Energy Delta Institute
Energy Business School

Smart Grids

Deze artikelen zijn door EDI geschreven in het kader van het EDIAAL programme

Utility renewable energy business model

Key concepts

Utility-side business models relate to large scale energy projects like wind farms, biomass-fired power plants or Concentrated Solar Power (CSP). These kinds of projects are comparable to conventional power production as they are large-scale projects that deliver large amounts of power at a concentrated location and are most often executed by (public) utility companies. Large-scalerenewable energy projects can be executed through the 'traditional' business model, where the utility develops, constructs, owns and operates the project as if it were a conventional power plant. However, as most utilities lack the necessary technical expertise and/or funding possibilities, most of the large-scale renewable energy projects are based on some kind of partnership.There are three main forms of external partnership: cooperation with suppliers, cooperation with project developers, and cooperation with other utilities(1).

Cooperation with suppliers

Through cooperation with the supplier, a utility can gain the necessary technical expertise while keeping control of the development of the used technology. For the supplier it offers security of demand and a solid business case for development investments. For instance, E.ON and RWE entered into framework agreements with wind turbine manufacturers Siemens and REpower. This form of cooperation is mainly limited to large utilities.

Cooperation with project development companies

A project development company is a company that develops, constructs, owns, operates, and/or manages projects. Many developers perform several but not all of these roles. Developers essentially act as facilitators for the utilities. They take care of the development of a renewable energy project, while the utility can focus on their core business of selling energy. For example, JUWI, one of the major German project developers in the field of renewable energies systematically offers to cooperate with utilities to develop wind, PV, and biomass projects. The utility and the project developer establish a joint venture in which both are 50% shareholders. Both sides bring in their expertise and benefit from a growing pipeline of projects.

Cooperation with other utilities

Groups of utilities bundle resources to be able to invest in larger power projects, which they otherwise could not realize due to a lack of size and financial resources. For example, several small and medium sized utilities currently cooperate to jointly invest in offshore wind energy (Richter, 2011a). Cooperation with other utilities is used by utilities of all sizes. It is attractive to small and medium sized utilities, but some of the largest utilities also follow this idea, for example to reduce risks of offshore wind energy investments.

Larger utilities tend towards integration of project development and maintenance services into their business model. In this way they enhance the value creation in the project and are able to earn a higher overall return with the energy project. Smaller utilities rely much more on external service providers for project development and maintenance service, because it is too costly to hire skilled personnel for a small generation infrastructure(2).

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2. Richter, M (2011). "Utilities' business models for renewable energy: Evidence from Germany" World Renewable Energy Conference 2011.

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Distributed renewable energy business models

Key concepts

There is a large potential for the deployment of distributed RES, especially in the case of solar PV. Distributed RES is characterized by a large number of low capacity generation points, most often installed at the consumer's premises. The most straightforward 'business model' would be the consumer buying and exploiting the RES. However, even though a business case will often exist for consumers in the residential and commercial sector, the upfront investment, access to capital and incurred risks are often insurmountable barriers. New and innovative business models are required to overcome these barriers and reach the full potential in these sectors. Würtenberger et al. (1) distinguished the following three categories of business models for distributed generation in which 10 business models can be defined. Even though this article is focussed on business models for RES, most of the business models listed can also be applied to investments in energy efficiency (EE) improvements.

Product service systems (PSS)

Product service systems are business models which make use of the delivery of the function of a product combined with a relevant service. In the area of energy these are business models offering energy related services beyond the simple sale of energy. Energy Service Companies (ESCOs) are the most prominent examples of PSS business models in the energy sector.

Business models based on new revenue models

New and innovative revenue models have been a main driver for new business models in some traditional industries. For the deployment of RES there are business opportunities in the intelligent use of available government incentives which contribute to revenues. New revenue streams may also emerge from realizing the additional value of the intangible climate or environmental benefit of a product, for example those associated with a house having a high rating by a voluntary 'green' building certification scheme.

Business models based on new financing schemes

Similarly, there are business opportunities in making use of new and innovative financing schemes. High upfront costs are a major barrier for increased deployment of RES. Innovative financing schemes may therefore create business cases if the financing schemes help to overcome the barrier of high upfront costs. Financing schemes can be offered by different organizations, including local governments. They generally take over the initial investments and are paid through periodic payments.

In which market segments can these business models be applied?

The above mentioned business models all have their own merits and solve different issues in different ways. The built environment is an exceptionally multifaceted system including many different market actors, such as building owners, tenants, government authorities; building developers; financial institutions, suppliers and manufacturers; architects, engineers, contractors, craftsmen and service companies; and utilities. For this reason, some business models might work well with a specific part of the built environment, while others work well in a different part. Figure 1 shows an overview of which business models relate best to each part of the built environment.

				Product-Service Systems			based on new revenue models			based on new financing schemes			
				Energy Supply Contracting	Energy Performance Contracting	Integrated Energy Contracting	Feed-in remuneration	Sale of certified buildings	Profits from rent increase	PACE financing	On-bill financing	Leasing	Energy savings obligations
Residential buildings	New	Built by a project developer		●		●		●				●	
		Built by the building owner		●		●	●					●	
	Existing	Owner-occupied	Multi-family									●	●
			Free-standing				●			●	●	●	●
		Rented	Multi-family	●		●	●		●			●	●
			Free-standing						●			●	●
Commercial buildings	New	Built by a project developer		●		●	●	●				●	
		Built by the building owner		●		●	●					●	
	Existing	Owner-occupied		●	●	●	●			●	●	●	●
		Rented		●	●	●	●					●	●

Figure 1: Market segments in which the models work(2)

From figure 1 it can be concluded that leasing can be applied to any part of the built environment. However, overall, leasing is not frequently used for RES. One reason for this is that not all RES can be leased. Generally, any equipment which is an integral part of a building is to be owned by the building owner. If installed technologies become part of the building, an operational lease is impossible because for this type of lease the ownership has to remain with the lessor, i.e. the actor offering the lease. Another reason could be that other business models are financially more attractive to the consumer, and therefore getting their preference(3).

This means that for every case the best business model depends on different factors like the type of building, the type of ownership, but also existing market and policy context and organizational and financial structures.

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Energy Supply Contracting (ESC)

An Energy Service Company (ESCO) supplies useful energy, such as hot water or steam to a building owner (as opposed to final energy such as pellets or natural gas in a standard utility contract). The ESC model is particularly well suited for generating electricity and heat from RES as the ESCO might invest in RES to supply the consumer.

Energy Performance Contracting (EPC)

An ESCO guarantees energy cost savings in comparison to a historical (or calculated) energy cost baseline. For its services and the savings guarantee the ESCO receives a performance-based remuneration. In this model, the value to the consumer exists of guaranteed cost savings, while the ESCO will make the required investments to produce these cost savings.

Integrated Energy Contracting (IEC)

The IEC model is a hybrid of ESC and EPC aiming to combine supply of useful energy, preferably from renewable sources with energy conservation measures in the entire building. The model is currently being piloted in Austria and Germany(1).

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Back-up requirements

Key concepts

As with every kind of electricity generation resource, some amount of back-up power must be available for renewable energy sources. However, where for conventional generation this amount is only a small share of the installed capacity, for wind and solar back-up must be available for (almost) the full installed capacity because of the low “capacity credit”. Because of the inconstant and difficult to predict nature of solar and wind energy this back-up also has to be able to respond quickly. From the point of view of moving towards a low-carbon energy system, the preferred back-up sources should also be renewable and the best renewable source of back-up so far is hydropower.

Hydropower

Hydropower is already being used as a back-up source, though mostly for short-term balancing (within a day). There is a physical limit to the back-up capacity from hydro-electricity due to a limited number of available sites. Even if the total technical hydropower potential would be developed and made available for back-up, capacity would still fall far short of what is required to back-up large shares of renewable energy.

Natural gas

This means that another (fossil) source of back-up power has to be available. Gas-fired power generation is the most economic and environmentally efficient back-up for renewable energy. Not only is coal more expensive as a backup (based on the levelized cost of energy instead of the variable costs), it also is more polluting and less responsive to changes in power demand(1)

Publications

1. Wind and Gas. Back-up or Back-out “That’s the question”. Nora Méray. Clingendael International Energy Program (CIEP). The Hague: CIEP, 2011

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Case studies – co-location natural gas and renewable energy

Key concepts

There are different manners in which natural gas and renewable energy sources can be combined through co-location or sharing parts of the installation. So far, the most common option is a combined cycle gas turbine (CCGT) with a concentrated solar power (CSP) installation. The two installations can share use of the steam turbine, thereby saving on the cost of hardware and improving overall efficiency. Other options include sharing grid connections for wind parks and gas-fired power plants and combining geothermal energy with other renewable energy sources. Some examples using natural gas or biogas and renewable energy are discussed next.

ISCCS Ain Beni Mathar

Morocco's ISCCS (integrated solar-combined cycle system) is the world's first integrated natural gas and CSP power plant, designed and built as a complementary hybrid facility.

ISCCS is widely regarded as a 'bridge technology' between fossil fuel and solar energy production. These plants integrate solar steam into the steam turbine of a CCGT power plant for preheating/superheating the steam, a tactic that approximately doubles steam turbine capacity. Particularly suited for North Africa and Southern Europe, similar projects have since been completed in Algeria (ISCCS Hassi R'Mel, 2011) and Egypt (ISCCS Al Kuryamat, 2012) (1).

FPL Martin Next Generation Solar Energy Center

Florida Power & Light's (FPL) Martin Next Generation Energy Center plant is the first ISCCS power plant to be developed in the United States. The facility includes a field of 190,000 parabolic mirrors which heats synthetic oil to temperatures of 398 degrees Celsius. The superheated oil is run through a heat exchange system and used to generate steam to supplement four CCGT units. Because this is a retrofit of an existing fossil fuel generation plant to incorporate CSP, there is no need to purchase and install new turbines and other generation infrastructure. FPL has stated that the cost of integrating the solar field is 20% less than building a standalone CSP facility (2).

Dervish solar-wind-gas hybrid in Karaman, Turkey

A new hybrid power plant to be built in Turkey will combine a traditional gas-fired combined cycle power plant with solar thermal power and wind power. The bulk of the capacity will be supplied by the 450 MW CCGT. The solar component consists of a 50 MW CSP facility, supplying superheated steam to the steam cycle of the CCGT. A small wind farm connected to the plant will provide another 22 megawatts of power. The varying systems can share a control center as well as connections to the grid, which can make them cheaper and easier to integrate.

The plant is expected to be operational by 2015, and an increase of total capacity to over 1GW has already been approved by the Turkish Ministry, allowing a second solar-gas hybrid plant to be built (3).

Apple Maiden iCloud Data Center

The Apple data center in North Carolina is the world's largest non-utility fuel cell installation, largest SOFC (solid oxide fuel cell) installation, and the largest end-user private ownership solar array in the United States

The plant includes a 20 MW photovoltaic solar array, a 4.8 MW fuel cell installation, and there are plans for an additional 20 MW solar array nearby. Apple is hoping to get a boost from the sun to power its rapidly growing cloud services. It is also using a large fuel-cell installation in an effort to get completely off the electrical grid. Apple indicates that the solar arrays, coupled with the fuel cell installation, will produce 60% of the power used by the data center (4).

Extensions
Hybrid Solar Power Plant in Florida by FPL (Youtube)

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1. Fundamentals of Renewable Energy Case Study – Hybrid systems – ISCCS Ain Beni Mathar. 14 January 2013http://www.cleanenergyactionproject.com/CleanEnergyActionProject/Hybrid_Renewable_Energy_Systems_Case_Studies_files/ISCCS%20Ain%20Beni%20Mathar.pdf

2. CS.FPL Martin Next Generation Solar Energy Center - Hybrid Renewable Energy Systems Case Studies. 15 January 2013http://www.cleanenergyactionproject.com/CleanEnergyActionProject/CS.FPL_Martin_Next_Generation_Solar_Energy_Center___Hybrid_Renewable_Energy_Systems_Case_Studies.html

3. GE touts hybrid gas, solar energy and wind power plant as answer to energy crisis | REVE. 11 January 2013 http://www.evwind.es/2011/11/23/ge-touts-hybrid-gas-solar-energy-and-wind-power-plant-as-answer-to-energy-crisis/14832/

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Case studies of gas and renewables

A variety of case studies combining the use of gas and renewables are provided in the list below.

Co-location of natural gas and renewable energy

There are a number of different possibilities to combine natural gas and renewable energy sources through co-location or shared parts of an installation. So far, the most common option is combining a Combined Cycle Gas Turbine (CCGT) with a Concentrated Solar Power (CSP) installation. Other options include sharing grid connections for wind parks and gas-fired power plants and combining geothermal energy with other renewable energy sources.

Power2Gas

Power2Gas is a promising solution to the intermittency problems associated with solar and wind power and there are a number of pilot projects on-going in Europe. In some cases the produced gas is stored on-site and used when necessary to produce power, in other cases it is fed into the natural gas system and used as normal natural gas.

The Canary Islands

The Canary Islands are a prime example of how an isolated group of islands can harness renewable energy and natural gas to strengthen their energy supply while reducing costs and reliance on oil fuels.

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