

INTRODUCTION OF ENERGY SAVING PRINCIPLES:
TECHNOLOGIES AND AWARENESS, LATVIAN EXPERIENCE

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The article presents an overview of the current situation of awareness of the Latvian citizens in the field of state-of-the-art energy-saving technologies. The authors present a wide range of data obtained as a result of a survey on the attitude of residents to new technologies and readiness to follow the development trends of a smart city.

The article contains the analysis and recommendations for improving the efficiency of introducing new energy-saving and energy-efficient technologies into each household in order to create the most favourable conditions for the implementation of long-term plans for the development of smart cities in Latvia.

Keywords: *citizen awareness, efficient energy use, energy consumption, energy control and management, energy saving technologies, smart city, survey*

1. INTRODUCTION

Urbanisation is becoming an integral part of our century, and according to various forecasts, in the coming decades 60 %–80 % of the population of the planet will move to the cities. This process is largely of objective character because it promotes an increase in a productive activity in many areas, and at the same time helps solve social economic problems of the society. It goes without saying that one of the most important directions in the development of smart cities is electric engineering, in particular, the introduction of economical, effective technologies of power and heat generation, increasing the safety of power and heat supply in the cities, introduction of energy saving technologies and application of materials and equipment ensuring longer terms of their exploitation. Energy consumption is also closely related to business activity and living standards of the population. The more aware and independently acting inhabitants of the cities are, the higher level of energy efficiency will be reached [1].

Furthermore, the 21st century is characterised by information technology explosion; many of the technologies offer their own solution to the task of competent and economical consumption of energy resources. Nowadays, web platforms are generally available that enable evaluation of quantitative and qualitative indicators of one's consumption and choice of the most appropriate variant of management of resource consumption and their cost.

Therefore, a successful model of a smart city can be based on the balanced long-term strategy of electric engineering development or activity plan aimed at stable electric engineering for a smart city, which in essence is also the starting point for future initiatives as an integrated tool for infrastructure development. Actually, the way to the smart city starts with a clear plan that includes ambitious goals, concept of necessary legislative amendments and, of course, indicators for measuring progress [2], [3].

2. BACKGROUND

As shown in paper [4], consumers sufficiently contribute to achieving flexibility in energysystems by changing the amount and way of energy consumption, which can promote a growth of stability of the whole energy system and decrease of the system load in peak hours. For that purpose, understanding and use of the technologies available in the market is crucially important, as well as understanding of one's contribution to promoting the growth of renewables share and ensuring a more flexible energysystem. According to the market research conducted by Lattelecom in 2017 [5], despite the fact that electric energy market in Latvia was opened on 1 January 2015, currently 97 % of households in Latvia are using services of the main trader and only 3 % of the population exploit new possibilities of reducing power consumption expenses by changing their consumption tariff and/or changing the trader.

The authors of [6] point to the fact that effective interaction with consumers is crucial for the electricity supplier, who installs smart meters and systems, and suggests using different tariffs of energy consumption, including dynamic tariff, i.e., variable price each month in accordance with the price at the electricity exchange. Commonly, consumers do not have or have insufficient experience of interaction with smart meters, hour-to-hour data provided by smart meters and control of energy consumption in their households.

The problem is compounded by the fact that a huge number of new technologies are entering the market, including on-line programs to control a power consumption rate and load, new equipment and information systems, Web portals, calculators and software to compare and control energy consumption. All the above requires customer attention, willingness to study and master new technologies, and readiness to use them to control their own resources. Some utility services are introducing new time tariffs, e.g., dynamic tariff, i.e., variable price each month in accordance with the price at the electricity exchange, load management as well as other user-oriented programs that help them to study their power consumption models, understand how the programs will affect the tariffs, and in the long run, make validated decisions regarding the use of energy and controlling it. These programs turn out only to be ef-

fective when customers have a good understanding of costs, profits and value of the offer, and decide to play a more significant role in the management of their energy consumption and expenses.

As experience shows, most frequent and informative communication with customers takes place either personally or by phone or, most frequently, in the electronic form using automatic messages and replies, as well as using the internet, web tools, social networks, TV and other tools used for advertising. Often, several communication methods are required to establish successful interaction. Teaching and incorporating new clients have to be performed on a regular basis. The authors have studied issues of the Latvian population's flexibility and adaptivity to initiatives of energy efficient use of resources, and also examined the causes and ways to influence awareness and acceptance of new initiatives by the country's inhabitants.

3. REVIEW OF ENERGY RESOURCES IN LATVIA

According to the data of Central Statistical Bureau (CSB) of Latvia [7], electric energy consumption in households (in percentage) increases every year (see Fig. 1).

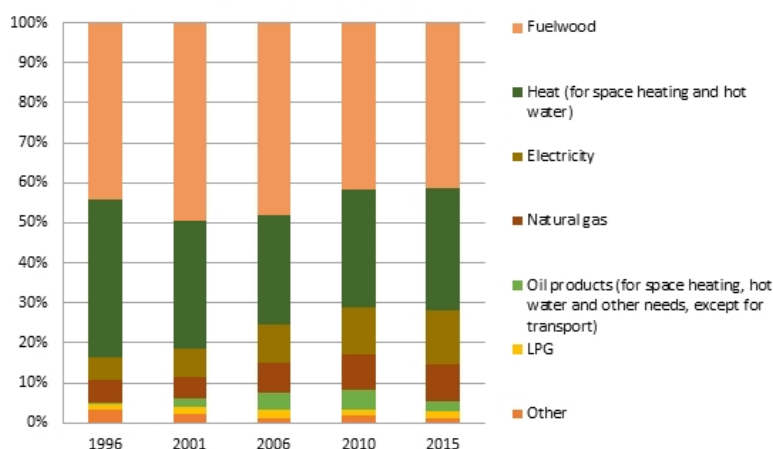


Fig. 1. Changes in the structure of energy consumption in households, by CSB.

As of 2015, energy consumption in households constituted 14 % of total energy consumption, excluding transport, while total household expenditure on energy consumed (see Fig. 2) was 40 % of the cost of total energy consumed in households. Since 2001, an average price of electric energy for households has risen nearly three times.

Since 2010, the electricity cost in the total expenditure has increased by 34 %, while the costs of other energy resources have diminished or have not changed [7]. While the total indicator of the final consumption of energy in Latvia has a tendency to decrease, energy consumption in households grows every year. In 2016, it constituted 28 % of the final energy consumption in Latvia.

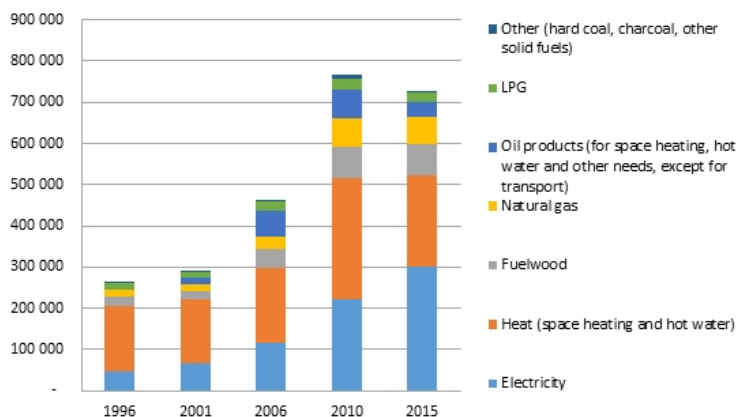


Fig. 2. Total household expenditure on energy consumed (in thousands of euros), by CSB.

According to CSB data, average consumption of electricity per household has not changed a lot: 2088 kwh/year in 2010 and 2185 kwh/year in 2015, which can serve as an indicator that under the continued growth of electric appliances and equipment that consume energy in households, efficient energy use is an important and necessary condition for the Latvian inhabitants.

4. ANALYSIS OF THE NEEDS AND AWARENESS OF ELECTRICITY CUSTOMERS IN LATVIA

To clarify the picture of the Latvian inhabitants' awareness in the field of innovations and possibilities of a smart city, an anonymous survey has been developed. Another aim of the survey has been to study the existing beliefs and habits in the sphere of energy resource management that promote or impede the use of new intelligent potentialities of a smart city. The survey included topics like information sufficiency on the specified theme, confidence in the information gained from different sources, issues of personal values and priorities, issues of finance as a motivator, as well as studying what else can serve as a motivator for changes, and the presence of possible limitations on changing the behaviour to ecological, stable and energy saving.

In the course of the survey, these trends have been discovered that are fundamental for understanding customer response to possible changes:

- A third of the respondents have no idea about such a notion as a smart city and have never heard about the initiatives aimed at constructing a smart city (Fig. 3, (a));
- More than half of respondents have admitted that they have no idea about any projects oriented towards "smart" energy resource consumption in their city (Fig. 3, (b)).

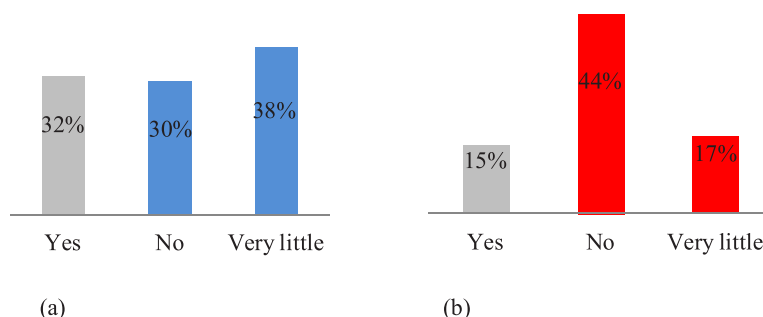


Fig. 3, (a) and (b). Answers to questions about smart city.

The data obtained reflect an insufficient level of the Latvian inhabitants' informativity about initiatives implemented in the sphere of a smart city. This is the gap that should be filled first of all by solving the issue about information sources that the Latvian inhabitants use and trust.

The above-mentioned consideration is supported by the fact that 4/5 of the respondents have positively answered a question “Are you interested in saving energy?” This is a very good dynamics for promoting projects and initiatives aimed at raising the intellectuality of the Latvian cities and saving energy in case of appropriate material delivery and information provision. Moreover, 80 % of inhabitants consider it important to have up-to-date technologies at home, whereas 20 % do not care about it.

To promote training and informing the inhabitants about the latest achievements in the field of electric engineering and energy resource saving, we have first of all to find out what the current state of affairs is and what issues are important and necessary not only from the viewpoint of the government, administration and legislative references, but also from the point of view of ordinary people, each of which is an energy consumer. It is also essential to search out which topics motivate their willingness to accept the novelties and develop by following modern technologies and trends, and which ones cause non-acceptance, as well as to find out the reason for such behaviour. These circumstances could be different within different countries, and may even differ in cities within a country. This is a detailed study of the circumstances that can promote further successful organisation and development of a city wishing to be “smart”.

Respondents have also been asked a question: What is your attitude to energy saving technologies? Their replies show the level of awareness existing in Latvia nowadays:

- The most numerous group of respondents (about 60 %) have responded that they do know about energy saving technologies and use them a little bit;
- 20 % of respondents have stated that they are aware of energy saving technologies but do not use them. While working with that kind of customers, it is crucially important to find out the causes, why a person refuses to try to apply “smart” technologies. Quite frequently, the focal point is distrust and/or willingness to follow a customary way of living and consumption;

- A bit less than 1/5 inhabitants are not aware of energy saving but wish to know about it. In this case, it is important to study further the ways people use information and what sources should be used to exchange information and communicate with them. Say, mobile applications and information in social networks would suit young people best, whereas for people of ripe age personal contact could be determinant.
- Only a very small group of people (about 3 %) have responded that they neither know about such technologies nor wish to know about them. Actually, this can only be evidence that a special approach is required to contact this kind of people to awake their interest in energy saving issues.

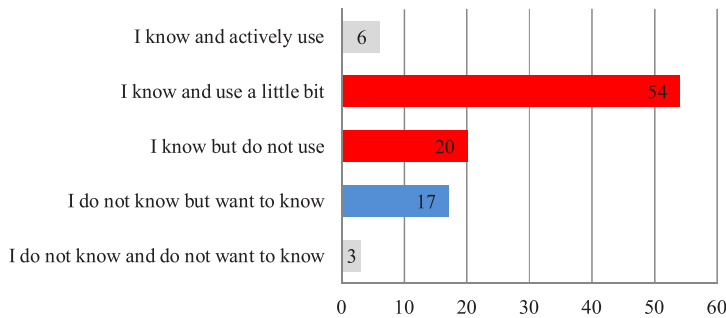


Fig.4. Respondent's attitude to energy saving technologies.

In Fig. 4, two groups of people marked can be considered, correspondingly, in red and blue colour. Respondents out of the red group do know about new technologies but due to some reasons do not use them or use them very little. Therefore, simply distributing information about new projects and innovations in the field of energy saving it is impossible to solve the issue of informed use of the technologies above by inhabitants. Additional studies are required to more precisely define the reasons as well as motivation that will work just in the specified group of people. Here, the research discussed in [4] should be mentioned whose authors have conducted considerable research aimed at clearing up what information sources customers trust, as well as what the form is in which information not only can be taken into consideration but also starts to be used in households.

On the other hand, respondents ascribed to the “blue” group, i.e., those who wish to know but know nothing about smart energy and smart consumption, due to some reasons are uninformed about energy saving and introduction of new technologies despite all advertising handled and existing within the initiatives of a smart city. Most probably, this gives evidence that training information has to find new channels of reaching clients. Again, this is a topic of thorough study of such group of customers, specifically, it is important to find out who enters the group, what the age-related characteristics are, what information sources they are accustomed to use and where they would be ready to obtain and take into consideration information, offers and initiatives on energy saving technologies.

It should also be noted that despite the fact that an absolute majority of respondents are interested in energy resource saving, their vision how to implement it dif-

fers: three fourths of inhabitants prefer to use at home a new energy saving technology that itself will care about smart consumption of resources after the adjustment, whereas one fourth of inhabitants prefers manual everyday correction of equipment that consumes energy resources in order to diminish their consumption.

The topic of the Latvian citizens' motivation to use energy saving technologies is quite interesting and important (the respondents could tick several techniques that are close and motivating for them). A question: "What would make you to more frequently use energy saving technologies?" has been answered as follows:

- 34 % of respondents have chosen the example of neighbours/friends/acquaintances;
- 32 % of inhabitants stand for public companies that would explain the advantages of new technologies;
- the overwhelming majority of respondents, i.e., 63 % are sure that they would benefit from vividly represented savings of energy and money;
- 13 % of respondents would be motivated by an example of state public figures;
- For 39 % of respondents, awareness that they will promote nature and earth resource preservation for their offspring is important.

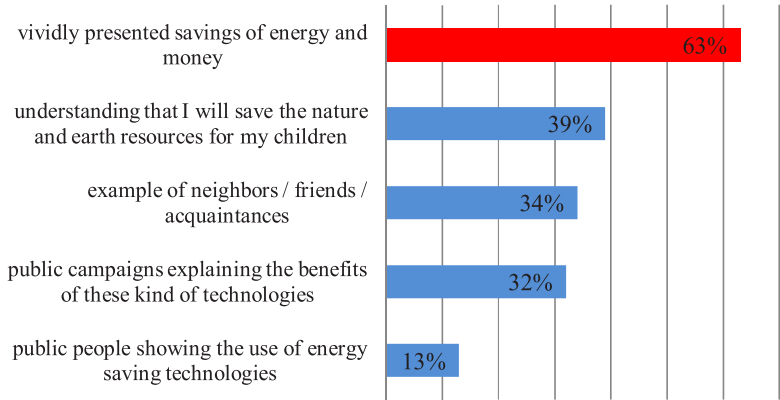


Fig.5. Motivation to use energy saving technologies.

All the aforementioned topics motivating the Latvian inhabitants to save resources as well as their distribution percentage deserve further attention and study with a view to organise effective introduction of new energy saving technologies in our life. As pointed in [8], a majority of approaches to reaching stable energetic behaviour consider people in the context of their wish to acquire and enlarge their wealth and property. Although a social context plays a great role in the way how people think and behave, they do not realise it frequently. We are members of different social groups and societies that can affect our behaviour and persuasion in using innovative technologies and energy efficiency attitudes.

Financial issue definitely also contributes to the influence of the Latvian inhabitants' choice on the use of innovative energy saving technologies.

- 46 % of respondents would be ready to use the new technologies provided they would pay off within 1–2 years;
- 39 % would be ready to wait for the payback period of 3–4 years;
- 12 % have made investments in new technologies or will be ready to do so if the payoff period is within 5–10 years.

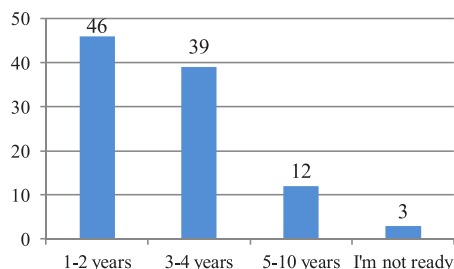


Fig. 6. Readiness to pay for new technologies: “I am ready to use the new technology if it pays off”.

Another vector of research has been directed towards finding out how much money a person is ready to pay for new technologies every month knowing that they help one save energy and lead to the enhancement of an ecological situation in the country. As a result, it has been found that (see Fig. 7):

- 17 % are ready to pay € 1–2 per month;
- 28 % – € 3–4 per month;
- 36 % – € 5–10 per month;
- 11 % – more than € 10 per month;
- 8 % are not ready at all to invest money that way.

In other words, it can be argued that 97 % of people in Latvia are ready to pay for new technologies.

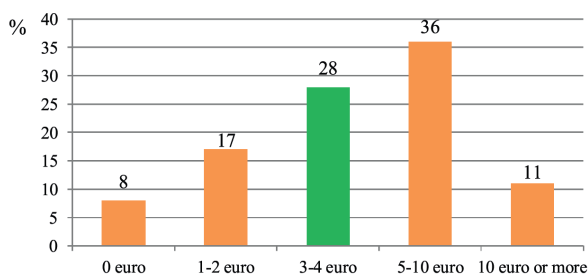


Fig. 7. “How much money would you agree to pay monthly for new technologies in your home, knowing that they will help to save energy and improve the environment?”

Basically, the Latvian inhabitants are ready to invest in new technologies € 3 – € 10 monthly provided they are sure that the investment would ensure energy, and respectively, money saving (48 % of all respondents).

In the course of the survey, the authors have also examined existing perception stereotypes of the Latvian inhabitants regarding new possibilities of controlling and saving energy, for instance, readiness/unreadiness to change a service trader or to

pass on to another mode of energy consumption and payment, as well as willingness and readiness to model their consumption by using mobile applications with game elements (see Fig. 8). In the survey, respondents could point several choices that were closest to them. Survey results are summarised below.

- For a third of respondents, stability and predictability are the key factors and they wish to change nothing. This is a serious claim for long-term and gradual working with this kind of customers aimed at having an opportunity to change habits of these people in the direction of new technologies and new possibilities. It is evident that the percentage of mature aged people in this group is high, and here, one effective way to convince somebody to try something new, bringing mutual benefit both to a customer and a trader and ecology of the country in general, is through personal contact;
- 4 % of respondents have experienced a negative result in an attempt to pass on to a new mode of electricity consumption;
- A large group of respondents (19 %) are not aware of the new potentialities in the sphere of energy resource management and saving;
- 17 % are ready to try something new provided that they are convinced of the benefits from it;
- A relatively small percentage of respondents (9 %) are ready to take part in modelling their expenditures and energy consumption management through mobile game applications.

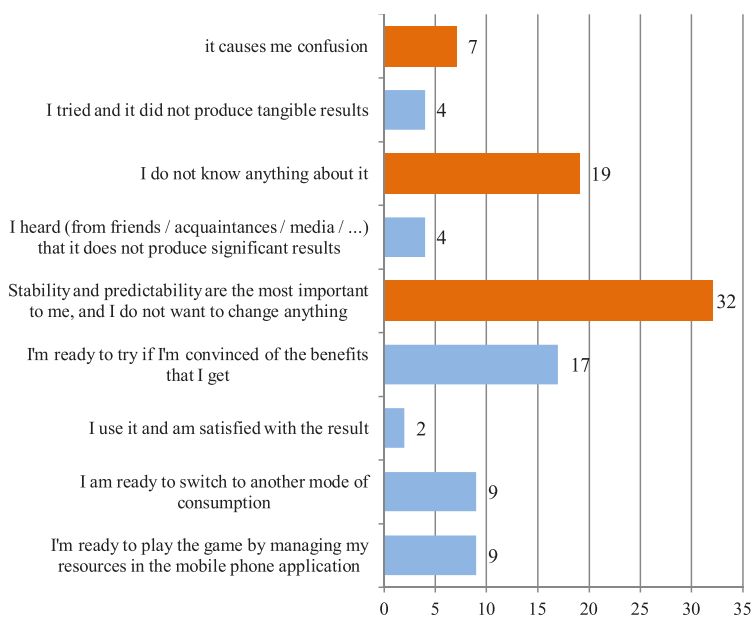


Fig. 8. "What do you think about choosing another electricity consumption mode for saving resources and money?"

There was quite a large group of respondents who knew nothing about new possibilities in the field of energy management and saving or wished to change noth-

ing or felt confused or uncertain (the group of replies marked in orange). Here, further research could be oriented towards finding the reasons for such unawareness and non-acceptance. One possible reason could be using insufficient information sources excluding widely used types such as TV, radio and the internet. If this is the case, new information dissemination channels should be searched for, say, in public transport, at the cash desk in a shop, as advertisement in mobile games etc.

5. CONCLUSIONS

Overall, survey findings show that awareness of the Latvian inhabitants of the processes related to formation of more smart or intelligent cities is not quite high. Many people prefer not to try new possibilities and technologies enabling one to be energy efficient in the field of resource consumption. Conservatism and unwillingness to lose the today's comfort level reached make them stick to frequently unprofitable consumption conditions from the economic point of view, but the lack of information does not further enlarge knowledge of the topic. Plenty of useful, up-to-date energy saving technologies and equipment could be available in the Latvian market, but the lack of interest and willingness to use them would reduce to zero all possible economic effects of such innovations.

Nevertheless, as the research shows, many people are willing to learn more and it is important to them to have and extend the overall picture of what is happening in the electric energy market so as to be able to actively participate in decision-making. Furthermore, in modern world, multidisciplinary studies are becoming increasingly requested that combine knowledge and competences from the spheres that are traditionally considered different. Electric engineering and smart consumption of energy resources, on the one hand, and awareness of inhabitants and their active participation in consumption management, on the other hand, if combined together, would further promote the most rapid and confident progress in a stable development of a smart city in general and smart management of the resources of every inhabitant of Latvia in particular. The issue of personal values and priorities of each consumer is one of the major issues in the successful strategy of city development, which contains possibilities and challenges to change habits and persuasions to more energy efficient, active and conscious ones.

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IEVADS VIEDO PILSĒTU ENERGOEFEKTIVITĀTES PRINCIPOS: TEHNOLOĢIJAS UN APZINĀTĪBA, LATVIJAS PIEREDZE

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K o p s a v i l k u m s

Pilsētplānošana kļūst par mūsu gadsimta neatņemamu sastāvdaļu, un saskaņā ar dažādām prognozēm turpmākajās desmitgadēs 60 % - 80 % planētas iedzīvotāju pārcelsies uz pilsētām. Šis process lielā mērā ir objektīvs, jo tas veicina produktīvas aktivitātes palielināšanos daudzās jomās un vienlaikus palīdz atrisināt sabiedrības sociālās ekonomiskās problēmas. Nav šaubu, ka viens no vissvarīgākajiem virzieniem viedo pilsētu attīstībā ir sasisītis ar elektroenerģiju, jo īpaši ekonomisko un efektīvo enerģijas un siltuma ražošanas tehnoloģiju ieviešanā, pilsētas energoresursu un siltumapgādes drošībā, enerģijas taupīšanas tehnoloģijas un materiālu un iekārtu energoefektīvā lietošanā, nodrošinot ilgāku to ekspluatācijas laiku.

Enerģijas patēriņš ir cieši saistīts arī ar uzņēmējdarbības aktivitāti un iedzīvotāju dzīves līmeni. Lielāko uzmanību pievēršot pilsētu iedzīvotājiem un tā ieradumu maiņai, ir iespējams sasniegt daudz augstāku energoefektivitātes līmeni. Rakstā sniegts pārskats par pašreizējo situāciju Latvijas iedzīvotāju izpratnē mūsdienu enerģijas taupīšanas tehnoloģiju jomā. Autori iepazīstina ar plašu datu klāstu, kas iegūti pētījumā par iedzīvotāju attieksmi pret jaunām tehnoloģijām un gatavību sekot viedās pilsētas attīstības tendencēm.

Rakstā ir iekļauta analīze un ieteikumi energoefektivitātes uzlabošanai un energoefektīvu tehnoloģiju ieviešanai katrā mājāsaimniecībā, lai radītu vislabvēlīgākos apstākļus ilgtermiņa plānu izstrādei viedo pilsētu attīstībai Latvijā.

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