Energy and Buildings 124 (2016) 273–280

Contents lists available at ScienceDirect

Energy and Buildings

journal homepage: www.elsevier.com/locate/enbuild

Business concepts for districts' Energy hub systems with maximised share of renewable energy

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ARTICLE INFO

Article history:
Received 26 March 2015
Received in revised form 13 July 2015
Accepted 28 July 2015
Available online 7 August 2015

Keywords:
Business concept
Business model
District energy systems
Renewable energy

ABSTRACT

This paper presents a set of new potential business concepts developed for districts' smart energy solutions with maximised utilisation of renewable energy (so called Energy hub systems). The concepts are targeted for different stakeholders with varying business ideas for optimal energy services and business. The concepts are presented in the form of a cookbook – a collection of business and service model recipes that describe the key idea and needed interactions between main stakeholders. Also costs and benefits of the business models are described, as well as key performance indicators for measuring the success for the stakeholders. The concepts are developed utilising Osterwalder's business canvas approach based on stakeholders' needs related to the energy demand and supply. The concepts are kept simple and focusing on one stakeholder at a time, thus improving significantly their clarity and enabling their further integration to energy analysis and simulation. These single business concept elements can be combined into broader and more specific business models, service offerings and business networks. Two specific example cases and one real life case area study are presented as examples. In addition, barriers for new Energy hub business and services are discussed.

1. Introduction

Currently lots of efforts are put on research and technical development related to improving energy efficiency, increasing the share of renewable energy, and improving of districts' energy systems. Most of the required technologies exist already, there are experiences about integrating them together, and they have been also piloted in several case areas. However, the wide-scale roll-out of more sustainable district level energy systems is yet to come. For this development, business models play a key role in the wide-scale implementation of new sustainable neighbourhood energy systems.

This paper presents the development process and a collection of business concepts developed for renewable energy based smart district energy systems, which are called in eHUB research project [1] as the Energy hub systems. According to the definition used in the project [1] "An Energy hub is a physical cross point, similar to an energy station, in which energy and information streams are coordinated, and where different forms of energy (heat, electricity, chemical, biological) are converted between each other or stored for later use". It is a mechanism for optimised energy and information supply exchange that integrates via various energy networks its members (households, renewable energy plants, offices, and businesses). These members can be both energy consumers and producers [1].

There are already some business models that could be potential for Energy hub systems, such as public private partnership models and its different variations. In addition, there are also some other interesting energy service related business concepts. Energy performance contracting (EPC) is a model, in which the service is defined in the level of energy performance and the client is buying the energy performance (e.g. for a building). Another interesting model is an energy service company (ESCO), which is a company delivering energy services. ESCO assumes the financial risk relative to energy projects and gets payment, e.g. according to the extent of realised energy savings. As an example, in an ESCO project the service provider optimises its customers' energy consumption through implementing energy efficient technologies and controls and by optimising the energy consumption, primarily with respect to heating and lighting [2].

2. Methodology

The overall methodology for developing business concepts for Energy hub systems consisted of following actions: a stakeholder

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http://dx.doi.org/10.1016/j.enbuild.2015.07.066
0378-7788/

analysis; development and analysis of business concepts; and an overview of the risks and barriers of energy business concepts are discussed in Section 5.

At first, an analysis of main stakeholder groups was done to understand the key players and their roles and needs in energy business (Section 3.1). Then a questionnaire was done to identify main stakeholders' needs related to energy services, focusing especially to end users (energy consumers) and energy service providers (Section 3.2).

The method for presenting business concepts was modified from the Osterwalder's business canvas approach [3] (Section 4.1). A preliminary list of possible concept level models was developed in a workshop. Then these business model ideas were further developed and analysed, resulting a cookbook: a collection of business concepts for Energy hub systems. All concepts were kept simple and focusing on one stakeholder at a time (Section 4), which simplified their further analysis. The analysis was done for all cases, of which two examples are presented in Sections 4.1 and 4.2.

2.1. Development of business concepts

This paper focuses on the development of business concepts, which are general level business ideas and elements. Business models are their next, more mature level for real life company specific operation models. Many typical European Commission (EC) funded projects state that they are studying and developing business models, although in reality they are usually working at the business concept level.

Among different research and coordination and support projects related to energy efficient neighbourhoods and buildings, different methods are used for developing business concept. Many EC funded projects, such as IDEAS [5] and Ambassador [6] define at first use cases, secondly define their relevant stakeholders and actors, and finally develop business scenarios and/or concepts for selected use cases. Another used development strategy is to build business concepts through executive workshops with the main stakeholders involved. Many other projects, such as EEPOS [7], are also describing business concepts and models via Osterwalder's business canvas [3]. As practical experience from these projects with business canvas, it is important to define data, energy, and monetary flows.

The common approach in analysing business and service concepts is the Osterwalder's approach [3] describing the product, customer interface, infrastructure management and financial aspects in nine different subtopics. In this work, the Osterwalder's model was simplified by choosing some elements of the model into the analysis. The structure of the analysis is presented in Table 1. All selected business concepts are described according to this structure. In addition, each concept is visualised by showing stakeholders and their main interactions related to the business concept.

2.2. Key performance indicators for measuring the performance

The performance of the business and services models is measured with key performance indicators (KPIs). Potential key performance indicators are presented in Table 2, in which KPIs are classified into three groups: environmental, economic and service level indicators. The KPI's will be selected by the stakeholders measuring the success of the model. As an example, energy consumer can measure the performance based on the total energy consumption and energy costs.

For each business concept or model, a suitable set of KPIs can be chosen based on the objectives and needs of the organisation at a given time. The metering of KPI's will give basis for evaluation of the success of business model concepts.

Table 1
Structure of the business concepts.

Elements	Description
Title	Describe in a few words the essence of the business model.
Business idea/objective	Describe in a few sentences the objective of the business model.
Offer/value proposition	Describe in a few sentences the service/product offered.
Customer	Who will use the service/product?
Seller/service provider	Who will offer the service/product?
Earnings/revenue model	Who pays, where does the money come from, and what needs to be bought? Who is the owner of this business?
KPIs	Main KPIs to measure the success of the concept. See Section 4.1.2.
Costs and benefits	What investments are needed? What are the costs and benefits?
References	Note, if the business model/idea is studied or applied somewhere else.

3. Stakeholder analysis of the Energy hub systems

3.1. Stakeholders' roles

The development of the business and service concepts requires the understanding of influencing stakeholders and their needs, goals and roles in energy business. A map of stakeholders is presented in Fig. 1. The main stakeholders are end users and service providers, who are running the practical actions in districts' energy business. The authorities and non-governmental organisations will give the regulation, rules, boundaries and public acceptance for the business. Main actors and their typical roles are described in Table 3. The basic needs of the main stakeholders are:

- End users: reduction of energy bill, reduction of energy consumption, improvement of energy efficiency, reliability and dependability.
- Energy network operators: balancing the network (achieving a calculable load).
- Energy retailers: reduction of imbalance (difference between predicted use and real use), and optimisation of energy trade.
- Project developers and investors: power peak shaving to limit maximum power and therefore reduce investment cost of the grid.
- Society and environment: reduction of CO_2 emissions, reduction of energy consumption, improvement of energy efficiency, maximising use of (local) renewable energy production.

3.2. Stakeholders' needs and attitudes towards Energy hub systems

The web questionnaire was carried out to find out the attitudes of stakeholders to smart energy [4]. The end users are interested to have green energy (produced by renewables, environmentally friendly, produced ecologically). The price of energy is important aspect and end users do not want to pay any extra or are willing to pay only small additional price of green energy, typically less than 10% extra price. The end users are interested in possibilities for own local production of energy and smart metering showing the consumption and costs of energy in own household. The users would likely use smart energy management service optimising energy consumptions and costs. The end users are interested in buying pools and demand side management pools. The service providers are willing to offer energy efficiency services (e.g. ESCO services), bundled energy services (e.g. heat/cool and electricity) and services minimising energy consumption and costs. The results