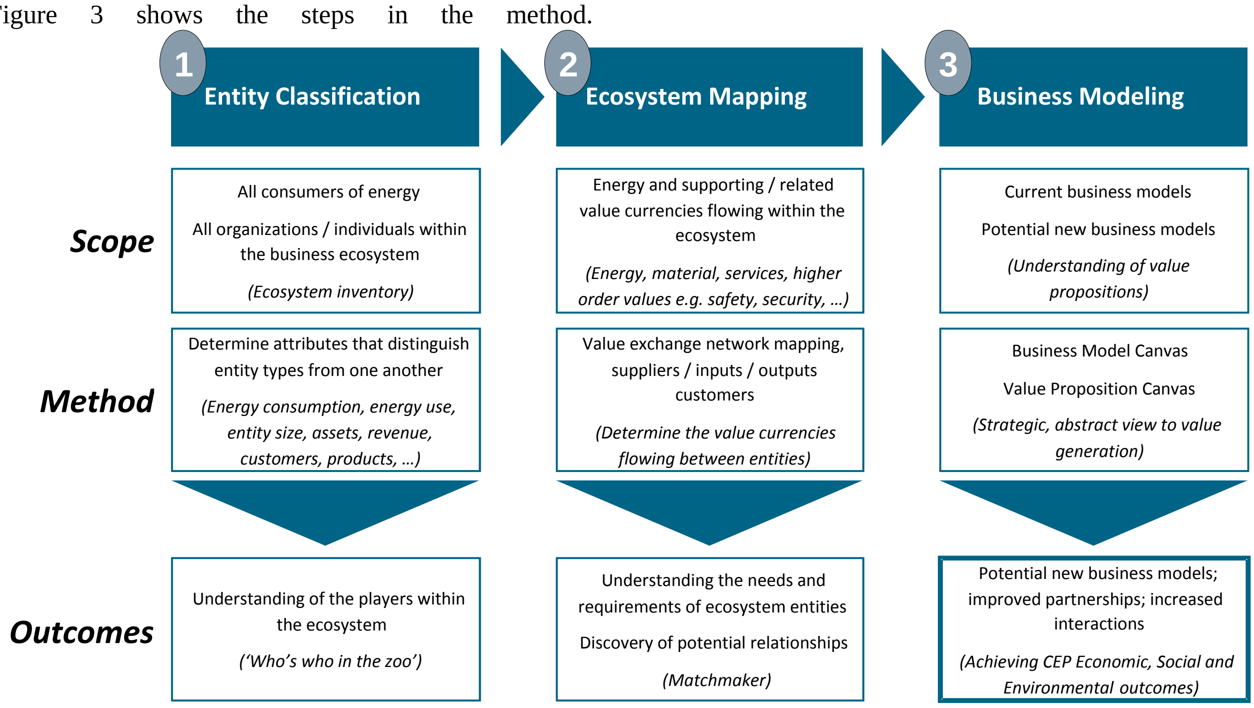

Figure 3 - Implementation Method

The energy inventory step is where conventional community energy planning initiatives often end; once the inventory is created, the analysis often focuses on methods to improve energy efficiency, reduce energy consumption, and reduce greenhouse gas emissions. While these efforts are commendable, experience shows that funding and executing these initiatives proves to be difficult. Going beyond the inventory and into the holistic dialogue of energy use (and potential misuse) within the community can itself be a source of initiatives targeting the community's socio-economic and environmental objectives.

STEP 2 – ECOSYSTEM MAPPING

The second step involves extending the classification and energy flow analysis of step 1 into flows of other value currencies within the ecosystem. A value currency is defined as any form of value that can be exchanged between two ecosystem entities. Energy and money are two examples and are examined in detail in step 1. Others include finished goods, professional services, health & education services, as well as non-economic values such as safety & security. Mapping value suppliers and consumers, along with their inputs and outputs, using the ontology developed in step 1, facilitates the recognition of sources of value as they flow between entities. This can lead to a deeper understanding of the needs and requirements of entities within the ecosystem. This can facilitate the discovery of potential relationships allowing further value generation within the ecosystem.

These newly identified interactions provide the core of the idea generation that take the community beyond energy transactions and into value creation.

STEP 3 – BUSINESS MODEL GENERATION

The increased understanding of the identified and analyzed interactions between entity types discovered and described in steps 1 and 2 form the basis of the business modeling phase of the framework. In the third step, this deeper understanding of energy users, along with the forms, types and flows of value produced within the ecosystem, facilitates the creation of new business ideas and entirely new business models. As the understanding of value propositions within the ecosystem grows, and the language and tools of describing these value propositions are developed within the community, the divergent and analytical phase can begin to give way to the convergence and synthesis of new ideas. It is these new ideas that contribute to achieving the economic, social and environmental objectives that must guide infrastructure planning in this new framework.

It is important to note that the process of executing the method is seen to drive as much value as the output of the method. In a recent example, when community energy planning workshop participants engaged in the first part of step 1 (Entity Classification), many who had not participated in energy inventories in the past began to categorize and classify entities by new types which led to innovative perspectives on classifications. These new perspectives can highlight significant areas of value interactions amongst and within entity classes that can be further evaluated in later process steps.

CONCLUSION

The framework and method for infrastructure planning presented herein is guided by principles shared by conventional infrastructure and community energy planning, but takes the planning process beyond the analytical, data driven approach. The method enables users to synthesize new business ideas centered around energy in the community, using established methods including the Siemens Smart Grid Compass® approach, community energy planning, design thinking, and the business model generation method. Together, the framework and method provides a powerful structure for utilities to get back to their roots and drive infrastructure to enable increased prosperity in their communities.

REFERENCES

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