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## Technology and the attractiveness of new business models in the digital economy

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### ABSTRACT

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Dissemination of new digital technologies is linked with the adoption of new solutions that give shape to relationships between those who offer goods and services in the market and their consumers. In past decades, not all new projects have been commercialised successfully, which explains why one needs to examine the reasons behind a success or failure in putting in place new business models involving elements of digital technologies. This paper discusses a comparative analysis of two cases. Rapid growth of the Californian start-up Airbnb, an operator of a virtual platform in the flat-sharing business that, on the one hand, helps people rent out their properties and, on the other hand, helps travellers find short-term lodging is an example of global success. The non-implementation of the *Energy Citizen* project demonstrates that, despite a number of advantages, the prosumer model in generating and consuming energy from renewable energy sources so far has fallen short of success. Comparative analysis has helped us to conclude that to be commercially successful in the digital economy one needs a virtual platform operator capable of finding a business model attractive to all operators in a selected market segment. Ensuring benefits to consumers as well as to operators who offer their goods or services in the market is the pre-condition.

**Keywords:** digital economy, new business models, flat-sharing, renewable energy sources

**JEL Classification Codes:** O11, O33, O50, P18

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## Introduction

In order to fine-tune the description of the digital economy, one needs to investigate into the relation between the diversity of features of innovative solutions connected with technology implementation and the attractiveness of new business models as assessed by the consumers. The scope of the analysis has been limited to economic processes typical of the digital economy, whose connectivity covers almost all market participants. In the digital economy producers and consumers benefit from disruptive innovations. There are three major milestones in the market crucial for the digital economy: Facebook as the first on-line social media service launched in 2004, Amazon Web Services as the first professional service of collecting and managing data in a cloud has been available since 2006, and Apple's iPhone smartphone, the first powerful multiple-function device offering mobile access to the Internet using 2G telecommunications technology was sold from 2007. Over the last 10 years new business models put in place in the digital economy could be investigated by the governments based on short- or mid-term (not longer than several years) observations only. What seems to be missing is a cumulated and published pool of knowledge about the impact of regulations upon the conduct of actors representing both sides of the market: supply and demand. That is why our considerations discuss the relevance of regulations, fundamental to the digital economy, only to a very limited extent.

As argued by C. Christensen and M. Johnson, a business model is a system of relations among the value proposed to consumers, material and non-material resources required to deliver economic processes, ways of pursuing economic activities, concluding transactions, and calculating costs, revenues and economic performance [Christensen, Johnson, 2008, p. 1].

Our analysis is a *case study*. For the sake of clarity, we compare only two completely different new business models. In the first model the virtual platform operator plays a crucial role, [Paprocki, 2017, p. 25 and the following]<sup>1</sup> while in the second model it is hard to identify who could become a virtual platform operator. The selected *cases* deal with:

- short-term flat-rental in the *flat-sharing* format carried out by Airbnb virtual platform operator that uses a package of modern technologies – the solution used already by a very big group of consumers;
- **prosumer** generation and consumption of electric energy obtained from photovoltaic panels and making energy available to neighbours under the *Energy citizen* project using a very extensive package of modern technologies – the solution has not been commercialised yet.

Both cases can be seen as examples of the dissemination of sharing economy, a stage in the evolution of managing resources that are at the disposal (irrespective of ownership regulations) of households, i.e., consumers or economic operators. Taking advantage of new opportunities

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<sup>1</sup> For more about how virtual platform operators work see: W. Paprocki, *Role of Virtual Platform Operators in Transforming Consumer Goods Market*, "Journal of Management and Financial Sciences", Vol. X, March 2017, p. 25 and the following.

opened up by connectivity (networking) among market participants both groups may, on the one hand, enter into transactions to meet the needs of (other) consumers and, on the other hand, be rewarded (collect revenue) for making resources that they have but do not need in a particular moment available to other consumers [The Economist, 2013].

Both cases are analysed based on the domestic and international literature, reaching out to representatives of service providers or potential service providers and their customers or potential customers. On top of that, we have used expert knowledge gathered from consultations with researchers from different universities, including the Silesian University of Technology and Albert-Ludwig University of Freiburg (Germany).

## Case I: *Flat-sharing* – Airbnb

Airbnb was launched back in 2008 to help in bringing together people who have flats or houses to rent and those who are looking for short-term rental as a substitute of staying at a hotel [Richter, 2018].<sup>2</sup> Originators of the project correctly expected that there will be millions of people across the globe interested in using this new business model. These expectations have been confirmed by 300 million transactions concluded over the last decade of their operations [Airbnb, “Handelsblatt”, 2018, *Bei Mitfahrtdienst*, “Handelsblatt”, 2018].<sup>3</sup> The tool that gave way to the new solution was an app for smartphones used by both sides of the transaction. The app was installed in the cloud and made available to the marketplace. It can be downloaded free of charge. The new business model referred to as *flat-sharing* and used by Airbnb ensures *quasi* zero transaction costs to the participants of the project [Pieriegud, 2016, p. 20],<sup>4</sup> who list their space available for rent on a virtual platform. To make the offer clear and avoid any confusion the following categories have been introduced: “shared room”, “private room” and “entire home/apartment”.

Table 1 provides the description of economic processes under the *flat-sharing* model. By analysing them we may conclude that the main effort in handling digital technologies and making them available to the consumers rests with the virtual platform operator. Both sides involved in the project do not have to cope with the challenge of carrying out complex tasks or making additional outlays. It suffices if they use generally available technical solutions, i.e., a smartphone, an app installed on it and a selected service of the Internet connection operator.

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<sup>2</sup> Results of studies on consumer preferences conducted in the early 2018 in Germany show that fewer than 10% of people staying outside of their domicile are interested in *flat sharing* services.

<sup>3</sup> Only very few start-ups have managed to attract millions of users. Beside Airbnb in the market there are leaders such as, inter alia, BlaBlaCar – an operator offering *car sharing* to people travelling between regions. In 2017 the number of registered users across the world reached 60 million out of whom 18 million travel at least once every three months.

<sup>4</sup> For more about business models “for free” see: J. Pieriegud, 2016. *Cyfryzacja gospodarki i społeczeństwa – wymiar globalny, europejski i krajowy*. In: *Cyfryzacja gospodarki i społeczeństwa. Szanse i wyzwania dla sektorów infrastrukturalnych* J. Gajewski, W. Paprocki, J. Pieriegud (scientific Eds.) Gdansk: publication of the European Financial Congress, p. 20.

**Table 1. Characteristics of an economic process served by the *flat-sharing* business model**

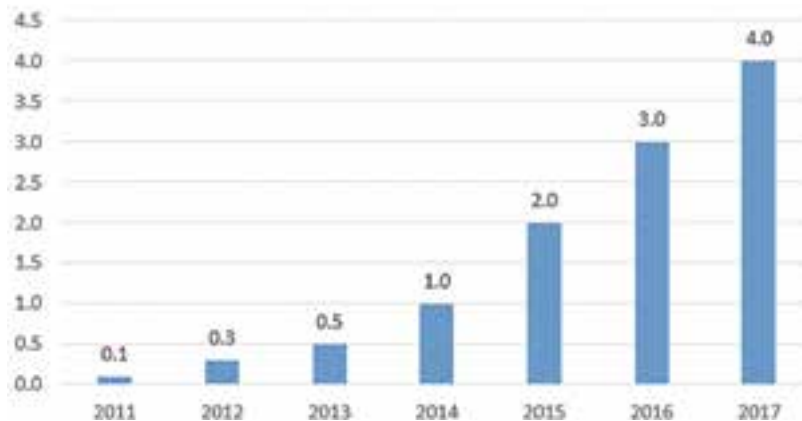
Stage	Characteristics	Comments
Offer preparation	A person who has got a place to offer may file an offer to rent a flat or part of it	A listing is made through the app developed using digital technologies and an Internet connection; the app is made available by the virtual platform operator; listing may include an image (photos, video), which makes part of it; the submitting party may also specify conditions under which the offer is binding (e.g. the minimum price, minimum renting period, availability of the listing); users interested in the listing and the virtual platform operator use the services of the Internet connection operator and, on top of that, the virtual platform operator uses the services of the "cloud" operator.
Making an inquiry	A person looking for a place to stay describes what s/he needs, i.e. where s/he wants to stay, their preferred type of accommodation (no. of persons) and the period for which s/he wants to use the place or part of it	An inquiry is made through the app; the interested party uses the services of the Internet connection operator. <i>Actions of the virtual platform operator are described above.</i> A person choosing between staying at a hotel and <b><i>flat-sharing</i></b> service may easily compare prices at hotels (available on the smartphone through other apps) with rates for short-term rental.
Transaction conclusion	Listings and inquiries are matched on the virtual platform operated by Airbnb; a person looking for accommodation may use one of the listings guided by her/his preferences and taking account of her/his ability and readiness to pay the set rate – by accepting a given offer s/he makes the payment part of which is received by the virtual platform operator as his or her commission.	The virtual platform operator helps in establishing a relationship between someone interested in short-term rental of a flat and a person looking for a place to stay – to execute a transaction both sides must be able to carry out a financial transaction (to make a payment order and to receive a payment) in digital technology. Both sides must use home-banking or alternative digital apps.
Service delivery	Having received the confirmation of the transaction, the person wishing to stay in a particular place goes to the location on a specific date to get access to the flat where s/he is going to stay. Checking out is optionally registered as a change in the availability status of the place.	The delivery of the service does not require digital technologies since check-in and check-out take place in the physical presence of the user of the service. Digital technology can be used when the person who offers the place for rent does not want to be present there on arrival and departure. Upon arrival the door to the place may open automatically using a remote control door opener.

Source: Own compilation.

From the point of view of these people, effort and resources they are supposed to invest, as well as the time spent on using the *flat-sharing* business model seem minor while measurable benefits so big that the business model is considered attractive.

Airbnb, whose apps were used in 65 k cities in over 190 countries worldwide in 2017 [Harrison, Coughlin, Hogan, Shakun, 2017, p. 1], owes its success to three principal factors. The first one is easy access to these apps which are easy to handle. The second is a rather common propensity of people who have flats to offer them for short-term rental. Finally, the third factor is relatively high propensity of people who travel to take the risk of renting a flat or a part thereof from a host they had never met before. The growth of *flat-sharing* services is shown in Figure 1.

The attractiveness of the offer to people looking for an alternative to hotel services creates rates per night at flats offered at the Airbnb platform. These rates and average prices for hotel services in selected European countries are compared in Table 2. The countries are ranked by the relative difference between hotel prices (per room/per night) and rates for short-term rental irrespective of the number of rooms (per night).

**Figure 1. Number of flat-sharing users between 2011 and 2017 [X – years, Y – mio. people]**

Source: Own compilation based on: *Infografik Meine Wohnung, deine Wohnung, keine Wohnung*, Statista 16.12018, www.handelsblatt.com (accessed: 16.12018).

**Table 2. Comparison of hotel prices and short-term rental rates offered under the flat-sharing model by Airbnb as virtual platform operator**

	Hotel rate in EUR	Rental rate (average per night) in EUR	Relative difference in %	Difference in EUR
Russia	82.00	38.00	53.7	44.00
Germany	111.00	64.00	42.3	47.00
Italy	136.00	79.00	41.9	57.00
Norway	147.00	88.00	40.1	59.00
France	144.00	88.00	38.9	56.00
Portugal	102.00	69.00	32.4	33.00
Poland	67.00	68.00	28.4	19.00
Spain	112.00	82.00	26.8	30.00
Greece	111.00	104.00	6.3	7.00

Hotel price per night is the average price in big cities in a given country.

Source: Own compilation based on: *Infografik Meine Wohnung, deine Wohnung, keine Wohnung*, Statista 16.12018, www.handelsblatt.com (accessed: 16.12018).

The analysis of the above described *case* brings us to the conclusion that the simplicity built in the use of the business model supported with digital technologies, including technologies such as: connectivity (smartphone/cloud/cloud computing) and creating shared data (cloud) are good examples of economic growth in the digital economy. Another issue connected with the *flat-sharing* model concerns the benefits of the virtual platform operator who collects a variety of data from his or her clients, i.e. service providers and recipients. Access to this data ensures potential microeconomic commercial benefits to the operator. If s/he makes this data available to public organisations, it may also be used in projects leading to macroeconomic effects.

## Case II: Energy Citizen

The idea to develop prosumer installations of renewable energy sources (RES) lies at the foundations of energy policy, which – together with environmental and climate policies – constitutes three major pillars of social and economic policy discussed and promoted at the international arena. At the European level, these issues have been addressed in the objectives of the Energy Union [Wojtkowska-Łodej, Graczyk, Szablewski, 2016, p. 22]. We witness a continuous increase in outlays on RES installations worldwide [Wiśniewski, 2016, p. 123]. According to many experts increase in RES share in the production of electricity is the condition for further economic growth [Popkiewicz, 2015, p. 10]. During the World Economic Forum in Davos in 2018 once again it was stressed that successful accomplishment of these policies' goals is needed to reduce the risk of a number of factors which could rapidly undermine global or regional economic growth [WEF, 2018]. One of the ideas promoting the RES is the *Energy Citizen* project [Weidlich, 2018].

To explain the conditions on which the project is implemented we need to provide selected information about RES [NFEPWM, 2012]. Photovoltaic panels or a wind turbine installed at a household may give a prosumer [Popczyk 2014, p. 10], i.e. someone who is a consumer and a producer of a particular good:

- energy self-sufficiency (if a consumer uses electricity as the only secondary energy carrier) in the “off grid” option,<sup>5</sup>
- a possibility of contributing to the reduction of electricity consumption from the grid in the “semi off grid” option.

In both cases the prosumer invests in the installation of an electricity generator and covers the costs involved in its use.

Major benefits of the prosumer include:

- total elimination of the cost of energy purchase in the “off grid” option;
- reduction of the costs of electricity purchase in the “semi off grid” option.

The efficiency of the project involving the installation and use of one's own electricity generator depends on the relation between the invested amount (cleared over time through depreciation) and current costs on the one hand and on the other hand, savings gained from the elimination or reduction of electricity purchase.

For the present development stage of technologies applied in the generation, storage, transmission and use of electricity, imbalance between electricity that is generated and consumed is rather typical. Hypothetically, a prosumer may nowadays avail her/himself of energy storage technology if in the times of the energy production surplus over consumption, unused energy goes to a local device (system) of electricity storage. The installation and use of an available

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<sup>5</sup> When a prosumer is deprived of access to the public distribution grid. It may be a necessity (when a consumer is on a “desert island”) or a conscious consumer choice (the decision not to connect to the public grid).

low potential local device (e.g. traditional lead acid batteries) necessitates investment (also in the recycling scheme), additional outlays and covering exploitation costs. The benefits of the storing of electricity include:

- in the “off grid” option, prolongation of the time window for using electricity generated by one’s own generator outside of the time of energy generation and, by the same token, improving the functionality of one’s own generator;
- in the “semi off grid” option, further reduction of electricity consumption from the public grid (since there is some time outside of the time window for energy generation when the stored energy can be used; this shortens the period of using energy from the public grid).

Due to still limited technical possibilities of using electricity storage technologies and for other reasons the existing surpluses of electricity generated by a prosumer in the semi off grid option may be sold in the neighbourhood, which may be interpreted as an example of *Energy Citizen* turnover.

The idea of the *Energy Citizen* project takes account of an important characteristics of local electricity distribution systems. Under such schemes – considering total energy generation by some or many prosumers – one may seek to ensure balancing energy production with energy consumption by some or many prosumers and a group of their neighbours who do not use prosumer installations at all. The idea is that these systems operate “off grid”, i.e., outside of the public energy distribution grid, which should reduce the burden on the national electricity and power system.

By selling some of the generated energy, a prosumer, beside saving on reduced energy purchase from the public grid, could additionally receive revenue “from her/his neighbour”. There is still a question of the pricing of a unit of electricity sold between citizens. The pricing process should take account of the two parties to the exchange:

- the prosumer who offers electricity to her/his neighbours;
- the consumer “from the neighbourhood” ready to buy electricity from the prosumer and reduce the amount of energy regularly bought from the public distributor.

In practice one may not use the *Energy Citizen* model in the “off grid” option when there are only two the above-mentioned groups of participants within the model. There are two reasons for that. Firstly, the participants to the model may not endlessly effectively satisfy their needs if prosumers apply only two electricity generation technologies (i.e., wind turbines and photovoltaic panels). Both technologies can be used to produce electricity only if some environmental conditions are met, i.e., when there is wind or high sunrays intensity. This is why the two technologies are seen as non-dispatchable (contrary to other technologies, which are dispatchable, e.g. a technology in which electricity is generated by incinerating organic energy sources). Secondly, building local (covering prosumers and “their neighbours”) autonomous low- and medium-sized voltage grids does not seem a rational option.

When prosumers are unable to use their own installations, they must have another “external” source of energy. This is why in practice the *Energy Citizen* model could rationally

operate only in the “semi off grid” option with additional and temporarily used sources of energy being public grids bringing together two groups of operators:

- operators of the public energy distribution grid who supply energy from professional producers of electricity through the national energy and power system; optionally each operator may receive surpluses of energy from prosumers operating within the *Energy Citizen* model;
- professional producers of electricity who sell their output through the national energy and power distribution grid to all recipients; they sell energy to the participants to the *Energy Citizen* project when the latter consume more energy than prosumer installations can generate.

On top of that we need to consider the role of the public electricity distribution grid operator who could make available the connection between a prosumer and a consumer “from the neighbourhood.” This is how an operator becomes a “co-participant” of the *Energy Citizen* scheme.

The *Energy Citizen* scheme needs various modern technologies, including digital technologies. Every prosumer who installs a new photovoltaic panel or a wind turbine with accompanying equipment and connects it with her/his home’s standard mains supplies uses cutting-edge technologies deployed to build devices that generate, control, and transmit or use electrical energy. Increasingly more often new materials and new methods to control processes are used, also those which deploy narrow artificial intelligence. From 2020 when in Europe, as well as in other parts of the world, 5G telecommunication technology is launched, these generators as well as many other electrical appliances will be equipped with individual meters to measure energy that they emit and consume. Besides measuring the quantity and quality of energy emitted from a prosumer’s household or received by the same household from the public grid, the so called “*smart metering*” will enable individual monitoring of electricity generators and consumers. The expansion and complexity of an electricity/power system in a prosumer’s household will advance with the installation of new equipment of subsequent generations. At the same time, new digital technologies will be implemented, including technologies employing devices able to automatically and autonomously co-operate with the Internet of Things (IoT). The process will take place in households whose users will get engaged into the transformation from traditional installations to the Smart Home or Smart Farm system. Both systems work to ensure higher comfort of the user of electric appliances, to expand their functionality, and reduce energy consumption.

By observing the market expansion of manufacturers of household electric appliances, one may expect that the dissemination of innovative solutions leading to achieving the Intelligent Home system will develop around people living in multi-family apartment buildings. Their households have very limited technical possibilities of individually installing their own photovoltaic panels or wind turbines to generate energy. The development of installations to several households housed in one building and the use of the *Energy Citizen* model can be assisted by a significant drop in prices of photovoltaic panels that could be placed on the



roofs or walls of multi-family buildings. Individual installations may be attractive to households in rural areas where in the vicinity of houses ground-mounted solar systems and wind turbines can be a viable option, while photovoltaic panels can be placed on the rooftops and walls of other facilities (within a farm).

Solutions used in the public energy and power system as well as within the framework of the *Energy Citizen* project are described in Table 3.

**Table 3. Energy generation and use within the public energy sector and in a modern prosumer project such as *Energy Citizen***

Process	Description	Comments	Use of digital technologies and new business models
Electricity generated by traditional and modern systems within the public energy sector	Electricity is generated by economic organisations specialised in power generation which in parallel or alternatively uses thermal energy technologies: <ul style="list-style-type: none"> <li>– fuelled with coal or lignite,</li> <li>– liquid fuels from the processing of crude oil;</li> <li>– natural gas;</li> <li>– biomass;</li> </ul> and technologies based on: <ul style="list-style-type: none"> <li>– nuclear;</li> <li>– hydropower;</li> <li>– marine (tides);</li> <li>– wind;</li> <li>– photovoltaic</li> <li>– power.</li> </ul>	How much electricity a particular plant in the energy sector generates depends on the decision of the central management body for national power grid. Decisions are made against different criteria. Regulations enacted by the government may give preference to plants, which: <ul style="list-style-type: none"> <li>– offer electricity at the lowest prices;</li> <li>– generate electricity using preferred, e.g. low emission, technologies.</li> </ul>	In the energy sector, development of technologies used to generate electricity, including the rapidly improved energy generation from the wind and new photovoltaic technology, is accompanied by the implementation of digital technologies. The most important are technologies used in smart metering, i.e. in measuring the direction and speed with which electric energy flows. Digital measuring devices are introduced together with the dissemination of the <i>Internet of Things</i> , i.e. equipment capable to autonomously and automatically send and receive data. These are solutions that upgrade “connectivity” bringing it to the next level much more advanced than “connectivity” that includes mobile devices (smartphones) and “computing clouds”. The solutions that are already in place allow measuring the amount of energy generated, transmitted and consumed in microsecond cycles close to the transaction cycle at the stock exchange trading platform using the <i>High Frequency Trading</i> technology. This opens up the possibility of trading in electricity at commodity exchanges.
Electricity distribution within the traditional “copper plate” system	Electricity is made available to “big customers” representing economic operators and municipal management organisations as well as to consumers buying electricity for their households.	Electricity recipients have access to public electricity distribution grid. Distribution grids in regions are operated by economic organisations which commercially build and operate distribution grids (medium or low voltage). In liberalised markets energy consumers can buy electricity alternatively from regional distributors who use their own infrastructure or from virtual distributors who use the regional operator’s infrastructure.	In the “copper plate” system digital technologies are used in ancillary processes, e.g. in trade and administrative services to customers. Analogue devices prevent from smoothly controlling and measuring energy transmission and consumption in short cycles (e.g., in microseconds). As a result, sales and purchase transactions are concluded traditionally disregarding electricity price dynamics at the commodity exchange. Almost 100% individual consumers of electricity (in Poland) are passive in the market and accept distributors’ practice of selling electricity at constant prices and making monthly (long-term) payments.

Process	Description	Comments	Use of digital technologies and new business models
Prosumer <b>Energy Citizen</b> model	Electricity is generated locally and the choice of potential (power) of installed photovoltaic panels or wind turbines is adjusted to peak demand for energy. At the absence of a local energy storage system, in time windows when generators may not generate desired amounts of energy, the participants of the <b>Energy Citizen</b> project use electricity from the public generation and distribution grid.	Since these are renewable energy sources (RES), a prosumer prefers generating electricity until s/he uses up all of the capacity output (changing in time). If there is a surplus of generated energy over consumption and absorption capacity in the storage system (if there is any), the surplus will be received by the public system of electricity generation and distribution. In practice, there is a problem how to estimate the value of electricity generated by a prosumer and received by the public system. If there is no public assistance to prosumers (such as a guaranteed price paid to a prosumer by a public system operator), prices may deeply fluctuate, while in some instances they may even be negative.	A prosumer uses digital technologies in two areas: <ul style="list-style-type: none"> <li>– smart metering (measuring and emitting data) and monitoring electricity distribution among the participants to the <b>Energy Citizen</b> project, including the control of electricity flow and transaction settlement (measurement, data transmission and processing, automatic control of devices in a prosumer's installation, automatic register of transactions and their settlement);</li> <li>– optimisation of energy consumption through automatic adjustment of energy consumption in terminals to eliminate energy consumption when devices should not be used (e.g. when they heat empty rooms) and better match electricity consumption with needs (e.g. by blocking them when some parameters have been achieved).</li> </ul> <p>"Smart Home" or "Smart Farm" consisting in the implementation of digital technologies by a prosumer is the precondition for the <b>Energy Citizen</b> model but it is enough. A public electricity generation and distribution grid operator must start cooperating with a prosumer, which may happen after adequate processes have been put in place. Controlling them calls for digital technologies and a new business model for settlements with the participants of the <b>Energy Citizen</b> project for electricity supplies.</p>

Source: Own compilation.

## Investment: comparative analysis

For the intermediary service to be feasible in short-term rentals in the *flat-sharing* format, investment was needed to launch the app and handle registration, data transmission and processing. To be able to invest and build an appropriate organisational potential and render the service to millions of customers worldwide, Airbnb as a start-up had to accumulate adequate funds. In 2008 their equity capital was USD 20 k. Increases in the amounts earmarked for investment over the period 2009–2014 can be seen in Table 4.

**Table 4. Capital raised by Airbnb between January 2009 and February 2017**

Time when funds were raised	Total amount of raised capital (m USD)	No. of investors
April 2009	0.600	2
November 2010	7.000	8
July 2011	112.000	8

Time when funds were raised	Total amount of raised capital (m USD)	No. of investors
October 2013	200.000	5
April 2014	474.000	6
February 2017	900.000	no data

Source: Own compilation based on: *Airbnb sammelt rund eine Milliarde Dollar ein*, Handelsblatt 9.03.2017, [www.handelsblatt.com](http://www.handelsblatt.com) (accessed: 9.03.2017) and *Infografik Meine Wohnung, deine Wohnung, keine Wohnung*, Statista 16.12018, [www.handelsblatt.com](http://www.handelsblatt.com), (accessed: 16.12018).

In the business model, investment outlays are paid by two groups of actors. The first one includes only one actor: Airbnb as a virtual platform operator. To be able to carry out the project, capital had to be raised as presented in Table 4. The second group brings together millions of users of the platform across the world, i.e. people seeking short-term rentals and people offering apartments or rooms. Investment outlays of this latter group are fragmented. Because each and every person on both sides has been granted access to the app offered by Airbnb in the business model “free of charge,” they have an impression that they are getting the service without paying for it. In practice they share their gains with the virtual platform operator who charges its commission on each concluded transaction. People involved in the *flat-sharing* project do not count how much they have paid for the mobile device, i.e., a smartphone (investment in modern *hardware* using digital technologies) and current payments for access to the Internet in this mobile device, i.e., fees paid to the local telecommunications operator (charges for using the Internet, which works thanks to digital technologies). They assume they would have to make these outlays and pay charges anyway, irrespective of being part of the project or not. The business model used by the virtual platform operator and the participants to the *flat-sharing* project is designed to accomplish measurable and immediately registered direct effects. The operator gets its margin and may earn on making the clients’ data available to businesses interested in penetrating the market; those who need short-term rentals save because they pay less than they would pay for a hotel service as shown in the data in Table 2. And finally, people offering apartments for rent get a higher monthly/annual revenue as a result of their cooperation with Airbnb than they would have got in the market from long-term rental contracts. In many European cities this is estimated at between 30% even up to a 100% increase in revenue. The approach of people who rent apartments is a under significant impact of regulations enacted by the government or local authorities. When a hotel service rendered as a hobby is taxed, interest in the project may be significantly reduced. This is confirmed by a dramatic (by ca. 50%) drop in apartments offered for short-term rental in San Francisco between December 2017 and January 2018 in response to the introduction of a local tax in the city since 1.01.2018 [Postinett, 2018]. We should also stress that all participants to the *flat-sharing* project either do not see or do not want to see negative indirect effects of the project [Kołodziej, 2017]. Its major effects are:

- some districts of highly attractive cities (e.g., Amsterdam, Barcelona) have changed from local community-friendly neighbourhoods into areas packed with tourists using short-term rentals permanently [NZZ am Sonntag, 2017, p. 1];

- a reduced pool of flats available in the market for long-term rentals, which acts against people looking for a job and a place to settle down in these cities.

The launching of the *Energy Citizen* project in combination with the increase in electricity generation by prosumers necessitates unambiguously dedicated investment resources which, besides direct effects, would also ensure significant indirect effects. Until now only indirect effects have been considered especially attractive. They correspond with Sustainable Development Goals [IEA, 2017], which after having been internationally approved in 2015 are broadly discussed in the media with references made to scientific and programme-related materials from local authorities and social organisations. These effects include:

- dissemination of RES and reduction of the share of energy generated from organic fossil fuels in the total energy mix;
- reduction of energy consumption in the economy as a result of the dissemination of solutions such as “*Smart Home*” and “*Smart Farm*”;
- local and global reduction of emission of greenhouse gases.

It is rather difficult to name and measure direct effects and benefits to prosumers from their investment. The implementation of the system of “*smart metering*”, and, in the near future, also enriching the power system in the country called “*Smart Grid*” with solutions from the IoT using 5G telecommunications technology will require prosumers to further invest in the purchase of these devices and software. On top of that, the cost of maintenance (servicing) of these installations will also be increasing. “*Smart Home*” and “*Smart Farm*” included in the *Energy Citizen* project will generate measurable investment outlays and current costs. On the side of benefits one can measure energy savings. It is the difference between the theoretically calculated amount of electricity that would have been taken from the public system by the participants to the *Energy Citizen* project if the project had not been launched and the energy effectively consumed after the project has been put into operation. Being aware of electricity savings, however, does not permit to indisputably decide how much has been saved in financial terms. That is because we have no experience as to what prices we should expect if *Energy Citizen* became a popular model. Without specifying the potential amount of savings for the *Energy Citizen* project one may not compare the effects with the outlays and the costs, with the latter being rather easy to identify as investment purchases and the purchase of goods and services are registered on an ongoing basis at unit (current) prices.

The principal obstacle in identifying electricity savings in financial terms lies in unforeseeable conduct of “*Smart Grid*” participants in the future. The advancement of technology, digital technologies included, will surely produce a situation where we will have electricity prices change “several times a minute” and exhibit high volatility. As demonstrated by German experience connected with the reconstruction of their power system, the so-called *Energiewende*, the electricity price at the commodity exchange may remain below zero for many hours. This is the price at which electricity buyers get a discount paid by the producers [Hubik, 2018].

A potential disadvantage of the *Energy Citizen* project consists in prosumers’ generating electricity only “when the sun is shining and the wind is blowing.” When these conditions

are satisfied in local installations, then the sun is shining everywhere in Europe (i.e. it is daytime, high pressure, dry weather, not cloudy or little cloudy) or it is windy (i.e. absence of high-pressure causing air masses to stop even over the seas in the off-shore area). Over the same period, there is an electricity surplus throughout the entire “*Smart Grid*” because in the energy sector both RES installations (mainly off-shore wind farms) and thermal energy installations can work at full capacity. Nuclear energy plants work 24/7, meaning they are non-dispatchable like RES *à rebours*. If in the entire energy system of a country there is an electricity surplus, its price must be especially low in times when prosumers could sell their surpluses either to the “neighbour” or to the public operator of the distribution grid. Since the price of re-sold electricity could be so low, it seems justified to estimate the value of savings (quantitatively) on electricity in the *Energy Citizen* project at these prices. Hence the conclusion that the efficiency of such a project measured in financial terms at the microeconomic level must be low [Flauger, 2017].

Obviously, the above reasoning would have to be radically modified if in the *Energy Citizen* project one could effectively deploy electricity storing that would be economically efficient. Other premises for substantial corrections in the description of the project and potential effects of its implementation would be accelerated dissemination of electric cars. If in the period 2030–2035 the share of electric cars in Europe actually reaches ca. 30%, the development of “*Smart Grid*” should speed up. “*Smart Grid*” will contribute to the propagation of IoT-based solutions as the only tools ensuring automated control of installations at households of “*Smart Home*” and “*Smart Farm*” type adjusted to charge car batteries at different times of the day [Flauger, Hubik, 2018].

## Summary

Observations of the consumer goods market let us conclude that innovative solutions are disseminated differently in the market. And the technical advancement of new technologies is not a decisive factor here. What decides is the attractiveness of new solutions, which much more depends on new business models put in place in the digital economy and measurable benefits available “here and now” to consumers rather than on additional, also earlier unknown, traits generated by projects deploying new technologies.

The above-presented case studies have led to some conclusions. The *flat-sharing* project has produced concrete benefits to consumers. This is true of those who have surplus space for rent and those who want to find accommodation for a short stay as a substitute to booking a hotel room. Airbnb as a virtual platform operator also gets benefits. Because positive direct effects at the microscale are accompanied by negative indirect effects, in many cities public authorities are seeking to restrict the development of the “*flat-sharing*” project. The *Energy Citizen* project is a completely different case. Due to potentially big positive indirect effects within the entire social and economic system, the authorities declare interest and support

to the idea. Yet, the engagement of prosumers and “their neighbours” in the project is very limited. This is caused by the absence of positive concrete effects at the microeconomic scale that could be achieved by this group of actors. Depending on changes in national regulations targeting national electricity/power systems, the approach of big economic organisations who are public producers and distributors in these systems may change. They are guided by microeconomic success and will not change their mindset even if called upon to carry out a positive mission envisaged in global policy. They know from experience that profits are not dependent on the size of electricity output and its price but on electricity transmission and distribution services sold at rates that guarantee high margins.

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