Community-led Renewable Energy Business Models for the Czech Energy Sector Transition

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Doctoral Thesis Summary

Tomas Bata University in Zlín

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Faculty of Management and Economics

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Obchodní modely pro komunitní obnovitelnou energetiku v procesu transformace českého energetického sektoru

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SUMMARY

The global energy sector has been going through turbulent times. The disputes and uncertainties between the future of fossil fuel and that of renewable energy build the basis for energy transition. The transition to low carbon energy systems has been on the way with increasing intensity in recent years and is also supported by global policy outcomes, such as the Paris climate agreement. Many scientific questions have appeared in this context about the types and forms of stakeholder participation, ownership issues, financial consequences, and increasingly sociological aspects. Even though historically centralised energy systems used to be economically efficient, local energy systems are promising because of both energy self-sufficiency and sustainability perspectives. Being an important pillar of this dissertation thesis, emerging local energy systems could thus provide potential contribution towards climate objectives. Changing energy business models needs to also take interested customers into consideration, who represent a shift from passive consumers to active energy prosumers. Thus huge research opportunities have emerged in the area of energy business model set up, such as the roles of new entrants versus established industry players.

As the Czech energy sector has been going through rapid transition in recent years as well, this dissertation thesis concentrates specifically on the aspects of energy transitions in the Czech Republic. Even though there has been some empirical evidence of sustainable energy initiatives at the local level, very few written sources are devoted to the emerging research area of local energy business models for the Czech Republic. Subsequently, this is reflected in the basic idea of the dissertation topic, which deals with the community-led renewable energy potential and the local sustainability initiatives in the Czech Republic.

The identification of factors influencing the diffusion of decentralised renewable energy sources at the community level in the Czech Republic is still in their initial phase. There is also a lack of systematic insights into energy business modelling in the Czech environment. A multidisciplinary and mixed method approach was chosen, combining the qualitative and quantitative research input from workshop, case studies, questionnaire, and feasible energy data analyses. The whole spectrum of stakeholders has been mapped and local initiatives undertaken for the in-depth analysis. As they represent the target, community-led renewable energy business models and value propositions together with a community-led energy policy framework are identified. The dissertation intends thus to contribute towards renewable energy initiatives reflecting also those opportunities and synergies found in the cooperation among sectors in small-scale energy management. In this context, community energy and Czech national energy policy recommendations are formulated in conclusion utilising innovative combination of the value proposition canvas and business model canvas tools together with a stakeholder helix model and triple bottom line concept.

RESUMÉ

Globální energetický sektor prochází již několik let turbulentními časy. Značná nejistota se odráží ve vizích přechodu budoucí energetiky od fosilních zdrojů směrem k obnovitelným zdrojům a tvoří podklad pro současnou transformaci energetiky. Tento přechod, nabývající poslední roky na intenzitě, je podpořen taky globálně, například Pařížskou klimatickou dohodou. V této souvislosti se otevírá mnoho vědeckých otázek zahrnujících typy a formy účasti různých zainteresovaných stran, otázky vlastnictví, finanční dopady a ve zvýšené míře také sociologické aspekty. Navzdory historické ekonomické výhodnosti centralizovaných energetických systémů, nabývají lokální systémy na atraktivitě v důsledků důležitosti parametrů, jako jsou energetická soběstačnost a udržitelnost. Lokální energetické systémy potenciálně představují příspěvek k řešení klimatických závazků. Na druhé straně, z mikro pohledu, energetické obchodní modely musí reflektovat změny v zákaznickém chování, a to posun od pasivního zákazníka směrem k aktivnímu zákazníku typu "prosumer". Otevírá se tak široké pole vědeckého potenciálu v oblasti nastavování obchodních modelů a definice rolí nových aktérů v porovnání s etablovanými energetickými hráči.

Vzhledem k tomu, že český energetický sektor těmito zásadními změnami v posledních letech taktéž prochází, dizertační práce se zabývá právě aspekty přechodu české energetiky na decentralizovanou a dekarbonizovanou. I když se v této oblasti objevují ojedinělé iniciativy, vědecká literatura reflektuje aktuální dění jenom v omezené míře. Dizertační práce se proto konkrétně myšlence potenciálu lokální komunitní obnovitelné energetiky a lokálních energetických iniciativ v České republice z různých úhlů pohledu věnuje.

Identifikace faktorů ovlivňujících rozšíření lokálních obnovitelných energetických zdrojů je v našich končinách na počátku. Rovněž systematické rozpracování praktických aspektů tvorby obchodních modelů vyžaduje zvýšenou pozornost. V dizertační práci je zvolen multidisciplární přístup v kombinaci s různými metodami zahrnujícími kvantitativní a kvalitativní výzkum. Formou workshopu, případových studií, dotazníků a analýzy dostupných energetických dat je mapováno celé spektrum zainteresovaných stran s cílem identifikace konkrétních obchodních modelů. Cílem dizertační práce je tedy identifikace obchodních modelů a hodnotových vazeb pro komunitní obnovitelné energetické systémy a koncepce komunitní energetické politiky zohledňující tyto vazby s využitím nástrojů value proposition canvas, business model canvas, stakeholder helix model a konceptu trojí odpovědnosti. Dizertační práce si tak klade za cíl přispět k rozšíření poznatků a praktických pohledů lokálních energetických iniciativ, reflektujíc zároveň možnosti mezisektorové spolupráce. V této souvislosti jsou závěrem formulována obecná doporučení jak pro komunitní energetické projekty, tak pro lokální českou energetickou politiku.

CONTENT

LIST OF FIGURES AND TABLES

INTRODUCTION

Think (Energy) Globally, Act (Energy) Locally

The core essence of energy transitions in the process of decarbonisation is replacement of fossil fuels by increased reliance on low carbon sources of renewable energy (Smil, 2016). This transition has been driven by increased energy demand by new appliances, converters, and together with more efficient final consumption and later environmental considerations has led to national and supra national policy agreements on greenhouse gas emissions (GHG) since 1980s.

Although centralised energy systems used to be economically efficient, local energy systems are crucial from both energy self-sufficiency and sustainability perspectives (Koirala et al., 2016). Modified business models reflect these changes and need to be investigated in detail. Being important pillars of the thesis, local energy systems could provide potential contribution towards climate objectives. According to some authors (Subbarao & Lloyd, 2011), many energy projects were found to have active community involvement and took often form of a cooperative. Energy landscape towards decentralized low carbon energy systems and new roles for local communities are presented by renewable-based production. Moreover, these new systems need to consider interested customers shifting from passive consumers to active energy prosumers.

Even though there has been some empirical evidence of sustainable energy initiatives at the local level, very few written sources are devoted to the emerging research area of local energy business models specifically for the Czech Republic. The Czech energy sector is governed by a vague energy policy, missing systematic approach to community energy project data and emerging community projects are based on diversified value proposition designs. The aim of the dissertation is a comparison and conceptualisation of community energy business models together with energy policy recommendations involving helix stakeholder structure and business model canvas framework. The dissertation intends thus to contribute towards local renewable energy initiatives reflecting also opportunities and synergies found in the cooperation of public, private, academic and civil sectors in community-led energy management. Furthermore, the thesis belongs to the recently blooming research field of energy social science, energy-SSH, which is described by Sovacool et al. as application of social science disciplines to the energy study (Sovacool, Axsen, & Sorrell, 2018).

The basic underlying framework concept crucial for the dissertation thesis is Zeleny´s transformational process from globalization to localisation (2012). Further, the transition of the energy sector from a fossil fuelled society to non-fossil fuelled society is reflected in this thesis, as elaborated by Smil (2016). The specific Czech energy sector transition assessment is based on the diffusion of innovation theory (Rogers, 2010). The multiple helix stakeholder theory (Calzada

& Cowie, 2017) together with business model theory (Osterwalder & Pigneur, 2010) represent the remaining theoretical pillars. This theoretical framework represents the backbone and main idea of the research (fig. 1), which is then united in the renewable community energy business model theory (Bauwens, Gotchev, & Holstenkamp, 2016; Walker & Devine-Wright, 2008) with an emphasis on actors, value propositions and business model building blocks.

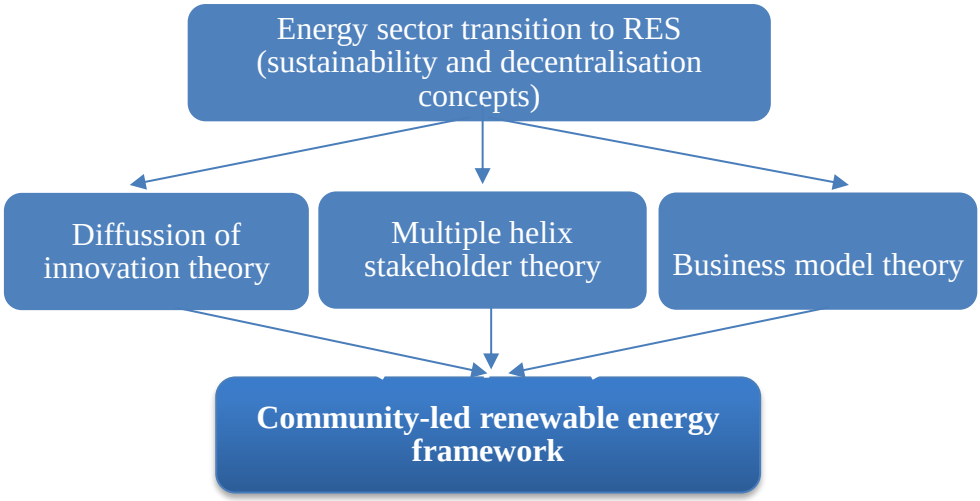


Fig. 1 Theoretical background for community-led renewable energy research

1. RESEARCH GAP AND RESEARCH PROBLEM SETTING

The energy transition challenge is to find appropriate RE systems in terms of concrete technology, territorial ´fitting´, ownership structures, scale and actors participating as producers, consumers, prosumers, or any other relations (Frantál, Nováková, 2019; Frantál et al., 2018). Subsequently, this is reflected in the basic background for the dissertation topic. To sum up, the research gaps identified for this dissertation are related to:

1. Understanding the role of community energy actors and institutional-legal and ownership relations in the energy sector helix structure (Hicks & Ison, 2018).
2. Multidisciplinary interconnection of business model theory to the community energy projects (Foulds & Robison, 2018; Osterwalder et al., 2014; Sovacool, 2014a).
3. Conceptualisation and classification of CRE projects as a part of the energy sector transition process in the Czech Republic (Frantál & Nováková, 2019; Smil, 2016; Zeleny, 2012a).

As the Czech energy sector is coming through rapid transition recent years, business models need to be found to support decarbonisation process. One of those mechanisms is represented by local sustainability initiatives in form of

community-led renewable energy projects. However, the CRE project are tightly connected to the national energy policy in the Czech Republic, no systemized up-to-date database exists and they are based on diversified value proposition designs. Identification of factors influencing the diffusion of renewable energy at the community level in the Czech Republic ais still in their initial phase. There is also lack of practical insights into energy business modelling in the national environment. In the Czech Republic the possibility to become an independent power producer is challenging in terms of regulatory structures. Thus, the dissertation intends to contribute towards answering the following conceptual research problem: *What role could have the community-led energy sourcing in the Czech energy sector transition towards renewable system?*

2. RESEARCH QUESTIONS AND OBJECTIVES

The research aim is formulated as *identification of both community-led renewable energy business models and value propositions with related helix-based energy policy implications for the Czech energy sector transition.* The research is divided into three partial observatory and exploratory objectives (Sovacool et al., 2018), which are further explained and displayed in tab. 1. Research objective 1 is related to the assessment of the transitional process from globalisation to localisation and from a fossil fuelled society to a non-fossil fuelled society (Smil, 2016; Zeleny, 2012):

(RQ1) In what way has been the position of renewable energy sources in the Czech energy sector been evolving? Three partial research questions were formulated to cope with the first objective, based on the energy sector transition interpretation as diffusion of innovation (Rogers, 2010): time dimension, social system dimension, and communication dimension defined as a set of interrelated units.

(RQ1.1) What trajectory have the shares of renewable energy sources been on the national energy mix in the Czech Republic following?

The Czech national energy mix is analysed, RES new installation shares are calculated from the data by the Czech electricity and gas market operator OTE. The SHARES data tool is utilised to analyse the time series of RES shares on TFEC.

(RQ1.2) What institutional-legal forms do the renewable energy licence holders in the Czech Republic have?

As there is no systematic community RE project overview available, the iterative process of legal form and business form structure analysis is needed (Němcová, 2010; Zilvar, 2012). Locally and collectively owned energy sources represent the research target. Additionally, top-down approach needs to be taken into account for other collective types of projects, such as interest-based virtual communities. In chapter 9.2 the legal form structures are analysed and community renewable energy projects scanned.

(RQ1.3) What spatial distribution do the renewable energy installed capacities in the Czech Republic follow?

The process of energy production de-concentration and re-territorialisation towards small-scale projects has some burdens (Frantál & Nováková, 2019) and it is important to monitor the spatial distribution with regional specifics of variable landscapes (Frantál et al., 2018). RE capacities installed through different Czech regions are analysed and physical placement compared to the place of subject registration (headquarters). As a result, the RE and CRE assessment for the Czech Republic is performed from time (R1.1), institutional (R1.2), and spatial (R1.3) perspectives.

(RQ2) What stakeholder model fits the community-led Czech energy sector transition?

Asking the question of what stakeholder groups are willing to participate in local energy sourcing, the community RE actors are identified based on Calzada and Cowie (2017), such as triple helix, quadruple helix and penta helix models. Following the stakeholder analysis, main stakeholder groups at the demand side are defined based on interests and concerns: community, municipalities, residential projects, and private companies. More detailed categorization of groups of stakeholders in community renewable energy projects is further introduced with the Research Objective 2 (RO2) Identification of helix model structure for the community renewable energy projects in the Czech Republic from the regional perspective resulting in (R2) Community-led renewable energy helix model structure.

(RQ3) How is it possible to utilize the business model canvas framework for Czech community-led renewable energy projects?

Recent research on motivations and values in the CRE projects by Hicks and Ison (2018) and Holstenkamp and Kahla (2016) has resulted in asking the question: What value does the local energy platform bring to the customers/all stakeholders in the network? The goal is summarization of energy community value propositions, while respecting the basic theoretical concept of 3BL (Elkington, 1997). As a result (R3.1) Czech community-led renewable energy value proposition canvas and (R3.2) Czech community-led renewable energy business model canvas with identification of the business model building blocks are provided. The community energy policy framework is summarised and Community-led renewable energy canvas model and Community-led renewable energy value proposition canvas are discussed.

Table 1 Research questions and objectives

Research problem	*What role could have the community-led energy sourcing in the Czech energy sector transition towards renewable system?*		
Research aim	*identification of both community-led renewable energy business models and value propositions with related helix-based energy policy implications for the Czech energy sector transition.*		
Research Questions	**(RQ1) In what way has been the position of renewable energy sources in the Czech energy sector evolving?**	**(RQ2) What stakeholder model fits the community-led Czech energy sector transition?**	**(RQ3) How is it possible to utilize the business model canvas framework for Czech community-led renewable energy projects?**
Partial Research Questions	(RQ1.1) What trajectory have been the shares of renewable energy sources on the national energy mix in the Czech Republic following? (RQ1.2) What institutional-legal forms do the renewable energy licence holders in the Czech Republic have? (RQ1.3) What spatial distribution do the renewable energy installed capacities in the Czech Republic follow?	x	(RQ3.1) What value propositions are significant for the community renewable energy projects in the Czech Republic? (RQ3.2) What business model archetypes are sifnificant for community renewable energy projects in the Czech Republic?
Research Objectives	**Assessment of the energy sector transition process towards renewable energy in the context of the Czech Republic from time (RO1.1), institutional (RO1.2), and spatial (RO1.3) perspectives.**	**(RO2) Identification of helix model structure for the community renewable energy projects in the Czech Republic from the regional perspective.**	**(RO3.1) Summarization of Czech community-led renewable energy value propositions. (RO3.2) Identification of Czech community-led renewable energy business models archetypes based on canvas framework .**
Methods	Descriptive statistical energy data analysis (OTE and EUROSTAT); Energy data contextual analysis (ERO licence holders); Spatial analysis-geovisualisation with choropleth map (ERO licence holders); Critical text analysis of EU and CZ energy policy documents	Storytelling based on story spines with multisectoral (multiple helix) representation	Case study approach together with publicly available information, structured interviews and questionnaires
Results	***Czech energy sector transition assessment from time (R1.1); institutional (R1.2), and spatial (R1.3) perspective.***	***(R2) Community-led renewable energy helix model structure in the Czech Republic.***	***(R3.1) Czech community-led renewable energy value proposition canvas. (R3.2) Czech community-led renewable energy business model canvas with identification of the business model building blocks.***

3. RESEARCH METHODOLOGY

The research methods chosen for the multidisciplinary topic of CRE include combination of quantitative energy data analysis and quantitative methods. The authors Tashakkori a Creswell (2007) argued that using mixed methods is not just combining them but it reflects a third way of tight interconnection of these methods within the research design.

Since there is no individual sector in the Czech national economy dedicated towards RE, there is limited summary evidence available for RES utilisation with community/municipal ownership in the Czech Republic as well. Several data sources and methods have to be utilised. Detailed description of research methods is presented in the following subsections.

Generally, the methods used in the dissertation include combination of spatial and time-series analysis, analysis of policy documents framed by critical literature review. Moreover, a workshop was organised and questionnaire used. As a result, the qualitative and quantitative information is interpreted and a CRE helix stakeholder model, CRE business model canvas and Value proposition canvas model are proposed. The targeted research methods are related to the specific research objectives, as depicted in the table below.

Table 2 Research methods & objectives

Research methods	**Research objectives**
Descriptive statistical energy data analysis (OTE and EUROSTAT)	RO1.1
Energy data contextual analysis (ERO licence holders)	RO1.2
Spatial analysis-geovisualisation with choropleth map (ERO licence holders)	RO1.3
Critical text analysis of EU and CZ energy policy documents	RO1.1 - RO1.3
Storytelling based on story spines with multisectoral (multiple helix) representation	RO2
Case study approach together with publicly available information, structured interviews and questionnaires	RO3.1 & RO3.2

4. THE CZECH ENERGY SECTOR TRANSITION TO RENEWABLE ENERGY SOURCES

4.1 The national energy mix and RES shares

Based on the first research objective, the assessment of RE development shows that the Czech RES shares on the gross final energy consumption have had an unstable trajectory. Except for biomass resources, and partially wind power

plants, the new RE capacity instalments decreased between 2013 and 2018. In 2013, the Czech government decided to stop the FiT scheme for RE except for small hydro. As a consequence, since the beginning of 2014, the FiT for biogas plants has been stopped as well and tariff levels for biogas plants put into operation before December 2013 depend on the date of commissioning. The following chapters (9.2 and 9.3 in the dissertation) elaborate in more detail the insight into the RET legal structure in the Czech Republic with indication of RE community-led projects and spatial distribution of RET.

4.2 RES institutional-legal forms

RES institutional structure in terms of legal forms seems to be diversified in the Czech Republic and not easily found. These forms indicate the ownership structure as well, therefore, proposed database analysis introduces a tool for legal and ownership structure with the aim to identify the position of community RES and their percentual share in total installations.

Reflecting the research objective RO1.2 on the institutional-legal forms of the renewable energy generation licence holders in the Czech Republic, diversified RET types and the ERO licence types were analysed. In case of electricity generation, 66 municipal projects were found in the PV sector and another few municipal project in the hydro energy sector. In case of wind energy, four public/municipal projects gained attention during the last years.

The community engagement is evidenced overwhelmingly in the LLC, collectives and municipal projects. LLC was chosen in some municipal projects (wind power plants 214 MWe and PV installations 1.5 GWe), as this legal form is most transparent with relatively simple structure, minimal requirements on capital, any natural person or legal person might be the company representative, whereby they are visible in the business register.

There were 286 collectives identified across the energy licence holder list. Most of the installation (200) were PV, however 84 of the total number belong to biogas stations with more than 64 MWe installed. The most diversified institutional structure is attributed to biogas with not negligible share of involvement of agricultural and landowner collectives.

The municipal projects build strong basis for the community involvement, since there are 49 PV installations, however some of the municipal RES are administered by LLC companies and it would require further in-depth ownership analysis. Additional 43 city based projects were found as well together with 4 wind energy municipalities, and 4 hydro energy projects.

The municipal-based project build the most visible and active CRE in the Czech Republic. Reflecting this, in 2016, the Czech Community Coalition for the promotion of RE was started gathering more than 60 cities and municipalities, associations, and industrial partners.

4.3 The RES spatial distribution

The variety of biomass and other RES is closely related to its territorial dispersal. The regional level perspective is based on the territorial division – NUTS 3 (Nomenclature of Territorial Units for Statistics). As can be seen from fig. 26 and 27, the total installed renewable energy electrical capacities are compared among the regions from two perspectives: the headquarters region of residence, where the provider is registered and the actual physical installation, where the RET facility is built. The data include all renewable energy installed capacities (MWe) including solar, combined heat and power, hydro and wind sources. The spatial distribution of RET installation is based on the ERU database of energy licence holders (power generation).

The most visible difference is attributed to the Prague capital, where the vast nmajority of RES company installations are centralised. Prague is often connected with the attribute of prestigiuous business address and excellent infrastracture. The central Bohemian region and Moravian-Silesian region are specific due to highest share of biomass power plants, however the crucial point is the co-incineration with fossil fuels. Central Bohemia has also high share of hydropower station installations. Ustí region, on the other, shows the highest wind energy physical capacities. Due to favourable natural conditions, the highest share of physical PV installations is evidenced in the South-Moravian region. Similarly to the conclusions by Dvořák et al. (2017), the map interpretation indicates that the distribution of the RET facilities is uneven and suitable natural conditions need to be taken into account.

5. REGIONAL RENEWABLE ENERGY COMMUNITY STAKEHOLDER MODEL

Territorial planning and local energy incentives correspond to a certain degree to the regional dimension. Communities might operate on the regional level and are part of regional innovation systems. As the author Frantál (2019) claims, although the government financial incentives for RES such as FiT and green bonuses are set the same for the whole Czech Republic, there are some differentiated regional attitudes towards local projects, such as wind energy projects. For the purpose of the stakeholder analysis, the Zlín region is chosen, due to balanced spatial distribution of RET based on the results from the previous chapter and active energy management public agency.

Based on the research question what stakeholders groups are willing to participate in the local energy sourcing (RQ2), the local RE actors are identified respecting the Calzada and Cowie framework (2017). In this respect, the penta helix stakeholder model structure is helpful, including five model elements: public, private, civil, academic and 5th, which corresponds the RE community (Calzada, 2016; Calzada & Cowie, 2017). The 5th sector is defined more precisely for community energy below. Moreover, the proposed 5-sector-model is framed

by policies, technology, and value propositions. Framed by the natural conditions, the penta helix model for CRE policy represents integration of energy policy, technology readiness together with a combination of 3BL proposition values and sectoral approach (Fig. 2).

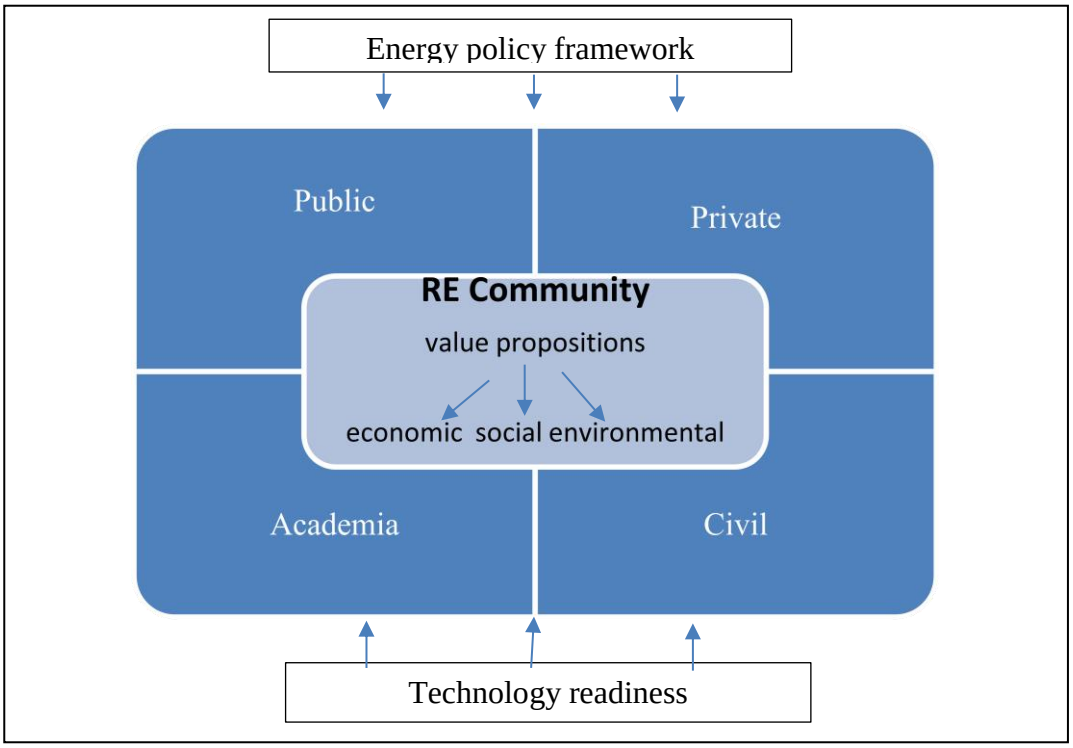


Fig. 2 Penta helix model for community energy

RE communities as a 5th element in the helix logic were evidenced in successful CRE projects, being organized groups of active public authorities, citizen, local companies, or local action groups and academia, or engaged NGOs/NPOs.

6. CZECH COMMUNITY RENEWABLE ENERGY CASE STUDIES

The canvas framework is used as a tool for qualitative data representation. In line with the authors Osterwalder and Pigneur (2010), the selected BMCs are divided into groups of building blocks in the following logic: infrastructure management (key activities, key partners, key resources), customers (customer relationships, communication channels, customer segments), financing scheme (cost and revenue streams), and value proposition.

Based on the case study results analysing the infrastructure, customers and financial scheme building blocks, three types of CRE project might be distinguished:

1 Bottom-up physical public CRE (NPO-municipality Hostětín)

2 „close-to“ bottom-up physical public CRE (Měňany municipality, municipality ESCo Kněžice, and municipality union Dolní Lhota)
3 Top-down CRE public virtual web community (CLEAR project platform)

While the new CRE installations need to setup financial planning, it seems to be highly relevant to give advice on new financial models and ownership structures, such as civil power plants where the municipal authority will use or rent the area or the roof (e.g. its own, or typically at the school building). Citizen are offered a share financing of financial effects for the municipality (project revenues, share in the investment, and rent from the investor). More innovative approaches consider peer-to-peer trading and blockchain in energy trading. Another opportunity are energy collectives, traditionally related to block of flats ownership in the Czech Republic. In line with Zeleny´s autopoietic principle (Zeleny, 2012), CRE production follows the tendency to keep the proximity to regional or local customers. Moreover, the concepts go beyond to provide food, products and services, including housing, education, health care, sports and entertainment (multiplication effect of the CRE project).

Similarly to Geels results (2017), complementary innovations need to be taken into account, such as energy storage (batteries, flywheels, pumped hydro), smarter grids (grid flexibility and management), demand response, and new market arrangements. The innovation in services, where the end user is a part of the system, requires a targeted behavioural approach, shifting from designing products to designing new business models. Energy accumulation will especially be a key element between production and consumption in the future. Therefore, it is important to develop and test energy storage systems of different physical and chemical nature potentially suitable for a given functionality.

Compared to the research on motivations and values in the CRE by Hicks and Ison (2018) STEEP model and Holstenkamp and Kahla (2016) using a socio-technical perspective, the dissertation pillar is 3BL concept (Elkington, 1997) with mostly balanced priorities in economic-social-environmental value propositions. The main community-based RES value proposition respecting the presented case studies are summarized in alignment with the 3BL approach. As a result, in the case of CRE projects, the 3BL approach is an integral part of the value propositions canvas, as proposed in the figure below.

Economic value proposition canvas

Gain Creators	**Gains**
RET installation integrated with another technology (WWTP)	Additional municipal budget revenue
Pain Relievers	**Pains**
Diversification of financial funds Start-up finance resources Administration support	Insufficient, mostly public financial resources for RET, operation and maintenance Complicated administration
Products and services	**Customer Jobs**
Cost effective energy generation, delivery and storage	Energy procurement

Social value proposition canvas

Gain Creators	**Gains**
New local jobs New related sustainable project ideas	Local population stabilisation
Pain Relievers	**Pains**
Information campaigns based on "back to the roots"	Limited confidence and trust in new technologies
Products and services	**Customer Jobs**
Community-led energy generation, delivery and storage	Community life based on locality or virtual platforms

Environmental value proposition canvas

Gain Creators	**Gains**
Environmental education Fossil fuel replacement	Biodiversity Cleaner environment
Pain Relievers	**Pains**
Sustainable RETs research and development	High CO^2 emissions
Products and services	**Customer Jobs**
Renewable energy generation, delivery and storage	Energy consumption (electricity appliances, heating/cooling, warm water)

Key partners	Key activities	Value propositions	Customer relationships	Customer segments
	Key resources		Channels	
Cost structure		Revenue streams		

Fig. 3 CRE Value proposition canvas

<table>
<tr><th>Key partners</th><th>Key activities</th><th>Value propositions</th><th>Customer relationships</th><th>Customer segments</th></tr>
<tr><td rowspan="3">Community energy sector

Public sector

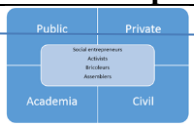
Private sector

Civil sector

Academic sector</td><td>RES

Generation
Distribution

Energy efficiency</td><td rowspan="3">Triple bottom line

Economic
Social
Environmental</td><td> 

Municipality
Municipal ESCo
Municipality-NGO
Municipality union
Virtual community</td><td rowspan="3">Community energy sector</td></tr>
<tr><td>Key resources</td><td>Channels</td></tr>
<tr><td>RETs/Infrastructure
CRE know-how
Experienced staff</td><td>Top-down;
Bottom-up

Physical;
Virtual</td></tr>
<tr><td colspan="3">Cost structure</td><td colspan="2">Revenue streams</td></tr>
<tr><td colspan="3">Capital cost
Operating cost
Material supply
Personal cost
O&M cost
Transportation, energy and fuel
Virtual platform cost</td><td colspan="2">Community own/crowdfunding
Municipality
Region
National/International funding
NGO
Loans
Private investors, Venture capital</td></tr>
</table>

Fig. 4 CRE Business model canvas

7. RESULTS AND DISCUSSION

Based on the first research question (RQ1) the assessment of the energy sector transition concepts (Smil, 2016; Zeleny, 2015) towards renewable energy in the context of the Czech Republic was elaborated. Three partial questions were considered with Rogers application of diffusion of innovation dimensions (2010).

Regarding the RES share trajectory development (RQ1.1, time dimension) it has been shown that the Czech RES shares of the gross final energy consumption have had an unstable trajectory with FiT scheme related consequences. Except for biomass resources, the RE capacity installments decreased between 2013-2018 mainly due to decreased RE technology cost and energy policy measures. The spatial distribution, second partial research question (RQ1.2 related to the dimension of communication channels), was interpreted as geospatial distribution indicating that distribution of the RET facilities is uneven with remarkable degree

of centralisation and suitable natural conditions need to be taken into account. The third partial question of institutional-legal forms (RQ1.3, system dimension) elaborated legal business forms of the renewable electricity licence holders in the Czech Republic. It was based on the ERO database and it was possible to assess the legal structure and scale of the RES projects, however the analysis of ownership structures need a more complex approach.

The municipal wind power plant is operated by three municipalities, PV power plants on municipal buildings are used for example by Litoměřice, Bukovany near Olomouc or municipality union Dolní Lhota (PV with WWTP). The most common municipal use of RES is still in the form of biomass heating plant, reaching more than fifty in the Czech Republic. Often village of Kněžice is set as an example of an energy self-sufficient municipality thanks to a biogas plant and a biomass plant. Not-for-profit Centre Veronica Hostětín represents a highly community-involving concept for local sustainable development. It is also worth mentioning that the vast majority of municipal RE projects originate from before 2013 due to unexpected changes in state energy policy related to RE support.

The helix model structure for the community renewable energy stakeholders in the Czech Republic is the result of the second research question (RQ2). Based on the relatively balanced RE installed capacities, active territorial energy management and two analysed case studies from Hostětín and Dolní Lhota, the Zlín region was chosen for the multiple helix stakeholder analysis. The penta helix model fits the community energy sector, according to the research, whereby the 5th sector is considered as the "renewable energy community". RE communities as a 5th element in the helix logic were found in successful CRE projects, groups of active public authorities, citizen, local companies or academicians have been involved. On the other hand, it is only partly true that successful energy projects were found to have good community involvement (Subbarao & Lloyd, 2011). Villages of Kněžice and Měňany show that the crucial factor was individual personal involvement together with favourable energy policy setup in the pre-investment phase. Additionally, it was observed that the complex energy projects such as Hostětín or Kněžice, proved also multiplication effect on the whole spectrum of the local economy (new employments, increased related economic activities). Moreover, the CRE is strongly oriented towards balanced 3BL value propositions. As a result of the case studies, three business model approaches were found towards CRE:

1 *Bottom-up physical public CRE*
2 *"Close-to" bottom-up physical public CRE*
3 *Top-down CRE public virtual web community*

The business model canvas framework with focus on the value proposition canvas was newly applied for Czech community-led renewable energy projects (RO3.1 and RO3.2). In line with Herbes et al. (2017), applying the business model concept to CRE is challenging, however very relevant, because the process of value creation applies to energy communities as well. Reflecting case studies

results and stakeholder workshop, together with initial analytical background, community-based frameworks are proposed.

Many community energy projects to date have focused on the heating sector, examples were presented also in electricity production. Key common characteristics of presented municipality project archetypes are that they are mostly based on collaboration, social, and environmental aspects and all project were publicly financed. In respect to ownership and legal status, the majority of projects were initiated by municipalities in cooperation with variety of actors. According to the research results, mostly local public authorities in municipalities are active in CRE. It was observed that individuals and groups of individuals were active in the community, initiating and taking active roles in community energy projects, building thus 5th sector element in the helix classification. In this context, RE community is seen as a separate model element. On the other hand, the virtual interest-based BM appeared, being supported by public finance sources.

8. Community energy policy recommendations

To sum up, the Czech definition of community RE should take the national specifics into account and virtual web communities (private and publicly financed) should be envisaged as well. The financial constrains cannot be ignored, in particular. Support policies especially for community RE for transitional period, until the set-up becomes self-sufficient are recommendable. To be concrete, changing energy policy from a FiT to an auction system might be a step forward. However as Herbes et al. (2017) claim, the shift to a tendering system, i.e. an open market bidding system, brings in the price risk and insecurity less suitable for community RE. Unlike the community RE initiatives, energy utilities dispose of risk management expertise developed over years.

Energy policy recommendations for CRE projects include:

- *Clear definitions* both on the EU and national level for renewable energy community, local energy community, energy community, and integrated community energy systems;
- *Enhanced research & development* in the CRE technologies – RE production, grid management and integration of storage (i.e. community energy storage);
- *Better evidence* for CRE projects - establishing universal access point with differentiated user modes with catalogue of services to access, store and utilise data, compared to Leuphana University's Department of Finance and Financial Institutions, which collects information on energy community organisations based on publicly available sources in their database (Holstenkamp & Kahla, 2016);
- *Integrated community energy platform*/virtual platform including database of community projects

- *Consistent EU policy instruments* with clear roles of CRE together with effective transposition to the national legislation;
- *Effective electricity market* design with market balancing responsibility limited;
- *Limited administration requirements,* better guidance and tools available for minimising bereaucracy;
- *Organisational support* of the interests of CRE (Herbes et al., 2017) such as group of municipalities requiring better conditions for community projects;
- *More interconnected partnerships* and ownership structures - sectoral cooperation encouraged especially towards private companies to create more complex energy communities, such as collectives where anybody could buy a share and the investment is paid back by a decreased energy bill or dividends, power purchase agreements with technology ownership by third party;
- *Better access to innovative* start-up finance, leasing and RE loans while the repayments are lower than energy bill savings, crowdfunding and blockchain platforms for physical as well as virtual projects.

9. CONTRIBUTION OF THE THESIS TO SCIENCE AND PRACTICE

The thesis aims to make a contribution towards multidisciplinary energy research and represents thus a part of the emerging research field of multidisciplinary social science in energy research (energy-SSH: SSH - social sciences and humanities and science, technology, engineering and mathematics; STEM; Foulds & Robison, 2018; Sovacool, 2014a, 2014b). In concordance with Yatchew (2014), the inter-disciplinary nature of energy calls for a 'big ideas' approach to both energy research and teaching. The key contribution to the theory is thus the multidisciplinary integration of the business model theory with theories from other scientific fields and their application in the energy sector:

- Diffusion of innovation theory (Rogers, 2010)
- Business model theory based on the Value proposition canvas and Business model canvas tools (Osterwalder & Pigneur, 2010; Osterwalder et al., 2014)
- Environmental and social aspect in the Triple bottom line concept (Elkington, 1997; Elkington & Rowlands, 1999)
- Together with policy framework based on the Stakeholder helix model (Calzada & Cowie, 2017).

The community renewable energy development in the national context of the Czech Republic is analysed and a community energy policy framework proposed, encompassing factors, such as behavioural, social and philosophical insights. The role of community energy sourcing in the Czech energy transition is clarified and

an empirically grounded proposal for sustainable energy transition is recommended to shed light into the Czech energy policy.

The application of decentralised energy business model theory in the Czech context and the application to RE at the local community level have been neglected so far in the Czech Republic. The results of this thesis might therefore serve as a support tool for energy decision-makers in this field, in terms of policy instrument design, such as FiTs or tender-based systems. Further, it serves for community ownership and energy cooperatives enhancement.

Broadening scarce literature sources devoted to the CRE business models for the Czech Republic result in structured, model-based energy policy recommendations at the Czech national and regional levels. Moreover, the initial comparison with other European countries might serve as an analytical background for further in-depth studies. The typology can be used for further qualitative and quantitative research on the community energy sector, although some of the results and interpretations are country-specific (Holstenkamp & Kahla, 2016).

CONCLUSION

The energy sector has been rapidly changing during the last decade. Bearing in mind the instant innovations in both fossil fuels and renewables, the decision models need a holistic and, at the same time, dynamic approach. Previous business models must be adapted to the new challenging tasks of the energy market liberalization, technology development, data management and consumer behaviour changes. The transition should be accompanied by a reduction in energy use and energy efficiency measures, along with a combination of efficient energy conversion, reduced demand and environmentally and economically feasible use of RES. Additionaly, ownership structures seem to play an increasingly important role with increased communities being involved.

The Czech energy system, both infrastructure and legislative framework, still have room for improvement in terms of emission reduction and energy efficiency. In order to achieve the energy goals, technologies, policies, and mind set all need to change and adapt to new business model types. Foreign examples have repeatedly proven that one of the key parameters for the successful development of RES is the question of who owns and operates them (and then benefits from them). The bottom-up principle in RES adoption needs harmonisation with the energy policies. Local projects and community collaboration (physical or virtual) in sustainable and renewable energy adoption will play an important role in the energy future (Pechancová, 2017). Despite obvious barriers, such as technological and economic, there is a huge potential for business model applications and social science contribution, which are the aims of this thesis.

The CRE field offers a lot of potential for projects differing in terms of governance (ownership and legal status), technology, social, and economic setting (REN21, 2019). Public involvement is relevant in the most important project

phases and tends to be the key success factor in the case of financial planning. Collective ownership in energy communities is still not widely spread in the Czech RE projects as can be seen in the Austrian and German municipalities.

To conclude, thinking energy globally and acting energy locally is the right slogan for the future community-led renewable energy projects. According to Zeleny (2012, p. 62), "the world will never be the same; it is autopoietic, self-configuring, self-organizing, self-healing and self-renewing – in spite all the counter-efforts of modern politicians and their parties". In this context, recently observed changes in energy sector are vital components of the distant sustainable energy future regardless of the energy policy failures.

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Title	Specification	Mental share
Pechancová, V., 2012. Energy security criteria viewed from the natural gas perspective; 7th PhD Conference New Trends in National Security. University of Defence in Brno University Press. 146-155. ISBN 978-80-7231-876-6.	Other results	100%
Pechancová, V., 2016. Behavioral aspects in sustainable energy use; Conference Proceedings DOKBAT 12th Annual International Bata Conference for Ph.D. Students and Young Researchers. 288-295. ISBN: 978-80-7454-592-4.	Other results	100%
Pechancová, V., 2017. Renewable energy potential in the automotive sector: Czech regional case study. Journal of Security & Sustainability Issues. 6(4). 537-545. ISSN 2029-7017	Jsc	100%
Wokuri, P.; Pechancová, V. Sumpf, P. and Buscher, C. eds. Islands of innovation in the UK and the Czech Republic p. 35, 2018. SHAPE ENERGY Research Design Challenge: Control, change and capacity-building in energy systems. Cambridge: SHAPE ENERGY	Other results	50%
Pálka, P., Blahová, M., Hrušecká, D., Juřičková, E., Pilík, M., Pechancová, V., Sumpf, P., Sari, R. and Foulds, C. 2018. Long-term stability beyond core funding – exploring options through a business plan and cost benefit matrix. Cambridge: SHAPE ENERGY	Other results	10%
Pechancová V., Hrbáčková L., Dvorský J., Chromjaková F., Stojanovic´ A. 2019. Environmental Management Systems: An Effective Tool of Corporate Sustainability; Journal of Entrepreneurship and Sustainability Issues; ISSN 2345-0282 (online) http://jssidoi.org/jesi/	Jsc (Q1)	30%

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