Mapping of New Business Models in Domains of Technologies and Energy for Modelling of Dynamics of Clean Energy Transition

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Abstract – The aim of presented study was to identify the most promising new business models which could help to reach climate and energy targets. ‘Business model’ means new opportunities (e.g. business for profit or non-profit community collaboration models) enabled by various technologies in energy domains, i.e., heat and power supply and demand as well as mobility. Based on scientific publications, nine most important technologies and 37 new business models, which could be among the most important for sustainable energy transition, were identified. Mapping of the new business models was done by looking at synergies between the technologies and the energy domains. Valuation of the business models is done by finding ‘expected impact’ with regards to reduction of greenhouse gas (GHG) emissions, which is obtained by multiplication of two factors: ‘potential’ and ‘feasibility’. The ‘potential’ represents ability to reduce GHG emissions considering technical characteristics of technologies involved and scalability. The ‘feasibility’ indicates how realistic is implementation of the new business model in the near to mid-term. Experts in the field of energy and environmental engineering were interviewed to obtain scores for the ‘potential’ and the ‘feasibility’ for all business models. The results show that electric mobility is among the solutions with the largest expected impact for reduction of GHG emissions. Results of this valuation will be used to choose the most promising solutions for further analysis with system dynamic modelling.

Keywords – Climate change; electric mobility; energy technologies; greenhouse gas emissions; renewable energy resources; sustainable energy

1. INTRODUCTION

The ‘European Green Deal’ has set necessary activities for the coming years to achieve the goal of the climate neutrality by 2050 [1]. At the same time, electrification of the energy supply sector and increase of electricity consumption is observed. The total global electricity consumption in 2018 has increased by 2.3 % compared to 2010 [2]. Although renewable energy sources (RES) have obtained an important role in the global electricity supply, according to the data of U.S. Energy Information Administration (EIA), fossil fuels still provide about 80 % of the total electricity consumption [3]. Therefore, it is essential to decarbonize power production sector. Five years have passed since the goals of EU to achieve the climate neutrality were set, and the initial goals begin to seem too ambitious to be achieved in such a short period of time. There are several challenges for that. Based on the forecasts of

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the EIA, energy consumption in buildings will increase by 65 % by 2050 compared to the year 2018 [4]. Wind and solar energies are intermittent and difficult to predict. In many cases, use of RES requires additional land which may be difficult to allocate due to the public resistance.

Therefore, it is necessary to integrate RES technologies with other technologies that allow these to be managed intelligently and predict their possible lifetime. It is also necessary to accumulate energy produced from RES by using storages as well as reduce usage of areas of land. In the transport sector, RES technologies are based on fuel changes as well as changes in the mode of mobility of society, e.g., by using car sharing options. Driven by necessity to introduce RES, technologies are being developed to integrate them into already existing or completely new systems. Technologies can develop very rapidly, and it often takes several years for a society to adapt and use it on the daily basis. Therefore, not only a development of the technologies but also new ways to implement these, including new business models, is important. For these reasons, it is necessary to focus on the already existing technologies and adapt these to the current needs by introducing new business models and policy tools to facilitate the development of these business models. By ‘business model’ we mean new opportunities enabled by various developing technologies in the sectors of the main energy domains, i.e., heat and power supply and demand, as well as mobility. In many present studies, each technology very often is considered as a separate entity and the same applies to each studied business model. Therefore, interconnection between the technologies and business models is not made. Most of the studies are based on technological review and simulations of its possibilities. The goal of this study is to find possible synergies between the technologies and the proposed business models. Expert opinions and assessment methodology is applied to find out which technology-business model synergies have the greatest potential for reducing greenhouse gas (GHG) emissions. Since the assessment methodology is based on the analysis of the existing technologies and energy domains, a short review of the most important technologies is considered below. It is claimed that by 2030, solar energy and its storage will provide at least 50 % of electricity demand of the world. As a result of technological developments, photovoltaic (PV) panels can be used not only on roofs of buildings but also in many new products that are powered by solar energy. In recent years, integrated photovoltaic (BIPV) buildings have been offered in construction, with PV panel systems integrated as ‘building skins’ [5]. According to the study of buildings installed in Norway [6], the total carbon savings over 30 years are 105 tons of CO₂ after installation of such a system (the total electric capacity of the façade PV system is circa 128 kW). Several studies have been carried out on the placement of solar panels on a roadway. In 2016 such roadway was created in France [7]. The author [8] considers possibility that the integrated PV of the road part charges a vehicle while it is moving along this part of the road. In the Nordic and Baltic countries wind energy is considered to be the best way to implement RES [9]. Wind farms are being set up both onshore and offshore, and in recent years the possibilities of offshore wind are studied very actively. However, in many countries construction of wind farms has been stopped by public resistance. According to the study [10], local communities often are not against construction of wind farms, but they want to share material benefits from these. In contrast, the study in Germany [11] indicates that communities oppose onshore wind farms but support construction of offshore farms. Due to the negative societal influences as well as technological developments, wind energy is evolving towards hybrid systems that use wind, solar and solid waste energy for fuel production [12]. Wind energy is used for production of hydrogen as the fuel for vehicles [13], as well as for production of synthetic natural gas, providing its production and storage facilities [14]. In the future, wind energy has a great potential for provision and development of various hybrid systems. Heat pumps (HP)

are mainly used in the private sector for both heating and cooling as well as hot water supply. Although the global demand for heat pumps has increased by 30 % compared to 2017, they provide only 3 % of the heat demand of buildings [2]. Studies carried out in [15]–[17] show that use of decentralized heat pumps to provide heat for buildings is significantly more advantageous than use of a district heating system. In contrast, the study in the United Kingdom [18] indicates that use of the HP provides savings for households, but the costs are still very high comparing to individual gas boilers. Hydrogen generated by electrolysis can be used in transport, for heat and power production, as well as production of synthetic gas and in chemical industry. There are currently only two major hydrogen projects in the world, and the hydrogen, produced from water by electrolysis, covers less than one percent of the total demand [19]. In the recent years, researchers' debate has focused on possibilities of combining the hydrogen and solar energy systems [20].

Energy sector of cities in the future will consist of smart grids (a combination of micro and mini networks with supply system management). Smart grid is a technology platform that includes smart metering, communication infrastructure, RES deployment and decentralized generation [21]. By using the platform, it is possible to reduce demand for peak capacity of utilities by shifting the maximum load outside peak hours [22]. Smart systems have become a part of people's daily lives, and these are used in healthcare and pharmacy [23], transportation, architecture and construction [24], smart meters [25], etc. and in other sectors. Share of renewable energy resources in the transport sector is critically low, and it is one of the most challenging sectors regarding climate change. In the EU countries the share of RES in the transport had to reach 10 % in 2020, but the overall goal was 8 %. Sweden has reached 30 %, Finland – 15 %, Austria and the Netherlands – 10 %. Latvia ranks in the 21st place with 6 % share [26]. Use of electric vehicles (EV) as well as biofuel will provide several opportunities in the sector of road transport for increased share of RES.

The reviewed technologies are some of the most important and the presented study describes business models and solutions which are enabled by these technologies in the main energy domains. Goal of the study is to identify a potential of these business models in reaching climate and energy goals.

2. METHODS

The technologies for assessment were selected based on the publications of the last five years. From publication analysis, it was concluded that solar PV, wind power, storage technologies, electrolyzers, heat pumps, EV, smart grids and artificial intelligence are among the most mentioned technologies regarding improvements in energy systems around the world. The technologies found in the publications were structured. The business models, mentioned in the publications, were structured considering the technologies that create synergies with the selected technologies (see Fig. 1).

Fig. 1. Algorithm of used methods.

Some of the technologies and their respective solutions are relatively far in maturity and have been used for a relatively long time, but some are rapidly developing and have been extensively studied only during the recent years due to the expected rapid development in the

future. From the analysis it was also concluded that many researchers believe that use of solar resources has the greatest potential; therefore, a large part of the studied business models is based on solar energy. As a result of the publication analysis, 9 technologies and 37 business models have been identified for the mapping (see Table 1). The business models are written in the cells of Table 1 where a respective enabling technology meets an energy domain. In order to avoid excessive information and maintain clarity, repetition of particular business model in several energy domains is avoided.

TABLE 1. MAPPING OF NEW BUSINESS MODELS AND SOLUTIONS ENABLED BY VARIOUS TECHNOLOGIES IN ENERGY DOMAINS OF HEAT, POWER AND TRANSPORTATION

Technologies	Energy domain/energy services				
	Heat supply	Heat demand	Power supply	Power demand	Transport/mobility
	Solar PV	‘Sun to heat’ via heat pump technologies in supply-side	‘Sun to heat’ via heat pump technologies in demand-side	1. ‘Building integrated photovoltaic’ (BIPV) 2. ‘Solar road’	1. Energy communities (solar PV based) 2. ‘Peer to peer’ (P2P) electricity sales (solar PV based) 3. Prosumers (electricity)
	Solar thermal	Solar thermal farms for district heating	Prosumers (heat)		
	Artificial intelligence	Accurate forecasts of heat demand	Control over operation of energy technologies	1. Accurate forecasts for power production from renewable energy technologies 2. Blockchain technologies for power market	Power aggregators Smart charge of electric vehicles (EV)
	Power storage with batteries		Power storage for back up and balancing	Flexible demand/flexibility services	Electric mobility technologies [18]–[27]
	Smart grids		Virtual power plants (VPP)	Communities of Virtual power plants (cVPP)	1. ‘Vehicle to grid’ (V2G) 2. ‘Vehicle to infrastructure’ (V2I)
	Heat pumps	1. ‘Power to heat’ 2. Waste heat integration into district	5 th generation district heating	Flexible demand/flexibility services	

heating supply			
Electric vehicles		1. 'Vehicle to home' (V2H) 2. 'Vehicle to buildings' (V2B2)	1. EV car-sharing ('peer to peer') 2. Shared autonomous electric vehicle
Electrolysers	'Power to gas'		'Power to fuels'
Wind power		Floating offshore wind farms	1. Energy communities (wind power based) 2. Peer to peer (P2P) electricity sales (wind power based)
			Excess power to EV charging

After mapping of the new business models (Table 1), a questionnaire among experts of energy and environmental engineering was conducted to find the expected impact of the new business modules as well as to test the methodology. Expert questionnaire helps to identify which may be the most promising new business models in terms of helping to reach climate and energy targets. Valuation of the new business models was done by finding 'Expected Impact' for each business model, which is based on multiplication of two factors (Eq. 1):

- 'Potential' – ability to reduce greenhouse gas (GHG) emissions considering technical characteristics (e.g., life-cycle GHG emissions) of technologies involved and scalability (local, regional, global?);
- 'Feasibility' – how realistic is implementation of the new business model in the near to mid-term? How complex is the solution? What support (financial, political) is needed? Extent of institutional and systemic changes (e.g., mode of mobility, new functions, transformation of values/attitude/behavior) needed? Potential for companies or individual persons to gain profits, save money or have other socio-economic benefits?

Experts were asked to assign scores for the Potential and the Feasibility:

- '0' – very low potential and feasibility; e.g., can be used only locally in very limited areas; can be realized only in very far future, if at all; needs tremendous financial support on unrealistic scale, etc.
- '0.25' – potential/ feasibility is below the level of other solutions. It has some potential, and at certain conditions may also be feasible, however, this business model is not competitive with other solutions and is far below average in terms of potential and feasibility
- '0.5' – potential/ feasibility is similar (comparable or on the same level) as other solutions
- '0.75' – potential/ feasibility is higher than for other solutions. The business model is not on the level of the best solutions but is more attractive than majority of other solutions
- '1' – the leader, or among the best solutions among alternatives with respect to potential/ feasibility. Clearly preferable business model for implementation.

The resulting score shows the Expected Impact Eq. (1) in terms of reaching climate and energy targets from technical, environmental and socio-economic viewpoint.

$$\text{Expected impact} = \text{Feasibility} \times \text{Potential} \quad (1)$$

Larger score indicates that the given business model has larger potential for aiding at reaching climate and energy targets.

Twenty experts participated in the interview. Even if a number of experts was small, the results allowed to test the methodology and obtain information for improvements which can be made. The results of the expert interviews are shown below in the categories corresponding to the assessed technologies. Each business model, enabled by a particular technology, was briefly described in the questionnaire and the form was created in MS Excel spreadsheet. The descriptions of business models were as follows.

Enabling technology: Solar PV (all 8 business models are enabled by solar PVs)

- ‘Sun to heat’ via heat pump technologies in supply side – using electricity produced by solar PVs to power heat pumps for heating purposes in supply side (e.g., district heating companies);
- ‘Sun to heat’ via heat pump technologies in demand side – using electricity produced by solar PVs to power heat pumps for heating purposes in demand side (e.g., industry, households);
- Building integrated photovoltaic (BIPV) – installation of integrated solar panels on building facades to obtain electricity and transfer it to residents of the building. The solution provides more efficient use of available area for production of solar power;
- ‘Solar road’ – use of solar PVs installed in road surface for providing power to various usage and storage with specific technologies. The solution provides more efficient use of available area for production of solar power;
- Energy communities (solar PV based) – group of people (prosumers) organized in community to install and use solar PV technologies primarily for their own needs;
- ‘Peer to peer’ (P2P) electricity sales (solar PV based) – possibility of selling (and buying) power surplus produced by prosumers to neighbours directly (avoiding power market intermediation);
- Prosumers (electricity) – consumers which produce power for self-consumption with solar PVs installed at their site. Able to share or sell produced energy surplus;
- ‘Sun to Vehicle’ (S2V) – PV panels provide power to chargers for electric vehicles (EV).

Enabling technology: Solar thermal

- Solar collector farms for district heating – array of solar collectors installed at site of district heating company and producing heat for supply via district heating system;
- Prosumers (heat) – consumers which produce heat for self-consumption with solar collectors installed at their site.

Enabling technology: Artificial intelligence

- Accurate forecasts of heat demand – possibility to obtain more accurate forecasts of heat loads and with this, to improve dispatching of renewable energy technologies and optimize parameters of heat supply for lower heat losses and improved comfort;
- Control over operation of energy technologies – possibility to optimize operation of various energy technologies, e.g., calculate the best usage or production times based on market price of electricity;
- Accurate forecasts for power production from renewable energy technologies – more accurate weather forecasts allow better planning of production of wind (also solar) power technologies and thus improve positions in the electricity market;
- Blockchain technologies for power market – mathematical algorithms which enable

safe and fraud-free transactions in energy sector, e.g., ‘peer-to-peer’ electricity sales.

- Power aggregators – grouping of power consumers or prosumers to combine (aggregate) consumption or production for participation in power market, e.g., selling power, providing power reserves and flexible demand services;
- Smart charge of EV – optimization of loading regimes of EV charge depending on EV standing duration, time of charge, power market price, etc.

Enabling technology: Power storage with batteries

- Power storage for back-up and balancing – electricity storage for planned and unplanned power outages and power system balance;
- Flexible demand/flexibility services in power system – provide fast adjustment of electricity demand depending on situation with supply and demand in power system;
- Electric mobility technologies – provide electric mobility, e.g., electric vehicles;

Enabling technology: Smart grids

- Virtual power plants (VPP) – cloud-based aggregation, control and optimization of distributed power generation capacities to enhance sharing of power and participation in power market;
- Communities of Virtual power plants (cVPP) – group of prosumers mutually using own (different or the same renewable energy technologies) produced energy by using coordination center;
- ‘Vehicle to grid’ (V2G) – electric vehicles, charging and control system which enables bi-directional power flow, i.e., from grid to EV during charging, and from EV to grid during peak-hours of power consumption or other time when EV serves as a power supplier;
- ‘Vehicle to infrastructure’ (V2I) – provides communication (data exchange) between vehicles and road infrastructure using an Internet connection.

Enabling technology: Heat pumps

- ‘Power to heat’ – using excess electricity, produced by intermittent renewable energy technologies (mainly wind) during hours of low demand, in heat pumps for production of heat. This way it helps to create flexible demand for intermittent power production;
- Waste heat integration into district heating supply – using surplus (waste) heat from industrial processes, data centers, office buildings, etc. for supply of district heat. If temperature is too low, it is usually elevated by heat pumps;
- 5th generation district heating – bi-directional very low (ambient) temperature district heating networks, which are connected in the same net with ‘prosumer-based’ heat substations (including heat pumps) and seasonal energy storages and controlled by artificial intelligence systems;
- Flexible demand/flexibility services – flexible demand of power provided by ‘power-to-heat’ concept with heat pump technologies.

Enabling technology: Electric vehicles

- ‘Vehicle to home’ (V2H) – technologies which use idle electric vehicle battery power as a grid storage tool to mitigate fluctuations from renewable electric power sources and to help supply backup power in the event of an emergency;
- “Vehicle to buildings” (V2B2) – electric vehicles act as vector devices for renewable energy exchanges among buildings. The main goal behind this concept is to benefit from the potentiality of electric vehicles toward the achievement of zero-energy target extended to a buildings cluster level, by exploiting renewable generation on- and off-site;
- EV car-sharing (‘peer to peer’) – shared usage of EV which can be owned by an

enterprise or by community;

- Shared autonomous electric vehicle – sharing of autonomous (driver-less) EV.

Enabling technology: Electrolysers

- ‘Power to gas’ – producing hydrogen or synthetic gas (SNG) in electrolysis process powered with electricity produced by renewable energy technologies. By this, the solution provides flexible demand for intermittent power;
- ‘Power to fuels’ – producing liquid transport fuels with help of hydrogen produced in electrolysis process powered with electricity produced by renewable energy technologies. By this, the solution provides flexible demand for intermittent power.

Enabling technology: Wind power

- Floating off-shore wind farms – floating wind energy platforms installed in sea. Potential to deploy larger areas with smaller influence on society. Floating platforms reduce specific investment (per unit of capacity) in off-shore wind farms;
- Energy communities (wind power-based) – group of people (prosumers) organized in community to install and use wind power technologies primarily for their own needs;
- ‘Peer to peer’ (P2P) electricity sales (wind power-based) – possibility of selling (and buying) power surplus produced by prosumers to neighbours directly (avoiding power market intermediation);
- Excess power to EV charging – lowering EV charging costs due to lower power market prices during surplus power production (in hours of large supply and low demand for power) from wind farms.

3. RESULTS AND DISCUSSION

The results of survey are summarized in the Table 2 according to feasibility and potential. The table is split into four sectors:

1. Low potential and low feasibility;
2. High potential and low feasibility;
3. Low potential and high feasibility;
4. High potential and high feasibility.

Although selection of 0.55 as the score which divides the ‘low’ and ‘high’ regions is purely subjective, this approach helps to visually assess an impact of each business model on reaching climate and energy targets both in terms of potential of addressing the issue and the possibility of its implementation.

The data shows that most of the assessed business models have a high potential to reduce GHG emissions. Approximately 20 % of the business models are valued as having low potential and low feasibility of implementation. This could be due to relatively high cost of using the technology or limited potential diffusion of the technology. Some of the assessed business models have a limited scale for reduction of GHG emissions. Approximately 40 % of the proposed business models have high scores for feasibility of implementation and also the potential for reduction of GHG emissions is estimated to be significant. This group of business models could be the one which should be targeted first in energy and climate policy design. More detailed results, with scores of Expected Impact for each business model, are shown in figures below.

According to expert opinion, ‘prosumers in electricity demand’ domain provides the greatest Expected Impact for the use of solar PV power because this solution has relatively high feasibility and potential for reducing GHG emissions comparing to other solutions.

TABLE 2. MAPPING OF BUSINESS MODELS ACCORDING TO FEASIBILITY AND POTENTIAL (ALLOCATED AMONG 4 QUADRANTS REPRESENTING HIGH-LOW FEASIBILITY AND POTENTIAL)

Feasibility of business models based on technologies	High 0.56–1		Prosumers (electricity)
			Solar collector farms for district heating
			Prosumers (heat)
			Accurate forecasts of heat demand
			Control over operation of energy technologies
			Accurate forecasts for power production from renewable energy technologies
			Smart charge of electric vehicles (EV)
			Flexible demand/flexibility services in power system
			Electric mobility technologies
			‘Power to heat’
	Low 0–0.55		Flexible demand/flexibility services (heat pumps)
			EV car-sharing (‘peer-to-peer’)
			Excess power to EV charging
		‘Solar road’	‘Sun to heat’ via heat pump technologies in supply side
		‘Peer to peer’ (P2P) electricity sales (solar PV based)	Building integrated photovoltaic (BIPV)
		Blockchain technologies for power market	Energy communities (solar PV based)
		Communities of Virtual power plants (cVPP)	‘Sun to Vehicle’ (S2V)
		‘Vehicle to grid’ (V2G)	Power aggregators
		‘Vehicle to infrastructure’ (V2I)	Power storage for back-up and balancing
		‘Vehicle to home’ (V2H)	Virtual power plants (VPP)
	"Vehicle to buildings" (V2B2)	Waste heat integration into district heating supply	
	Peer to peer (P2P) electricity sales (wind power based)	5 th generation district heating	
		Shared autonomous electric vehicle	
		‘Power to gas’	
		‘Power to fuels’	
		Floating off-shore wind farms	
		Energy communities (wind power based)	
Potential of business models based on technologies			
Low 0–0.55		High 0.56–1	

In Fig. 2 shows the business models of each technology that have received the highest score of Expected impact in their category.

Fig. 2. Expected Impact of on scale 0–1 of business models with highest score in category.

‘Solar collector farms for district heating’ have the largest score among the two business models enabled by ‘solar thermal’ technologies. The results of Expected Impact of the ‘power storage with batteries’ show that electric mobility technologies, such as electric vehicles, have the largest score of 0.58 from all business models, and are among the most promising technologies in the future developments. The greatest potential of business models enabled by ‘smart grid’ technologies could be ‘virtual power plants’. It could be related to development of artificial intelligence in the future and almost limitless possibilities of digitalization. The greatest potential among the business models enabled by EV could be EV car sharing. This technology is already in use in many places. Although studies have shown that this option does not reduce the number of vehicles, their use is more environmentally friendly compared to the fossil fuel vehicles. The obtained score of Expected Impact for ‘electrolysis technology’ could be considered as average, and the results are quite close for both offered business models. ‘Power to gas’ scores a little bit better since it could ensure possibility to produce synthetic natural gas, which can be stored and delivered via the existing infrastructure. The largest score of the Expected Impact among the business models enabled by ‘wind power technologies’ is reached by ‘excess power to EV charging’ which is quite surprising considering the other alternatives. Fig. 3 shows business models of each technology that have received the lowest score of the expected impact in their category.

The ‘solar road’ has received the fewest points, most likely because of complexity of implementing the technology and high costs. Prosumers (heat) – could be due to the fact that the probability of prosumers operating in the heating domain is lower, and district heating also makes a greater contribution to reducing GHG emissions. ‘Vehicle to grid’ solution, which is very promising technology for managing of power supply and demand, has obtained the lowest result. This can be explained by large investments and required restructuring of the existing power distribution system for introduction of this technology. Use of the heat pumps in 5th generation district heating has obtained the lowest score because according to experts, feasibility of this solution has the lowest scores in this category. ‘Vehicle to buildings’ solution, which in our opinion, is an interesting service that could provide RES for

non-renovated buildings. Although the cost of the service should not be high, it is very complicated in terms of provision. ‘Wind power – based energy communities’ which may be related to relatively complicated installation of wind farms and wind turbines due to resistance from local communities as well as high costs of the turbines.

Fig. 3. Expected Impact on scale 0–1 of business models with lowest score in category.

Fig. 4 evaluates four business models with the highest expected impact of all technologies.

Fig. 4. Expected Impact on scale 0–1 of business models with highest score of technologies.

According to the summary of the results, out of all possible business models, the three highest positions have been taken by the business models offered by different types of EV. This could be explained by the fact, that the technology due to EV transport is sufficiently developed and continues to improve, as well as the interest of people is increasing. This is an opportunity to increase the impact of EV in the road transport sector, as well as to move towards the necessary climate neutrality targets.

The results of the expert interviews also showed differences in the assigned scores depending on profile of the experts. Among experts working purely in the field of energy engineering in the energy company, the three largest scores of Expected Impact were assigned to ‘energy communities (solar PV-based)’, ‘solar collector farms for district heating’ and ‘power-to-fuels’. Among the experts working in the fields of environmental engineering and energy at the university, the three largest scores were assigned to ‘electric mobility technologies’, ‘excess power to EV charging’ and ‘EV car-sharing (‘peer-to-peer’)’.

4. CONCLUSIONS

Results of the study show that electric mobility could be the solution that have the largest potential for reducing GHG emissions among all business models considered. These results were obtained from expert interviews which were collected by using the questionnaire representing map of business models enabled by different technologies in the main energy domains. The mapping of the business models was done by using analysis of publications. The current study can be considered as the first step and test of the methodology designed for assessing the potential impact of different business models on reaching climate and energy targets. The methodological approach can be used in other countries as well, with adjustment of the business models and the energy domains to the local specifics. Such a study provides an opportunity for a country or region to identify the key opportunities that it should focus on. The results of this study will be used in creating system dynamics model for energy transition.

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