



Why companies do district heating – the business model perspective on network expansion and renewable sources of energy

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“WHY COMPANIES DO DISTRICT HEATING -THE BUSINESS MODEL PERSPECTIVE ON NETWORK EXPANSION AND RENEWABLE SOURCES OF ENERGY”

FOR THE PROCEEDINGS OF THE SDH CONFERENCE 2014

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Abstract – The following paper is based on a master’s research project among district heating companies in Germany, 2012. Interviews were conducted with 15 heating companies, 4 of which pursue /or have in the past pursued) activities in solar (district) heating. Although certain interviewed companies employ e.g. solar heating for their heating networks, they show no or at least little intention to either replicate their project in other locations and/or increase their current solitary project. They do not actively seek new market opportunities and instead seem satisfied with serving a single community. However, new business models set on to stir up the market with new services for communities.

1.1. INTRODUCTION

It is widely accepted that heating networks will be needed for future energy scenarios: They are future-proof, able to use large-scale alternative sources of energy like solar collector fields, deep geothermal, large biomass and waste energy and are comfortable for the end-user. Heating networks are a viable option to built future energy scenarios with today’s technology (Clausen and Kahle 2012).

What is needed is an economic entity that plans, builds and operates these networks to deliver solutions for costumers and thus motivates those to adopt new solutions, because a heating network involves more changes in infrastructure than other energy services (e.g. domestic gas combination of heat and power, CHP). Since heating networks face both large upfront costs paired with longtime returns on investments, this does not seem to fit a profit-oriented actor to do ‘business’ in. Therefore the underlying question of this paper is:

Which economic actor is best equipped to building new heating networks and employing renewable sources of energy?

Hence this paper aims to tackle the issue of heating networks and renewable energies from a market perspective a certain tool is needed in order to compare how today’s companies cope with this market environment.

1.2. CONCEPTUAL FOUNDATION: THE BUSINESS MODEL PERSPECTIVE

A business model explains how a company creates value for a customer – this common definition includes two benefits of the business model perspective: It is driven by the idea to create value (not per se to sell some sort of product or service) and also customer-centric. If the customer is not satisfied with future energy scenarios these scenarios will not be realized; the novel idea will not spread. It could be important to assure customers ‘gain’ some benefit from a new energy solution other than being part of the energy transition. The premise holds that if

some companies have been successful in using district heating and alternative sources of energy these businesses should differ in some components of their business model from their conventional counterparts. A business model consists of different components, such as the Value Proposition, Partners, Customer Segments, Customer Relationship, Costs, Revenue Streams, Activities, and Assets (Osterwalder)

but also of Core Competencies, Earning Logic and Path Dependency (Stähler). Especially the contributions of Osterwalder (2004) and Stähler (2002) have gained influence. This research therefor employs a mixed framework adopting parts of the business model canvas drawn up by Osterwalder, extended with components of Stähler’s framework. Wüstenhagen et al. (2008) point out that often energy solutions do not fail to gain market

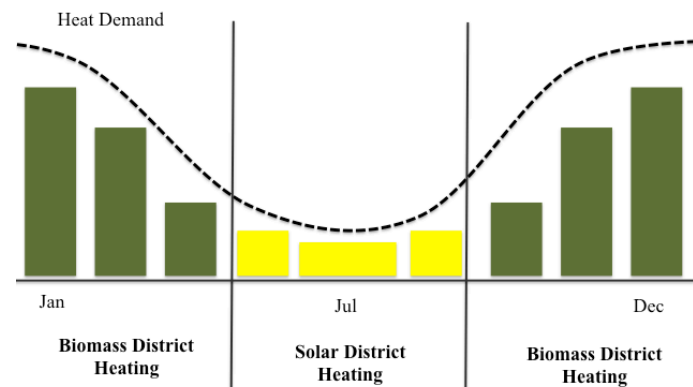


Figure 1: Idealized solar/biomass district heating business model

friction due to a lacking technical solution but instead because they are lacking a business model, i.e. a vehicle to bring the novel idea to market diffusion. Another benefit of the business model perspective lies in its analytical feasibility: in theory every single company may be analyzed by means of the business model perspective. It is both an analytical tool as well as a conceptual foundation. It is a conceptual foundation since an increasing number of researchers using the business model perspective to develop theory or contribute to existing theory (Zott et al.: 2010). The energy sector consists of different business models, ranging from planning, building and construction, over provision of energy, conversion, energy services, contracting and maintenance (see also Table 1).

1.3. RESEARCH DESIGN

This research is based on an exploratory study and uses anonymous interviews with experts of the district heating industry as method. All interviews were conducted based on a semi-structured script and afterwards fully transcribed and personal information removed. Interviews were usually conducted over the phone but also face to face. The purpose of this study was not to present a representative overview of the heating sector in general but instead to investigate as many interesting single phenomena as possible.

1.4. OBSERVATIONS:

Based on the research interviews it seems that only few companies actively develop heating networks using alternative sources of energy. Much more often near-to-market technologies such as CHP or biomass are frequently used together with a heating network. Only two examples were found for deep geothermal energy. Other sources such as large scale solar or excess heating even seem to lack a business model which triggers expansion (see Figure 4). The usage of sources like solar, excess heat and geothermal energy seems unlikely to be managed by a business model of a conventional large scale network operator on the one hand or a business model of a large thermo-technological company such as e.g. Vaillant or Viessmann on the other. Therefore the goal of this study was to investigate which actors actively build new heating networks and what sort of energy sources they employ. The interviewees of this research give various comments which indicate future scenarios for district heating: “5 years ago we derived 80% of our sales from gas networks, today we derive 80% from district heating networks. The change in sales is enormous. Nobody builds gas anymore, the gas networks have all been built between 1990 and 2000 and now there are only heating networks being built” (Comp. 3). Also interviewee 13 explains that 5 years ago his company’s sales were “70% sales in gas, 20% in water and 10% in district heating”, whereas today they are “10% water, 10% gas and 80% district heating”. He explains that until two years ago the dominant theme for companies in district heating was to consolidate and to increase the density of existing networks. But two years ago “a strong change occurred (...) new networks are constructed or heavily

extended. Networks get extended (...) by a significant amount of meters” (Comp. 13). Company 13 also plans to become a network operator in the future and thereby become a “strategic partner for the utility industry” (Comp 13). Under that business model the company will uncouple heat from energy plants, construct and operate networks and carry out distribution and sales. The interviewee describes this as a “completely different business model” (Comp. 13) which will be pursued within the next 5 to 10 years. He clarifies: “*Den Netzbetrieb zu übernehmen, das ist eine ganze andere Basis den Netzbetrieb sicherzustellen als den Netzbau. Netzbau ist ein punktuales Geschäft: Projekt anstoßen, Projekt bauen und an den Kunden übergeben, dann raus aus dem Geschäft. Währenddessen im Netzbetrieb die Sicherstellung der Netzsicherheit über den kompletten Lebenszeitraum des Netzes darstellt, also ein ganz anderes Geschäftsmodell das da hinter steckt. Und auch Geschäftsfeld, was das Sicherheitskonzept betrifft.*”

Nr.	Business Model	Interviewee	Business Focus
7	Project Developer	Project Manager	Biomass Focus
14	Project Developer	Project Manager	Consultancy for municipalities
3	Pipeline Engineering	CTO, Executive	DHC piping, Gas, Water
13	Energy Infrastructure	Department Head District Heating	Electricity, Heat, Cold
2	Project Engineering	Executive	Planning for utilities
5	Public Utility	Department Head Heat Provision	15% solar DH
6	Public Utility	Head of Marketing	City center DH
9	Public Utility	Company Procurator and Founding Member	Geothermal DH
11	Private District Heating Company	Process engineer Heating Company	100% renewable DH (Biomass)
8	Energy Contracting	Technical Project Management	Decentralized energy systems
4	Energy Contracting	CTO	Decentralized energy systems
10	Special Purpose Association	General manager	Geothermal DH
1	Networked Model of large enterprise	Head of Distribution Sales	Coal-fired district heating
15	Private District Heating Company	CTO / CEO	Regional operator
12	Networked Model of large enterprise	Head of Customer Acquisition	Nationwide operator
16	Networked model of large enterprise	Heads of Marketing and Sales	Nationwide operator

Table 1: List of Interviewed Companies

RESEARCH QUESTION 1 EXPANSION OF DISTRICT HEATING

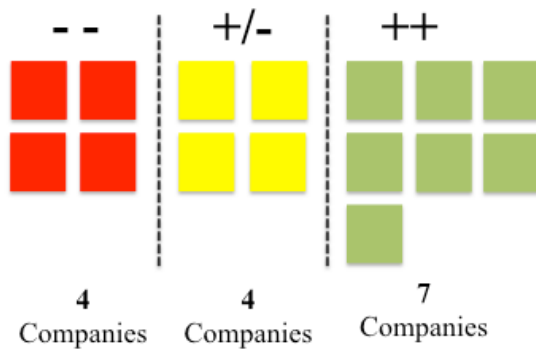


Figure 3: Expansion of District Heating

Progressive business models expand district heating: project developers and green utilities

Seven interviewees provided comments that indicate significant expansion activity of their companies (see Figure 2). Among these companies are two planning companies, one of which in addition plans to evolve from a project developer into a network operator (Business model transformation). Also some network operators (companies 15, 12 & 11) pursue active expansion of district heating. For example company 12 follows a general growth strategy and expands district heating networks based on renewable energy from biogas and wood-chips and energy from large fossil CHP. Company 11 owns and operates two wood-chip heating plants to supply a heating network in a dense city center. In addition it is active in district heating in municipalities and actively develops new networks in neighboring municipalities. It derives minor sales from energy contracting. Unlike other utilities or private energy companies this company only sells heat through district heating and electricity but no natural gas. Both heat and electricity are generated primarily with renewable sources of energy. Most important today are the large wood-chip plants which have begun operations in 2011, for which currently the district heating network is build and expended into the city. Interviewee 11 stresses that the district heating project in a nearby municipality is still in planning status because consumer willingness to connect to the grid is still too low. However, the company actively persuades private customers (B2C) and institutional customers (B2B) in order to supply large amounts of heat. "It is our goal, to feed both our city heating network as well as our district heating networks with renewable heat energy" the interviewee explains.

Accommodative business models: energy contracting companies and renewable innovators

Two energy service companies (Comp. 4, 8) develop district heating in contested B2B energy markets. Company 4 is an energy service provider which operates over 700 heating plants nationwide to supply shopping malls, public property and apartment-units with heat, warm water and cold. Company 8 in general offers district heating, but from the last 40-50 projects overseen by the

interviewee only a limited number have been district heating projects whereas in most projects smaller CHP-units have been deployed without explicitly setting up a district heating network.

Availability of energy sources can be a motive to expand heating networks. Regional energy provider (9) operates a heating network supplied through deep geothermal energy and plans to develop into a neighbor community as soon as political obstacles are removed. Company 9 is already a network operator but according to the interviewee it faces two possible future scenarios: Either the company integrates consumer-side services ('Sekundärseite Versorgung') into its business model or it evolves into a full scale energy provider ('Vollversorger') including electricity, adopting the business model of a utility. Company 6 built a network around biomass and solar collector fields but has stopped expanding years ago.

Defensive business models: The remaining four companies show only limited expansion activity: local utilities, larger utilities (1,16) and another geothermal network operator. Two public heating companies (5, 6) expand and condense their heating network based on plans of local authorities and show at best marginal initiative to expand into markets in new regions. However, the company is offering "green heat" (Comp. 1) if the consumers are willing to pay a price premium. The interviewee explains, that "if the consumers wants better heat, than he will get it from us" (1). Company 16 also plans to condense its existing network: "We will continue business as usual as before".

RESEARCH QUESTION 2: RENEWABLE SOURCES OF ENERGY

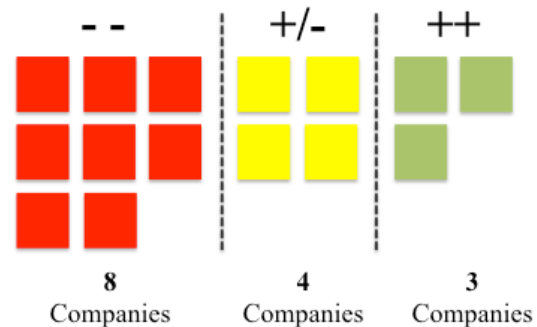


Figure 3: Alternative Sources of Energy

To what extent do current business models encourage the integration of alternative sources of energy into district heating networks in Germany? Less business models seem to encourage new sources of energy than expansion of heating networks. Some network operators actively integrate renewable sources of energy into district heating networks (12) or set up district heating exclusively for renewable energy (11) or develop projects for renewables (7, 14). Yet only three of the interviewed companies actively pursue means to integrate different sources of renewable energies into district heating networks.

The Project developer (7) uses biogas, wood chips and natural gas. The interviewee does not recall a recent project in which excess heat was successfully integrated into a district heating network. Geothermal energy however is viewed promising, only high costs for exploration and drilling weaken near future potential of this energy source, according to interviewee 7. Solar-thermal energy is suggested for domestic purposes only, in these cases it could supply the base load for a detached house while peak loads could be met through small wood chip heating. In opinion of interviewee 7 this however is

only viable for single houses and not applicable to district heating networks.

Renewable network operator (11) provides district heating to private and public customers, based entirely on renewable heat from two large wood chip heating plants including an ORC-module. Currently the company evaluates options to operate a biogas plant. It is unsure whether to feed it directly into a CHP-unit and harvest electricity and excess heat on site or whether to enrich the biogas to standards under which it can be fed into the natural gas networks in form of bio-methane.

Greening network operator (12) undergoes a transformation from fossil fuels into renewables (business model transformation). The interviewee stresses geothermal energy and biogas as most relevant future energy sources in the heating sector. He observes that many recently built biogas plants are operated to generate electricity based on the favorable feed-in tariff but fail to use excess heat of the combustion. As a consequence company 12 is involved in biogas facilities connected to district heating networks and also actively works in lobby groups and industry associations in order to use excess heat from biogas plants. In addition the company is involved in different geothermal projects and in industrial excess heat projects.

Energy contracting companies (4,8) form a homogeneous group yet again: Both demonstrate modest activities to integrate alternative sources of energy into their generation facilities. Both companies are not bound by tangible assets in form of large-scale fossil heating plants. Instead they focus on decentralized solutions to supply heat energy (and in cases electricity) to their B2B-customers. One interviewee identifies financing of projects as general means for his company to contribute to the integration of renewable energies into the heating sector. He explains that even if today much capital flows into wind energy projects, various key

technologies have not attracted capital yet. “This is what a bigger company can do”, he elaborates. It is necessary to “try things a smaller company could not recover from if the project fails”. Both companies plan to employ new technologies as soon as those reach market maturity.

Incumbent energy companies (16,1) don’t seem to fit this description: “We are not married to any technology - yet we invested into a certain technology a while ago and this needs to run a certain time, but bottom line is that we like to employ a new technology if it can be operated profitably or if customers are willing to pay the additional costs” (Comp. 1) :“We follow the trend - the consumer is in charge. If he wants better warmth and is willing to pay for it, he will get it from us”.

Renewable Innovators unable to scale up „We are bound by our founding purpose”, interviewee 10 explains. “It is not our goal to begin own initiatives in solar thermal energy or anything alike because it’s simply not our mandate”. In addition the company needs to defend the profitability of its geothermal heat source against competing renewable heat sources. For example solar-thermal energy could have a negative effect on the profitability of the geothermal heat source, especially during summer when it would generate large amounts of energy at costs falling below marginal costs of geothermal energy. This points to a situation in which renewable sources of energy not only face competition from fossil fuel technologies but also from other renewable sources of energy!

Also regional network operator (5) began as a landmark-project which over 20 years ago, but interviewee 5 views his company as “too small to be able to make a contribution” in this field, although the company has constructed large scale solar-thermal collector fields and a wood-chip plant 20 years ago.

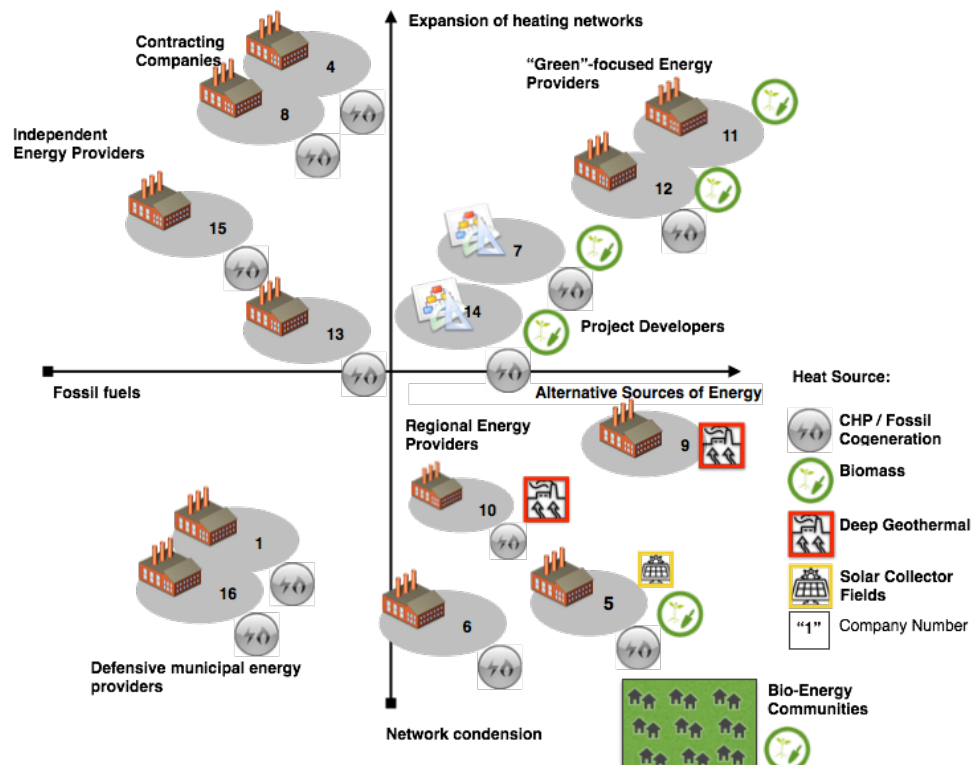


Figure 4: Integrated presentation of results: Companies at the top right of the matrix actively expand district heating and renewable sources of energy

1.5. SUMMARY OF OBSERVATIONS:

Especially the business models of independent energy companies (15, 12), energy contracting companies (4, 8) project developing (7,13) and 'green' utilities (11) seem to actively expand heating networks. On the other hand certain business models encourage only expansion of district heating networks (network operator 15, contracting companies 4 & 8) but not explicitly the integration for alternative sources of energy. Also only few business models encourage the integration of alternative sources of energy such as geothermal (regional utilities 9 &10) and solar energy (regional utility 5), whereas large woodchip (regional green utility 11) and large fossil CHP (national operator 12) are frequently used in current business models. Other business models such as classic utilities (1,16), conventional district heating (15) and energy contracting (4,8) show less initiative to integrate alternative sources of energy. On the other hand, certain business models which encourage the integration of alternative energy sources do not exhibit desire to expand their business cases towards new markets. This is especially true for the business models, which have a limited mandate, such as regional utilities 5,6,9 and 10 (see Figure 4).

1.6. DISCUSSION OF RESULTS FROM A BUSINESS MODEL PERSPECTIVE

1.7. THE VALUE PROPOSITION:

This research indicates that new value propositions offered through project development companies, consultancies and network engineering and construction companies could play a key role for the transformation of the energy system. A project developing company (see 7, 14) does not satisfy the demand for a warm home but instead solves the complex task to integrate regional energy sources with regional consumption patterns. A network construction company has capabilities and resources to manage complex infrastructure projects which network operators did not integrate into their business models (3, 13).

1.8. LEVELS OF VALUE CREATION

This research also indicates that companies, which actively pursue district heating and alternative sources of energy seek to integrate new levels of value creation into their business model instead of focusing on niche markets or small parts of the value chain. This implies that certain network operators aim to reduce transaction costs along the value chain (11, 4, 8) while other companies decided to focus on a small part of value creation and seek strategic partnerships (14, 10, 9). Marutt (2011) argues that vertical integration helps energy companies to reduce costs ('Cost Shifting') along the value chain but also increases pressure on other market actors (ibid.: 10). Problems of 'vertical integration' such as inefficient price-mechanisms have already become apparent in the electricity sector (DENA 2012b: 33), which casts doubt on the longterm side-effects of vertical integration in the heat market. This leads to a question whether to set up a supply side or a demand side oriented business model:

Company 11 (green utility) expands district heating networks based on large wood chip plants. Richter (2012) argues that German utilities favor supply side business models for renewable energy sources over customer-side business models. This research contributes that heating companies apparently not exclusively rely on supply side business models but in some cases develop a network on behalf of a municipality and then transfer network management on the municipality itself (customer-side business model).

1.9. PARTNERS OF VALUE CREATION

In analogy to vertical integration also partnerships play an important role for a business model in district heating. Few levels of value creation seem to stress the need for partnerships as part of the business model in order for the company to fulfill its value proposition: For example company 10 owns geothermal wells and a heating network but network maintenance and customer services are provided by another company (in this case the national network operator 12). This also corresponds to the business model for 'public private partnership' identified by Okkonen and Suhonen (2010). Which also relates to the findings of Wüstenhagen and Boehnke (2008), who propose that small energy companies need to focus on a small part of value creation and "avoid head-on competition" with established energy companies. Other companies (e.g. local utility 10) are encouraged to share their learning on innovations with partners but are not encouraged to explore new business opportunities. Neither are they encouraged to increase their 'learning rate' because they do not actively duplicate their business case

1.10. CORE COMPETENCIES AND RESOURCES

Alternative sources of energy are likely to require specific competencies from companies (Jacobsson and Bergek 2004). The question is which business models encourage the organization to develop capabilities necessary for sustainable energy system. Again this research indicates that competencies nurtured by current business models in the heating industry by tendency penalize radical innovations. The key problem appears that some business models 'guide' companies to increase their competencies for efficiency technologies (national energy providers 4, 8, 15), while other business models guide companies to collect capabilities but fail to motivate them to expand to new markets and replicate projects (regional utilities 10, 9, 5, 6).

Although energy-contracting companies (4,8) have not engaged significantly in alternative sources of energy yet, these companies are active at two levels of value creation (planning and network operation). Such a business model based on specific projects rather than continuous management of the same heating network seems to induce expansion of district heating networks and create 'learning curves'. Christiansson (1995: 18) has shown that the R&D phase and repeated implementation of technologies stimulate more learning effects than continuous management of technologies over time. As a consequence their

current business model encourages these company to foster and incrementally optimize capabilities regarding matured technologies, which focus on efficiency but not on radical innovations. Ergo energy contracting companies could be in a position to contribute to the integration of alternative sources of energy in the future as soon as they begin to repeatedly employ alternative sources of energy and begin to rapidly generate learning effects on how to design proper contracts and project execution plans for these technologies as well (Meinefeld 2004).

Companies 4 and 8 experiment with new technologies but not decisively with new business models. This can be described as the strategy of a ‘fast follower’ or ‘fast second’. Markides and Geroski (2004) show how various companies were able to profit from quickly assimilating radical innovations after those had been brought to the market by other companies. Schaltegger and Wagner (2011) argue that companies which employ the strategy of “fast second” will be key players in transformation of industries for they combine “complementary assets” which could accelerate the diffusion of a radical innovation (ibid.). Relevant assets in this case could be wide customer reach due to the national market in which certain energy contracting companies operate as well as their business model which prefers replication logic. This in turn could trigger learning effects for alternative sources of energy, once those technologies are integrated into the business models of contracting companies, or once the companies add new business models for new technologies.

1.11. EARNING LOGICS AND REVENUE STREAMS

Either a company earns once per customer (transactional sales) or it raises recurring revenues through repeated sales per customer (Osterwalder and Pigneur 2010). The dominant earning logic of the energy sector is recurring revenue streams per customer (price per energy unit). This poses a challenge to Sustainable Development since sales are based on intensifying consumption of energy - not on reducing consumption of energy (WBGU 2011). This research indicates that some business models in district heating have found ways to align their financial goals with sustainability goals: While some seek to maximize revenue (e.g. Comp. 1,16), others seek to break even and recover investment costs and become self-sustaining communities (e.g. certain customers of Comp. 7 and 14): “Für die größeren Netze braucht es aktive Stadtwerke, dort ist die Renditefrage relevant, wohingegen eine kleinere Gemeinde auch einmal über 3 Jahre hinweg eine Null vor dem Komma akzeptiert” (Comp 14). While this serves the local community well, there is no inherent driver to expand the business model to other communities - implying that the push to expand self-supporting communities must not necessarily stem from the communities themselves, but instead from business models like project developers, which draw revenue not from recurring sales of energy but from transactional sales based on individual projects. Various companies have raised concerns that they could not operate a district

heating network profitably because recurring revenues were expected to be insufficient. Hence they transfer some of the investment costs onto the customer, in addition to his monthly service charge. Company 11 however innovated its revenue model so that private customers are charged a fixed price per unit of energy sales but they do not have to pay any upfront investments for piping to connect the house to the network.

1.12. PATH DEPENDENCY OF THE BUSINESS MODEL: TO NEW BEGINNINGS

Stähler (2002) proposes to investigate how quickly a business model can be transformed to adopt a new configuration of value creation (ibid.: 34). This research yields findings which relate to the concept of ‘path dependencies’ in the energy sector as suggested by Cimoli and Porcile (2009); Geels and Schot (2007); Hillman and Sandén (2008). However, fixed assets and a stable configuration of value creation of a company seem to play a twofold role for the expansion of heating networks and integration of alternative sources of energy: On the one hand companies 1, 16, 5 and 6 employ a stable, in that way, path-dependent architecture for value creation which relies to a significant extent on fossil fuels. Thus these past investments in generation facilities hinder the company to quickly uptake new technologies and alternative energy sources because investments have to amortize over time or because revenue streams from these investments are steady. In contrast, revenues from renewable sources are only expected after investment for new facilities have been recovered. Companies 1,12 and 16 correspond to “network models of large enterprises” (Okkonen and Suhonen 2010) and have developed strategies to cope with path-dependency through business model adjustments. Based on observations of the current heating industry one could argue that large-scale facilities bind companies to certain alternative sources of energy such as geothermal (9,10) or wood-fired (11) as other companies are bound by large-scale fossil generation capacities (1,16). Other companies (4, 8) employ a dynamic architecture of value creation. This business model combines aspects of project development with the management of networks and generation capacities. One could argue that these business models support expansion of heating networks as they successively develop new projects. On the other hand, business models which depend on projects will have to pursue those in order to maintain sales revenues. Hence the company is encouraged to employ a ‘safe solution’ and satisfy its customers instead of employing alternative sources of energy. This could explain why the energy contracting companies actively expand the number of individual heating networks but seem to have less success or show less effort to promote alternative sources of energy.

1.13. CONCLUSIONS ON BUSINESS MODELS IN DISTRICT HEATING

(1) A stable architecture of value creation does not inherently hinder the evolution of the heating industry, as long as the company has set up an architecture consisting of different levels of value creation (e.g. planning, operation and distribution) in order to maintain the potential to include alternative sources of energy into its generation capacities.

(2) Dynamic architectures of value creation contribute to the expansion of district heating networks but fail to integrate alternative sources of energy due to a price-competitive market that encourages companies to prefer developed technologies over radical innovations. However, these companies do contribute to building the infrastructure for sustainable energy systems since they aggregate energy consumers towards a central source of energy. Existing networks can then be equipped with new source of energy, given availability of such sources. Therefore these companies will have to significantly increase experimentation and prototyping of new business models for alternative sources of energy in the future.

(3) Certain alternative sources of energy (deep geothermal energy, solar energy, waste energy) lack a business model which encourages expansion to new markets. Mature technologies like fossil- and biomass CHP seem to encourage regional vertical integration whereas radical technologies for alternative sources of energy seem to demand strategic partnerships between regional and national actors. Actors who have access to an alternative energy source hence either need to develop a regional energy company with different levels of value creation to avoid dependency on a single source or they can partner with a national network operator and thus focus on a smaller part of value creation.

Current business models for network operators follow an earning logic of recurring revenues based on sales of energy and thus encourage companies to identify additional areas of heat demand and to build and operate networks to supply consumers with price-competitive heat from fossil CHP or biomass- CHP. Heating companies employ only those technologies in district heating networks they have most experience with in order to ensure security of supply. This does not promote the full range of alternative sources of energy yet but it creates infrastructure that can later be equipped with alternative sources.

Since recently a number of project developers drive momentum for small scale biomass projects from the beginning of the value chain. They explore possibilities to use heat energy from biomass-powered CHP for specific customer segments like smaller municipalities and local heat cooperatives. Biomass can be stored and transported which evades the storage-problem other sources of energy face. However, biomass and wood-chip in essence continue the logic of the old fossil energy systems. Also biomass is limited and cannot sustain the energy demand of the future (Nitsch et al. 2012: 129) which means that a shift away from burning resources of any kind (natural

gas, biogas, biomass or bio-methane) will become necessary. Yet one finds only few initiatives in pursuit of completely novel energy sources at the beginning of the value chain. It seems that many project developers become active upon request of operators or of local administrations, but only seldom do they pursue their own business case, which favors energy sources other than biomass and fossil CHP. This configuration of actors is unlikely to foster the uptake of radical innovations such as geothermal energy sources or solar-collector fields. Hence new actors will have to engage in the heating market and develop momentum for new business models for other sources of energy such as deep geothermal energy, solar-collector fields and waste heat.

New business models will need to follow a holistic approach, taking into account availability of alternative sources of energy and match these to a specific energy demand. Consequently a business model is not only conceptualized as a means to satisfy an energy demand but also as a vehicle to exploit alternative sources of energy: "Industry customers are very price-sensitive. Then all of a sudden a farmer constructs a biogas-plant next to an industrial facility and literally gives the heat energy away for free. You cannot compete with that" (Comp. 16)."

Sustainable energy systems hence require more businesses similar to companies renewable project developers (14, 7 & 13), and also renewable network operators (11 & 12) because these companies offer a value proposition which offers different customers segments (municipalities, housing industry, process industry) a convenient way to contribute to Sustainable Development. According to this logic the following business models will become important:

National Market:

- **Planning and project development for solar energy**
- **Planning and project development for geothermal energy**
- **planning and project development for waste heat**
- **Franchising companies for standardized product/service bundles**

Regional Market:

- **Regional operators of large scale CHP and biomass heating plants**
- **'Spin-offs' from project developers, i.e. new regional network operators for new alternative sources of energy**

This demands a new kind of business, which actively uses its possibilities through its business case and refuses to regard itself as "too small to make a difference" (Comp. 5). Also established companies need to overcome a 'the-consumer-is-in-charge'-attitude (Comp. 1) and instead use their financial resources to experiment with new business models for new energy technology in order to contribute to new energy systems. Instead of waiting

for the business model environment to change, they will need to innovate their business model and take responsibility for their impact on patterns of production and consumption (Parrish and Foxon 2009) and thereby also unlock future business cases and profits. This is already pursued by company 11: “We always try to persuade municipalities to use renewable sources of energy. This has been always successful so far” (Comp. 11).

The majority of companies in this study seem to protect their business models. This finding aligns with Okkonen and Suhonen (2010) who argue that public utilities tend to depend significantly on the local administration. The same is true for company 10, which protects its business model not only from competition based on fossil fuels but, even more compelling, from competing sources of renewable energy. It is therefore suggested that companies need a portfolio of business models and not only a portfolio of products and services (Osterwalder 2004: 22) in order to meet the demands of a changing market environment and to minimize risk (Raynor 2007).

A recent example which could not be included into the original research is the case of bioenergy community Büsingen planned and realized by Solarcomplex GmbH (2013) (see Figure 1). In this case a biomass fed district heating network is complemented through large scale solar panels during peak solar irradiance in summer time. This fits close to a near perfect business model adaptation for renewable energies in which two different sources are combined. This is ever more interesting as other companies investigated fail to integrate different heat sources at the same time. As a consequence this company could serve as a fruitful prototype to research further.

The findings are twofold: First, there are business models other than conventional network operators, which increase the expansion of heating networks (e.g. business models for contractors and project developers). Yet on the other hand many operators (e.g. regional municipalities) of technologies such as solar district heating currently employ a business model, which does not seem to incentivize scaling of alternative technologies. Heating companies employ only those technologies in district heating networks they have most experience with in order to ensure security of supply. This does not promote the full range of alternative sources of energy yet but it creates infrastructure, which can later be equipped with alternative sources of energy.

As a result of this study it is to be stated that today conditions and market costs of both solar thermal energy and excess heat energy apparently do not allow the usage of these technologies for a sustainable heating future. Also long term heat storages are not developed, although they were necessary to compensate for fluctuating sources such as solar thermal energy.

New business models will be needed to accelerate the transition towards sustainable energy systems. Existing companies need to increase prototyping of new technologies and corresponding business models and new businesses will have to enter the heating sector to offer new bundles of products and services to business-to-business customers. Actors who have access to alternative energy

sources hence either need to develop a regional energy company with different levels of value creation to avoid dependency on a single source of energy or they need to partner with a national network operator and thus focus on a smaller part of value creation. The business model analysis has shown, that especially energy contracting companies will have to adopt their business model in order to frequently propose alternative sources of energy to their customers and creating learning curves. Project developers on the other side need to focus more explicitly on new energy sources and organize demand accordingly to use district heating. Thus working closely together with communities in order to help them become ever more self-sustaining communities. Learning effects from respective projects can than be transferred upon new projects through the personnel of project developers and contracting companies (Figure below).

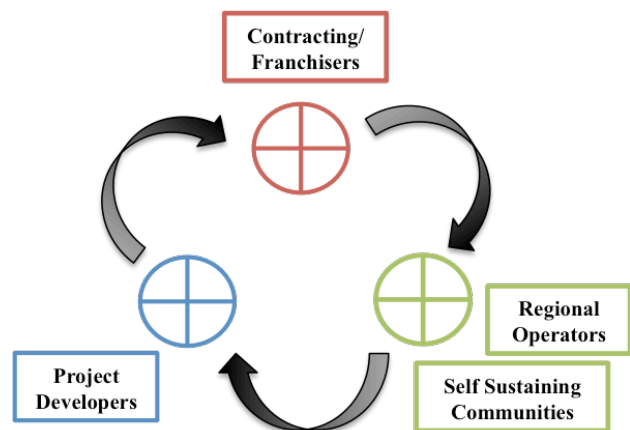


Figure 5: Outlook of the interplay between new business models for district heating in the future

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