



Transformation of energy market and building using renewable energy sources

**Social values of CO₂ emissions
as a tool for the transformation towards
the sustainable society.**



Liptovský Mikuláš, March 2013



The Centre for Research on Economics of Renewable Energy Sources and Distribution Systems with the seat in 3 Murgašova Street, 040 01 Košice (Centre VEOZEDIS) was founded in 2008 on the initiative of the President of the Economic Policy Committee of the National Council of the Slovak Republic Ing. Maroš Kondrôt. It was founded by:

1. Slovak Technical University in Bratislava
2. Technical University in Košice
3. University of Economics in Bratislava
4. HONORS, a.s. with the seat in Liptovský Mikuláš

The subject of the applied research was the transformation of the office building in 3 Murgašova Street, Košice with the area of 5,370m². HONORS, a.s. company started the reconstruction of the office building in 1996 with the gradual adaptation of space and the reconstruction of the source. Then, the reconstruction of the envelope structure of the building was executed and after its finalisation the transformation of a heat supply from the fossil fuels to the local renewable energy source supply was done. Another solution for the quality rise of internal environment of a building and the reduction of the energy consumption has been already being solved in cooperation with the Centre VEOZEDIS. The core of the research team consists of specialists from energy practice, Ing. Ľudovít Tkáčik and Ing. Ján Ferenci, and scientifically oriented workers of TU Košice, Ing. František Vranay, PhD and in 2012 Ing. Marek Kušnir, PhD, too. The cooperation with professor Ing. Milan Bielek, Dr.Sc has meant a significant contribution to the systematizing of works since 2010.

The aim of the work was the elaboration of the principles for the transformation of the energy market and the verification of the validity of the designed solution on a small project of local renewable energy source. The submitted report contains the results of 5-year-systematic works of the direct realization of chosen technologies during the building operation. The model of the transformation of the energy market was done from experimentally verified data. The overall study is broad, supported by the protocols from the measurements and extensive analytical studies of systematic nature whose aim is to answer the question about the position of renewable energy sources in the society and their role in the processes of actual social crisis. It also deals with the issue of how the organisation of the market should look like in order to prevent the moral hazard, negative stimulation at the expense of a consumer and economic redistributions damaging a part of the investors. The solution focuses on the searching for the cooperative-competitive organisation that preserves a decisive part of realized investments and do not damage them in competition.

The submitted report explains the role of the social value of CO₂ emissions as a tool for measurement of transformation costs and also an effective regulatory tool in the process of the transformation of the energy market. It also shows that it is possible to significantly increase the quality of internal climate of buildings, if the physiological human characteristics are respected at thermal regulation within the actual transformation of a building into a building with zero energy balance.

A part of a research process is the gradual presentation of achieved results in the range of professional publications at international conferences and monographs and moreover, the results of works are verified directly in the practice by real users of a building.

The submitted works were led by Ing. Dušan Lukášik, CSc and financial funds were provided by HONORS, a.s. company. Liptovský Mikuláš



Executive summary

"The fact that we lack the energy concept is true. However it is always like that. The present conception has been valid since 2008 and I am working so that we adopt a new one in 2013".

Tomáš Malatinský, Minister of Economy of SR, 29th January 2013, National Council of the Slovak Republic

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Košice, March 2013



"I take a pen in my hand because I want to say few words about Stodola, the master of the technology, about a gentle and strong man, the master of technology; I feel that my verbal skills are too limited to behave to such a person in way he deserves. ..."

Albert Einstein

on the occasion of 70th birthday of Aurel Stodola,



Aurel Stodola

He was born on 11th May 1859 in Liptovský Mikuláš. He attended grammar school in Liptovský Mikuláš. He graduated at State higher secondary school in Košice. From 1876 he studied the engineering in Budapest and from 1877 mechanical engineering in Zurich. In 1883 he continued the studies at Technical College in Charlottenburg and he finished his studies in 1884 at Sorbonne in Paris. In 1892 he accepted the invitation to become a docent at the Technical College in Zurich where he became a professor (1893) and he worked there until he retired in 1929. Aurel Stodola was a professor of Albert Einstein.

In his scientific activity he focused on the area of the theory of automatic regulation of machinery, he laid the scientific foundation of projection and construction of steam and gas turbines. He achieved the biggest success in the field of steam turbines and his calculations and constructions laid the foundation for this field of engineering. ***He was the constructor of the first heat pump in the world. His heat pump from 1928 still works in Switzerland and heats the town hall in Geneva by removing the heat from the water of the lake.*** Almost each household has got a heat pump in a fridge.



The submitted material briefly informs a reader **about the decisive experiments during the transformation of the office building in a full-pledge operation into the building with almost zero energy needs from 1996 to 2012**. It is shown that without the transformation of the energy market from a competitive market to a cooperative-competitive market within a strategic segment of providing the services, the realisation of these buildings is not possible. It is the result of the fact that **local renewable energy sources that are the parts of buildings have to supply the market with the energy**. Otherwise it is not possible to reach almost zero needs of buildings. We demonstrate on the systematically measured value during 16 years of gradual transformation of a building that is able to **achieve the reduction of the heat consumption by 73%, the reduction of the primary energy sources consumption by 87% and the reduction of CO₂ emissions production by 96%**. The solution provides also a reaction on climate changes that cause the occurrence of heat waves causing the increased risk of organism collapse or death. **It is a substantial quality rise of the internal environment of a building with the mechanism of energy transport suitable for the human physiology**.

The issue of renewable energy sources and energy effectiveness of building is expressed in a quite complicated way of abstract solution of the terminology in the whole range of the EU directives converted into the form of laws. These models can be factually understood only after the confrontation with concrete gained facts achieved in an experimental way. The situation in the laws is complicated because of the **active use of weighting factors that change the physical parameters according to the social preferences and they are implemented in the laws on the basis of political decisions**. The transformation of buildings is an example that shows the logics of this principle usage as a suitable tool for the constructions of models expressible in laws. On the contrary, the example of biomass documents an inappropriate application of this political tool.

Transformation solution of energy market is based on the knowledge that irreversible transformation process of the society happens simultaneously with the cyclical crisis that is related to the disruption of the old value system. The data point to the fact that **renewable energy sources represent the production technology and they are able to be as much important within the crisis solution as the IT technology was within the energy crisis solution in 1970's**. We analogously with IT point to the fact that the crisis solution can last for circa 15 years and the transformation of the society can last from 40 to 60 years.

Material as a decisive tool for the transformation of energy market **defines the transaction costs measured by CO₂ emissions** which are assigned social value in the amount of 85 USD/t (65 €/t) in the Stern Review. In the form of green bonus they create the economic stimulus for the energy suppliers without CO₂ emissions in the form of excise tax on the energy from the fossil fuels with the amount that is significantly decreased regarding the energy content; **they create economical sources of transformation of the market**. The chosen amount of the price of green bonus determines the pace and dynamics of the market transformation, while the price represents a decisive regulatory tool for a regulator. This principle eliminates the actual economic redistributions among the investors via energy markets and creates fair environment for competition.

Material introduces **knowledge curve of CO₂ emissions** as a systematic tool for the regulation control. The knowledge curve of emissions explains how is it possible to isolate the technologies via economic criteria that are not determined for the market. These technologies require further technological research and development. On the contrary, the chosen amount of social value of CO₂



emissions determines whose implementation via the economy of scale will reduce the costs and ensure that ***in the competition on the market the technologies get under the tipping point and get the investment return within the market price.***



On the basis of published data of a market regulator about the amount of the supplements for 2011 and 2012 show that the principles of market management by the Act no 309/2009 Coll. achieve their possibilities in 2013 and without the implementation of competition whose aim is to reduce the costs, the market with the energies with supplements will go in collapse what threatens the chance of the Slovak commitment fulfilment to the EU in the energy mix in 2020. The volume of the market was calculated on the basis of published data to 16 billion€ until 2020. If the commitment of the payment of supplements up to 15 years should be complied with, the amount of the payments would be 30 billion by 2035 in the form of the rise of the price and supplements. The designed 6-level-model of 40-year transformation of the market eliminates the possibility of the moral hazard, negative stimulation of the market in favour of investors and at the expense of consumers and it brings the market to the strategic cooperative-competitive level where investors cooperate within the compliance with distribution networks and compete within providing the services related to energy on the consumer market at energy consumers.

Holistic approach that requires the complexity of solved phenomena is described by Doidge very vividly in a following way (1). When in 2004 the tsunami hit the area of Indian Ocean and killed hundreds of thousands people, all members of the tribe Mokena living on the water survived. They noticed that the sea started to recede in a strange way. The retreat was followed by an unusually small wave. They saw the dolphins swimming into the deep waters and elephants going to higher places. They heard the cicadas silenced. They remember the tale about the wave that eat people. Mokena correctly sensed the oncoming danger faster than the modern science was able to assess the arrival of tsunami and inform people by communication means. One part of Mokena tribe escaped to higher places of the land and the other part sailed into the deep waters of the ocean. All Mokena tribe survived. The modern science was late to react and assess the oncoming danger by excellent measuring device and to warn inhabitants. The Mokena people were able to connect unusual events together and see the whole using extremely wide angle of view unlike the modern people influenced by analytical science. Since the tsunami wave does not occur very often, the information were stored in the deep memory and only the intuition made them getting a correct answer to the unusual combination of observed facts. Some experienced sailors from Burma were on the sea then. They did not survive. One Mokena man answered the question about the death of the Burma's sailors in a following way: "They watched the sepias and ignored everything else. They did not know how to look".

It is a holistic approach to the solution of the problems of modern society that enables to fulfil the visions and by their verification in the practice select the knowledge from the huge amount of the knowledge that is nowadays at the disposal of humanity that can be transformed into the actually applicable knowledge. That is also a reason why Einstein emphasized that **„a vision is more important than knowledge, because the knowledge is limited but the vision can include the whole world“**.

Only a real experiment of local energy source and the transformation of a building within the relative extent enable to transform the available knowledge into the skills and on their basis to elaborate or form new functioning models with the ambition to change the standards of behaviour in the society in favour of a man through their implementation into the legislation.

Dušan Lukášik



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Transformation of the society related to the value system change

The crisis on the financial market in the USA in 2008 became a catalyst of global social movement. The effort to understand the crisis led many analysts to extensive works whose aim is the identification of the nature of the crisis and especially a design of its future. The analysis of wider time range enable us to say that since 1995 there have been processes on various markets that have gradually fulfilled the model of existential crisis (2) just as the modern psychology developed it (3). The unifying fact that caused the formation of the crisis of cyclical nature on the individual markets was the creation of moral hazard on the side of a consumer that together with a negatively stimulated market on the side on the investors quickly led to the saturation of the market possibilities and then to its collapse. A market regulator (usually it is a state) either mishandled its task or it has become an active co-author of the state of moral hazard by a relative legislative change. The asymmetry in the information on the market among the providers of the products and consumers (4) (5) was not adequately balanced by the laws protecting the consumers' rights. A consumer accepted an unreasonable risk that he did not know about before and moreover, if the risk became apparent, he was no able to control it - he did not have the tools for the risk management and often nor the knowledge.

More throughout analyses show that under the cyclical crises on the individual markets there happens also an irreversible transformation process (6). This is only a different expression of the existential crisis. Each irreversible transformation process as well as existential crisis is always accompanied by the disruption of value system. After the disruption, a new value system is set. ***The transformation into sustainable society using the renewable energy sources within the lowest social costs*** represents synthetic expression of an ethical solution of actual social crisis. The part of the transformation of the society will be a new organisation of the relations including the organisation of settlements within the information technologies, available renewable energy sources and price rise of fossil fuels.

Global risks

Ecological risk and the risk of declining of supply energy market

If we ask which of natural processes threatens the human existence, the answer is the climate changes (7) (8) and we can prove it on the experimental facts of the pace of increase of ocean level. The risk of a fatal political conflict on a global scale (10) (11) would contribute to the pace of depletion of fossil fuels (9), if the significant reduction of market energy supply happened in a part of the world. Safety analyses show that even the locally created chaos could very quickly spread into an unmanageable range (12).



Man and his characteristics as a decisive risk

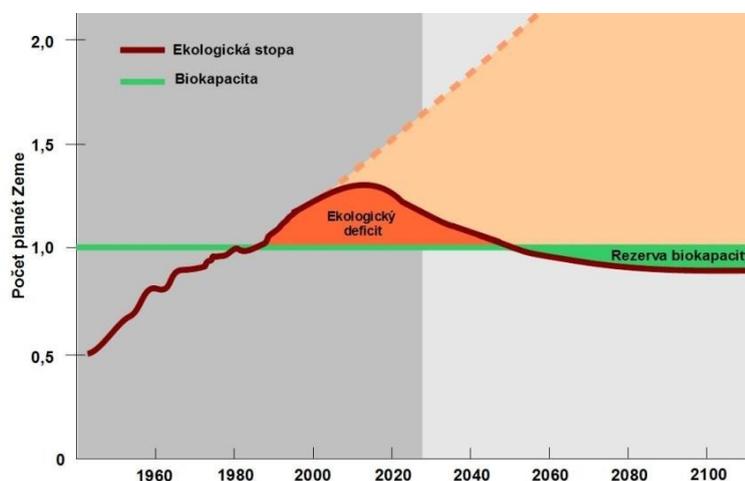
The conclusions of the researches in the psychology enable us to claim that a man displace his bad characteristics as personally unpleasant into the subconsciousness. A significant part of life energy transforms into unproductive compensatory energy that serves for keeping the bad characteristics out of the subconsciousness on the individual level as well as collective one. While the consciousness accepts 40 pieces of information per second, the subconsciousness processes 20 million pieces of information per second (14). This subconsciousness represents a many times more powerful system than consciousness. The subconsciousness simultaneously with the consciousness processes the achieved information and these two systems mutually create always dynamically new, mutually compensated state within the external changes. The subconsciousness creates new **prospective information** for a man. Their purpose is to make new quality of information serving for better future-oriented adaptation of a man in the environment, either the social environment or the natural environment (15). It is important that the subconsciousness expresses itself symbolically in images (13). The subconsciousness places the processes information in the projection on the people and processes (16). And therefore, even though a man or the society stubbornly displaces them into the subconsciousness, the power of their projection causes that in the end they stand directly in front of a man. It often happens quietly and indirectly through the positioning on the processes but it is stronger and more urgent. **They are objective processes that acquire a critical dimension and their emergence compels the attention of a man by the force of its destruction.** Actually already visible demonstration of climate changes for the first time after 3 and half billion years lasting existence of the life on the Earth shows that the life is threatened not as a result of natural processes, but also **as a result of its highest known form - a man.** The essence of the problem is formed by the aggressive attitude of a man within the usage of natural resources without setting the limits in economic activity of a man, which would accept available capacity of ecosystem of the nature for recycling of produced waste. The natural resources globally participate by 60 -75% (17) in goods and services produced by a man. The aggressive attitude of a man to the nature as a result of destructive emotions of greed, envy and hatred (18) implemented into a modern theory of micro economy (19) at the turn of the millennium eventually lead to the situation when standard economic model became invalid and they were not able to foresee the crises formation. The explanation of the crisis formation from the first decade of the 21st century is not possible only via the emotional equipment of a man (20) in the combination with marginal state duties as a market regulator. The result of the accelerating and from the point of view of existential and even unnecessary waste of natural resources, is that ecological systems of the Earth do not have enough time for processing and reproducing the waste from the human production. The waste accumulates in the nature and creates the toxic environment (21) for life.

Ethics as a dynamic parameter

Biological body of a man represents auto-poetic system from the point of view of a system. Auto-poetic system is a system that depends on the information feedbacks provided by external



environment. The paradox of a man as well as every auto-poetic system represents the fact that a man is freer the more available information gets from the bigger amount of external feedbacks. A man broke away from the nature by achieving the ability to distinguish contradictions that eventually lead to the awareness of oneself. He started to distinguish the opposite poles of good and evil (23). It is the consciousness of a man that exceeded his biological body. However, at the same time the consciousness is bound to the biological body. However, the human biological body remained the part of the nature and is subject to its regularities. The conflict between the possibilities of consciousness and possibilities of biological body is a permanent characteristic of a man (24). This conflict requires continual solution in the form of the selection. The part of the selection is the selection between the contradictions that represent good and evil. The assessment of what is good and evil in a given moment depends on the assessment of external relations in order to make a problem more complicated for a man. And since the external context changes, the same fact can be represented in one moment by good and then immediately by the change of external conditions it can be transformed into the state that represents the evil. The need for continuous selection and simultaneous ability to distinguish what is good and what is evil in a moment of deciding represents an imaginary cross that a man carries on his shoulders (25) (26). A man changes the environment of the Earth by his activity and during the period of the first industrial revolution a smoking chimney represented the symbol of progress and prosperity, by exceeding the bio capacity of the Earth it actually represents rather the symbol of the threat



Picture no 1 The exceeding of the bio capacity of the Earth at the end of 1970's. Source: (27)

of the human existence and it is the sign of the degradation of the environment. The nature provided a considerable amount of the signals that warn a person that he exceeded the reproductive capacities of ecosystems of the Earth and he quickly approaches the boundary limit. After this limit there is no way back neither within the investment of any costs. The elaborated conception of human ecological footprint identified 5 basic indicators that measure the human requirements on nature and its sources in a synthetic way. Among them there is the energy, the extent of settlement of the country and its coverage by impervious areas as concrete surfaces and asphalt surfaces, the volume of wood and paper processing, the volume of occupation of the country for the food production and cereals and the volume of fishing. The measurements show that the method of human economy activity burdens



the ecological systems of the Earth so that if we wanted to achieve the equilibrium we would need the capacity of ecosystems of the Earth by 50% higher than its actual availability is (27). A gradual reduction of the biodiversity of the planet represents one of the decisive secondary effects related to the degradation of the ecological environment. We can see that a quick increase of the content of the greenhouse type emissions, especially those of CO₂ in the ecosystems of the planets causes the chemical change in the atmosphere and in the whole ecological cycle and it is responsible in the range of 45-55% for the exceeding of the capacity of the Earth. The loss of the oxygen in the oceans leads to repeated one-off mass mortality of fish, often in the range and volume of annual fishing quotas.

The task of prognosis model and their paradoxical perception by a man

They are long-term forecasting models whose aim is to identify the critical values of the systems whose exceeding causes the transfer of a system into a new, irreversible state. However, the issue of the forecasting models is that their task is not only the identification of these boundary limits but suggesting the solutions in order to prevent them. Only then the forecasting work has its meaning and value. Then the means are invested and measures are done in order to prevent the imminent damage. If an announced catastrophe actually happens and it is precisely because of the measures proposed by the forecasting model, there is often a question about the purpose of the money spent. (28)

Two reports of the Club of Rome from the beginning of the 1970's (29) (30) started a significant interest of the professional public in the understanding of the relationship of technological, economic and population trends in a global context. The identification of critical trajectories of the way of using the natural resources in the human economic activity led the authors to the conclusion that ***only an important economic and technological changes can globally avoid the catastrophe.*** Mesarovič and Pestel state that ***the results of the analyses lead to the conclusions that the necessary changes can be obtained only if there are changes of basic human values and attitudes.*** The solution is represented by a new attitude to the nature and new method of building the relations in the society, i.e. the implementation of new ethics. ***The issue of new ethics lies in extensive work of the identification of new values, their qualification and measuring and subsequent evaluation and elaboration of new economic models and their verification.*** Up on the basis of new economic models it is possible to implement these methods of behaviour in the form of laws and standards into the life of the society and establish new ethics of social behaviour. Not only the analyses from the area of sociology, philosophy and psychology but also economic-technical analyses finally lead to the same conclusion that ***in the process of new relations it must simultaneously get to the basic change in the actual structure of human character*** (31) (32)

Energy crisis of 1970's and model solution of present crisis

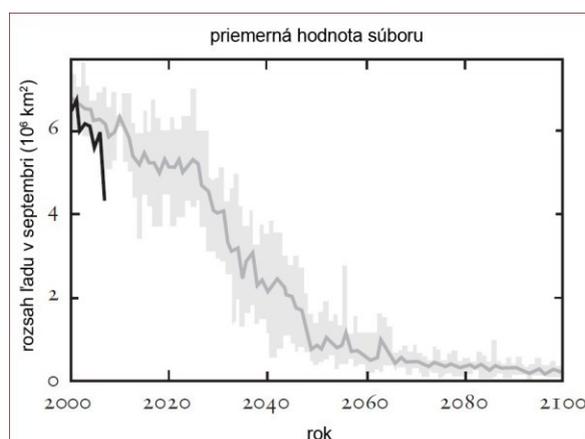
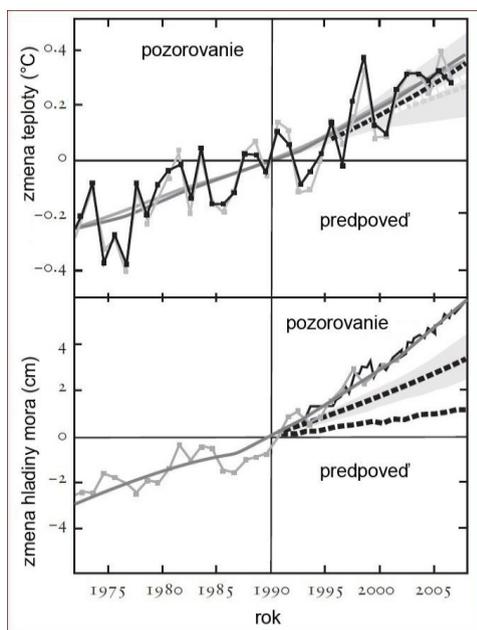
The energy crisis of 1970's that was provoked by the double energy prices caused the stagnation or the decrease of the living standard rise during 15 years. The whole range of renowned economists failed in the attempt to explain the crisis, often stating that it is an exception to the



standard regularities of the economy. Although there were enough oil reserves, there were no other producers that would place further volumes of oil on the market and therefore reduce its price. This economy phenomenon was explained by Schumacher (33) who pointed to the fact that it is the nature that provides the capital to a man for his economic activity and while this capital is consumed like in the case of fossil fuels by their incineration, there must happen the restoration of new balance so that the available natural resources reach the balance with the human economic activity. The crisis represents the process of establishment of a new balance between the natural resources and human economic activity. This approach was subsequently elaborated by Constanza and other ecologically oriented economists (34). The energy crisis of 1970's made the IT development faster. It caused the reduction of demands for the natural resources and energy in goods and services to approximately one half and therefore it achieved the balance between the human economic activity and natural resources. At the same, the range of services extended and the new markets were created so that IT became a decisive tool for providing above average added value creation and they became the engine of economic prosperity of the second half of 1980's and following years of the 20th century. Nowadays the IT create the entry to market from any place of the planet, whether it is the market of services, good or labour market.

Crisis of ecological systems of nature

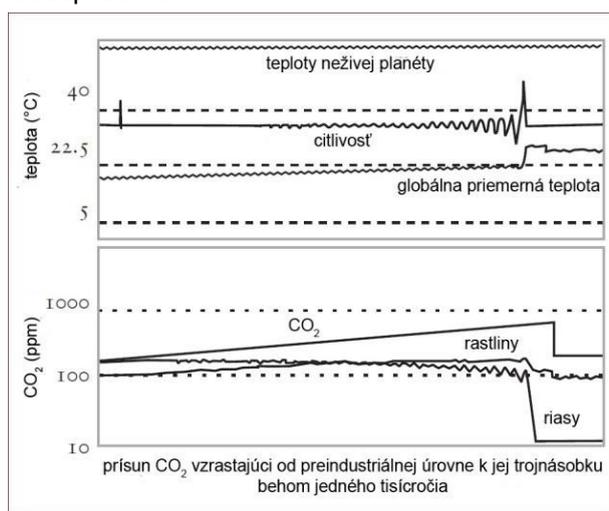
The whole amount of the signals that the nature has given to a man in the last two decades requires not only the attention of a man but also the change of his attitude to the nature. Various scientific teams got the support. Their output consists of elaborated complex models. These models also include the range of parameters that are being processed in long time series. Even a small change of these parameters





Picture no 2 and 3 The IPCC models and actually measured values (Source: (8))

causes fundamental changes in the outputs as the result of processing of long time series. And right here there is the core of quite intensive discussion in professional circles about the level of accuracy and truth up to which these models are able to predict the future states (35), (36). Since the given assumptions can set the solution in any forward direction and influence the relative result. The authors of the models usually state the compliance between the boundary conditions and the achieved result. However, it often happens that the outputs of complex models are in considerable distance in confrontation with the reality. In other words, the established boundary limits do not describe the reality precisely enough and the model without corrections from the measured values in the form of the feedback often does not have a denouncing value and it is easily questionable. So it is necessary, even for the complex models to search the synthetic indicators. If we measure them, we can verify the validity of a certain model. Lovelock in his publication (8) refers to the fact that such complex indicators for the models of the climate changes can be the growth rate of global sea levels and the rate of decline of glaciers' area. He shows that the change of measured average temperature at simultaneous processes with phase changes as the melting of ice, does not have to be a correct measure of the dynamics of the changes happening in the environment of the planet. On the contrary, the exhaustion of the capacity of relative ecosystem (in this case the energy consumption needed for the phase behaviour of ice into water) can lead to a jump change of temperature and climate stabilisation at the temperature of 5°C higher far earlier than the officially accepted IPCC models predict. Temporarily it is possible to ignore the signals of subtle type subdued by available capacity of relative ecosystems. However, the harder will be the impact after the exhaustion of the capacities of ecosystems and it is questionable whether a man will have enough sources and time space for the reaction and adaptation.



Picture no 4 The alteration of the chemical composition of the atmosphere, the alteration of the average temperature with the indicated risk of jump change of the Earth into a new state (source: (8))

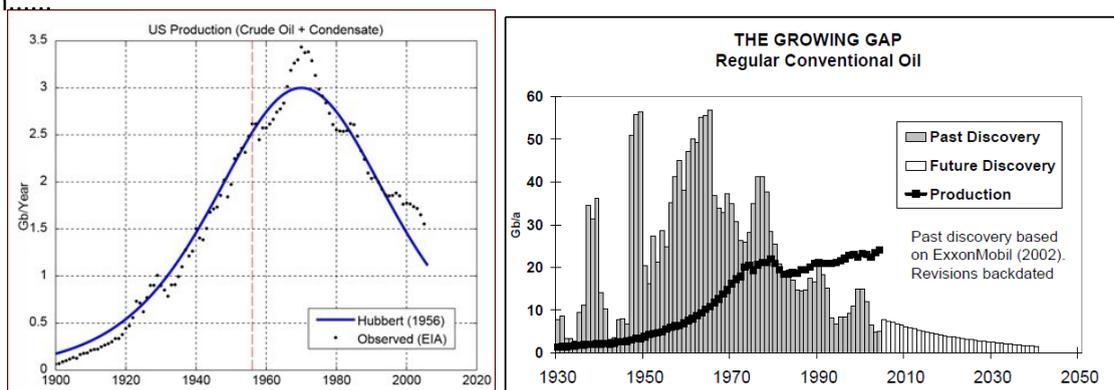
The conclusion that was provided by the specialists of IPCC panels is criticised by economists (37), politicians (35) and geologists (38) who question the cause of climate changes and economic effectiveness of designed measures. On the other side of the criticism there are the arguments based



on the criticism of the models used by the specialists of IPCC panels as politically modified solutions that are in conflict with the observed dynamics of the changes of synthetic indicators in the form of the rate of seas level rise or the pace of glaciers 'melting. They are the rational arguments in the form of energy needs for the alteration of the ice into the water without the temperature change. At the same time within the energy balance it is the effect of 80% reflection of fallen solar energy on the white surface of the glaciers that after the melting of glaciers disappears and the ability to accumulate and reflect the energy of this huge ecosystem of the Earth will be exhausted. Then the Earth can get by jumping into a new equilibrium with the temperature of 5°C higher far earlier than the models of IPCC panels predict (8). The problem of model forecasts of climate models is that the result is a half of actual measured data of synthetic parameters. The life exists in a narrow band of phase interface (22) and while the environment is not stable within its limits, minimally higher forms of life get endangered as a result of jump motion of the Earth into a new state with the temperature by 5°C higher far earlier than the models of IPCC predict. The repeated mortality of large amounts of fish at the annual fishing rate in 2012 and 2013 as a result of the lack of oxygen in warmed seas and oceans are a warning that the environment gets closer to the state that is incompatible with life. The published measured parameters of the rate of melting the glaciers and the rise of oceans level (8) question the relevance of the models of IPCC panel and signalize a far bigger extent of crisis than the climatologists predict.

Crisis of fossil energy sources

In 1956 M.K. Hubbert presented his researches in the field of geology of natural resources and especially fossil fuels (39). Submitted conclusions of geological studies and a presented model in the picture no 5 forecasting the pace of depletion of the sources of fossil fuels in the USA have been.....

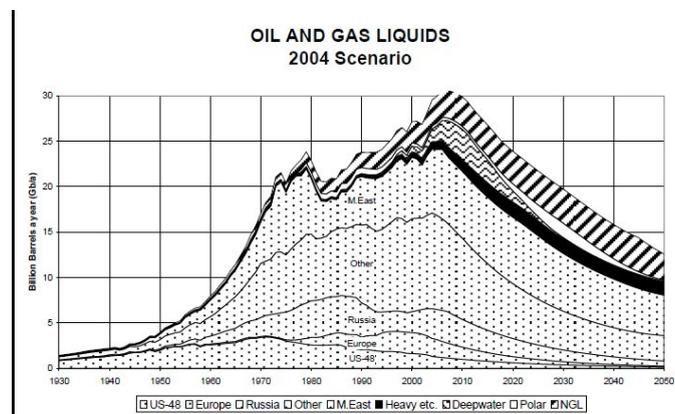


Picture no 5 Hubbert curve from 1956 and experimental data (40) confirming the validity of the curve. Picture no 6 The development of the state of verified resources of fossil fuels and an assumption of their discovery together with the curve of annual market supplying by the fuels (10).

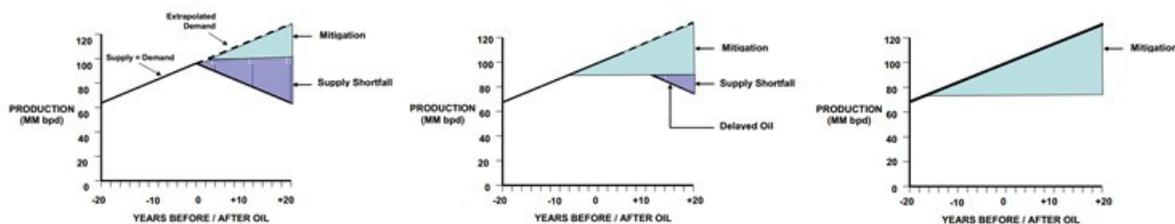
Nowadays the Hubbert's model represents the standard tool for the assessment of the resources state and expected development on the market with the fossil fuels. The Hubber Curve stimulated to the elaboration of the whole range of the studies of renowned institutions to the



question of the pace of global depletion of fossil fuel. These studies prove that the resources of fossil fuels and especially of oil will go through the Hubbert break during 2000-2025, with the highest probability around 2010 (picture no 7). After passing the Hubbert break the pace of the decrease of energy supply by fossil fuels is expected to be 1.5 to 2% per year. If the measures are not adopted, approximately after 10 to 15 years the risk of local chaos formation increases as a result of failure of supply of the local energy market that can spread into a fatal political conflict (10). The crisis does not lie in the future depletion of energy sources but in the fact that there are no developed technologies for other energy forms yet that would be able to supply the energy base in required amount and time within economically acceptable costs and in the future substitute the decrease in supplying the market by energy as a result of the decrease of fossil fuels resources (36) (41).



Picture no 7 Scenario of global transition through Hubbert break (10)



Picture no 8 Three scenarios of beginning of implementation of renewable energy sources

The question is how many years before reaching the breaking point is it necessary to start with the transformation towards the renewable energy sources in order to avoid a noticeable outage of energy supplies on production market? Safety analyses state (12), (24), that it is necessary to create a 15-year time space for the research, development and implementation of these technologies in order to substitute the decrease of market supplying with the energy of fossil fuels by renewable energy sources and use them for providing the demand for further rise of energy consumption by the society without the outage of energy supplying.



Transformation of value system of the society

It is a new attitude and new ethics that enable to make necessary measures. (31). They are the statements of the people that underwent the directed process of the consciousness transformation under medical supervision and reported about the threat to human existence but also about optimistic news that it is not too late, yet (32). A correct way of life is not only the requirement for fulfilment of religious and ethical principles. For the first time in the history, the survival of human race depends on the change of human heart (31). **The transformation towards the sustainable society based on the renewable energy sources at the lowest costs** represents the solution of actual social crisis.

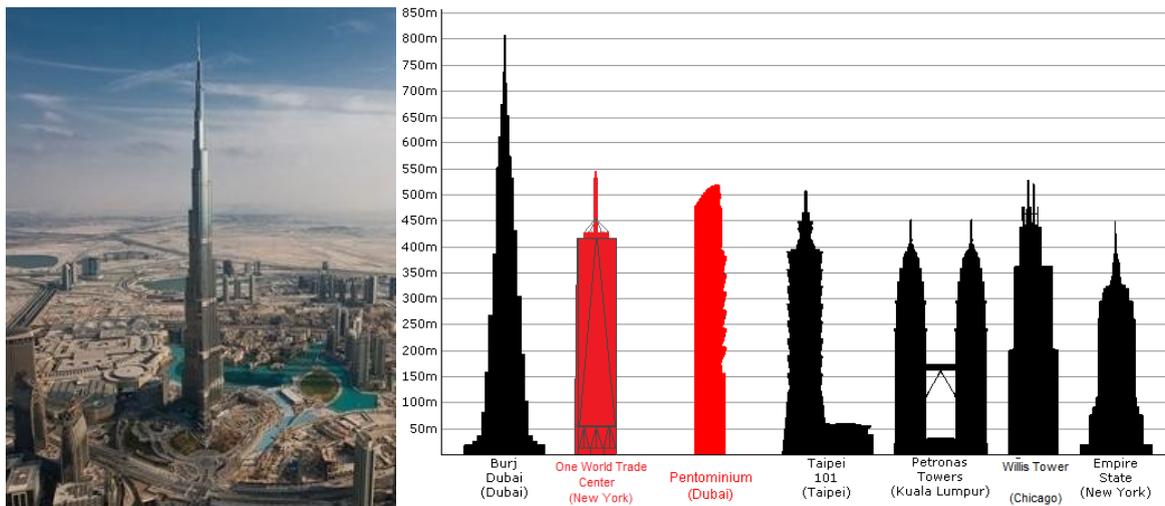


Picture no 9 The transformation of the values in the society

The solution also includes the identification of new values and relations, determination of the method of measuring and evaluation. Then they are incorporated into economic models after the experimental verification and reflected in the legislation. The correct solution ensures that the economic parameters of these new social values together with the legislation form economic motivation and also the pressure that transform individual markets and eventually the whole society. While the natural resources, whether in the form of material or energy sources and nowadays also the capacities of ecological systems seemed to be inexhaustible, a man attributed them very small or no value. Once the natural resources start to be precious, their value will quickly go up. If a person thought for a while that he would be able to subordinate the nature thanks to the modern technical devices, nowadays the nature shows him that he was wrong. The hurricane Katrina was an example for the society in New Orleans in the USA to experience the horror comparable with the horrors of war. The nature also showed its strength in Fukushima in Japan. The world could have compared a very different way of human reaction. A man that is individually oriented, preferring ratio and using primarily destructive emotions of greed and envy that are demonstrated within the individual self-promotion who despises sentiments and social values (this is how a psychologist Giannini (43) described the American population) started to loot in New Orleans and after the natural resources damaged the repressive power the whole groups of inhabitants attack one another in the extent of a civil war. On the contrary, people who have a collectively oriented attitude to the society and mostly use the functions of feeling and emotion of mercy with a high level of social feeling understood that the natural powers have to be respected and we have to jointly seek for the mitigation of the impacts



of natural catastrophe. The world watched the method of the organisation of rescue operations in Fukushima with respect. Just Jung found out that preferred functions are not only an individual characteristic but a respectively preferred function in the society can influence the orientation of the society at the collective level within the actual preservation of individual variability (13). Only when the nature shows its strength by the power of its system a man is at least temporarily able to admit his subordination to its powers and then his reaction on the individual and collective level according to the dominant preference of society's focus.



Picture no 10 and 11 Burj Dubai and the highest buildings in the world

A typical example of the change in value system is represented by real estates. It was a man who in the era of fossil fuels decided about the size, shape and mission of a building in a corresponding location and the nature in the form of fossil fuels supplied enough energy. A man in the time of fossil fuels use realizes the competition and started the race for the builder of the highest skyscraper. However, in the time of spread technologies of renewable type a man must again boldly ask the nature what energy sources can offer him in the location of the land and within these limits given by nature it can realize his intentions. Will an owner find enough renewable energy sources in the location of such high-rise buildings after the depletion of fossil fuels supply for energy supplying and if so, what will be the price? A biblical story of the fall of the Tower of Babylon can repeat with the depletion of fossil fuels. The depletion of fossil fuels brings a challenge for searching of new solution for energy supply. It is the situation as if a man becomes a sailor on stormy sea. The wind has turned right the opposite direction and it blows from the coast where he wants to drop the anchor of the boat of life. If he continues at the set rate of headwinds, he will never get to the target but he will run out of power and die. If he reasonably rotates the sail and uses the power of the wind to act in accordance with his targets, finally it is the headwinds that will get him to the destination point through crossings. If a journey lasts longer while respecting the possibilities that the nature provided him, then the man - sailor identified his targets with the possibilities of natural powers and instead of fighting against them without the chance to win, he will act in accordance with the nature and its powers. Marcus Aurelius already considered such behaviour to be the behaviour in accordance with



the sense (44).

Crisis solution – the consumption rise or though-out investments?

No crisis has ever been solved by increased consumption. The meaning of the increase in consumption as an immediate reaction on the crisis formation is to provide time space for the correct identification of the problem and adoption of its solution. It is the purpose of the adoption of the policy of increased consumption. ***A crisis is not solved only by industrial investments that create the added value by the reduction of the costs or widening the range of services and goods that the customer is willing to pay for on the market.*** IT offered the crisis solution within 15 years from the beginning of the energy crisis of 1970's by the means of the reduction of energy consumption and natural resources to the half in a production unit. They also created the infrastructure that enabled the development of new markets and services with economic added value. The transfer of utility values into intangible programme equipment in the broad extent of products became a key tool for the reduction of the share of natural resources and energy in products. IT provided the above standard creation of added value approximately to 1995. The formation of new globalized society is a result of the processes related to information revolution (45). The development of new markets and improvement of standard markets by the means of IT also caused the pressure on the quality of offered goods. While in 1970's in average 60 basic ideas were necessary in order to put one of them in the form of a product on the market (46), in the beginning of the 21st century 6 times more creative components are necessary, in average 300 (47). The results of the analyses gained the meaning and sense for the transformation processes taking 40 to 60 years. The analyses claim that the companies that correctly apply the verified high technologies by the market gain long-term above standard results (48). It is even more valid for the area of the energetics and buildings as long-term stable and also huge sectors of the economy.

Weighting parameters and the responsibility of political decisions

Economic models that would describe only physical parameters could not be implemented into the legislation so that they substantively fulfil their mission. Therefore the weighting factors represent a tool that can change physical parameters with the aim of promotion of social needs and they are realized by a political decision in the form of adopted laws. A typical example in the context of this text is represented by the factor of CO₂ K emissions (kg/kWh) set in the Decree no 364/2012 Coll. It is clear that CO₂ emissions are released after the incineration of fossil fuels through a chimney into the atmosphere and produced electricity does not contain any CO₂ emission component in physical terms. However the adopted economic model does not attribute a corresponding measured share of CO₂ emissions according to the type of primary energy source and it determines its value in the law. Then the society accepts this information as a standard of the behaviour and evaluation in economic processes. As if such assigning of weighting factor in time was viewed as a physical quantity, even though it is not. Therefore the selection of weighting factors must be premeditated in order to make its actual application really enforce social interests, even though they are not physically expressible.



The concept of a building with almost zero energy needs (49) (50) itself is a controversial term, physically unrealisable, suitable for political marketing determined for the public but causing many questions within professional public working with the physics of building constructions. The concepts of energy-efficient building, low energy building and building with zero energy balance (51) (52) with quantitatively defined energy consumption are formally and substantively closer to reality and to a certain extent they are also more acceptable terms. Therefore a consistent model of buildings with almost zero energy needs (53) works with the concepts as a building with zero energy needs with energy distribution networks and very precisely works with the weighting factors.

In the chapter "Transformation of the office building in operation (5,370m²)" we show on an illustrative example a correct expression of weighting parameters step by step in a model of a building with almost zero energy need expressed in the Act no 300/2012 Coll. We demonstrate on the measured parameters the method of weighting parameters used in the model and how they are expressed in the legislation.

In the chapter Renewable energy sources - biomass, biogas and landfill gas we show the unsuitability of using the tool of weighting factor in the form of quantification of CO₂ emission factors with the important negative impacts in the national economy.

Two economically different groups of renewable energy sources

Nowadays there are renewable energy sources (54) that offer two sides of the coin whose **value is in the above standard production of added value** and also solve the whole range of social issues in synergistic harmony.

Renewable energy sources, biomass, bio-gas and landfill gas.

Continuous economic cost related to procurement of fuel remains similarly as within the fossil fuels and incineration of forced energy sources, e.g. biomass, biogas and landfill gas even after repayment of the investments into technologies. It is connected to the human work, whether it is within the purposely grown biomass or it is a case of secondary product of human economic activity. While the mode of the waste treatment reflects the fact that it is about a secondary product of human economic activity so it is possible in this case to sustain the economy of energy sources within socially necessary costs and competitive, too. Once the "waste" achieves the status of primary human economic activity by a political decision then the economy of these energy sources can be solved only by permanent money above the current market prices. In such an economic mode we cannot expect that such operational energy sources achieved an economical breaking point and the prices at the level of the market as a result of the economy in the extent. The society pays unnecessary costs and there is a conflict between individual interest and social interests. The society expressed the preferences of these types of energy sources by a political decision expressed in the Decree 364/2012 Coll., when the parameter of the CO₂ emission factor applied the weighting parameter and set the value e.g. biomass to 0.02 kg/t. However the calculations (55) show that the CO₂ emission factor for



the biomass is at the level of coal. It is enough to look around with the naked eye to the valleys where people from the economic reasons started to heat with firewood and the smog can be seen and pungent smoke felt. If we express the social preferences also by the investment incentives in the form of above standard supplement to the market price we can see the growth of investment costs as well as operational costs and therefore the prices in conflict with the demand of the pressure on the costs. The circle of collection of biomass expanded from the original economically limited 25 km to 80km circle and biomass is actually transported from Hungary to Prešov. But biomass or originally firewood is suitable for local processing, whether in the area of wood processing industry, or in mountain villages in the form of firewood. Approximately 500,000 m³ of biomass was missing for the installed capacities of biomass burning in 2012 according to calculations. A part of missing sources was substituted by a higher quality wood material by producers. It limited the wood processing industry that did not have enough raw materials and announced lay-offs.

The economy of these energy sources can be solved by the reorganisation and accepting that it is a forced economy source and we have to set a corresponding legislative aim for it. This will reduce the chance of burning wood of higher quality.

Renewable natural resources providing the energy output for the economic activity of a man in the real time

Within the renewable energy sources of this groups they are the ecosystems of nature that provide the necessary energy output in real time of human economic activity without any additional economic costs. So after the payment of primary investments into technologies of conversion and energy storing another operation of these energy sources represents the operation with significantly lower costs. Moreover, it is not necessary to pay the costs connected to the applied development within the restoration of a device. Therefore the restoration of the devices after their technical and moral life will be significantly lower in comparison to the primary costs. Therefore we can divide renewable energy source in two categories (54) in accordance with the definition of the Directive of EU 2009/28/EC. This group of renewable energy sources where the natural ecosystems provide required energy output for human economic activity in real time of human economic processes has the conditions for higher formation of added value as it is in the case of renewable energy sources that are burned in the process of conversion. The group can be divided according to the fact whether the additional devices are needed in order to be able to store the energy and provide corresponding supply quality as it is within the electricity from wind or energy from sun or this problem is not connected to the corresponding energy sources as is it in the case of geothermal sources.

The time enables a man to experience an interesting and creative period, in which a man again reaches a new quality of a contact with the nature and through the nature he makes the contact with himself. ***A human has to understand that he is not going to save the nature. Otherwise he will not be able to save himself without the restoration of the balance between economic processes of a man and reproduction processes of nature.*** Therefore various rationalisations of solutions that are taken out of the context that follow immediate economic effects in a simpler way, do not solve the



problem and they also significantly deepen it as a result of depletion of available sources including the time without effect. The following solutions correcting the previous decisions are always more expensive. The signals that the nature provides in a feedback say that a man depleted a significant part of available time and he must adopt resolute decisions.

Synergistic solution of transformation of energy market

Two basic sources of crisis - a high grow rate of CO₂ emissions concentration in ecosystems of nature and the need to use remaining 15 years for the research, development and implementation of the technologies related to the renewable energy sources provided by ecosystems of nature represent the danger for the society, if we do not solve the problem. In the same context they represent the opportunity to create a long-term energy sources creating the added value and providing the conditions for economic growth of society. ***Controversial discussions to the task of greenhouse gases can be integrated into the economic model of the transformation of energy market after assessment, while the transaction costs of energy market do not rise and they simultaneously solve both issues within the industrial approach. One part of the experts can be right who connect the climate changes to the production of emissions as a result of human economic activity or the other part can be right.***

Buildings with almost zero energy needs

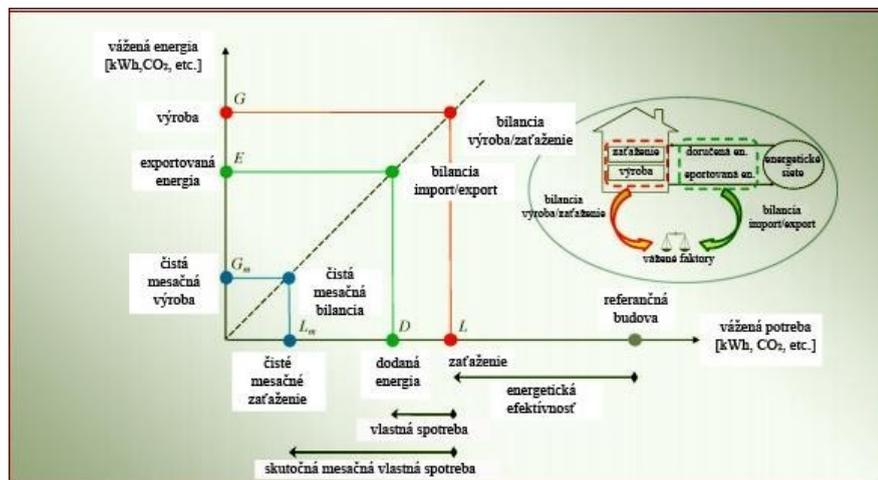
The conception of buildings with almost zero energy needs represents another important element that enters in the transformation of the energy market. The buildings as the biggest consumer in the extent of up to 40% of all energy consumption represent the most important consumer of the energy sources on the market. The solution of energy efficiency of buildings represents an important contribution to the reduction of energy burdening of the society. On the other side it creates the pressure on the providers of central heat supply systems. Without the change of business model the acceptable economic level of prices for the provided services cannot be kept. The central heat supply systems undergo the transformation for the objective reasons and the skills of the owners and management of companies are the most important in the selection of a strategy. It is also important what costs will be necessary for the transformation implementation.

The buildings with the controversial definition of almost zero energy needs (50) have a factual significance only as buildings with almost zero energy balance with distribution energy networks and sometimes in the future as buildings of island operation (56). Since the buildings will be gradually equipped by local energy sources because they represent the biggest number of consumers it is necessary to solve the legislation in such way that the local sources of renewable type would have the access on the energy market through the distribution energy networks. Even in the case of a building with zero energy needs it is necessary to very precisely set the weighting parameters changing the physical parameters, because this approach cause the formation of highly abstract and complicated models, whose projection into the legislation is very difficult. It includes the formation of almost



confusing maze of provisions in variously connected laws, what can lead to the situation when they will be hardly realizable in the practice. The consistent model of a building with nearly zero needs gives a technical meaning only with the buildings with zero energy needs with distribution networks (53).

If an act is complicated or formally built incorrectly from the economic point of view, as it is with the Act 180/2005 Coll. in the Czech Republic on the support of electricity production and on the change of some laws from 2005, neither 5 amendments are able to eliminate these contradictions and the legislature is forced to repeal it, in the case of Act 180/2005 Coll. to 1st January 2013. It is quite probable that with the adequate interval the same will happen to the Act 309/2009 Coll. and related legislation of the Slovak Republic, whether it will be completely remade or repealed.



Picture no 12 The conception of a building with zero energy balance

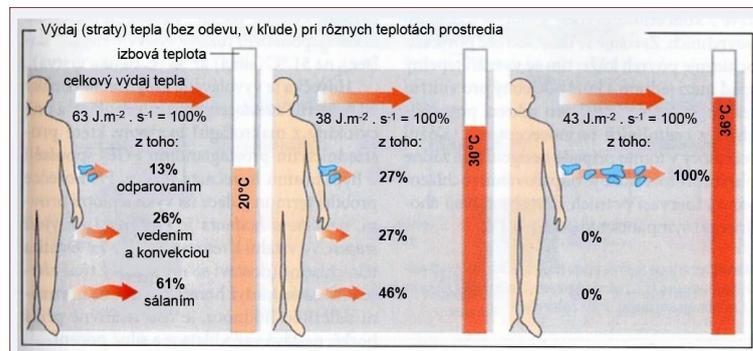
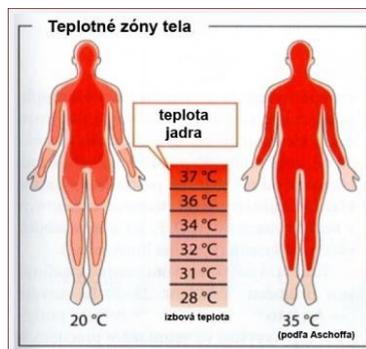
The standard technologies that ensure the energy efficiency in the combination with modern technologies help to increase the quality of internal climate and they are also the answer to such phenomena like climate changes and related issue of thermal waves linked to the increased risk of organism collapse. We can demonstrate on the example of thermal regulation of a man that a man represents auto-poetic system and his biological body is not out of context. While the surrounding environment can create the conditions incompatible with the human life when the temperature rises during 48 hours and more above the critical level, it leads to the collapse from heat and the death of the organism.

Quality of internal environment of human physiology

The thermal regulation of the human organism keeps the core temperature at the level of 37°C and the temperature goes down towards the outside. The lowest temperature is on the feet and it is 28°C. The balance between the organism and environment is maintained by three mechanisms of energy exchange, while a decisive two-third component consists of the mechanism of radiation at the

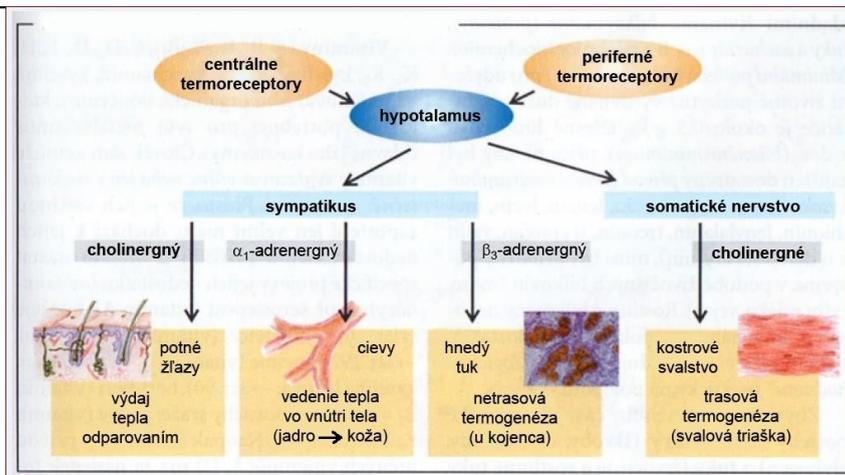


temperature of external environment of 20°C. The mechanisms create a 26% share by convection and conduction, the rest is evaporation. The share of the mechanisms of radiation and convection together with the conduction gradually weaken with the external temperature growth and they disappear at the temperature of 36 °C. At this temperature there is only the mechanism of evaporation available for an organism. A body is able to keep its micro climate in the form of small air layer heated by human body at the air movement of < 0.1 m/s. The signals that are provided by peripheral thermo receptors of the skin into the centre of thermoregulation management in the hypothalamus provide correct information for the regulation of heat exchange. If the rate of airflow is above 0.1m/s, the flow of the air removes the micro climate from the body surface and the flowing air directly affects the skin. The body is not able to heat the micro climate on the places when the skin is continuously cooled by the airflow. The thermo receptors provide misrepresented data about the temperature (lower) to the control centre of thermoregulation. The information from the peripheral thermo receptors creates the feedback of regulatory circuit that informs the centre of temperature control of the hypothalamus about the changes in the environment out of organism. The internal thermo receptors inform the control centre of the temperature about the actual state of the temperature of the centre of an organism. This allows actively managing the exchange of energy with the environment described above by energy transport mechanisms through sympathetic and somatic nervous system.



Picture no 13 and 14 Human thermal zones and energy transport mechanisms

The end heating units in the form of radiators first heat the air and then the constructions and organisms by airflow. The radiant system of energy transport firstly heats/cool the constructions and areas, which then heat/cool the air. Therefore the systems of radiant ceiling heating are suitable also for cooling, while they use a decisive element of energy transport in the human physiology. They increase the quality of internal climate in comparison to the radiators at heating and especially the split systems at cooling in a significant way, because they are able to comply with the requirement of thermal comfort for the parameter of the air $\leq 0.1\text{m/s}$. The split systems are not basically able to comply with it. Similarly, the radiant ceiling system does not cause the reduction of relative air humidity what happens with split systems and radiators.



Picture no 15 Control of human thermoregulation

25,000 to 70,000 people died because of the heats from 2003 in the countries of the European Union (57). The calculations show that the thermal wave during the summer in 2010 caused the death of 55,000 people in Europe (58). Similarly, in Slovakia on 20th August 2012, 109 people collapsed, 26 of them from Košice region (59).

In the literature there is the discussion, whose aim is to form a universal definition of thermal wave by the means of achieved data of increased mortality. The analysed sample of 9 European cities with the total area of 25 million people represents the variability of climate conditions, socio-economic conditions and atmosphere pollution. The studies in different cities of Europe show that there is a critical minimal annual value and a critical minimal daily value that determine there is the exposition to the thermal wave characterized by increased risk of organism collapse with subsequent death. The risk grow varies from 7.6% to 33.6% in the relation to the corresponding city (60). A thermal wave is determined by the extreme daily temperature T_{app} given by a formula¹ and the lowest night temperature T_{min} . A thermal wave happens if:

1. T_{app} exceeds 90th percentile of monthly temperature distribution in the period of at least 2 days
2. T_{min} exceeds 90th percentile and T_{app} exceeds the median of monthly temperature

The use of large-scale radiant system of capillary matting for heating and cooling means the reduction of heating temperature that results in the growth of work efficiency of the heat pump and the shift of the factor SPF 3 for radiator to 4.5 within the heating and the chance of achievement SPF =14 within cooling. The target value of annual SPF factor 7 is a realistic expression of the possibilities of the combination with the heat pump water-water.

In order to provide the growth of the society life quality in the relation to the climate changes it is possible to provide the buildings:

1. expansion of provided range of services by the cold

¹ $T_{app} = -2.653 + 0.994(T_{air}) + 0.0153(T_{dewpt})^2$ T_{dewpt} is the dew point temperature



2. To provide the transport of energy while respecting the human physiological characteristics in a decisive part by a radiant component
3. The synergic effect of the technologies oriented on a man and respecting the nature measured by the lowest investment costs can be reached only if the energy source is a renewable source of water well and large-scale radiant system of terminal units.

Transformation of office building in operation (5,370 m²).

The executed experiments in the office building in 3 Murgašova Street, Košice demonstrate the technical and economic feasibility of the transformation of buildings into buildings with almost zero energy balance with distribution energy networks without the interruption of service. On the example of position of heat pump and central heating system on the market with the heat in Košice they also determine economic volume of the barrier of heat pump input into the distribution heat system as a result of Slovak legislation at the local energy source entry on the energy market. The concrete prices in 2012 on the linked energy heat markets, electricity and the market with CO₂ emissions point to the fact that economic barrier for the heat pump entry was higher in 2012 than the individual unit energy price on the market. Experimentally achieved data also enable to correctly interpret physical parameters, help to understand weighting parameters of social preferences and subsequent political decisions and interpret the provisions of the Act 300/2012 Coll. and Decree 364/2012 Coll.

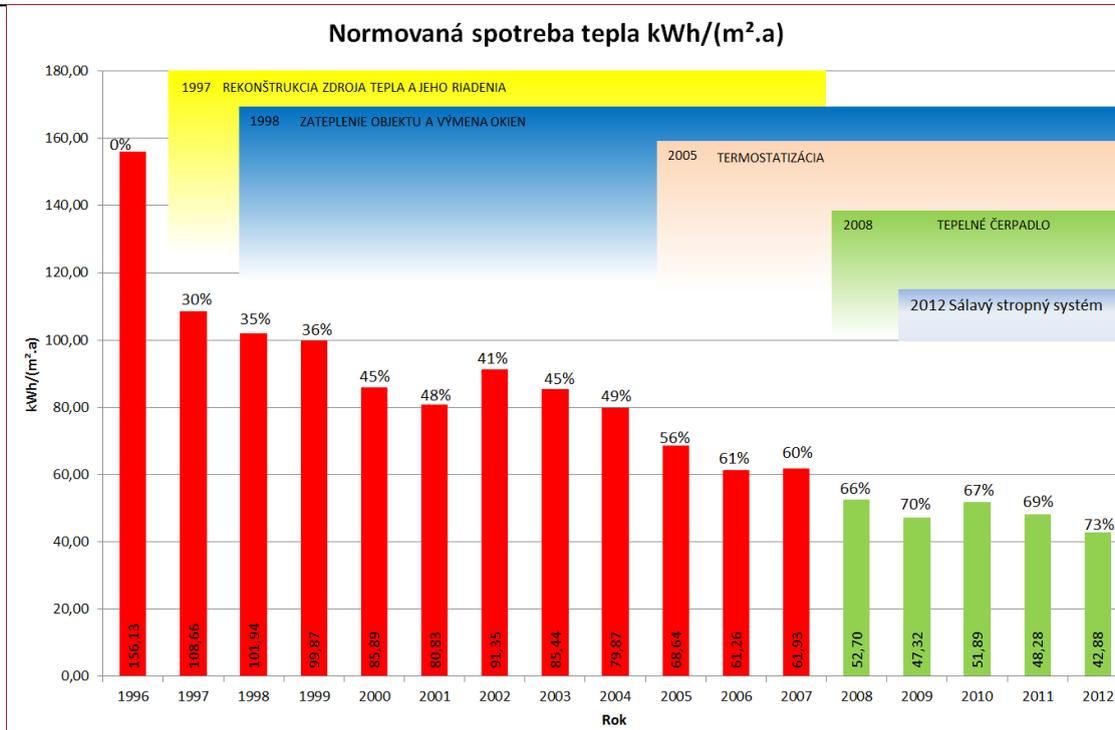
According to the need of this material we divide the system boundary of a building within the logical order in three basic parts:

1. Physical
2. Economic
3. Ecological

1. Physical parameters

The experiments and applied technologies of envelope structures of the building together with the technologies of energy management show that we can achieve the savings at the level of 73% within the solution of energy efficiency of heat consumption. It characterizes the physical characteristics of envelope structures.

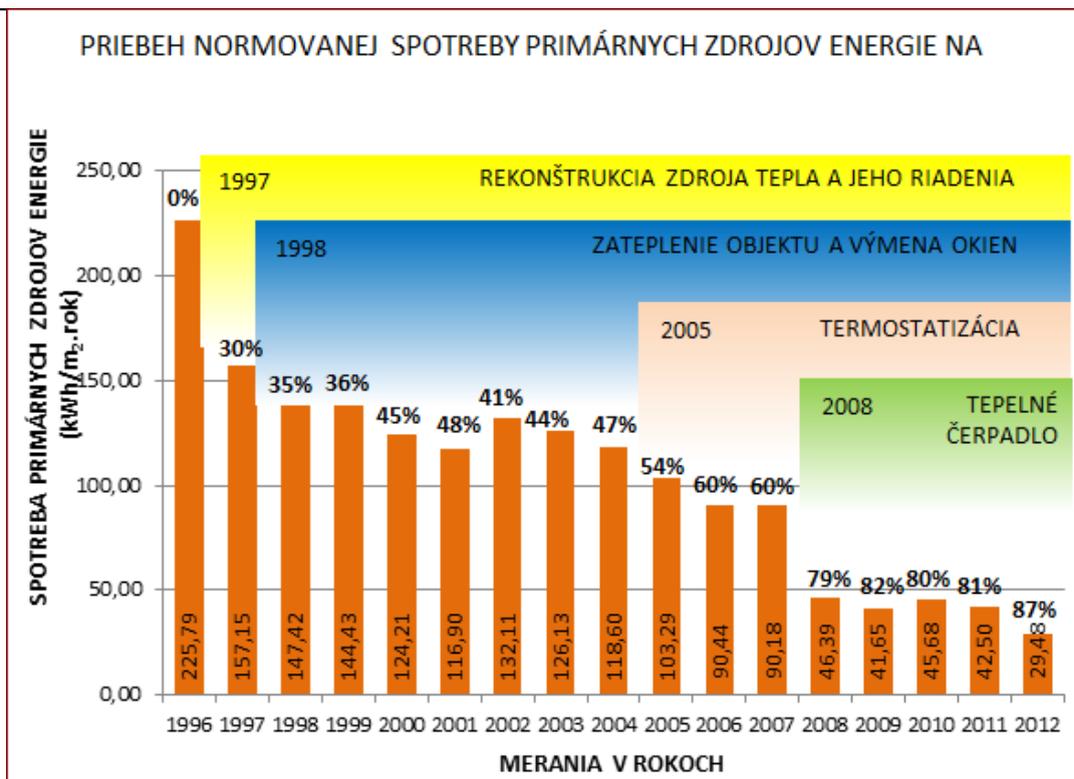
In such a case the primary energy in the form of electricity that is necessary for the power of heat pump is not included in the energy balance because it does not pass the envelope structure creating a physical part of system boundary of the building, although the economic part of system boundary of the building passes.



Picture no 16 Standardized heat consumption in office building

2. Economical parameters

The economic level of the solution is characterized by the reached level of energy savings of primary sources implemented through the system boundary of a building in the amount of 87% with the achievement of a consumption state of 29.4 kWh/(m².a) for the heat and 64 kWh/(m².a) together with other obligatory items of energy consumption in accordance with the provisions of the Act 300/2012 Coll. and Decree 364/2012 Coll. In such a case the neglected primary energy of renewable energy sources is supplied by the heat pump because this part of energy does not pass the economic part of system boundary of the building.

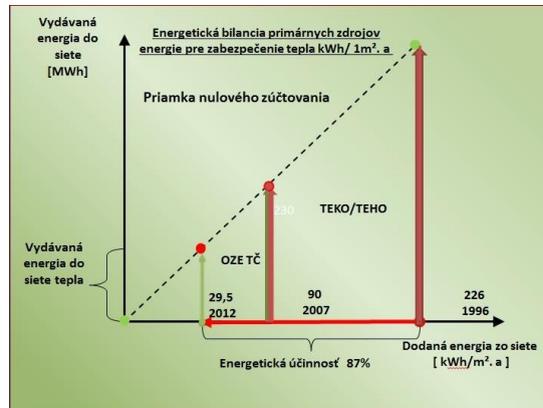


Picture no 17 Standardized consumption of primary energy sources for providing the heat in office building

Consumption of primary energy sources in the office building in 3 Murgašova Street, Košice		
	kWh(m2.a)	kWh/year
Electricity consumption for the heat production	10.67	57301.02
Electricity consumption for the cold	1.94	10443.1
Electricity consumption for heating the hot water	0.56	3,000
Electricity consumption for lighting	2.79	15,000
Electricity consumption for circulation pumps of building and distribution of heat and cold	7.19	38,606.59
Total electricity consumption in building	23.15	124,350.7
Total consumption of primary energy sources	63.98	343,705.4

Chart no 1 Energy balance of office building in 2012

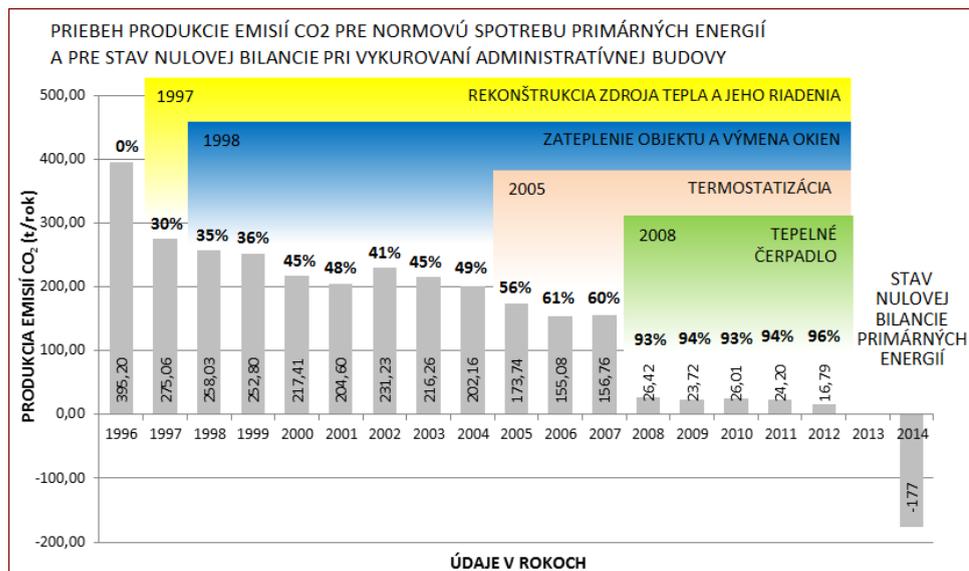
The chart no 1 shows the assessment of balance of all consumed primary energy sources in accordance to the Act no 300/2012 Coll. and Decree 364/2012 Coll. within the qualification the building to the boundary between A0 and A1, while the simple replacements of lighting devices and the adjustment of the local energy source move the building to the energy class A0.



Picture no 18 Energy balance of primary energy sources and designation of reached energy efficiency

3. Ecological level of achieved state

Ecological level of solution is characterized by the achievement of 96% of savings of CO₂ emissions.



Picture no 19 The CO₂ emissions for standardized consumption of primary energy sources in office building

Regarding the year 2008 the total investment into local energy sources of heat pump water - water varies within 90,000€ within the expected lifetime of energy source of 40 years with one GO. If there is the annual saving of CO₂ emissions in the volume of 156t/r -26t/r = 130 t/r, then in 40 years there will be the saving of 130t/r x 40r = 5,200t. The investments in the volume of 78,000 €/ 5,200t mean that we invest 15€ for the saving of 1 ton of CO₂ emissions and we gained the value of 15€/t. Within the requirement of 8-year investment return via



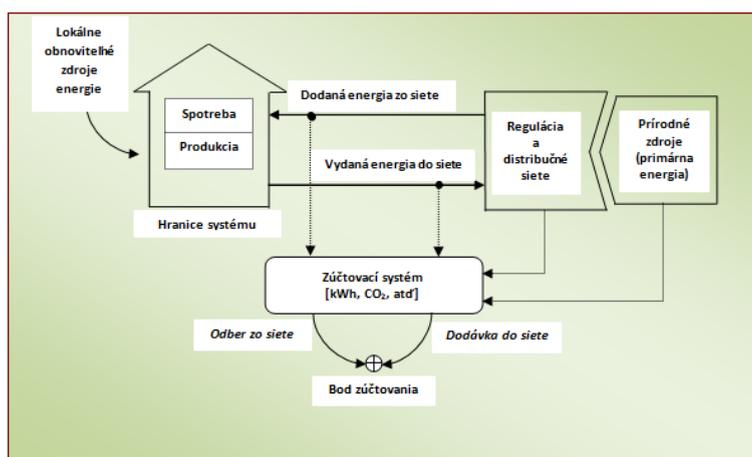
saved CO₂ emissions it means the price of 75 €/t what is the price by 25% lower than the calculated average price in Slovakia in 2012.

4. Investment level

The investment level is characterized by the solution with the investment return under the economic breaking point for each used technology. Except of the technologies of radiant ceiling heating system the investment return within other used technologies is achieved from the energy savings. The investment return is achieved from the expansion of the range of functions by a significant change of the internal environment quality within the radiant system of heating and cooling. The energy transport is crucially provided by a radiant component of what helps to expand the range of services in the building by the cold and thus solve the work efficiency rise, the reduction of morbidity and provision of resistance to heat waves that in the extreme conditions increases the risk of organism collapse and death by up to 30% when the heat waves occur.

Local renewable energy sources, distribution energy networks and barriers for market entry

Economic importance of local renewable energy source lies in the expansion of energy basis by the energy source of domestic primary energy sources. If the energy source is placed inside the system boundaries of a house as appliance, there is no need for the construction of over dimensioned distribution networks and the problem related to the distribution loss disappears. It is 15% in case of electricity and 20% or more in case of heat.

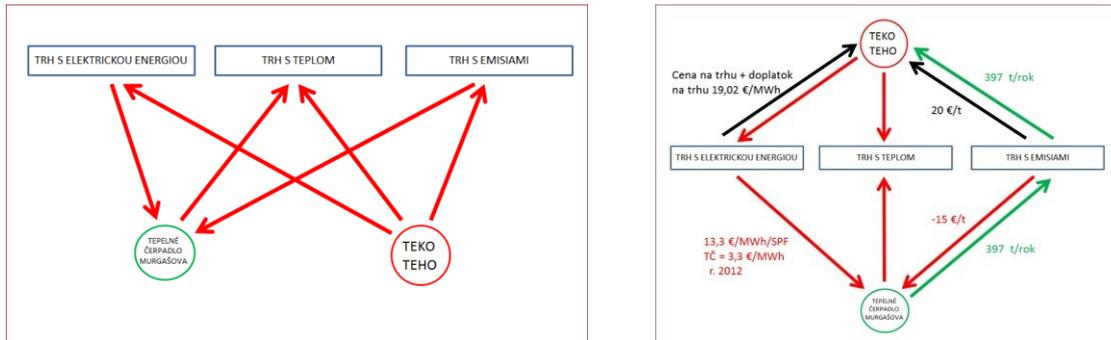


Picture no 20 Clearing system of building with distribution energy networks

The definition of a building with zero energy balance with distribution systems means that distribution networks do not serve only as an energy supplier to a building but also as a recipient and distributor of energy from the local energy source. Otherwise the characteristics of local source could not cover the quality and required output on all energy carriers in a building. Energy markets of electricity, heat and CO₂ emissions are mutually connected. If the legislation does not solve it,



there are economic transfers between energy sources happening through the market with electricity and market with emissions between the competing sources within the heat supply that can create economic barriers for the entry to the market up to the level higher than the market price itself. It is the case of position of local renewable energy source of heat pump and central heating system in Košice.



Picture no 21 and 22 Economic transfers on energy markets

Complex model of transformational of office building

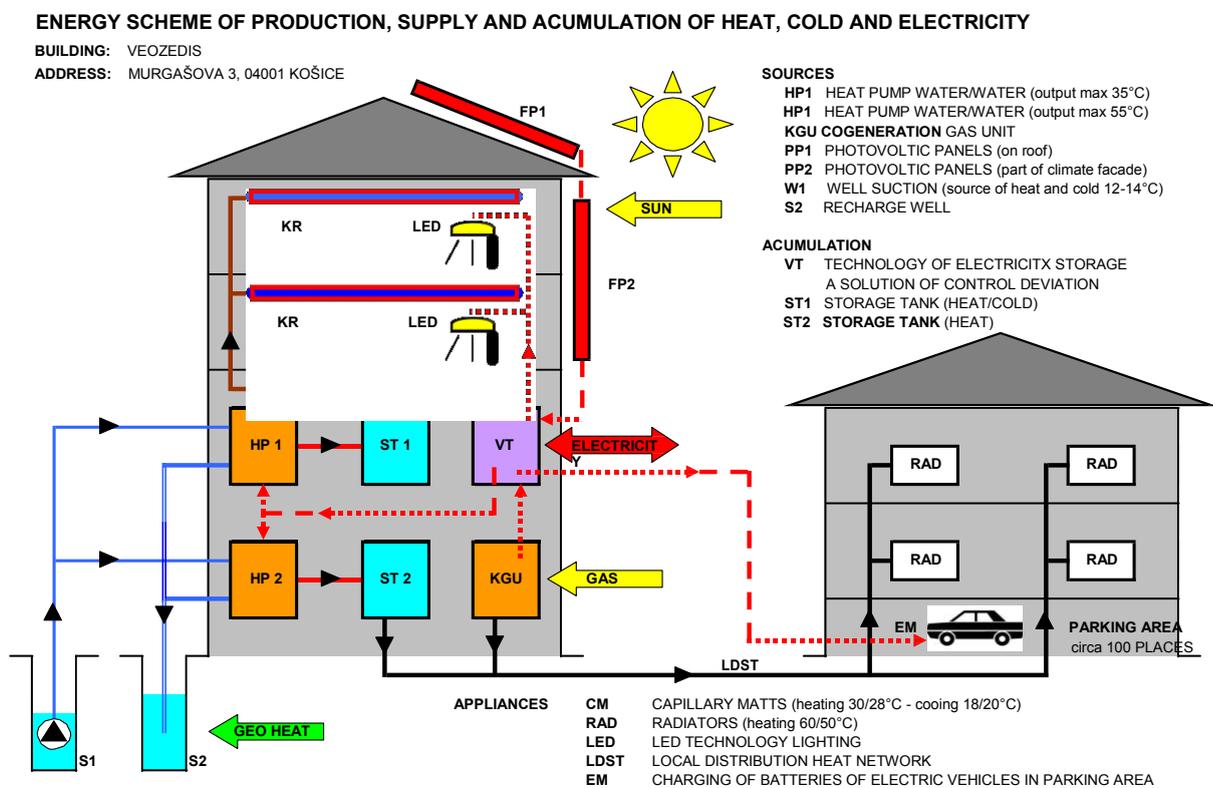


Picture no 23 and 24 The office building 3 Murgašova Street, Košice and a model fitted by photovoltaic panels

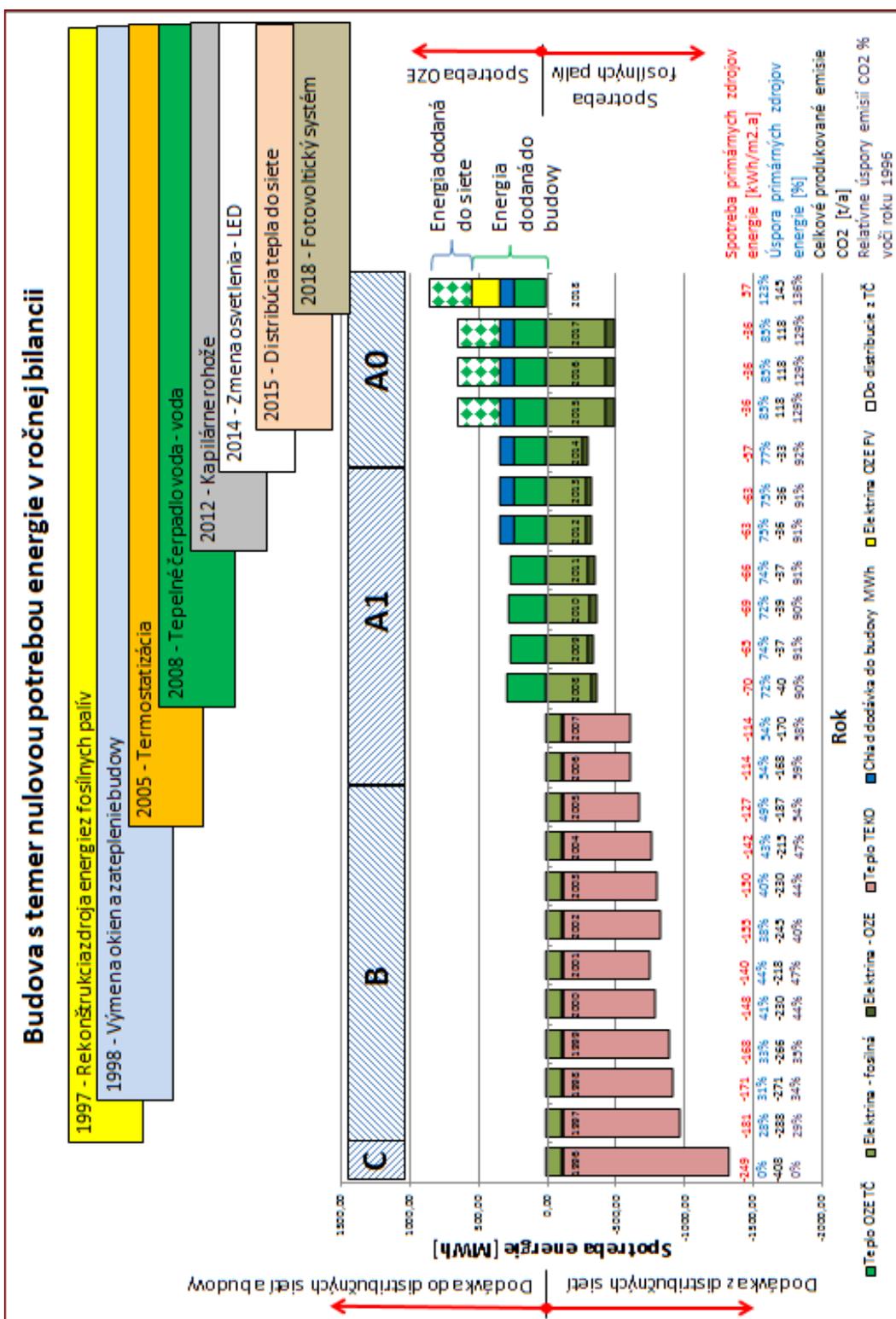
A complex model of the transformation of the office building in 3 Murgašova Street, Košice includes the technologies of insulation and windows replacement that are used as a part of solution of the energy efficiency of envelope structures, regulation technologies solving energy management, technology of heat pump water-water solving the transformation of energy base from fossil fuels into renewable energy sources within the energy carriers of heat and cold. This technology is combined with the technology of radiant ceiling system of heating and cooling that improves the technical-economical parameters of energy source and have the potential to achieve the improvement of SPF from 3.14 within the heating by radiators to SPF 7 for all year round service. Nowadays the achieved state of SPF represents the value of 6.5. Planned technologies for the reduction



of the electricity consumption represents the replacement of lighting device by LED systems (the expected saving is 70% of energy for lighting), construction of photovoltaic power plant in the extent of the supply of 200 MWh per year and the elimination of human factor of electricity consumption via clearance system. The building is after the construction of photovoltaic source able to cover its whole energy consumption for the operation within the energy balance and also supply the distribution network by the heat of 350 MWh what also covers the consumption for the use of the building (circa 120 MWh per year)



Picture no 25 Model of local energy sources of office building.



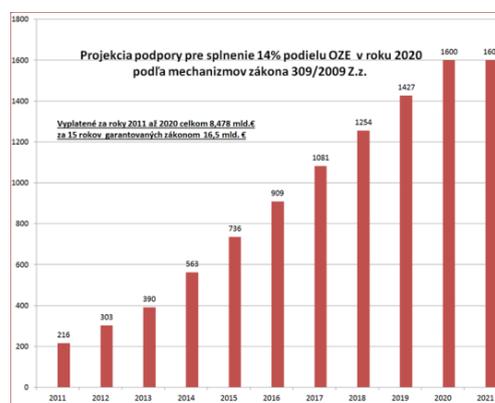
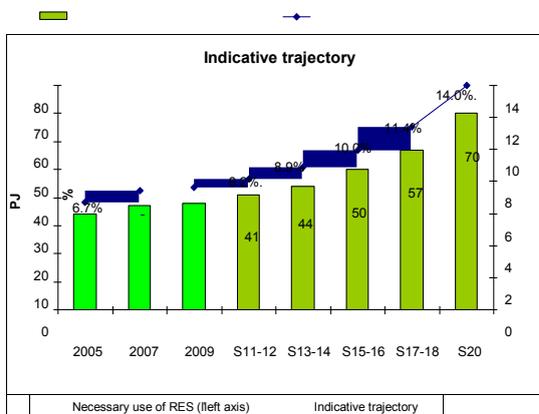
Picture no 26 Complex graph of the progress of energy consumption in the office building in 3 Murgašova Street, Košice



Description of the model of transformation of energy market

The model for 40-year adaptive transformation of energy market combined with the project of experimental realisation of the transformation of a building into a building with almost zero energy needs consists of:

1. Analytical part which:
 - a. Defines the core of the crisis and presents the existence of irreversible transformation processes related to the disruption of value systems and setting a new value organisation of the society.
 - b. Defines the position of renewable energy sources in the society.
 - c. Determines the social value of CO₂ emissions as an economical tool for the regulation of the dynamics of society transformation.
 - d. Formulates **the transformation of the society using renewable energy sources at the lowest social costs** as a solution that provides
 - i. The generation of value added
 - ii. The solution of energy safety of the society
 - iii. The reduction of the operational costs of the society and therefore it improves the standard of living.
 - e. The calculations of the data from 2011 and 2012 published by Regulatory Office for Network Industries (URSO) show that the continuation on the basis of the principles of the Act no 309/2009 Coll. means the investment of 16 billion EUR for the achievement of the commitment of 14% share of renewable energy sources in the energy mix of Slovakia until 2020 and in 2020 itself the amount of 1.6 billion EUR. The run of the system 15 years after 2020 means the total investments of circa 30 billion EUR, while the actual amount of distribution fees that is the highest in the EU creates the pressure on the competitiveness of Slovak economy and therefore it creates the natural limit for the continuation of this way of solving.



Picture no 27 and 28 The commitment of Slovakia for 14% share of renewable energy sources in the energy mix and the costs for it according to the present legislation

- f. The principles of the Act 309/2009 implement the economic redistribution through the markets of electricity, heat and CO₂ emissions what disrupts the competition on the market



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- and creates the economic barriers that hamper the competition.
- g. It is shown that the system in accordance with the principles of the Act 309/2009 Coll. reached the top measured by the amount of distribution fees as the highest in the EU and therefore it has a negative impact within the criteria of competitiveness of Slovak economy and restricts the domestic consumer market.
 - h. It notes that the state has got a right to allocate the chosen technologies from the competition in accordance with the Act on the Competition Protection.
 - i. It criticizes the fact that the source of the fees to the price on the market is a consumer and not a tax payer and thereby the used principle acquires the character of excise tax. So the used principle gains the nature of the excise tax. On the contrary to the excise duty, the implemented redistribution mechanisms via the markets among the market participants are also a part of this principle. They make a part of the participants significantly favourable and another part is put in disadvantage.
2. The constructions of the multilevel model of the energy market that
- a. includes the researches made in economy theories as the response to the failure of economic models used until the crisis on the financial markets in 2008.
 - b. It defines the transaction costs related to the transformation of energy market.
 - c. It determines the method of measuring the transaction costs by CO₂ emissions.
 - d. It implements a green permit as the complement to the produced CO₂ emissions.
 - e. It implements logical boundaries 1t/Mwah for specification of the factor of green permit as the top limit of emission production for thermal power plant burning the coal.
 - f. It integrates contradictory opinions to the issue of the role of CO₂ emissions without any costs rise for the solution of the issue of climate changes.
 - g. The assessment of CO₂ emissions follows from the published value of the social value of CO₂ emissions released into the atmosphere in the amount of 85USD (65EUR/t) (Stern at all, 2006).
 - h. On the basis of published data of Office of Regulation of Network Industries (URSO) on the paid supplements it calculates the social value of the CO₂ emissions in the amount of 93.84EUR/t for 2011 and 97.8EUR/t for 2012 and therefore it determines the energy market in 2011 and 2012 as negatively stimulated in favour of investors without the pressure on the costs.
 - i. It proposes the rational value of green bonus in the amount of 70EUR/t as a reward for a supplier of the energy from renewable sources.
 - j. It creates a dynamic algorithm between the excise tax and the green bonus for the 40-year-transformation of the market.
 - k. It determines the value of green bonus and the amount of excise tax on fossil fuels as a decisive tool for the market regulation, while the amount of the green bonus represents a motivation component and the amount of the excise tax represents an economically repressive component of regulation.
 - l. It creates a hierarchical, multilevel model of the shift of the market from the competitive organisation with discriminative attitude to energy sources on the energy market into a strategic segment of cooperative-competitive relations.
 - m. It proposes that the subjects cooperate exclusively within solving an investment vehicle – distribution systems of energy.
 - n. It means that the subjects are competing in providing the services to a consumer.
 - o. It ensures the lowest costs as a result of cooperation within the investment vehicle in the



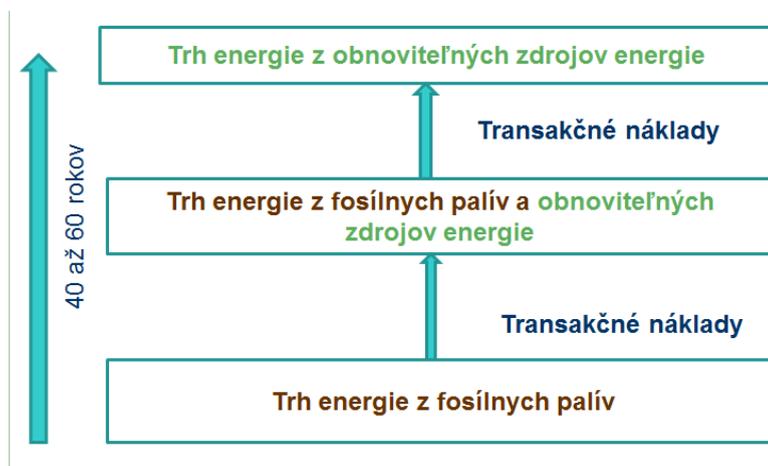
form of distribution system and reduces individual costs at the realisation and operation of energy sources as a result of competitiveness on the consumer market.

- p. It provides the tool for deciding in the form of knowledge emission curve of CO₂ (green bonus) for individual technologies.

The designed model of the transformation of energy market can be characterized as it follows:

1. Simple and therefore doable.
2. It has got the character of adaptation mechanism where the pace of transformation is set based on the selection of the amount of individual social costs on CO₂ emissions and the amount of green bonus in the relation to the commitments of the Slovak Republic and possibilities of the Slovak economy and society.
3. It is suitable for the heat market and after subsequent analysis and modifications it is adaptable even for the market with electricity.
4. It solves the issue of access of local energy sources in a non-discriminatory manner into the energy market through the distribution energy networks and thus creates the conditions for solving the transformation of building into buildings with almost zero energy needs in accordance with the Act no 300/2012 Coll. and Decree no 364/2012 Coll.

The model respects the fact that during 40 to 60-year transformation there exists a mixed state of renewable energy sources and fossil fuels and searches the economic balance among them where the economic stimuli are incorporated for the motivation to the transformation of the market towards renewable energy source.



Picture no 29 Model of transformation of energy market

The philosophy has always considered the implementation of the principles of contradiction unification to be the top of the solution and also the symbol of a correct approach to the exploration of the issue and subsequently to its solution. The designed solution of the transformation of energy market is simple, and thus it has the conditions for adequate implementation into the laws and other standards and therefore law enforcement, too. The attractiveness of the designed model increases because of the fact that only parameter of transformation costs accedes to the supplied energy in the form of the social value of CO₂ emissions. The social value of CO₂ emissions well fulfils the function of transaction costs within the transformation of the market, it is measurable and valuable and also



represents an utility value. The social values of CO₂ emissions can act in the economically motivational form of green permits and their prices in the form of green permit and vice versa as the economic repression that is imposed in the form of excise duty on the fossil fuels. By setting the amount of this parameter we can:

1. regulate the price, pace and extent of energy market transformation
2. provide the adequacy of the costs to the needs and possibilities of Slovak economy
3. adaptation principle enables to patiently verify regulatory measures and determine the dynamics of the transformation in order to avoid the unnecessary waste of social sources
4. create the conditions for the competition of investors on the market and therefore ensure the permanent pressure on the costs and adequate prices

Since the transformation of the energy market also includes the transformation of small number of energy sources with high energy output, the shift from the competitive market into a strategic segment of cooperative-competitive market with non-discriminatory attitude of energy sources into a market represents the part of the solution.

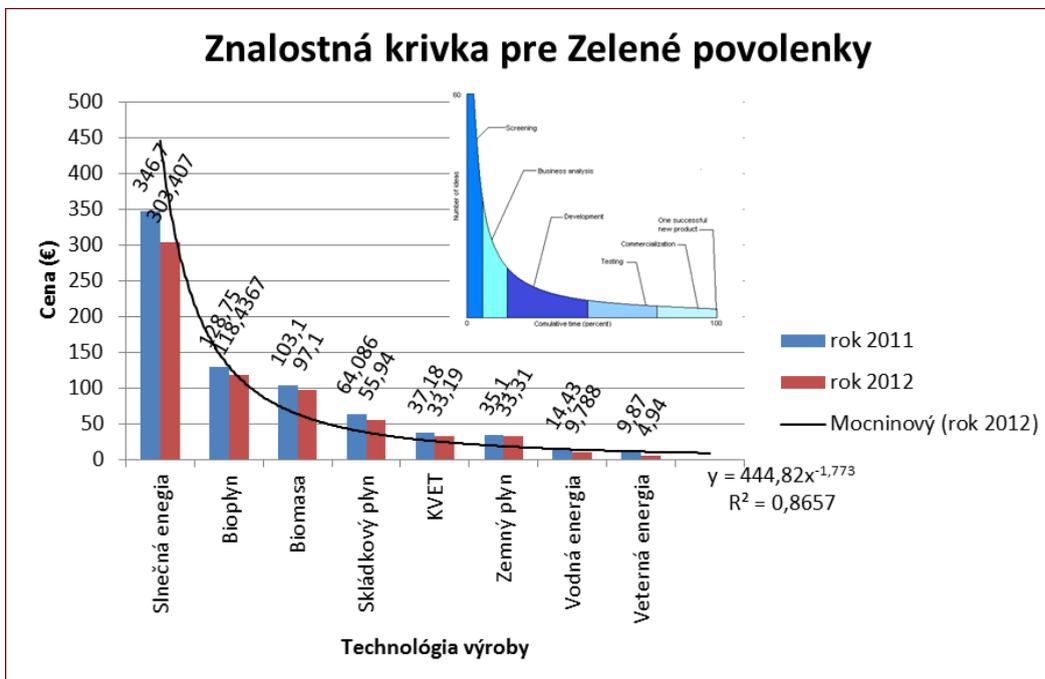
The unification of contradictions into a model of the market transformation with the adaptation principle enabling to solve the pace of the market transformation on the economic basis means to implement transaction costs into the value chain of economic model. We can measure them and attribute them a stimulation role in the form of green bonus and a repressive role in the form of excise tax on fossil fuels.

Then the social costs get to the centre of economic model connected to the transformation of energy market and while they are measured by CO₂ emissions, then also by social costs linked to the CO₂ emissions.

The society must be interested in a question of what is the volume of costs that the society must invest so that the supplied energy on the market would not contain an additional production of CO₂ emissions. It is necessary to know the unit costs for the management of the transformation process of energy market needs. Firstly, it is necessary to know the costs that are related to CO₂ emissions, if the society continued to release them to the atmosphere and also eliminate the consequences and damages linked to CO₂ emissions. The report of Lord Stern (61) set such defined social costs to 85 USD (65 €). On the basis of published data of URSO (Office of Management of Network Industries) on the paid supplements it calculates the social value of the CO₂ emissions in the amount of 93.84EUR/t for 2011 and 97.8EUR/t for 2012. This sum represents the average additional costs calculated per a ton that the society invested into the energy supply on the market without additional production of 1 ton of CO₂ emissions. The grow of average costs by 4.3% in 2012 in comparison to 2011 represents a negatively stimulated market and if there is no change it will represent the beginning of crisis. Also because according to the report of Lord Stern it is economically more rational to release the emissions to the atmosphere within these prices, because the costs of the elimination of the consequent costs are by 50% lower than the average costs paid in the form of a supplement to the price of energy on the market. The knowledge curve of green permits shows that the support is discriminative and provide a different assessment of the same utility value in the extent from 9.87 €/t for wind energy to 303.4 € for solar energy. A discrimination factor reaches up to



3,000% for



Picture no 30 Knowledge curve of green permits in accordance to the paid support according to the Act 309/2009 Coll. and corresponding legislation. Source: (62)

the same utility value. The designed solution for 40-year transformation mechanism is represented by the level of green bonus that is 70€/t with the following adaptation algorithm between the amount of green bonus and the excise tax on fossil fuels. It is just the knowledge curve of CO₂ emissions that enables to purposefully select the economically suitable technologies for the implementation on the market and also regulate the pace of the transformation by suitably selected amount of the price of green bonus and select the suitable technologies. This principle also puts the pressure on the costs as a natural motivation for their reduction by the suppliers of the energy from renewable sources on the market. Within such a perceived solution of the market transformation, the solution of the issue of the reduction of CO₂ emissions together with its value represents another utility value of the model without any other additional costs. ***It is also a targeted solution of the most important part of the burden of ecosystems of nature as a result of human economic activity.***

The hierarchical model of the transformation of energy market is built on the basis of the following 6 layers:

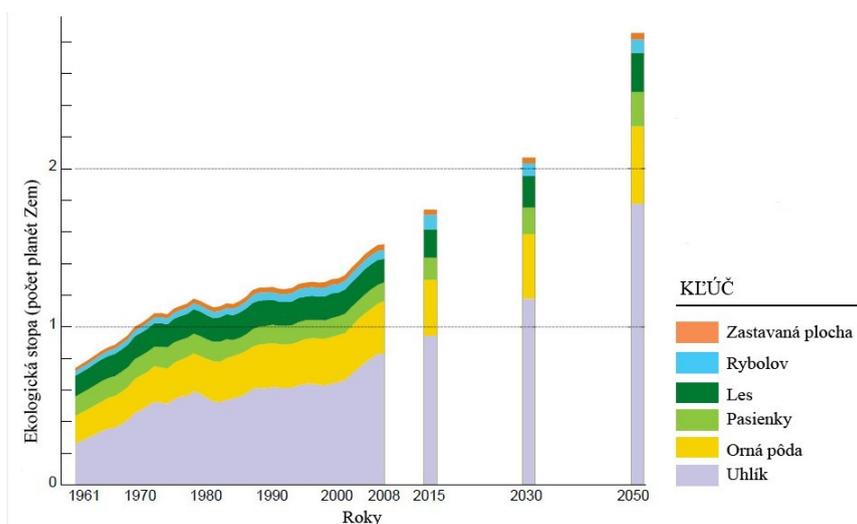
1. Man and his characteristics
2. The law on hunting large animals
3. Conclusions of game theory and sociological principles of construction market
4. Collard altruistic model with warranty
5. Cooperative-competitive model of market with energies represents the transition of the market organisation to strategic segment enabling the development of the whole range of services that are necessary within the construction of energy network called smart grid



6. Social value of transformation costs measured by CO2 emissions economically expressed by the price of green bonus and excise duty on emissions and their implementation into the energy market.

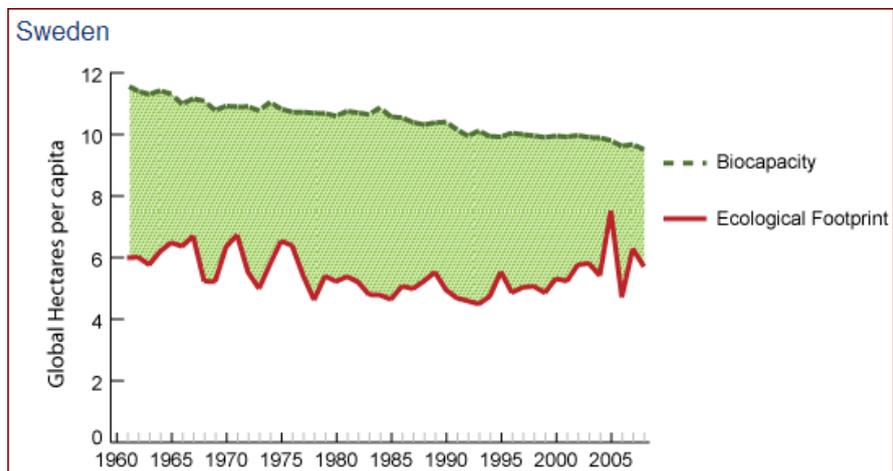
Relation of ecological responsibility and economic prosperity

The ecological researches show that CO2 emissions have the utility value and they contribute on exceeding of ecological systems of the Earth by 45 to 55%. A reasonable handling of this value enables to implement an economically controlled method of market management within the period of the transformation based on the ethical basis of a new value system of the society. An example from Sweden shows that by the implementation of circa 200,000 heat pumps we can achieve a significant reduction of ecological burden, significantly increase the share of renewable energy sources in the energy mix of a country (Sweden actually has the highest increase of renewable energy sources within the energy mix from the EU countries) and reach the ecological reserve against the produced ecological burden without worsening the standard of living. The technologies provide the added value formation for more than 25 years after the repayment of the investments. The human economics and ecology of nature can be put in harmony within a sophisticated process and provide the man and society with economic prosperity without an excessive ecological burden creation.

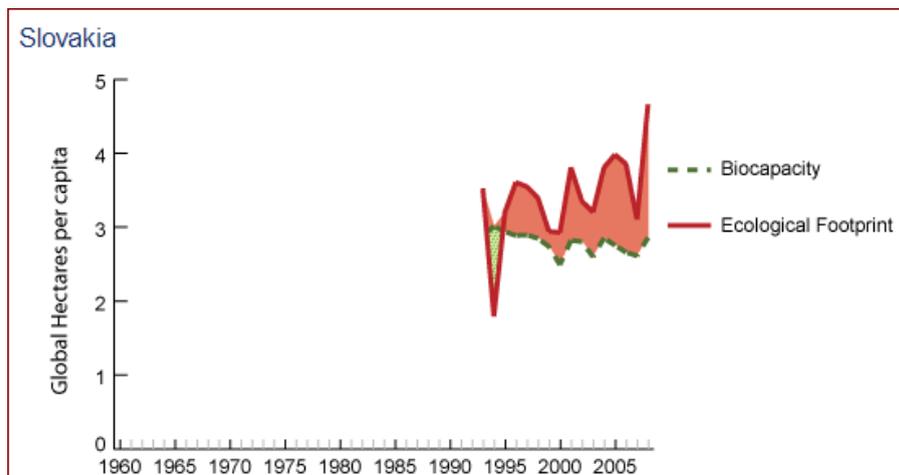


Picture no 31 The share of individual components burdening the ecosystems of the Earth and their development without adopted measures.
Source: (21)

The transformation of the energy market into strategic segment of cooperative-competitive relations preserves a certain part of the values in the society that would be otherwise damages by a competitive market. A correct implementation of the market transformation into the legislation creates the conditions for the acceleration of the transformation without unnecessary investment of precious social means including the time.



Picture no 32 Ecological footprint of Sweden
(27)



Picture no 33 Ecological footprint of the Slovak Republic
Source: (27)



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