Breakfast Debate

Sustainable Society

in cooperation with Novitech

Tuesday 1 October,

Members' Salon, European Parliament, Brussels

The main challenge and objective of all policy makers both on EU and on Member state levels is a sustainable society. Our study conducted on level of Slovak Republic shows 3 core interrelated components which achieve this objective:

1. *Practical experiment transforming administrative building into the net zero energy building shows that proper selection of the technologies allows transformation without subsides. 87% reduction of the primary energies and 96% reduction of the carbon emission have been achieved comparing to the year 1996. The limit of the transformation lies in the energy market organisation which creates economic barriers and prevents competition.*
2. *Study of energy market shows importance of the social cost of the carbon emission used in the form of the green credits and consumption tax which in dynamic interrelation could create driving force for transformation of the market and at the same time stable market environment suitable for the long term investment. The study shows interrelation between energy, carbon emissions and GDP and between energy technologies and future pensions.*
3. *Observed facts from 10 years long transformation of the PAYG social security system in Slovakia into I. and II. Pillar indicates that new distribution of roles between state and private sector is needed for pension reforms. This will solve inequality issue among insured persons and remove conflict of interest between asset and account management creating at present extra cost and squeezing down the future pensions. Individual accounts create the base for new arrangement of intergeneration transfers within the three generation family and could solve the free ride problem and large family disintegration.*

All studies showed that corruption creates the basic limit for the transformation into the society based on the innovation.

Host and speaker

Host:

Attila Tóth
Chairman of the Board, Novitech, Slovakia

Speaker:

Dušan Lukášik,

THE CENTRE FOR RESEARCH ON ECONOMY OF RENEWABLE ENERGY SOURCES AND DISTRIBUTION SYSTEMS, Košice, Slovakia

Member of the Board

- Graduate in electrotechnics (1978). Doctorate in physics and mathematics (1980)
- Research and development in Tesla Liptovský Hrádok, Slovakia, Telecomm industry (1981 – 1991)
- Capital markets (1992 – 1995)
- Research of transformation of social and pension system in Slovakia – advisor to ministry for labour, family and social affairs (1999 -2002)
- Member of the board in Novitech j.s.c. ,Košice (2002 – 2004)
- Advisory to Chairman of the Economy Committee of Slovak parliament (2007 – 2012)
- Research and development of transformation building into building with nearly zero energy consumption (2000 -)
- Member of the convocation of Civil Engineering Faculty Technical University Of Košice, Slovakia
- Research and development of transformation of energy market towards renewable energy,
- Member of the board of Centre of Economy Study of Renewable Energy and Distribution Systems, Košice (2008 -)

Presented articles describe results of various fields. A common integrating idea lies in fact that all research is focus to find the sustainable solution of the presented problem, wether it is pension system, energy market or transformation of the building.

It includes social security system with the focus on pension system and transformation of Pay – as – you- go system into Pillar I. and II. solution. Main of the work in this field has been done together with Ľubo Ružek during years 1999 and 2002.

Experiments regarding transformation of the building towards net zero energy building is a result of cooperartion with František Vranay and Ľudovít Tkáčik during years 2006 to 2013. Systemic approach to the transformation has been developed in cooperation with Milan Bielek.

Concept of transformation of the energy market has been developed together with Ľudovít Tkáčik and Ján Ferenci.

The presentation on 5th European Innovation Summit Brussel is a result of my long term cooperation and relation to Attila Toth, founder of NOVITECH, j.s.c.

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Obsah

1. Transformation towards sustainable society

Crises on financial markets and public debt as top of the transformation process with value change

Transformation of the administrative building into nearly zero energy building

Transformation of energy market

Transformation of pension system

Conclusion and main findings

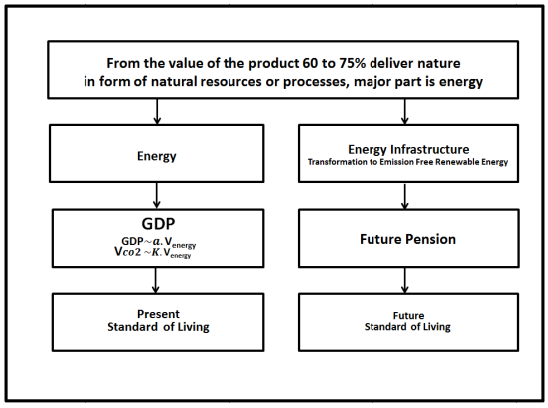
Review of Agenda K4I Summit 2013

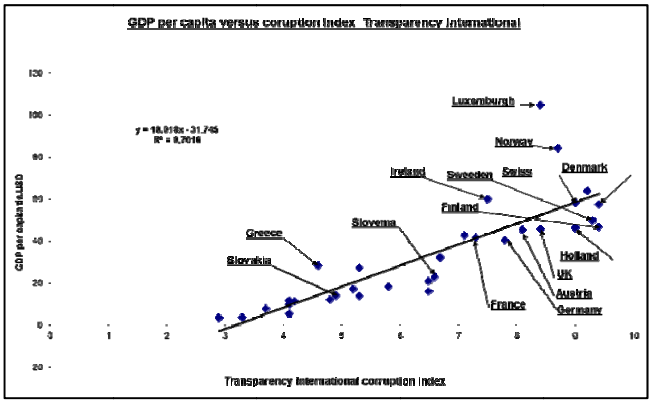
July 2013 Košice, Slovakia **Dušan Lukášik**

1.1. Management summary

The main challenge and objective of all policy makers both on EU and on Member state level is a sustainable society. Our study conducted on level of Slovak Republic shows 3 core interrelated components which achieve this objective:

1. *Practical experiment transforming administrative building into net zero energy building shows that proper selection of technologies allows transformation without subsides. 87% reduction of primary energies and 96% reduction of carbon emission have been achieved comparing to the year 1996. The limit of the transformation lies in energy market organisation which creates economic barriers and prevents competition and possibility to supply renewable energy to the market.*
2. *Study of energy market shows importance of social cost of carbon emission which used in the form of green credits and consumption tax in dynamic interrelation could create driving force for transformation of the market and in the same time stable market environment suitable for long term investment. The study shows interrelation between energy, carbon emissions and GDP and between energy technologies and future pensions.*
3. *Observed facts from 10 years long transformation of the PAYG social security system in Slovakia into I. and II. Pillar indicates that new distribution of role between state and private sector is needed for pension reforms. This will solve inequality between insures and remove conflict of interest between asset and account management creating at present extra cost and squeezing down the future pensions. Individual accounts create the base for new arrangement of intergeneration transfers within the three generation family and could solve the free ride problem and large family disintegration.*





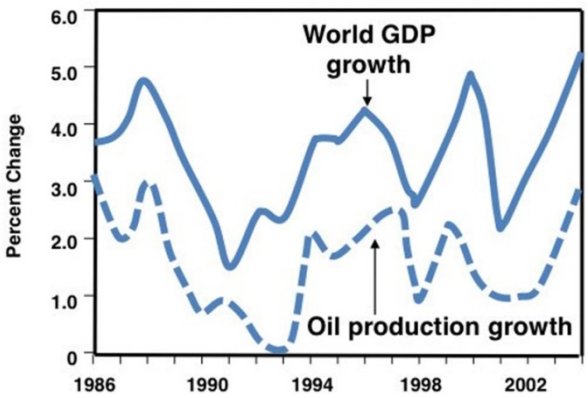
All studies showed that corruption creates the basic limit for the transformation society based on innovation. Removing 10% of the corruption measured by perception index of Transparency International nearly doubles GDP per capita within the EU states.

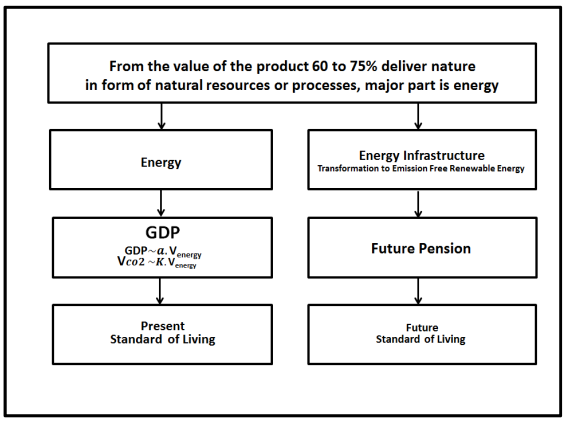
1.2. Crises on financial markets and public debt as top of the transformation process with value change

Psychology model of existential crises has been applied on economy process started 1995. Analysis shows that the processes fulfill criteria of the transformation process connected with change of values. Following main economy crises have been identified:

- Crisis of technologies suitable for effective energy conversion known as energy crisis
- Crises of ecological systems
- Crises of PAYG pension system

Analysis shows key role of the energy for the GDP and hence the same key role play energy infrastructure and conversion technologies for pension system in modern society.



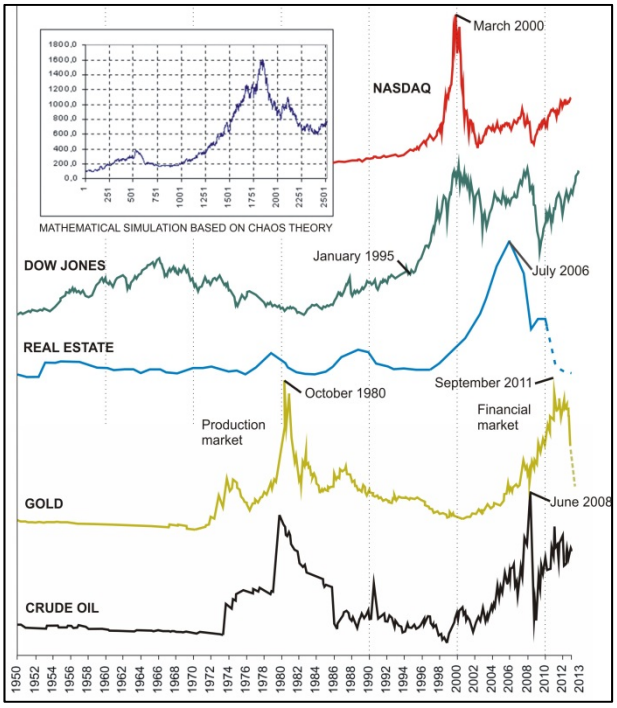


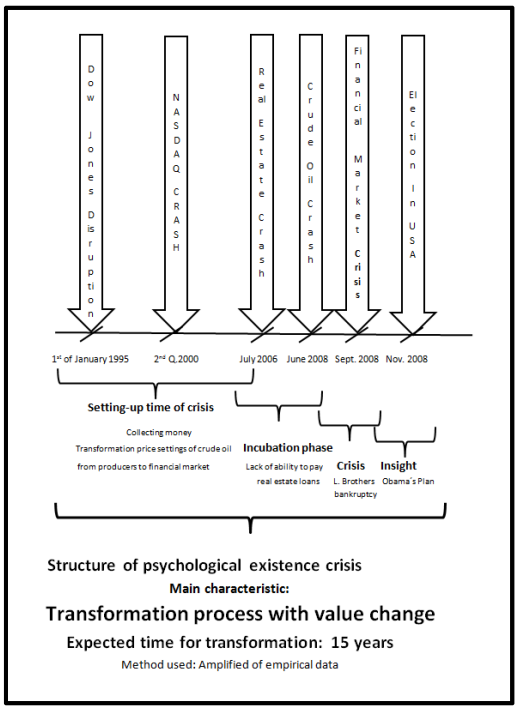
Sequences of cyclical crises with crashes on different markets started in 1995 have following common features:

1. Shows asymmetry in information on markets
2. Shows developed moral hazards for consumers as consequence of failures of governments and regulators to set up and regulate markets
3. Shows the dynamics on markets which could be successfully described as interlinked behavior of people through chaos theory. This very modern approach to economy problems completely change basic assumption – agents are not any more independent in their rational decisions rather influenced by each other
4. Changes on financial market started in 1995, crash on Nasdaq in 2000, transformation of price management of the crude oil from production markets to financial markets between years 2001 to 2006, crash on real estate market with the peak in July 2006, crash on energy market in July 2008 developed into the economy crisis and peaking in September of the 2008 on financial markets. This sequence of events together with the content of each period fulfills exactly the existence crisis model developed by psychology.
5. On the top of existence crisis the old values are breaking and new set of values and new order of the values are set up. Long term transformation process underlays cycling crises and introduce gradually new set of values.
6. IT technology solved the energy crisis of 70ties last century. The nature resources and energy consumption in average product went down to 50%. 15 years were needed to solve energy crises of 70ties.
7. Energy crises and ecology crises could be solved in the same 15 years' time period. The least cost of transformation can be achieved if transformation cost of energy market towards

renewable energy is measured via carbon emission and social cost of carbon is embedded into market in form of green credits as an incentive stimulus and consumer tax as vehicle for money collection and penalty instrument. The transformation cost could be applied on the whole market directly or restricted to energy market. This political decision in the same time decides about the way how the consumption tax is constructed.

8. Since energy supply is accompanied by carbon emission the dynamics of carbon emission is also the same.
9. Eco systems do not reproduce the waste produced in human economy processes anymore. The main problem has been identified by science that carbon emission are responsible for about 50% of the problem
10. Dynamic interrelation between energy and GDP not only determines the economy activity and standard of living measured by GDP, but also volume of carbon emission produced. ***This relation shows importance of energy companies in form of assets for pension systems.***

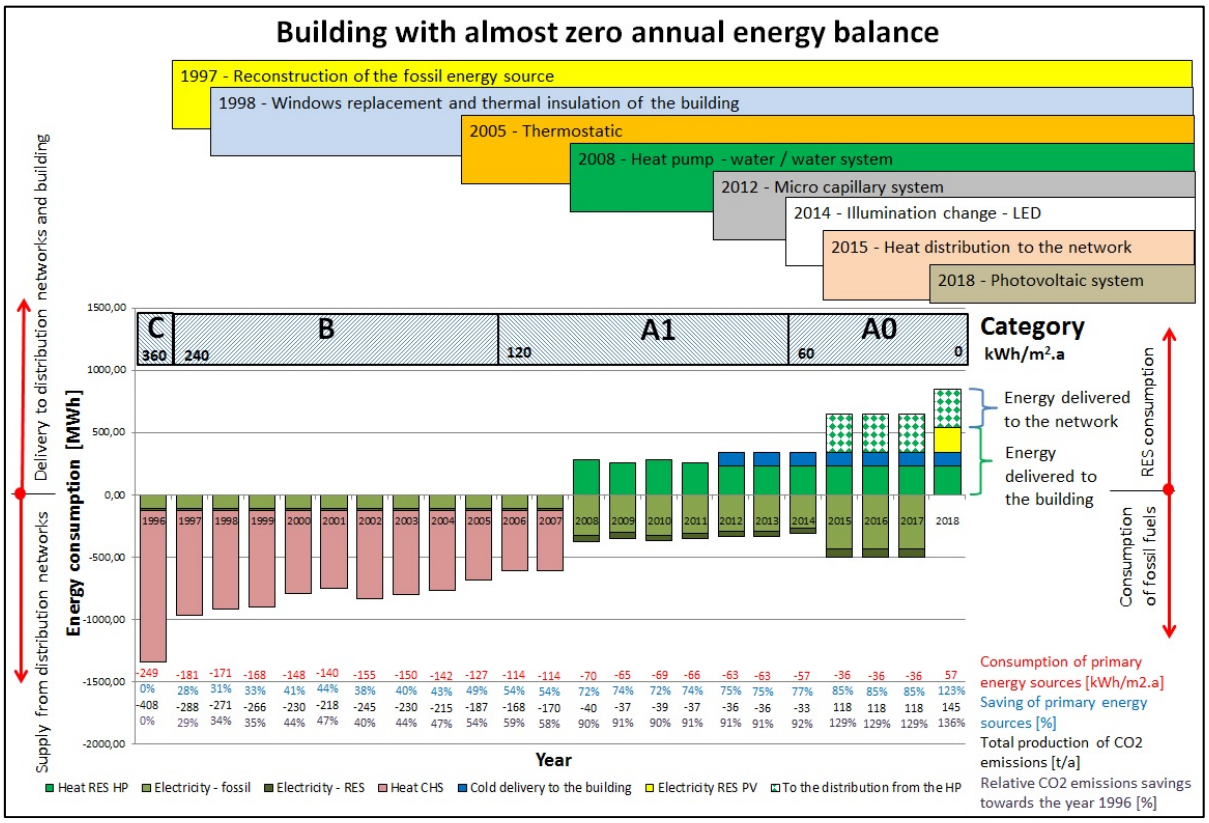




Transformation to the sustainable society means transformation of the energy sector to using renewable energy without producing carbon emission with the least investment spending policy and in the same time transforming PAYG pension system in order to:

- solve free rider problem within PAYG system,
- splitting risk equally between yields from labor and yields from asset in PAYG system
- keeping social solidarity as main economy advantage in order to keep the cost of labor competitive
- our main findings are:
  1. social value of the carbon emission seems to be the determining economic value which could be used as a main drive force transforming society towards renewable era. The value of the carbon emissions could be adjusted to the society need and their actual possibilities
  2. transformation from the competitive energy market to cooperation competitive markets seems to be the determining factor for market organization to achieve less possible resource spending
  3. new role between state and private sector for asset management and market organization in pension system should be settled down

1.3. Case study 1. Transformation of the administrative building into nearly zero energy building without subsides



The heat and cold in administrative building with the 5 400 m area have been transformed into renewables energy source.

Key findings:

- technology applied allows savings measured since 1996:
  - 73% of the heat
  - 87% of the primary energy sources
  - 96% of the carbon emission produced

The transformation of the building includes building renewable energy source and related technology on site in order to response to energy crisis and climate change. This changes the building from the pure energy consumer status into source of energy. In the same time is solving also quality of inner climate during summer using irradiation as the main energy transport principle. This solves problems with heat waves which dramatically raises probability of human collapse up to 33%. From the economy point of view the transformation of the building has been done only from the income of the market. No subsidies of any form have been used till now. Key problem which limits the transformation into net zero energy building is providing indiscriminative access of the local energy source on the energy market. This needs to change principles of energy market organization in order to achieve net zero energy balance of the building.

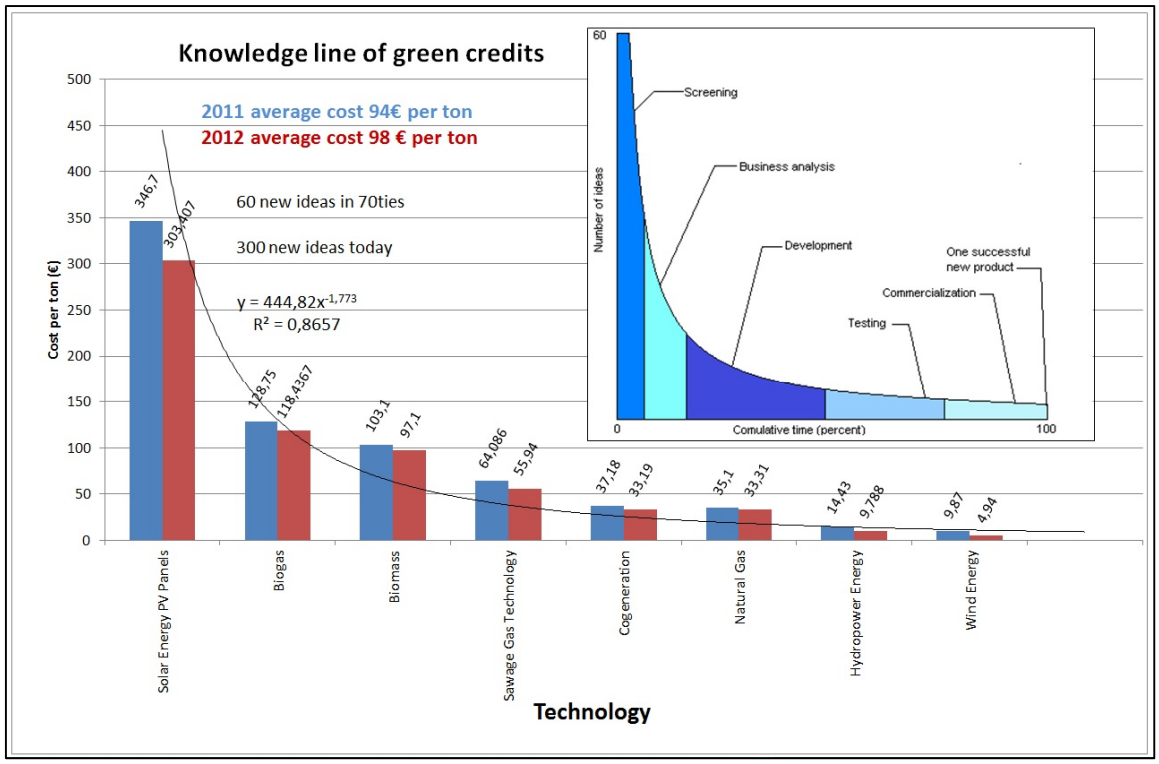
1.4. Case study 2. Transformation of the energy market

Transformation of the energy market towards renewables has been studied. The social cost of carbon emission has been recalculated from subsides known as feed in tariff. We have obtained in average 94€ extra subsides over market price paid in order to supply energy without 1 ton carbon emission in the year 2011 and 98€ per ton in the year 2012 respectively. The knowledge line of cost of carbons for different technologies used has been constructed which spans from 10€ till 346 € per ton for different technologies.

Study of using financial principle based on the feed in tariff distributed as mandatory payment of consumers' shows:

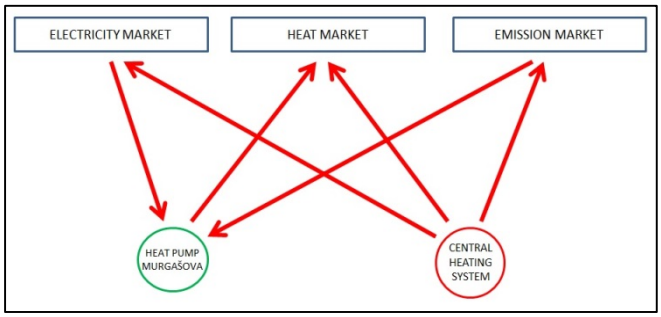
- *the application of feed in tariff transfer risk from investor to consumer and do not creates the effective press on cost, it has negative impact on the energy market,*
- *destroy investment effectiveness allocation*
- *introduce economy redistribution processes between investors through markets of heat, electricity and carbon emission which highly influence competition*
- *create economy barriers for entry to market comparable to market price*
- *create incentives for raising the cost and hence consumer prices EU has 30 to 40% energy prices higher than USA and China – this way destroy competition of EU*
- *change distribution of resources through the society acting as consumption tax which burden social system, hence shifting large part of the society towards so called energy poverty*
- *study of European Court of Justice judgment PreussenElektra AG v Schhleswag AG [2001] EUECJ C-379/98 shows that no expert or scientific opinion has been considered rather formal and political decision has been made:*
    - *no real influence of the feed in tariff principle applied to the market has been considered rather the decision is based on formal arguments. The argument says that subsides are no state resources hence arrangement of feed in tariff do not damage article 87 of the Treaty*
    - *because the arrangement of feed in tariff is useful for protecting the environment and reduce the emissions of greenhouse gasses the political decision prevails over content of Article 28 Treaty*
- *spreading out the feed in tariff principle through energy market introduced many corruption practice known from media and is one of the reason why price of the energy raised up to 30 to 40% higher comparing to prices in USA or Asia as has been discussed in May premier´s summit.*
- *There was no real reason for subsiding technologies through market which do not fulfill selection criteria of the knowledge line, rather direct state support of research and development is strongly needed*
- *as example of the result of this practice means yearly payment of 18 billion € in Germany, 1,7 billion € in Czech Republic, 0,4 billion € in Slovakia etc. This costs each citizen in these countries from 71 to 218 € per year and negatively influence the investment and consumer market*

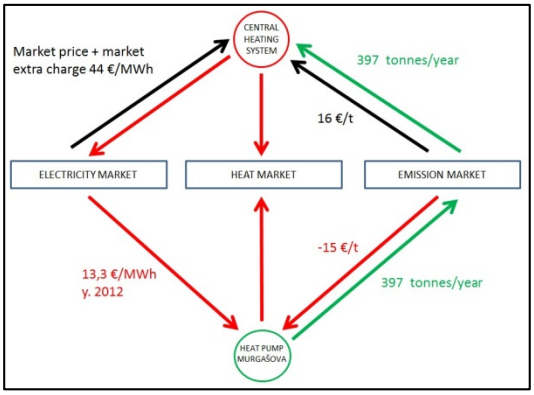
The transformation of the energy market is also transformation from few power stations with large energy power into many energy sources with low energy power. The reason of local renewable energy sources lies in fact that they should be consumed directly on site. Therefore the construction of large renewable energy power stations of site means in many cases waste of the valuable investment resources without bringing real value. Transformation cost measured and valued via carbon emission allows construct transformation as a process *which will*



introduce real competition on the market between investors. Value of carbon emission:

1. *acts as incentive fee in form of green credit selects effectively between different technologies.*
2. *creates the economy force which squeezes down the cost and the price of the energy*
3. *introducing as part of the price and cost it create the condition for indiscriminative access of the both fossil and renewable energy resources if the qualitative conditions are met*



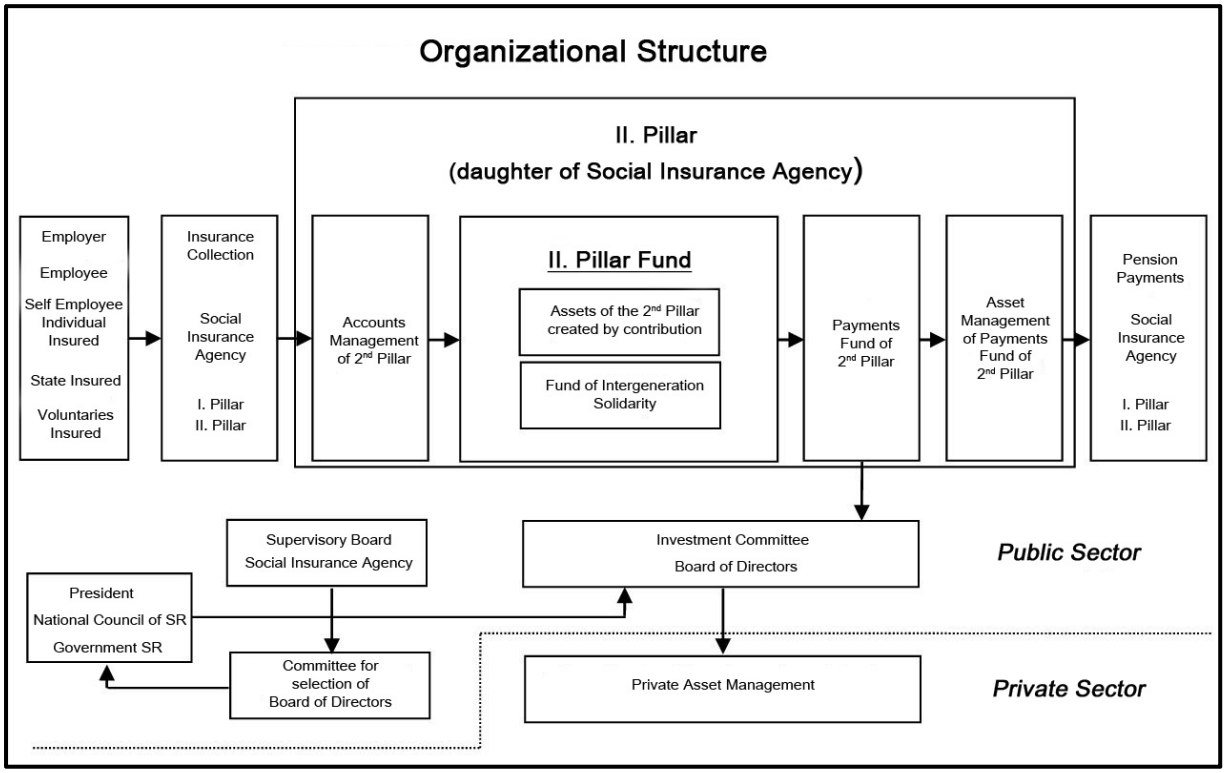


The study shows the important role of the value of the social cost of carbons as transaction cost, which could be measured and charged. Proper use of this tool in form of green credits as incentives for renewables and consumer tax for fossils ***in mutual dynamic relation could be used for regulator as general instrument for market regulation according state of the economy and their needs***. No other subsidies are needed in form of feed in tariff for transformation of the energy market. There are only two products on the energy market. The first one is energy itself and the second is ability to supply energy from renewable sources without carbon emission. Suggested solution: The energy market constructed as cooperation concurrency market with nondiscriminatory access to the market for both fossil and renewable energy sources with embedded social cost of carbon in terms of green certificate on incentive side and consumption tax burden on fossil energy, transform market towards renewables. ***Research and development of the new technology should be financed from public money in form of general tax.***

1.5. Case study 3. Transformation of the pension system

Analysis of pension system shows importance to solve key problems as:

- free rider problem,
- baby boom problem,
- proper risk splitting between two different sources of the pension - asset and work force respectively
- splitting asset and account management between two different bodies will solve introduced problem of equality of insurers and conflict of interest



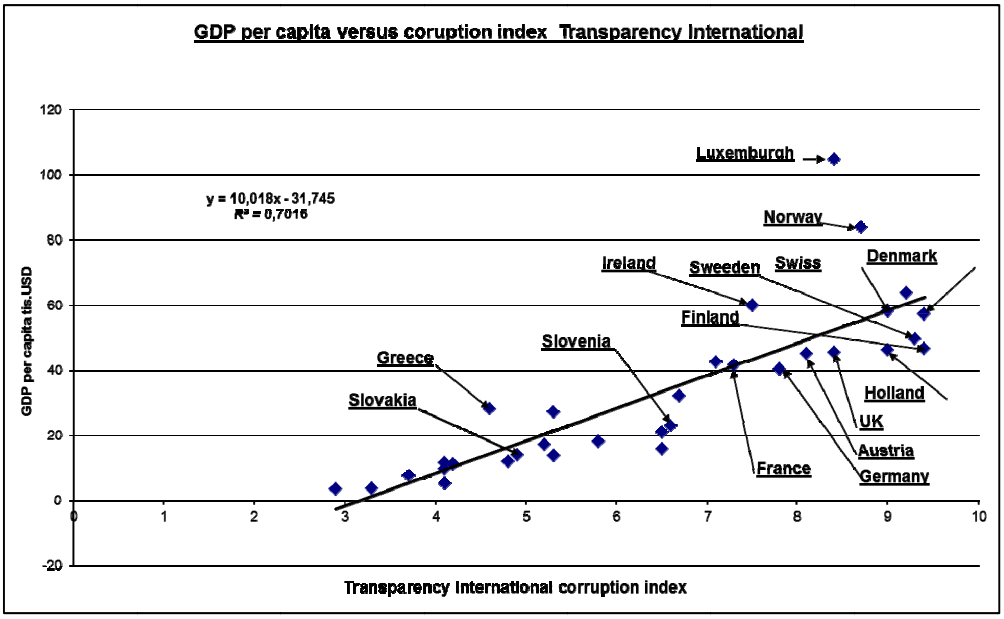
1. The suggested solution keeps social solidarity with redistribution from 3:1 during accumulation phase to 2:1 during retirement phase as key economy factor which keeps down the cost of labor.
2. Free ride problem could be solved introducing individual accounts.
3. Baby boom problem needs accumulate enough resources in order to create financial reserves and cover and guarantee the future pensions.
4. Both, yield of labor and yield of asset in 40 years interval is nearly the same between 2% to 3% a year. The risk should be equally splitting between income from labor and asset, respectively.
5. General model of the mandatory two pillar system and voluntary state supported third pillar has been constructed. Transformation from PAYG system will take 40 years
6. Analysis shows that in mandatory system there is competition on asset market but there is no competition between accounts.
7. Economies of size favor management of accounts in Social Insurance Agency.

8. Competition principle suggests that private sector manage the asset.
9. General model contain effective regulatory and control instruments for state.
10. Private sector should manage the asset and compete on market.
11. State should put on individual accounts the same level of guarantee as in PAYG system. So called intergeneration pension fund has been constructed as heart of the 2nd Pillar. Shares of state owned companies like those from energy sector or other infrastructure could be used effectively as asset of this fund.
12. Freedom of movement of the work force through the labor market EU is solved within this this model as well.
13. Transferring accounts within the public finance solve also problem connected to public depth.

1.6. Concluding remarks

1. Analysis of the different factors shows that in the energy sector (including transformation of the buildings) there is no stable investment environment allows predictable long term investment.
2. The present market construction allows conflict of interest and is highly influenced by lobbying.
3. The analysis of each market shows presence of the asymmetry in information which creates moral hazard for consumers combined with negative stimulus for investors.
4. Feed in tariff principle negatively stimulates energy market and destroy stability of investment environment on energy market.
5. The volatility on carbon emission market shows that rather condition for speculation as serious investment into renewable energies has been created.
6. The social cost of carbon emission has been calculated 94 €/t and 98€/t in the year 2011 and 2012, respectively in order to produce one green credit
7. Price on the market is only around 5 € or less. Where is the reason for the investment?
8. The subtle border between lobbying and corruption has not been solved which shows the Transparency International perception index of corruption. The chart showing GDP per capita versus TI index indicates that solving 10% of the corruption nearly doubles the GDP per capita within EU states.
9. Price analysis of privatization process of Slovak Gas Industry in the year 2002 and the dividend paid between 2003 and 2012 shows that corruption TI index could be consider to some extend as risk premium.
10. Conflict of interest between asset and account management has been introduced into pension reform in Slovakia. Due to this fact expected loss of 20 to 40% in 40 years horizon has been proved during last 10 years.
11. More effective split of function between public and private sector has been developed.
12. A very simple analysis shows that corruption also influences dramatically the innovation process. If the competition is based on corruption there is no real interest for innovation. It is

valid neither for winner nor for those who failed. Simply resources are needed for corruption not for financing innovation. In fair market competition even those who failed will innovate.



1.7. Main findings

Transformation to sustainable society based on renewable energy at least possible cost seems to be the answer to present crises. There are three different crises foreseen:

1. *crisis of technologies connected to energy conversion shortly energy crisis*
2. *ecological crisis tight to climate change*
3. *pension crisis in form of baby boom crises and free rider problem*

According to solution of energy crises of 70ties of 20th century 15 years will be needed in order to set up new eco technologies into market delivering enough added values which will:

- *Transform large part of energy market in order to fill expected supply gap of fossil energy and substitute fossil energy to renewable one.*
- *Squeeze down greenhouse emission as main ecological problem.*
- *Shift an organization of the market from pure concurrency market rather to more economically effective cooperation concurrency market.*
- *Social cost of carbon in form of green certificate and consumption tax seems to be universal regulation value which embedded into the market drive the market towards renewable resources based on least possible cost and stimulate innovations based on renewable, nano and bio technologies.*
- *These principles, if applied, will select the least cost technologies and drive the market transition in order to create the stable investment environment which will squeeze down prices of energy.*
- *Transformation of the administrative building to net zero energy building without any subsides have been demonstrates.*
- *Corruption creates limit of growth based on innovation.*

- *Raising bureaucracy does not address the problem of corruption, rather transparent market rules are the answer to this topic.*
- *Comparing the results obtained from energy market to decision of European Court of Justice judgment PreussenElektra AG v Schhleswag AG [2001] EUECJ C-379/98 indicate that no expert or scientific opinion has been considered. Rather formal and political decision has been made. Application principles in form of feed in tariff subsides create large part of economy problems connected with higher price of energy in EU of about 30 to 40% higher compared to those in USA and China.*
- *New distribution of role between state and private sector is needed for pension reforms which will solve inequality between insures and remove conflict of interest between asset and account management creating extra cost and squeezing down the future pensions.*
- *Individual accounts will create the base for new arrangement of intergeneration transfers within the three generation family and will solve the free ride problem.*
- *The key of the transformation process seems to be a human being itself.*
- *Modern psychology is needed in order to solve the puzzle between high standard of living and in the same time low quality of life and vice versa in EU states.*

2. Determining factor is new value system

Interview concerned renewable energy published in May 2013

S L O V A K P O W E R E N G I N E E R I N G

The basis for the transformation to a sustainable society when using renewable energy resources with least possible investments is primarily a transformation of the whole society to a new value system. One of the most outstanding specialists of the The Centre for Research on Economics of Renewable Energy Sources and Distribution Systems (Centrum pre výskum ekonomiky obnoviteľných zdrojov energie a distribučných sústav) is its founding member Dušan LUKÁŠIK who was interviewed by an editor of Parlametný kuriér, Anna Komová.

In 2008 you founded the Centre for Research on Economics of Renewable Energy Sources and Distribution Systems together with TU (Technical University) Košice, STU (Slovak Technical University) Bratislava and EU (Economic University) Bratislava. What is the subject of your research?

We focus mainly on the practical application of cutting-edge technologies intended for energy market and buildings that adopted the term of near zero energy building. The team consists of prominent experts from the energy sector industry such as Ing. Ľudovít Tkáčik and Ing. Ján Ferenci together with the researchers from the academic environment Ing. František Vranay PhD and Ing Marek Kušnír PhD. We collectively form the core of the research team designated to the acquisition of knowledge enabling the proposition of an economically effective solution for the transformation of the energy market. We use the experiments with an office building with the area of 4,300 m2 which is gradually being transformed into a near zero energy building, while still being used as offices, as a practical model for our research. It enables us to set the actual parameters for the model of the energy market transformation.

The energy market is again getting into the attention of the professional and general public and eventually also politicians, too. Why is the energy market so important for the society?

The development of a modern society is from approximately the beginning of the 19th century largely based on the energy. There are always several core technologies that are able to realize the energy conversion and create the prerequisites for such goods and services that have a forming impact on the society forming an above standard economic added value. For example the second half of the 19th century and the beginning of the 20th century were characterized by coal, steam and iron and it was the coal supplies that boosted the economics of Great Britain and ensured its dominance in the world. Great Britain gradually lost its dominance. The discovery of crude oil supplies in the North Sea in 1980´s not only covered Britain's consumption but it also brought income from the export. That lead to a new economic development and Great Britain returned to the countries with the highest standard of living. Energy dominates in economics as the basis of goods and services. Together with the foods they represent the biggest item within the family spending. Thereby they directly influence the standard of living and they remain interesting for the general public. It is a huge market because of its capacity and therefore it is interesting for the business sector both for an energy supplier or a consumer. If the price of energy is too low such situation creates conditions for social waste and development deceleration. However, high priced energy causes the effect known as the energy poverty and eventually the reduction of the demand on the internal market and restriction of investment activity. For that reason the energy security and balanced management of energy sources is one of the main economic policies of a state and it is the center of interest for politicians. The infrastructure of energy supplies forms the basis for the necessary infrastructure of a modern society.

The reduction of economic activity related to the crisis caused the reduction of energy consumption in the European Union and therefore the reduction of prices, too. Is it really necessary to invest on expensive new technologies of renewable energy sources?

The energy crisis in 1970´s set an enigma for economists. New

energy suppliers were supposed to enter the market in accordance with the standard economic models of a competitive market and they should have squeezed the price of energy in the market. However, it did not happen. Many reputable economists have identified this fact as an anomaly and left it without an explanation as an exception to the rule. It was Schumacher who pointed to the fact that natural resources do not figure in the models of human economic activity. He showed that the crisis is nothing else than an imbalance provided by the nature between available resources and a decline in economic activity that is perceived as a crisis. This means the striking of new balance between the available natural sources and human economic activity. Globally, the natural resources form 60 to 75% of the values of the goods and services, specifically energy and only the rest of it is supplied by human economic activity that is perceived as a crisis. This means the striking of new balance between the available natural sources and human economic activity. Globally, the natural resources form 60 to 75% of the values of the goods and services, specifically energy and only the rest of it is supplied by human economic activity. The crisis of the 1970´s was not solved by the expansion of the energy supply to the market but by the development of information technologies that were able to reduce the energy and natural resources consumption on average to the half of a GDP unit. It took 15 years until the information technologies were sufficiently developed and implemented on the market in order to ensure the prosperity of the society approximately until the turn of the millennium. However, around the year 1995, even the information technologies started to lose their ability to form the above standard economic added value. Nano technologies, biotechnologies and especially renewable energy sources can play a very similar role that the information technologies played within the solution of the energy crisis in 1970´s. The society needs approximately 10 years to master the technologies related to renewable energy sources and their effective implementation on the market. Our analysis verified by the experiments show that renewable energy sources will form an above standard economic added value and fill in the expected decline of supply by fossil fuels as well as the demands for new volumes. Moreover, the decisive part of renewable energy sources is not related to the production of CO2 emissions, which also solves this social issue. Renewable energy sources have a strategic position within the economy of a country. Therefore it is not surprising that the European Union set out an ambitious plan 20-20-20. For Slovakia there are 14% of renewable energy sources set as target in an energy mix in 2020.

The National Council adopted the Act on Energy Efficiency of Buildings in 2012. The Act no 309 on the support of renewable energy sources was criticized during the discussion of the amendments in the National Council of the Slovak Republic at the end of 2012 and in the beginning of present year. The Prime Minister, Robert Fico has already announced its further change.

You are right. The present Minister of Economy, Tomáš Malatinský expressed the strongest comments in the National Council, what is not a typical thing, when he said in a debate on 29th January 2013: „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 on it, so that we may accept a new one in 2013". It is perhaps a tragedy of Slovakia that all crucial laws are prepared in a hurry and even though their negative impacts are known, they are promoted first in the government, then in the National Council. Think about the Act on the Second Pension Pillar that has a similar economic importance in the society. It has been subsequently revised 20 times and another revision is going to happen again. A similar faith awaits for the Act no 309/2009 Col. We can take an example from the Czech Republic. There was the seminar in Lysá Poľana in 2011, during the discussion I asked the representative of the Ministry of Economy and Industry of the Czech Republic, Mr. Pokorný, whether he does not consider the realization of energy sources according to the Act 180/2005 Col as an economic sabotage. The change of practically all energy supply from the photovoltaic cells during the summer means that though it would be technically manageable at the level of energy network, the price of electricity would increase three or four times and the economy of Czech Republic would count the weeks till the date of collapse. It is known that the Act 180/2005 Col. ceased to apply on 1st January 2013. The problems of similar type with the high price of energy are in Bulgaria and also in Romania.

What is the problem if on one side we need the renewable energy sources and you claim that they will play a strategic role and on the other side they create economically unsolvable situations?

The development of the society is based on several economic principles. These are the relative

prices that ensure the effectiveness of allocations of investments; it is the tax and levy systems that ensure equitable distribution of values in the society and their reproduction and the third principle shows the setting of limits for available resources, whether they are natural, human, financial or other. Nowadays, there is also the corruption phenomenon that joins them. If you have a look at the wording of the Act 309/2009 the violation of the first principle is represented by the increased additional payments together with preferential market access that deform the prices. The fact that the additional payment is not realized by the state at the level of taxes, but by the increased obligatory fees in the distribution part of the price for energy represents by its character the excise tax. While the excise tax on alcohol and cigarettes has its aim in limiting the negative health impact on citizens, this type of excise tax in the form of distribution fees represents direct taxation of a citizen and it affects their standard of living. By doing so it violates the second principle - the distribution of values. They are the strategic materials regarding the energy concept or strategy of the development of energy sector, where the social needs for energy are set with the view to 2030, where the relative structure of energy sources the need for recovery and economic context should be determined with relative accuracy. In other words, these materials should provide the third part of power system control in the form of determination of required capacities. The market is not able to set them; they must be set by an expertise of available resources, whether they are natural, human or financial in relation to the needs of the society. The situation where the law and lower legal standards did not solve these links caused the useless investments and creation of capacities that either do not have enough primary energy sources or they are actually unnecessary. This violates the third principle of economy management.

What should be done in order to come up with a change which brings a real impact?

In the first place it is necessary to set a future position of a particular technology in the society. Our analysis of the financial crisis from 2008 lead to the conclusion that the financial crisis is only the top of the irreversible transformational process which is always related to the change of the value system. We identified two problems. The crisis known under the term of climate change connected the disability of ecosystems to assimilate the CO2 emissions and future crisis in supplying the energy market with fossil fuels approximately 15 years after the global transition by Hubbert peak. Security analysts found out that the crisis is not in the fact that there will be the lack of energy itself. Rather in the fact that if the technologies are not developed and implemented on the market that would ensure the renewable energy sources for common market prices quickly enough, there is a possibility, of the failure to supply the local market. This can cause chaos that will not be able to be controlled. Therefore the development of renewable energy sources represents the preventive safety precaution and determines strategic position of technologies of renewable energy sources in the society. The ideal solution is having the economy based on the renewable energy sources. However our everyday decisions are based on the compromise between what is realistically possible and what we consider as an ideal. We must accept the actual reality and design transformation processes that lead to reaching of a desired ideal state. If we do not do it and the realism prevails over the ideal, the society will start to stagnate. On the contrary, the thoughtless deflection to idealism causes a quick exhaustion of resources and the collapse of the solution. The deflection to the ideal and the subsequent collapse has already happened in the Czech Republic. The options of the Act 309/2009 in Slovakia are practically also exhausted. We have one of the highest distribution fees for the electricity within the EU states and we have high prices of energies in relation to the incomes of inhabitants. The result is that a significant proportion of the population is in real energy poverty which is one of the important agents that causes the inability of internal market recovery. Big investors like Slovalco or US Steel have also spoken up and they are searching for a solution that would not reduce their competitiveness on the market. The depreciation of the investment climate is finally mirrored in the unemployment growth. There is a need to have a different view of the problem.

Can the results of your research bring a really qualitatively different view of the problem?

The current wording of the Act provides various supports for various technologies. However, the consumers do not purchase the technologies or their proportions on the energy market but the energy itself no matter what technology was used. Energy represents the basic utility value. After exceeding the capacity of ecosystems of the Earth related to the ability to assimilate CO2 emissions, the ability to supply the market by the energy without the accompanying production of CO2 emissions became the second

utility value. It is the second utility value. So far, there is no other. Then the correct question is: How many additional costs must a company invest into the energy supply without producing 1 ton of CO2 emissions? A known Stern Review set the social value of CO2 emission to $85/t, that is about 65€/t to 70€/t according to the conversion rate. In other words, it is the amount of money that a company must invest in the damage recovery connected to the release of 1 ton of CO2 into the atmosphere. The logic of this solution is that it pays to use energy when the additional payment to the energy price on the market does not exceed this value. Otherwise it is more convenient to release the emissions into the atmosphere. It is no problem and possible to calculate the fees for individual technologies published by a regulator for 2011 and 2012 for a parameter determining the amount of costs paid by a consumer in order to avoid 1 ton of emissions getting into the atmosphere. We can see that a consumer paid additionally from 5€/t for the wind energy up to an astronomical 346€/t for the solar energy to generate one permit. Our calculation shows that a consumer paid in 2011 on average 93.84€/t in order to produce energy without 1 ton of CO2 emissions and 97.9€/t in 2012. An increase of more than 4% means a negatively stimulated market. Every negatively stimulated market signalizes the beginning of a crisis. But the costs higher than 50% than the ceiling of social costs related to damage recovery after the released emissions into the atmosphere tells us that the serious economic mistakes occured within the solution of the system of the market transformation. Recommended values of Stern Review set the range of 20 to 30 €/t, also indicated by the development of the emissions trade. In relation to this it is worth mentioning that on the basis of a government and parliament decision it is illogically a consumer and not a tax payer that has to put together nearly 100€ in order to generate one emission permit which will be sold by the state for 5€/t. In addition to violation of the above mentioned three decisive economic indicators there is also the fourth important indicator. It is a high rate of corruption that in this case exceeds all known economically quantifiable unit indicators and reaches up to 90% of the value. The principle of the rise of distribution fees together with the method of CO2 emissions disposal cause economic redistributions among the energy sources through energy markets. The proportion of the investors is harmed by the others, further impacted by a chosen form of regulation. This creates economic barriers and distorts the competition of the energy market. The result is clear - the restriction of the competition ensured the increase in costs and hence energy consumer prices.

Which findings from your researches are applicable in practice?

Even politicians found out that the actual crisis does not have the character of a cyclical crisis and we cannot treat it as a flu by lying in a bed and doing nothing. It is about the transformation in the horizon of 10 to 15 years providing effective measures are taken. In my opinion, we need the change of the value system and in the case of the energy market it has been shown that it is the social value of CO2 emissions that can play an important role within the transformation of the energy market. It fulfills all requirements in order to measure the transformational costs of energy sector precisely by this parameter, because not only we are able to measure them but we are also able to attribute them the values, thus the economic values, too. We can make a knowledge curve from the calculated unit costs based on the energy supply to the market, separately for each technology and based on the fact that within them we do not produce 1 ton of CO2 emissions. We can determine what technologies are already suitable for the market. It is possible to use the development trends of relative technologies to determine which of them have a down trend and roughly identify the period when it will be possible to implement them in an economically effective way on the market. However, technologies that showed the rise in costs should be analyzed in detail to identify the cause. An example is the biomass where the price of investments funds has doubled during the past 8 years. The price of the biomass has risen in a similar way. However, the inflation during this period reaches circa 25 %. It is a principle of obligatory redemption price and setting the amount of additional fee to the price. This created the negatively stimulated market in favor of an investor and at the expense of a consumer. The result of our calculation is that already in 2012 there were so many energy sources that market lacked approximately half a million tons of biomass. And others have been launched since then. The lack of biomass was partially compensated by burning the higher quality wood because the redemption price of electricity enabled it. However, the wood-working industry pointed out the fact that there is not enough wood on the market and it will lay people off. Here you can see immediately an impact on the employment. However, if we understand that natural gas represents a strategic commodity that will be on the market for 60

more years, a practical measure is the transition to the natural gas in the places where there is no biomass within 30km. The level of the redemption price set by a regulator enables to transport the biomass from the distance of 80 km. There is actually the transport from Hungary to Prešov. The customer pays for all of these unreasonable expenses. If that was not enough, the legislature used weighting factor and changed the physical parameter of CO2 emission factor for the biomass that is higher than for the black coal into almost an insignificant value.

What do you mean by the weighting factor?

Nearly in every system described by technical parameters for which it is necessary to elaborate economic model suitable for legislation and expressible within legally binding standards, some parameters must be transformed into an economic model through weighting factors to promote the socially desirable aims and to suppress unwanted ones in adopted laws. The already mentioned factor of CO2 emissions does not represent a direct physical parameter related to the energy at a consumer but represents the amount of CO2 emissions produced by a specific energy source burning a specific fuel and measured in a chimney. And yet the factor of emissions is linked to the energy consumed by a consumer, e.g. buildings. Then in the energy mix the average value of the factor of emissions stated is based on the proportion of energy produced per unit of time from individual energy sources. This is the calculated value of CO2 emissions used in energy certification of buildings that burdens the environment. After some time the public views them as technical parameters, even though they assume a more model character of weighting parameter. The determination of a near zero factor of emissions for the biomass means that such an energy source does not pay for released CO2 emissions in the atmosphere, even though we measure them or can even see them with our naked eye. The result is that with our naked eye it is possible to see a huge areas of naked forest land in High and Low Tatras, Slovak Paradise and Malá and Veľká Fatra. The small water cycle is interrupted by the excessive deforestation. The water cannot be held in leaves and pine needles, the flood risk is increased and there is less of underground water. The lack of water will influence drying of landscape and will cause the rise of food prices. Only because we burn the wood in order to produce the electricity that we actually do not need. That is why the political decisions of this type should be thought out, well tested and outreached studies should be elaborated before being transferred into legislative form.

One of the initiatives of the European Union is also the emphasis on the energy efficiency. It is represented by the buildings with near zero energy need. Isn´t it an utopia?

It is a really controversial term chosen in Brussels probably because of political marketing and many technically oriented experts have problems with it. This model is relatively highly abstract, but it is fully consistent. However, its understanding is easier if shown on a specific example. The principle of the idea is that local energy sources that are the part of the object which they supply the energy into are not included in the energy balance of a building consumption. If a building consumes the energy supplied from the distribution networks and vice versa, from the surplus of local renewable energy source back into the distribution network, it is possible to calculate the balance between the local energy source and the distribution network in the clearing interface point of building and distribution network. If the energy balance reaches zero in a clearing point, we can talk about a building with zero balance of energies with the distribution network. A system interface of a building and distribution networks then have minimally three levels of balance, namely the balance of individual energy carriers, the balance of primary energy sources and the balance of CO2 emissions. Professor Milan Bielek introduced the concept of a building with zero energy balance for such a type of building that is closer to technical expression and reality as the concept that is linguistically managed within the possibilities of Slovak language but controversial, too. Many operators of centralised heat supply companies got scared of this issue, as they were afraid of losing their jobs.

And are they? Is it not about the closure of centralised heat supply companies?

I think it is quite the opposite. On the one side the consumption of heat really goes down because of the energy efficiency. For example, we have saved 73% of heat consumption in our building by the implementation of progressive measures since 1996. However, the heat balance had to be constantly supplied from a local renewable source. We expanded the range of provided services by modern technologies for cooling and therefore we increased the energy supply by one third using the same local energy source. However, we saved up to 87% of primary energy sources and 96% of CO2 emission in comparison with 1996. The heating and the cooling in the office building of the

area of 4,300 m2 is ensured exclusively by renewable energy sources. In our case it is the energy water source where the processes of natural ecosystems provide necessary energy output for our economic activity in real time of our economic process of heating or cooling without the necessity to invest in a human effort. This is a difference in comparison to biomass or bio-gas. That is the reason why the operational costs reduce significantly after paying these investments creating an above standard economic added value. This situation cannot be expected within forced energy sources like biomass, biogas or landfill gas. The trends in technologies of solar energy show the fact that in the year 2018 to 2020 we can expect the technological progress which provides realistic return on investments and moreover with the panels efficiency two times higher than at present. The area of roofs on buildings is small and it gains the value with the possibility of installation of solar power stations. The area enables us to install a solar power station with the annual production of 200 MWh of electricity by 2020. It enables not only to cover the need of a building but also to supply the distribution heating network with 350 MWh energy per year. The building becomes a clean energy supplier within the energy balance. In this situation it is necessary for heating companies to understand that it is in their interest to change a business model and start to build local energy sources and connect them into their systems. Through 309/2009 legislation they got high funding for the prices of electricity and while their money cumulated, they have them ready for investments. However, the transformation of centralised heat supply companies is economically and technically demanding and it is necessary to distribute it within 15 to 20 years. Regulating function of a contradiction compels us to appreciate even the reverse of the original ideal of centralised heat supply system. Everything what a man created is relative and lies in the internal antimony. It is not about the closure of centralised supply systems but about their transformation whilst preserving current values and the recognition of the contradiction in the form of the number of dispersed energy sources localized directly in the place of consumption.

What is necessary for the transformation of centralised heat supply systems?

First of all, it should be realised that the buildings represent a consumer for energy sector. The aim is to minimize proportion of the energy consumption of buildings from actual 40% to significantly lower proportion within the total energy consumption of society. For new buildings it means that an investor can build only such a big building that can be supplied by the energy from the local energy sources. The relation in which a human makes a decision and nature supplies the energy, changes into the relation where the nature restricts the possibilities of a human. This is a practical example of a value system change. Moreover, it is pleasing to know that the research sets up to 18 parameters in architecture and building construction. If they are optimized by a designer according to the principles of sustainable architecture, he reduces the energy consumption necessary for the operation of building by half in comparison to the situation without optimization. This twice the size within the same performance of energy sources. These are the possibilities of a new building. We realized the transformation of a building constructed in 1980 during the full operating mode. We did it without any subsidy, even though we have been doing the applied research. Practical experience enables us to assess what technologies and their combinations are really suitable for a specific building. The solution is given by the building itself, its construction and architecture and energy output of local renewable sources. They are the technical solutions. As I have already shown, the buildings become real energy suppliers of the distribution networks. Our analysis has shown that the solution must also include the transformation of the energy market based on the competitive principle for the organization of the market with cooperative-competitive principle. The transformation costs can be measured by CO2 emissions and we can allocate them the motivation role in the form of green bonus and create the economic resources for the transformation of market by the method of excise tax on energy from the fossil fuels. The level of social value of emissions is determined by the possibilities and needs of economics and functions in a selective way choosing the cheapest technologies. At the same time the profit potential causes the pressure on the costs and the prices. Energy sources in the proposed solution cooperate at preservation of distribution energy networks and compete within the energy supplies to the customer. Thus a customer gets socially reasonable price created by the market and regulated by the volume and price of CO2 emissions. Those who want to stay in the market, must be active and innovate, reduce the costs and expand the services. This is the meaning of the whole transformation.

The crisis has been recurring continuously, but changes its form. Once it is the crisis of

mortgages, then the crisis on the financial markets followed by the crisis of the public sector. Will we find a way out?

I have already stated that together with the cyclical crisis there is also an irreversible transformation process connected to the change of value system. The society has got two possibilities exactly as the yachtsman when the wind turns in the opposite direction. Either he will fight against the wind or he will turn the sail so that the opposing wind will get him to the destination point. He will wisely use the natural powers or he will stubbornly fight a losing battle. Financial markets are the image of the economy that can be temporarily deformed. The solution is not the economy of the deformed picture but creation of a massive base of new technologies of renewable energy sources, nano technologies and biotechnologies. Similar to previous big economic cycles known by scientific literature under the concept of Kondratieff Waves, it will be these eco technologies which will influence in a forming way a man and society and ensure the above standard formation of economic added value. The period of interface of two cycles is the period of a crisis, but at the same time it brings many stimuli and original solutions. It is a time designated for the formation of new value systems. To the contrary to Kondriatieff who understood the social movement only in technologies, the modern researches in many disciplines clearly show that it is necessary to move to a higher organization of cooperative-competitive market that will enable better and more effective allocation of resources and expand the range of services. The same way as the customers in the information technologies and other services are drawn into processes that wipe out the differences between the provider of services and their consumer, it also happens in the energy market. The buildings which are now a passive energy consumer become active energy market participants and wipe out the difference between a provider of energy and a consumer. Only a close cooperation between them helps to increase the energy effectiveness and thus the energy safety and to create the conditions in energy market for the future development of the society. To this end the whole number of laws must be changed and set the stable investment environment for relatively long-term transformation of the energy market and of buildings as energy consumers. It is the task for 10 to 15 years, but exactly like in the case of information technologies it will lead to important social effect and they will form the society for a long period in line with a new values system. Such transformation of the energy market and buildings creates a huge number of job opportunities and preconditions for future growth of the standard of living measured not only by GDP growth but also by the quality of life. Because the economic added value can be achieved also by the reduction of the energy consumption and natural resources whilst at the same time increasing the quality of internal condition of buildings. This is precisely what helps to correctly select technologies and implement them in the right time. In the following ten years it is possible to expect the explosion of technologies designated for the electricity supply from the Sun and technologies enabling the storage of electricity. All that at the prices with return on investment. The dynamics of the entries of new technologies will verify mainly the quality of the system analysis and the decisions and determine how cost-effective they are within the long-term investment cycle of the energy sector. Here is hidden a substantial portion of society's prosperity in the future. The Act 309/2009 violated all three basic national economic principles of economic governance, which, topped up by the corruption have a devastating effect on the development of society. The withdrawal of circa 400 million € per year from the consumers can cause not only the decrease of the placement of this money on the internal market but it has a psychological effect that due to the concern about future growth of energy prices a citizen will rather save the money that spend it on the consumer market. This is visible in the growth in the savings in banks and the decrease of the consumer market. What is needed is increase in National economic turnover and a fundamental change. Just what the Minister of Economy, Tomáš Malatinský said in the National Council.

3. TRANSFORMATION OF THE OFFICE BUILDING INTO A SUSTAINABLE NET ZERO ENERGY BUILDING

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3.1. INTRODUCTION TO ENERGY TRANSFORMATION OF BUILDINGS

The basic aim of the transformation of buildings is the preservation or increase of their economic values while retaining the harmonisation of the aims of energy effectiveness and ecological criteria. It is only possible to do within the harmonisation of the parameters of economic models expressed within the legislation based on society targets. The analysis of the Shiller´s Index Development of Real Estates Prices since 1890 - picture No 1 - confirms that from the economic point of view buildings fulfil the function of the preservation of the value in time. The average growth of the inflation adjusted values represents 2‰ per year. Buildings represent an important wealth of the society and up to a certain level they also stabilize a part of the economy within the national economy.

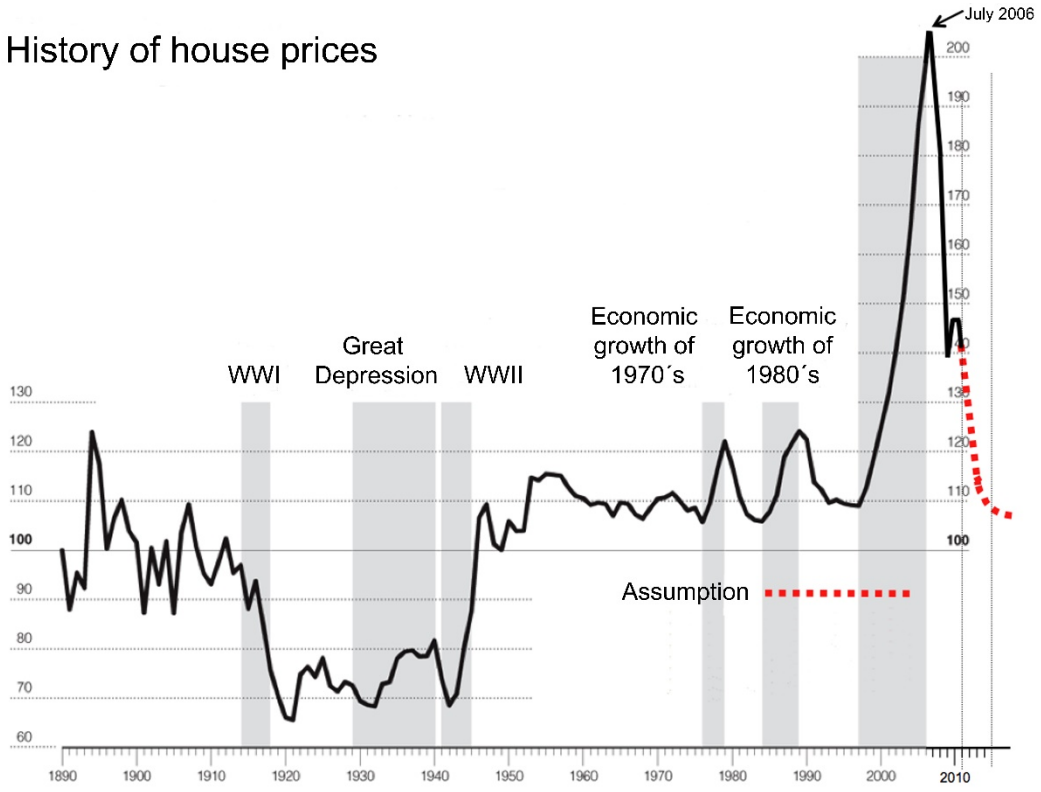


Figure 1. Shiller´s Index Development of Real Estates Prices in the USA. (Shiller, R.J., 2011) [1]

The period related to the WWI and WWII and Great Depression between the wars from 1910 to 1940 in combination with the progress in technological development of the houses construction moved the real prices of real estates on average by 30% lower than the original value in 1890. On the contrary, the prices doubled only in the years from 2001 to 2006 and then rapidly went down along with the price development corresponding to a typical course of social polarization model, i.e. the market characterized as the market with the presence of asymmetry in the flow of information between a consumer and an investor with an artificial stimulation of the market favouring investors while creating a moral hazard for a consumer. An expected return of real estates into the prices on the level of 110 points sometimes around 2015 means that the real estates increased the value by 10% in 125 years. It says that real estates generally maintain the values in time. The real estates have the nature of long-term investments for 100 and more years. The reconstruction and also the improvement of the equipment quality is necessary during their lifetime, whether they are the issues related to the aesthetics, expanding the functionality, quality of internal climate or safety and energy efficiency. The only way how to achieve the preservation of the building value within a long time is

the compliance with the criteria of reconstruction that does not cause the building value loss as a result of physical or moral depreciation. Once the prices of buildings rise on the balanced market, i.e. the demand goes up; the market sensitively reacts and immediately saturates the increased demand by a new offer and copes with the imbalance in the horizon of several years.
Nowadays there are following basic economic incentives leading to the restoration
of buildings and their transformation to the target state of buildings with Net zero energy needs:

- *Climate changes and related occurrence of heat waves causing a significant increase of the risk of human organism collapsing because of the heat with a possible fatal effect. The solution is represented by the improvement of the quality of internal environment through the function of cooling during the summer period while respecting the human physiology.*
- *Permanently increased price of fossil fuels with the acceleration of the growth rate of the price from 2015 as an impact of expected switch of the oil market to a decreasing trajectory of market supply with the rate of decline from 2 to 4% per year combined with the possibility of charging for the CO_2 emissions.*
- *The increase of a building profit if the local energy sources supply the market with more energy than they consume within the building.*

The reduction of energy consumption needed for a building service represents one of economic sources that cover the investments. The second one is the preservation of a building occupancy because reduced operational costs enable the effective price competition within the expanded range of services. They are additional profits, e.g. the impact of expanded range of services of cooling together with increased quality of internal climate that provide the second part of economic sources that enable to solve long-term financing of investments.
The gradual realisation of the transformation of office building is made so that it first meets the criteria of an energy-efficient building, then the criteria of a green building and an intended target is represented by the achievement of the state with zero energy balance in the clearing point with distribution networks or the achievement of such a balance that ensures the use of technical potential of local renewable energy sources and places the energy surplus against the building consumption in the distribution networks. It is a long-term project realized during 20 years. The time distribution of the investments into technologies with a precise timing regarding the market conditions is enabling to realize the investments from the internal sources of a building itself during full business operation. If the financing from external credit sources is used, these investments are again paid from the internal sources of building. This principle forces to search the solution that enables the implementation of the investments in full operation of the building. No grants or external financial sources were used for the realisation of the building transformation that would not be the subject to repayment from internal profits of the building. The technologies used harmonize the economic possibilities of the building and ecological requirements and show that to be economic does not exclude being ecological, too. The main incentives for the transformation of a building include:

1. *the reduction of operational costs of buildings by the means of energy efficiency*
2. *the reduction of the CO_2 emission production related to the energy supply consumed in a building and thus the reduction of future costs connected to the fees for CO_2 emissions released into the atmosphere reflected in the energy prices*
3. *pro-active strategy of the elimination of increased risk related to the price rise of energy from the fossil fuels as a result of their increased consumption and an expected decrease of market supply by transition through the Hubbert break*
4. *the increase of the range of the provided cooling services and therefore providing required temperature of internal climate with the positive impact on the productivity of worker´s performance*
5. *the change of the way of the energy transport especially from the conventional method to predominantly radiant system - the solution provides a higher quality of internal climate more*

suitable for the human physiology with a result of the reduction of the illness, headaches, allergies, etc.

It is necessary to evaluate the following facts within the determination of the project of a building transformation:

1. *Building - its architecture, construction and the mode of operation*
2. *The state of the technologies on the market that enable to solve the energy efficiency of a building individually for separate energy carriers, heat, cold and electricity, eventually their combination in the synergistic effect of their technical and economical parameters*
3. *Available local renewable energy sources, their quality and quantity, i.e. the ability to provide the required energy output in real time of economic process for a corresponding energy carrier*
4. *Technical and economic state of the technologies of a corresponding energy carrier enabling the conversion of the energy from the local renewable energy sources for a required economic process in a building*

The measurements in the laboratories and corresponding energy models only rarely describes the reality in the building accurately. It is the result of the fact that buildings are characterized by huge amount of mass and by a complex system of variable parameters connected to a specific building. Without the correction of the models on the basis of measured parameters, the literature points to the fact that the models elaborated on the basis of laboratory measurements often reach the accuracy of only about 50%. The method of real operation of a building also represents a significant impact on the parameters. The behaviour of an operator and users is individual and can influence made in the form of parameters into models and therefore significantly influence the values of calculated parameters. A qualitatively different problem is that while the technology is used for the first time in pilot project, it is possible to gradually eliminate the identified problems from implemented solution only by detailed measuring and analysis of gained data. Two or three-year verification in practical operation represents the standard time for the achievement of necessary knowledge and their projection into project documentation. *Therefore the measurements on site in real operation of a building play an important role for the future projecting as a tool for achieving a corresponding know-how.* The costs of pilot project related to the verification of the procedures and their subsequent correction are normally released into the costs within the projection of future solutions in the form of intangible assets.

3.2. PRINCIPLES FOR THE SELECTION OF TECHNOLOGIES AND DETERMINATION OF TIME OF THEIR IMPLEMENTATION INTO OPERATION - KNOWLEDGE CURVE

Buildings represent a significant long-term value within the national economy where apart from their mission in the form of service they also fulfil the tasks in the world of finance - they protect the investments against inflation. Their 40% share of the energy consumption creates the possibility to increase the economic value of a building by correctly performed transformation into a building with almost zero energy needs. New construction technologies of envelope structures of the buildings enable to provide better energy efficiency of building service by the means of technological innovation. The eco-technologies and mainly the renewable energy sources that provide required energy output via natural process of ecosystem in real time of human economic activity are able to transform the consumption of heat, cold and electricity from fossil energy sources and create the economic added value of a significant importance after repayment of the investments. Their application also reduces the CO_2 emission production related to the energy supply of buildings and

also increases the range of provided services and the quality of internal climate. Through the assessment of building characteristics, its construction, architecture and operational characteristics in relation to available renewable local energy sources it determines the possibilities that the nature provides by its ecosystems in a given location for human economic activity in the form of building service. What is also important to fulfil is the achievement of investment return of realized technologies. There are two economic sources for the investment return: energy saving and expanded range of services.

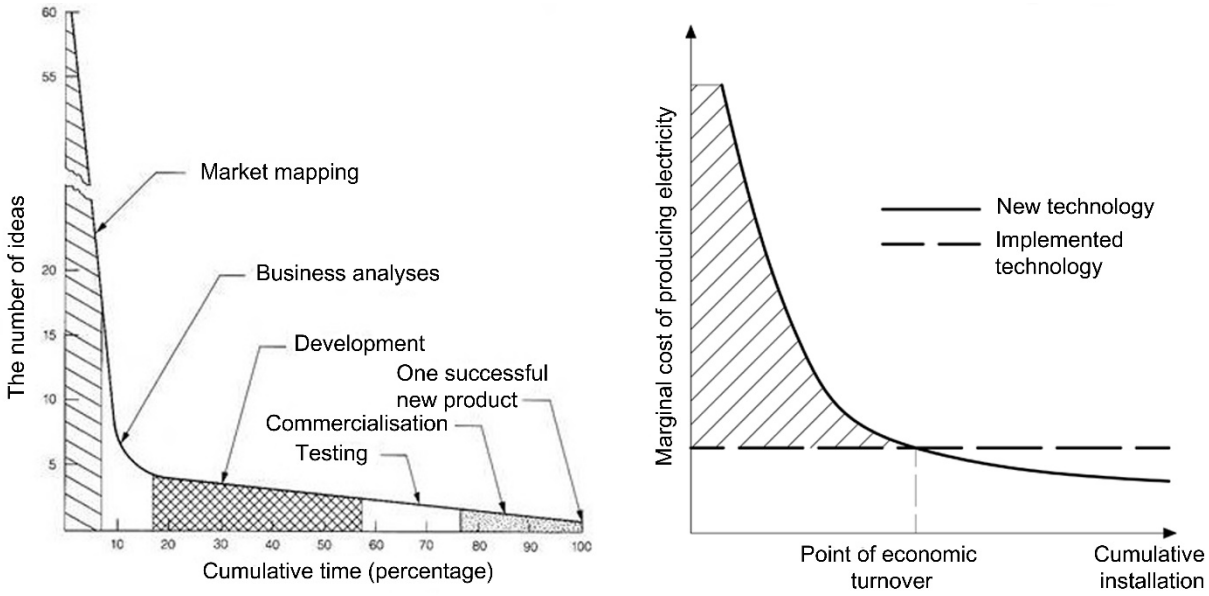


Figure 2. Qualitative and quantitative knowledge curve (Pierce, J.A., Robinson, R.B. 1988) [6]

The analysis of long-term, above average successful companies have shown that *one of the important keys to success is the use of high technologies proven by the market.* While in 1970´s in average 60 different basic concepts were needed until one of them was applied in the market in the form of a product, nowadays we already need on average 300. Thus the probability of the success within the research of basic technologies went down 5 times. Transformation of the building needs to select technologies which are suitable for applied research and development. It is necessary to study whether a selected technology is on the market long enough, what the number of innovations is that it went through and especially what its future is. It is necessary to answer the question whether the actual development of corresponding technology ensures the investment return in relation to the price of money during the investment period. If not now, whether the trends in technological innovation and within the application of economy of size of studied technology will lead to the achievement of the economic breakeven point and therefore to the investment return. It is necessary to determine how many technological cycles and within what volume of production the corresponding technology complies with the criteria of the investment return within standard market conditions. A very important criterion seems to be the criterion of achieved synergy effect within used technologies. This should enhance provided functionality and services and improve technical and economic parameters. The analyses of technological possibilities by the means of knowledge curves have to be executed on two levels:

1. *A qualitative level - we determine the exact stage in the life cycle of a corresponding technology and what is the probability in order to achieve economy breakeven point, i.e. the investment return. Each phase of a life cycle is related to a certain risk that gradually goes down along with the transition from the phase of market analysis through the phase of business models and research and development up to the phase of testing and commercialization. A curve for qualitative analysis is depicted in figure No 2.*

2. A quantitative level - this analysis has its meaning for the technologies that reached its technological qualitative aim. Other improvement of economic parameters is gained only by increasing volume of production and competition on the market. The analysis should determine when the expected future moral obsolescence of a specific technology will occur.

The knowledge curve for the density of elements on the integrated circuits from 1965, known as Moore´s knowledge curve, has been showing its informative value practically up to the present days and showed the veracity and reliability of the principles of the construction of such predictions for various technologies. Actually it is necessary to evaluate both approaches to knowledge curve simultaneously and determine the qualitative criterion together with the economic criterion that determine the required technical level of parameters and also a suitable time for the implementation in the corresponding application. In the knowledge curve depicted in Figure 2. it is expressed by achieving the economic breakeven point when a new technology gains the investment return toward the actual technologies. If we talk about the transformation of already constructed building, the considerations should include also the issue of a physical recovery and the issue of a planned obsolescence of used technologies. An ideal solution is represented by the selection of such technologies, the application of which improves the technical parameters, improves the quality of internal environment and increases the share of renewable energy sources up to the state of zero balance with energy networks. A future solution of the energy market enables the energy output of local renewable sources to supply the energy not only for a building but to place the energy surplus above the state of zero balance into the distribution energy networks. The original assumption that the transformation of energy networks on the grid marked as "smart grid" provides a significant saving on the side of a consumer is not being fulfilled. It is expected that the investments in the technical equipment of distribution network within the savings of 1 to 2% will not be interesting for a consumer. In order to achieve return on investment it is necessary to find a solution which will allow local renewable energy sources supply energy distribution networks with surplus energy not needed for direct consumption on site within the corresponding building. This will enhance the use of technical potential of local renewably energy sources and therefore improves its economic parameters. The technology of heat pumps is assessed according to the seasonal performance factor SPF that determines the ratio between the supplied energy and the consumed energy for the power of devices of energy source. The state of zero energy balance in the clearing point between the building and distribution networks plays a similar role. Here a balance between the energies locally supplied by energy sources of building and distribution networks is studied.

3.3. THE DESCRIPTION OF A COMMON OFFICE BUIILING APPLIED TO A MODEL OF ITS ENERGY TRANSFORMATION

3.3.1. THE DESCRIPTION OF A COMMON OFFICE BUILDING

FUNCTIONAL AND OPERATIONAL SOLUTION OF A BUILDING

A building has got a character of a non-residential building designed for administration and management, for banks and post-offices. The building has a concrete frame construction which allows to structurally adjust the interior according to the required needs. It has got 6 above ground floors and one underground floor. The built up area of the land is 629m^2. There is a second part integrated to the building an extension on the built up area of 311m^2 with three above ground floors and integrated corridors. Regarding the used construction the space of the second and third floor

has the extensions with the area of 326 m^2. The building includes also a protected yard covering the area of circa 750m^2 used for parking and garages.
The office building is operated as business centre for financial and bank services, insurance services and advisory services of financial market, IT services, leasing services as well as the services of a legal nature, whether they are law firms, notary, bailiff, etc. as well as the operation of the management and the administration of standard business companies. The building infrastructure is adjusted to the requirements of a specific tenant with the security solution up to a bank category.

Figure 3. and 4. Photos of the office building in 3 Murgašova Street, Košice. The first depicts situation before and the second one after the renovation of the façade.

The building is systemically designed so that on each individual floors there are entire premises created and they are divided from a corridor by a separate entrance with own sanitary facilities. The standard office spaces are available with the area of 20 or 40m² within separate wings. However, the frame construction enables to handle the space according to individual requirements, which is used for example within organisation of bank spaces. Also the rooms like kitchen and specialised rooms are built according to the customers´ requirements. The object has been built in the centre of Košice in 1980. It has been extended in the year 1985. The provided services ensure 24-hour reception service together with supplying all media and services linked to the operation. Maintenance and investment activity are gradually realized in the building.

TECHNICAL AND CONSTRUCTION DESIGN OF A BUILDING AND ITS ENVELOPE STRUCTURES

The construction design of the building with 7 floors (6 above ground and 1 underground floor) is subordinated to the purpose and possibilities of construction materials used at any given period. The purpose of building use defined the object as a triple tract with the offices along façades and a corridor in the middle wing along the length of the object. A framed structure building consists of prefabricated reinforced skeleton with beams in the transverse direction in combination with brickwork forming a vertical wall construction. Double wing windows of standard dimensions are used. Original wooden windows were replaced by the plastic ones with insulating double glazing. Interior walls are made of brick. Ceiling structures are made of panels that are longitudinally perforated. Stairs are prefabricated and made of reinforced concrete. Roof construction is a single casing horizontal with asphalt - bitumen roofing.

The extension of the object was realized later. It has three above ground and one underground floor and uses longitudinal and transverse reinforced concrete modular panels. Ceiling structures are also panel prefabricated. The ceiling above the highest floor also forms roof. It is made of steel truss girders with large span. Thermal-technical characteristics of the construction comply with the standardized requirements for a given period. Nowadays, the object is thermally insulated by the standard system based on polystyrene insulation.

AESTHETIC-ARCHITECTURAL SOLUTION OF A BUILDING

The building was architecturally designed in the period at the turn of 1970´s and 80´s. The aesthetic-architectural concept was subordinated to functionalism with the proposed use as the office building. Simple lines formed by a simple cuboid oriented longitudinally in the direction North-South ensure suitable orientation towards solar radiation, but also minimize the impact of dominant North-South winds. The building fits into the concept of surrounding housing development by its size and shape.

In the original version the external walls were faced by ceramic glazed panels which formed a base layer with high resistance to outdoor weather conditions. The external heat insulation covered the facing with further surface treatment using the plaster of pale blue-grey colour. The building has a positive form factor (the ratio of the area of heat-exchange package of the building to the converted building capacity) that positively influences the thermal loss of the object.

3.3.2. A CHANGE OF ENERGY CHARACTER OF A BUILDING

BUiLDING AS AN ENERGY CONSUMER AND SPACE FOR CONVERSION OF PRIMARY ENERGY IN SITU

The standard building and its operation is based on the fact that the distribution energy networks are connected to the building. It used them to supply the energy, whether it is heat, cold or electricity. Generally the building acts as the energy consumer. However, the local renewable energy sources can exist in situ within the boundary of the plot or within the area of the building. The form of energy supplied by the nature must by suitable for the available technologies enabling its conversion into the form suitable for human economic activity. They are for example the hydrothermal energy sources, geothermal energy sources or solar energy. The technologies designated for the conversion of local renewable energy sources can be stored in a building or on the building roof or its cover as well as on the surrounding lands. Therefore there exists a system boundary of the building that contains a physical part and a logical part. The physical part of the system boundary includes, apart from the building itself, also the plot under the building and the lands adjacent to the building if they are used for the purposes of the local renewable energy source. The logical part of the system boundary consists of clearing interface of various technical, ecological and economic parameters.
The strategy of the building transformation into a building with zero energy balance with distribution energy networks is based on the fact that in the place of the location bounded by the physical interface of a building there are local renewable energy sources whose energy output enables to cover the operational costs of the building within the use of corresponding technologies in real time in zero balance in the clearing point with connected distribution energy networks or supply the distribution networks with the energy surplus above the zero balance state in the clearing point. The time period must also be defined. Thus it is determined that natural ecosystems provide a required energy output of local energy sources and thus they create the conditions for gradual transformation of a building via the energy-efficient building into a building complying with the criteria of green

building up to the targeted state of a building with zero energy balance with distribution networks. The principal advantage of the solution when the energy sources are localized within the system boundaries of the building is that there are no distribution energy losses in the distribution networks. Depending on the type of energy carrier, the distribution energy losses form 15% to 30% of energy losses depending on the distance of the energy source from the building and the way of solving the distribution system. When the excessive technical potential of local renewable energy source is used, the energy above the consumption of the building supplies the closest buildings; it means that the energy losses are minimal.

ENERGY FROM DISTRIBUTION NETWORK AND ENERGY CONVERTED FROM PRIMARY RENEWABLE IN SITU ENERGY

The buildings labelled as buildings with nearly zero energy make sense only when the buildings supplied by local renewable energy sources are situated within the system boundary of the building. The condition is that the energy balance in the clearing point with distribution energy networks reaches zero during specified time, normally one year. The initial state presents the building as an exclusive energy consumer. In the particular case being described, the energy consumption of the building in the reference period of 1996 represented 840,000 MWh a year. The electricity consumption used for the building operation is 60 MWh a year that represents only 7.5%. There were many different technologies available on the market for solving the heat energy efficiency in the period 1996-2005. Therefore they were the economic incentives that determined the improvement of the parameters of energy efficiency of buildings within the heat consumption. The solution of the cooling and electricity was represented by the subsequent and partially parallel steps within the building transformation.

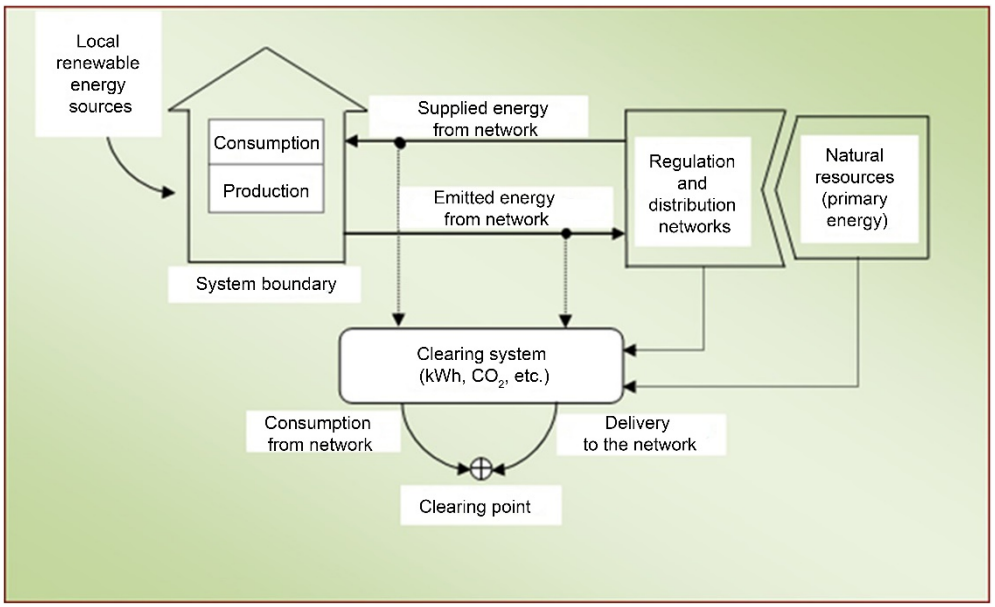


Figure 5. Simple clearing system of building with distribution energy networks

The ideal state of realisation of a building with nearly zero energy needs is represented by the achievement of the state of zero balance at any moment. Then it is possible to define such building as building in the condition of an island operation. This is normally a very costly and therefore seldom situation. The remaining states of net zero energy balances in the clearing point with the distribution energy systems include the unit of time that is usually a year or a month. We expect that next

technological progress will provide the technologies that would help to fully supply the buildings by the renewable energy without the necessity of connection to distribution networks within the standard economic conditions of the market and the buildings will be in an island operation mode. Buildings will be gradually equipped by the technologies providing the energy conversion during individual stages of the transformation. The energy is supplied by local energy sources connected through interfaces into distribution energy networks. In case of buildings with zero energy needs it is necessary to set the weighting parameters in a very precise way. These parameters change the physical parameters that provide the creation of economic models suitable for legislative process and therefore the social preferences, too. A consistent model of buildings with nearly zero energy needs makes technical sense when talking of the buildings with zero energy balance with distribution networks that we named by the expression of Net Zero Energy Building (hereinafter Net ZEB) and a building in an island operation which is called Zero Energy Building (hereinafter ZEB) (Sartori, I., et. all 2012) [7].

MODELS OF BALANCING BETWEEN ENERGY CONVERTED IN BUILDING AND ENERGY FROM DISTRIBUTION NETWORKS

All clearing models in the clearing point at the system boundary between of a building and the distribution networks for the zero balance satisfy the relation:

NetZEB balance = | weighted supply| - | weighted consumption| (1)

The use of absolute values avoids the exchange when deciding whether the supply by local energy sources or the energy consumption supplied by distribution energy networks is considered with a positive or negative value. In some cases, economic models do not provide the chance to express physical parameters in a direct way during balancing. Similarly, there are the cases when it is socially desirable to form the preferences for chosen energy sources. In both cases, the physical, eventually technical parameters are transformed through weighting parameters into weighting parameters that modify the values of physical parameters or have so called a coordinating function. We can use the calculation as an example of such a coordinating procedure

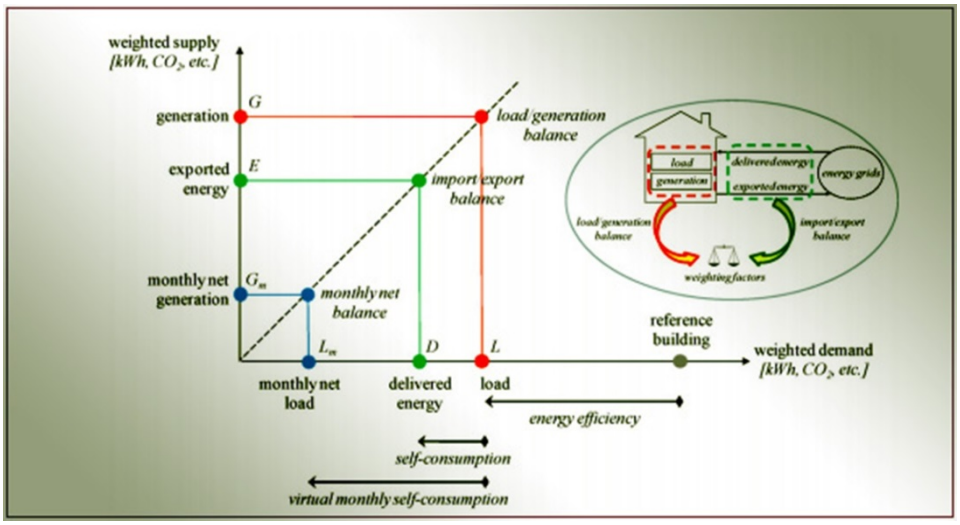


Figure 6. Graphical representations of three types of balance: import/export balance between weighted exported and delivered energy, load/generation balance between weighted generation and load, and monthly net balance between weighted monthly net values of generation and load.

The example of such weighting procedure could be seen on definition of K factor representing carbon emissions in economy models. The K factor is set for any particular energy

source. The electricity supplied through the distribution networks is characterised by the K factor. K factor of the supplied electricity is calculated as weighted number of K factors related to different energy sources and the related volume of released CO_2 emissions. For example, value of set K factor of CO_2 emissions for the biomass equal 0,020 kg/ kWh is in conflict with the measurable technical parameter. This is simply political decision. Therefore the expression of the equation (1) by the means of weighting parameters represents a general relation that can be used for all clearing models. A basic approach for the clearance of exported (supplied) and imported (consumed) energy represents clearance on the annual basis for every energy carrier separately. Clearance can be done on the basis of energy units.

There is a qualitative difference among energy carriers in the form of electricity, heat and cold. It is manifested not only by technical parameters. There is also a difference in economic costs connected with investment for the particular energy conversion. *Therefore it is suitable to solve export/import balance separately on the base of individual energy forms as a higher level of energy clearance or its generalisation as the balance of the related primary energy sources.* The primary energies from the local energy source consumed in the building do not enter the balance in the clearing system of primary energies. Only the primary energy sources which cross the system boundary of the building enter the balance. They are exported (supplied) into the distribution network. Primary energy sources necessary for providing the energy delivered from distribution networks to the building form the other part of the calculation.

Apart from the energies we can do the clearing with the second utility value, too. It is the CO_2 emission production. The clearing mechanism should be used for this parameter on annual basis. This parameter characterizes the ecological quality of solution. Social cost of carbon emission is important parameter which has a great importance for new economic models suitable for transformation of an energy market using renewable energies.

If the dynamics of the energy exchange between local renewable energy source and distribution network is high, for example if local energy source is solar photovoltaic power plant located on the roof, the building appears to be the standard energy source with variable and to some extend also as unpredictable energy output. The character of the building as an energy consumer changes into the character typical for energy power sources and it is necessary to watch also the provided output or energy burden within total energy. Because of this reason, it is necessary to extend the basic definition by a solution that includes the balance of energy output whether it is on the hourly basis, monthly basis or annual settlement. The examples of three clearing systems are in the figure 6.

Annual energy clearing represents the static approach to the issue and describes the building more-less as per its original mission. If we focus on the dynamic parameters, then we assess the energy burden that a building puts on the distribution networks and on the other side the supplied energy output that the building provides into distribution networks. Within this approach we assess the building as the energy source with all its characteristics. Local energy sources of renewable type in the position of buildings are represented by energy sources with low energy output compared to the typical power stations. If their number is small they do not represent any problem from the point of view of the system regulation. Their gradual numerous and subsequently performance expansion in distribution networks will cause the problem with regulation, because the immediate output of renewable energy sources supplied to the distribution network can far exceed the need and vice versa. A consequence is the problem related to the energy storage. It will require the complex solution of the regulation and ensuring that the supplies from local renewable energy sources are realized in accordance to the fulfilment of other quality indicators, too, whether directly or by the means of clearance by way of trade. Also because of this reason, we approach the issue of clearance similar to a typical energy sources connected to the distribution energy network on the basis of the energy tariffs whether those that are set by the market or feed in - tariffs set by a regulator, where the energy price represents the society's value of balance in a more complex way.

"Smart grid" is a concept for distribution networks that will be able to perform the measuring and power regulation of a large amount of small energy sources distributed around the distribution

network providing the output that is regulated in relation to the requirements on the side of the consumption with the option of optimisation of the time of energy consumption via the active management of energy consumption in coordination with a consumer. A part of the solution is economic incentives for a consumer from the point of view of time optimisation in relation to the supplied output. The original idea of the significant savings of the energy consumption on the side of a consumer by the means of optimisation of power burden of appliances to the time of lower burden of the energy network is nowadays on the base of real experiments modified so that by a better organisation of appliances burden we can gain the savings of 1.5% on the side of a consumer. It is a small saving in comparison to the solutions and contributions of local renewable energy sources. For comparison, in case of the heat by the exchange of energy source by local renewable energy source we can gain the economic operational savings of up to 50%. The achievement of the quality of distribution network „smart grid" is a necessary condition, if the distribution network should be rebuilt in order to provide continuous energy supply on the market through the system of large amount of small local energy sources. It represents technical and economic assumption for the effective regulation and clearance of large amount of energy sources with small energy output.

Economic criteria determine if it is appropriate to provide the reduction of energy consumption by the means of the measures by the application of the technologies ensuring the energy efficiency expressed by the energy consumption for a unit area per year while maintaining or increasing the quality of internal environment. It is necessary to study the economic parameters such as an economic breakeven point and the investment return related to the realisation of a specific technology. After exhaustion of the option of energy efficiency in terms of economic criteria, it is rational to adopt the change of energy source of a relevant energy carrier. It is done in order to ensure, that the investments into technologies designated for the conversion of the energies from local renewable sources are technically and economically optimal in relation to the need.

We can gain net zero balance between the building and distribution network by supplying enough energy from the local renewable energy source into distribution energy network. If we set too strict criteria in the form of physical parameters on the energy efficiency of a building, it can provoke increased investment costs into technologies of envelope structures that will not reach the economic breakeven point and will be investment-inefficient. On the contrary, the investment and operational costs of the construction of local renewable energy source can have such technical parameters that even a higher level of the energy supply to the distribution network with the aim of gaining the state of zero balance will be economically justified. Technical and economic conditions for a specific building and a specific local renewable energy source are specific in a relevant location. We can gain a suitable technical solution with return on investment by their proper combination. The important parameter is also time of implementation related to the level of development of the relevant technology. To determine the sharp limit on the energy consumption per square meter per year as universal measure could create a problem for such parameter as is return on investment. It is necessary to balance and harmonise technologies solving energy efficiency and technologies which convert renewable energy supplied by the nature into form suitable for the use in real time of human economic processes. Moreover it is necessary to consider the type of the building and their design and architecture as well as their purpose and mode of operation. It is more practical to set the interval in the form of the energy consumption per unit of area per year that enables the investor to select the optimal mix of technologies providing the energy efficiency and the technologies related to the conversion of a relative local renewable energy source into the required energy carrier while meeting the criterion of investment return. It is the economic motivation for the owner of local energy source to supply the distribution energy network by the maximum available renewable energy and thus maximize his economic efficiency and maximise return on investment. But the access to the energy market should not be at any conditions favouring the renewables as we see it in many cases now. It is necessary to ensure the non-discriminative approach in the legislation of all type of energy sources (fossil and renewable) into the distribution network. This is the basic condition which will create conditions in order to achieve minimum costs and therefore the prices,

too. In this way it is possible to convert administrative approach of the management of the buildings transformation into the system driven by the market economic motivation. Green credit vouchers serve as economy stimulus and excise tax as economy repression instrument. Social cost of carbon emissions in form of green credits and excise tax could be effectively used to measure the transformation cost without any dramatic burden imposed on any economic sector.

STAGES FOR MODEL OF ENERGY TRANSFORMATION OF BUILDING

The focused solution of the transformation of a building into a building with net zero energy balance is divided into 4 basic stages that are appropriately designed within content for each energy carrier independently. The individual stages include:

1st stage - includes the solution of energy efficiency of building
2nd stage - includes the transformation of district fossil energy heat source into water – water heat pump hydrothermal energy renewable source
3rd stage - includes the change of the quality of internal environment and expanding of the range of provided services by the supply of cooling from the same source of renewable energy
4th stage - includes the energy supply from the local hydrothermal energy source into the heat distribution network with the aim of achievement of the net zero energy balance. The local source of solar photovoltaic energy power source is planned during this period. This last investment will create a situation in which building will deliver more energy to distribution networks as consumed, estimated to 350 MWh per year.

The development of available technologies verified by the market is different for the heating, cooling and electricity. The correct timing of their continual implementation enables to minimize the costs and provides the adequate investment return. The criterion of the investment into technologies designed for the solution of energy effectiveness represents a selected zone of investment return under the economic breaking point. ***There are basically two economic sources that are the result of investments made and provide the return on invested resources:***

- ***energy savings***
- ***expansion of the range of services***

The competitiveness of the building on the market increases, if there is the expansion of provided services in the form of quality improvement of internal environment. It has the impact on the preservation and/or rise of economic incomes and therefore positively influences the production of economic added value. Within the system design of the selection of modern technologies that serve to provide the energy efficiency of buildings, also a long term plan should be included, whether the local renewable sources will be used or not. The reason lies in the fact that it is possible to combine the chosen technologies so that the effects of mutually supporting technical parameters are reached. In effect it leads to lower investment costs and faster return on investment. Suitable selection of technology results in synergic effects reducing the energy consumption of the buildings as well as the quality improvement of internal environment necessary for the solution of the issue of heat waves as an impact of climate changes.
Solar energy and hydrothermal energy were selected for the transformation of the studied office building from the available local renewable energy sources in the system boundary of a building. The corresponding technologies of the water-water heat pump, micro capillary ceiling heating and cooling system and the systems of photovoltaic panels were chosen in relation to this energy mix. The time of their implementation was set as well. In 2008 the local hydrothermal energy source was put into operation in order to provide the heating and cooling. The micro capillary ceiling system has

been put step by step into operation during years 2009 to 2011 which allows us to enhance provided services and made the building resistive to heat waves. For customers, the cooling supplied and transmitted through irradiation principle represents real answer to climate change since it improves the quality of inner climate. Solar power plant with the energy output of 200 kW (200 MWh per year) is planned with the targeted implementation set for the period 2016-2020 according to the reached state of the technologies of photovoltaic cells and related storage technology of the energy market. The economy is another basic parameter for decision. Already implemented renewable energy source squeezes down the carbon emissions as much as 90% so the ecology target has been reached excessively. The same is valid regarding the quality of inner climate and possibility to deliver enough renewable energy to distribution network which allows reaching the net zero energy criteria.

3.3.3. SELECTION OF PRIMARY ENERGY SOURCES AND CORRESPONDING TECHNOLOGIES FOR CONVERSION OF ENERGY

The concept of the energy from renewable sources includes the energies from renewable non-fossil source that can be subsequently divided into two categories:

1. renewable energies whose energy output suitable for the needs of human economic activity is provided by natural ecosystems themself without additional production of greenhouse emissions
2. energies whose energy output is generated as result of a combustion of secondary product of human economic activities with parallel production of greenhouse emissions

The first category includes wind, solar, aero thermal, geothermal and hydrothermal energy, the energy of ocean and water energy. The second category includes biomass, landfill gas, gas sewage treatment and biogases.

The economic difference between these two categories of energy sources is visible in the fact that from the moment of repayment of the investment connected to use technology of the first group, the energy source brings economy efficient above average profit (reaching up to 50% and more) during the remaining lifetime of the technology that can cover 60% to 70% of the total lifetime. Within the second group of energy sources it is necessary in order to produce the fuel always to use human work. This will cause the increase in the costs at least along with the inflation. Actually biomass, landfill gas, gas sewage treatment and biogas represent wastes from the primary economy production. If there are negatively stimulated conditions on the market that support the demand rise, the price of raw materials for energy of biomass of biogas increases and therefore the costs of the delivered energy, as well. Moreover, in the cities there is not a suitable environment for the generation of energy sources of the second group due to the CO_2 emissions formation, fall of solid particles and often unpleasant odour. A present government support scheme aiming to support renewable energies chose in a form of feed in tariff, to support investors in specific technologies and fuel type by means of adding to prices. This is the crucial economic problem. But the consumer does not purchase the technology or a part of it or fuel type. Consumer buys the utility value on the market, the energy. With this type of support scheme there is no competition on the market rather it creates all conditions for corruption. Naturally the society should cover an extra cost connected to so call green permissions. The extra expenditures made by investor in order to produce energy without parallel production of the carbon emissions should be repaid by the society through relevant financial instruments. In order to decide what technology is perspective within the current organisation of social preferences in order to achieve the economic breakeven point, the right question is: „ how much of additional cost must society invest in order to supply the market with the energy without accompanied production of the carbon emissions, calculated per one ton of CO_2 emissions?" From the support scheme and related value of the feed in tariffs given by the legislation it is possible to subtract market value of the energy and via considering carbon emission factor K it is possible to calculate concrete figure for each supported technology. This allows to construct so called knowledge

curve for the extra cost of green permits. From the time data it is possible to evaluate whether the extra cost falls in time or rises in time. So we can construct so called qualitative and in the same time also quantitative knowledge curve as it is given in the figure 7.

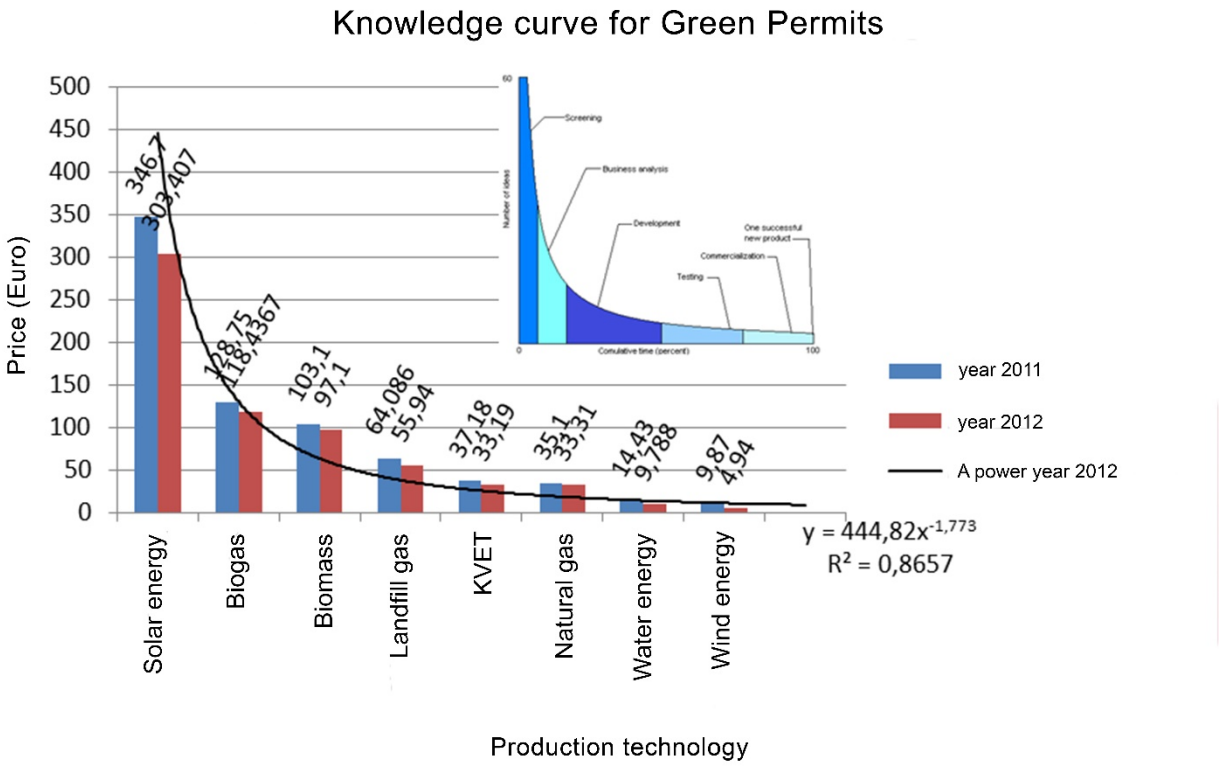


Figure 7. Qualitative and quantitative knowledge curve of the green permits calculated for the subsidised technologies of renewable sources of energy and cogeneration systems.

The knowledge curve for green permits with enough accuracy follows the shape of universal qualitative knowledge curve. It enables to determine that the technologies above 65€/t are the technologies that do not meet the limit criteria given by the social costs of CO_2 emissions. The social cost of emissions has been determined as expenses naturally forced by nature which must be paid by the society in order to recover damage imposed by emitted carbon emissions. Careful examination via energy audits of the tendencies in the projects from 2004-2011, i.e. during last 8 years shows, that the investment costs related to the biomass as well as the price of biomass itself rose by approximately 100%, around 4 times more than the inflation. This is an example of negatively stimulated market in favour of investors and at the expense of customers. Only change in the principle of market organisation could create an effective concurrency pressure and therefore also the costs and consumer´s price reduction. Otherwise, according to the law, next ten years will conserve this situation. This is generally true for the whole group of second category of non-fossil energy sources where the energy is gained by the combustion and where the CO_2 emissions are produced in parallel along energy supply. Fossil fuels, like natural gas or coal are combust in co-generation systems in order to produce both electricity and heat or electricity only. Parallel production of carbon emissions is a side effect. It represents a future economic burden. Therefore, as a perspective solution for the next step, mainly solar, hydrothermal and geothermal energy are recognised as a suitable local renewable energy source. There was no supply of the electricity from the geothermal energy source on the market in Slovakia in the years 2011 and 2012 respectively. Therefore green credits derived from these types are not shown in the knowledge curve. The same is valid for the green credits derived from supply of the energy of the ocean.

The selection was oriented to renewable energy sources whose energy output in the locality of building is provided by natural ecosystem itself. We have chosen technologies able to perform the energy conversion in relation to the requirements of real time human economic processes, i.e. of energy demand of the building for the purpose of heating in winter heating season, cooling in the summer season and electricity supply all the year round. The chosen mix consists of the geothermal energy of the water from the well designed to supply the building by heating and cooling and solar energy designed for the supply of electricity.

PRIMARY ENERGY SOURCE – HYDROTHERMAL ENERGY

Requirements for heating and cooling of the office building

- Heat:
  a. energy loss during the heating season: 278,000 kWh
  b. requirement for maximum performance of energy source: 125 Kw

- Cooling:
  a. energy loss during the summer period: 91,700 kWh
  b. requirement for the maximum performance of the energy source: 50 kW

Energy output and technical energy annual input of energy source of the well.

Energy potential of water source was measured by hydrological screening test. Regarding the character of subsoil and construction above it, the sediment test showed that the particles from the ground are not detected at the level of pumping water source with pump performance of as much as 7l/s – 9l/s. The test running for 7 days x 24 hours showed that seepage well is able to continually absorb such content of pumped water. The energy output of a well can be set in a following way for the purpose of heat supply:

- Performance of water supply: 7 l/s – 9 l/s
- Annual average water temperature: 13 °C
- Two water heat pumps connected in series
- Temperature drop of water from wells 4 °C for each heat pump
- Number of the days of heating: 204
- Number of the days of cooling: 153

Heat:

a. Maximum power output of the well for heat supply: 234 kW
b. The total energy input of the well per a heating season for the heat supply:
(((7 l/s x 3600 s)/0,86) x 4 °C x 2 x 24h x 204) /1000 = 1 147 713 kWh

Cold:

a. Maximum power output of the well for the supply of cold: 117 kW
b. The total energy input of the well during the summer season for the supply of cold:
(((7 l/s x 3600)/0,86) x 4 °C x 24 h x 153)/ 1000 = 430 392 kWh

Energy output of local renewable hydrothermal energy source is sufficient for the heating of the building in the winter season and for its cooling in the summer season. The present state of the art of technology of heat pumps water-water is suitable for providing the heat. Water circulating pumps are sufficiently efficient for cooling. The power source is operating in the passive mode without operation of water heat pump. There are two different operational modes of local renewable hydrothermal energy source. The first one is designed for winter period where water heat pump is operating. The second one is suitable for summer period. In this case the water heat pump is

switched off. Synergic effects in technical parameters occur between renewable energy source and technology of micro capillary ceiling system which is designed for low temperature operation hence SPF rise from 3 to 4,5 in winter period and from 11 up to 14 in summer period. Moreover, micro capillary ceiling system connected to renewable energy source predominantly transports energy through irradiation which is far more suitable for human body and its physiology hence during summer season the quality of the inner climate rises dramatically in comparison to conventional air conditioning. This is the real answer of the transformed building technology to climate change in order to protect people against heat waves.

The technology of heat pump is a well market proven technology that was put first time into operation in 1928 in town hall in Geneva and it has undergone various technological improvements during 90 years since then. It is mass implemented in Germany, Sweden, Japan and Switzerland. The large running projects, e.g. in Denmark, are known to be operating with the total thermal output of 500 MWh. The heat pump of Waterkotte company, model DS 5017,5 AI, as the first one in 2011, overcame the performance value of COP 5 within the standardized conditions of measuring that are given by the conditions of B0/W35. The technology of heat pump meets the criterion of the technology verified by the market, while the combined use of the technology of local energy source enables in the combination with the system of radiant ceiling heating to reach the targeted solution of a year-round SPF=7 and SPF 4,5 during heating and SPF= 14 during cooling. The same is valid for the micro capillary ceiling system. This principle is known for a long time in the form of copper water distribution lines in the building ceiling that were constructed in Slovakia in 1950´s. Modern plastic micro capillary systems can be considered to be the next generation of technically verified and proven system.

PRIMARY ENERGY SOURCE – SOLAR ENERGY

Requirements for annual supply of electricity for the building operation

- **Requirement for energy output:**

  a. Energy source of heat pump: input max.: 35 kW
  b. Other electronic appliances: input max. 60 kW, including lighting max. 30 kW

- **Consumption of electricity necessary for the building operation:**

  c. Energy demand of the heat pump and the circulation pumps: 106 MWh
  d. Electric lighting: 10.5 MWh, replacement for LED technology 3 to 4 MWh
  e. Other consumption of electricity necessary for the building operation: 8 MWh
  f. The total consumption of electricity necessary for the building operation is 124.5 MWh, after the implementation of LED technology the consumption of the electricity is about 118 MWh

- **Consumption of electricity necessary for the use of a building outside of the building operation per year: 130 MWh**

  There is a large dispersal of the values resulting exclusively from the calculation or exclusively from measuring, when setting the electricity consumption for the lighting. The reason is the means of the building operation and the behaviour of users. The modern measuring methods of electricity enable to eliminate these deficiencies with the sufficient accuracy and to determine the electricity consumption for the lighting during the year on the basis of actually measured values during a year-round operation of the building. For example, it also includes such rationalisation measures such the installation of motion sensors to lighting devices in the hallways, when consumption is heavily dependent on the movement of people along the corridors, which leads to a substantial reduction in energy consumption and so on. The value of the measured consumption of the electricity used for lighting of the building reached the value of 10.5MWh. In the future we consider the electricity consumption for the lighting,

after the replacement of lighting devices by the modern technologies of LED type, to be at the level of 3 and 4 MWh per year.

Energy output and annual amount of the solar energy supply

The office building is constructed in such a way, that the Southern part of the façade allows for the construction of optimal area slope to place the panels at the angle of 37°. The angle of 37° can be also achieved on the flat roof. The Southern façade and the flat roof provide the space of total number of 365 panels with standard dimensions. After the lift modification up to a total of 400 panels can be considered - figure 8.

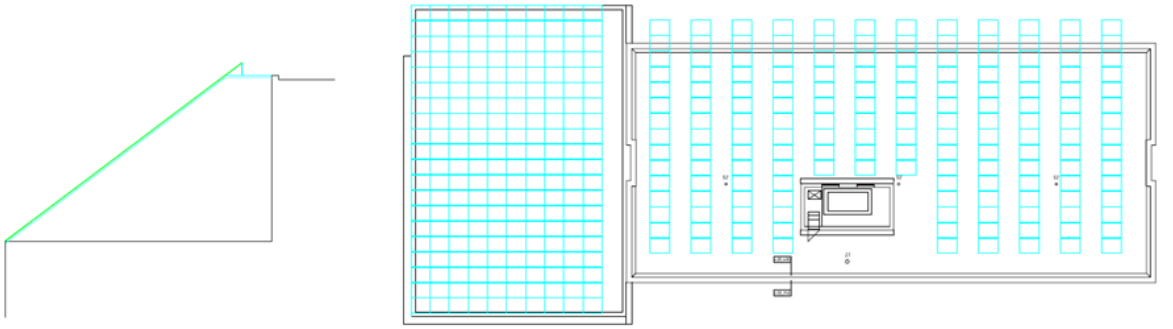


Figure No 8. A graphic representation of the solar panels distribution placed on the Southern façade and on the flat roof of the building. The view is directed from the top and from the South.

The analysis of knowledge curve of photovoltaic cells and panels

NREL Company analyses the development of the technologies of photovoltaic cells in its market analysis with photovoltaic panels and technologies of photovoltaic cells. It points to the fact that the efficiency already achieved in laboratory is as much as 43.5% (NREL, 2012) [5]. A significant increase in efficiency growth has been recorded since 1990. Nowadays, the mass production in the technologies of photovoltaic panels reaches the efficiency of 19% and more, while NREL expects the photovoltaic panels with the 40% efficiency by 2018- 2020. The investment return can already be expected by 2014 regarding the photovoltaic panels with the efficiency about 20-25%. Survey report of Deutche Bank announces the achievement of economic breakeven point of photovoltaic systems already by the end of 2013 and in 2014.

The importance of local renewable energy sources lies in the fact that the energies are consumed in the place of supply therefore the distribution losses are eliminated. In case of electricity the distribution losses are generally as much as 15%. It requires the compliance with the qualitative parameters of electricity supply for the appliances. The instability of sunshine causes that it is necessary to ensure the effective balancing and accumulation system located in situ that would be able to store the electricity with the sufficient number of cycles for 8 to 12 hours and offer it for the consumption with appropriate loss (up to 25%). The use of Nano-technologies as well as the systems based on the vanadium cells and biotechnologies show promising results.

In relation to the introduction of the electric cars we can expect that this type of the vehicles starts to be massively implemented especially in the cities, while the charging of accumulators will be realized at the parking places during the working part of a day. In such a case, batteries will produce an additional robust regulatory system and will make the technologies related to the electricity supply by the conversion of the energy from the Sun and wind in this synergistic effect cheaper.

The last known problem nowadays, related to the installation of solar power plants represents the issue of upper harmonic waves that occur in the surrounding of the installation and cause a damage to electronic devices especially those that are sensitive to the voltage stability. The electrical

impulses up to the level of 6,000V with the duration of 50μs can occur in the electricity network. The energy with frequent repetition of power peaks in the energy network influences the electronic device and after the corresponding exposure by power peaks of upper harmonic waves causes its permanent damage. This issue has been known from the industrial disturbance in energetic network for some decades, especially in relation to the use of robots and therefore these observed problems are solvable by standard procedures.

The installations of solar power plants are expected to last for 20 to 25 years. Therefore the expected technological progress within 4 to 7 years leads to the step increase in use of the building area that is available. The expected next development of the storage systems leads to the solution of the required quality of supplied electricity into the networks through the accumulation systems designed for 24 hour cycle. When we compare the demand on the energy output and the annual amount of the electricity supply of the building, we can conclude that it is economically advantageous to wait with the investments. The available building surface area and the in situ sunshine conditions, assuming 40% efficiency photovoltaic cells with energy output of the panels as much as 500 Wp, makes it possible to install power plant of 200 kWp delivering as much as 200 MWh per year. In addition, the construction of the power plant must fulfil the architectural criteria of the solution, so that the building would meet the criteria of urbanism and relative aesthetics of the solution. The architectural study of the building with the solar power plant is given in the figure 9.

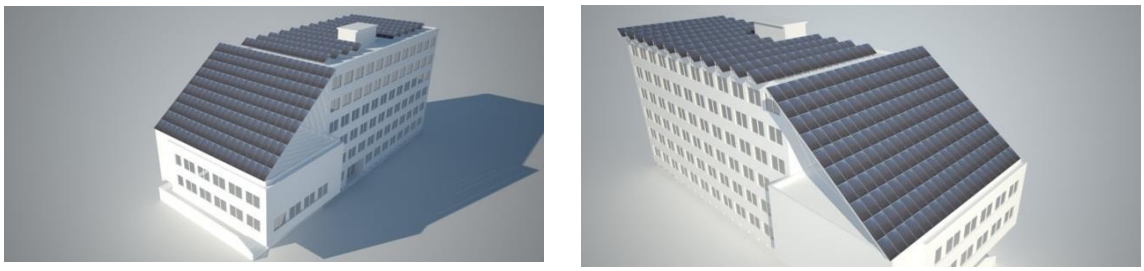


Figure No 9 The architectural study of the building in 3 Murgašova Street, Košice equipped by the solar power plant.

3.3.4. IMPLEMENTATION OF ENERGY TRANSFORMATION OF OFFICE BUILDING

With the above criteria the following technologies were selected for the transformation of the building. The year of implementation of the relevant technology is also indicated.

1. The reconstruction of the exchange station of the district heating system - 1996
2. The exchange of the heating system for hot water for the building from a district heating system to a local distributed type - 1996
3. The replacement of windows in the period of 2000-2005
4. The insulation of the building in the period of 2000 to 2005
5. The installation of internal window aluminium sun blinds in the period of 2000 to 2005
6. The hydraulic regulation of the heating system of the building in 2005
7. The installation of a local renewable energy source – a water heat pump – 2008
8. The installation of the micro capillary ceiling heating and cooling system from 2010 to 2011; the improvement of the quality of internal environment and expansion of the services by cooling
9. The replacement of lighting devices and the implementation of motion sensors in 2012
10. The implementation of LED lighting bulbs - a plan for the years 2014-2015
11. The expansion of heat supplies from the local renewable energy source into the heat distribution network - a plan for the years 2014- 2015, according to the legislative conditions
12. The realisation of photovoltaic power plant with the output of 200 kWh with the annual supply of 200 MWh of electricity - a plan for 2018-2020

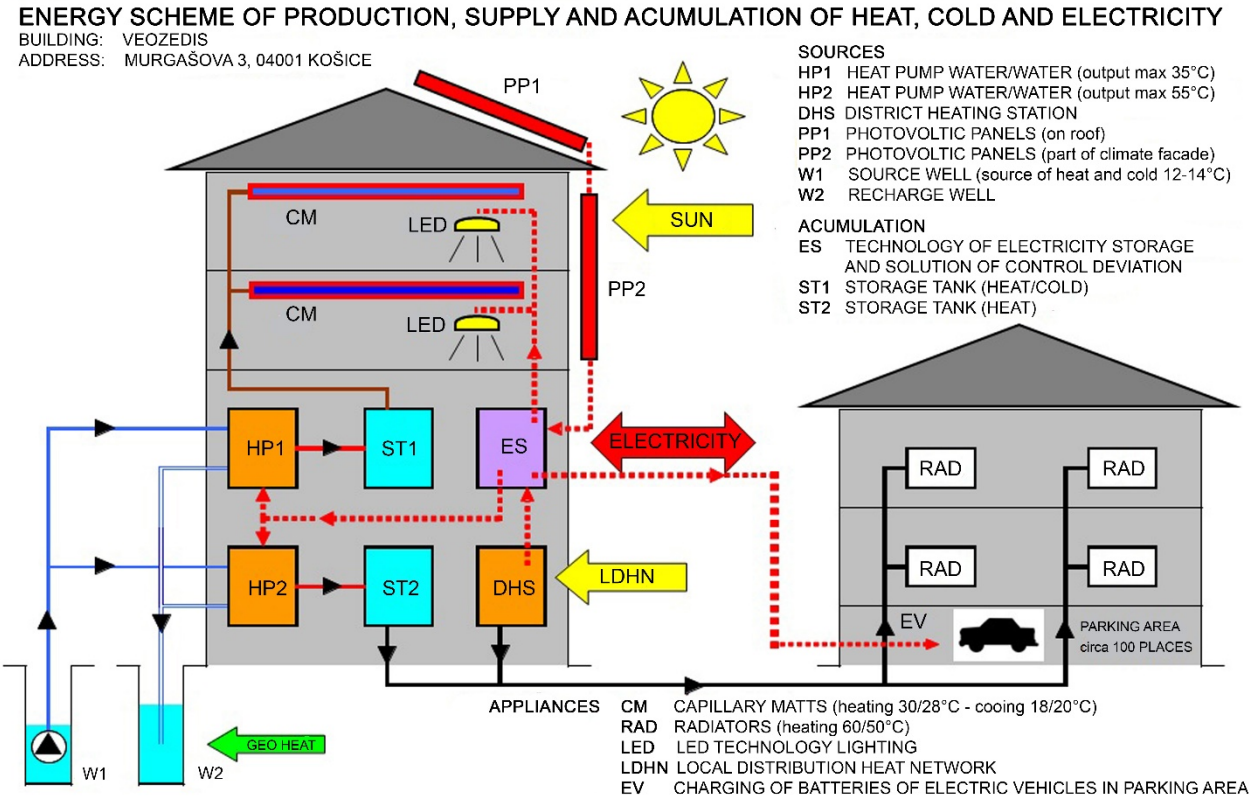


Figure No 10. The total energy scheme of the office building

A complex energetic scheme depicted on figure No 10 includes also the construction of the parking place equipped with the charging stations for electric cars or cars with hybrid drive as a logical part of the whole complex of the building. The time estimate of the realisation of such parking place can be harmonized with the realisation of solar power plant as a subsequent investment. It is possible to expect the suitable timescale for effective investment around the year 2020 taking into account the development in car industry and the preparation of needed infrastructure by the state.

ADJUSTMENT OF THE HEAT SOURCE

Originally the building was supplied by the heat from the exchange heat station connected to district heat supply system. Technical and also moral lifetime has expired sometimes before the year 1996. The exchange heat station is located in the basement of the building. It provides heat also for residential buildings standing close to administration building. The regulation of the temperature of heating water was the same for the residential buildings as for the office building. The heat supply had a low efficiency and very pure regulation. Therefore it was not possible to keep the required temperature parameters stable in the building. The building was often overheated without the chance of deployment of setback mode during weekends or at night hours when there are no employees there. The reconstruction of the source was provided by a heat supplier. Original horizontal counter-tube heat exchangers were replaced by modern plate heat exchangers. At the same time, the regulatory nodes of heating were done for the Eastern (UK1) and Western (UK2) façade and the extension (UK3) as depicted on the figure No 11. Each branch has been equipped with three-way mixing valves in order to regulate the temperature of heating water in the equithermic way. Deployment of daily and weekend setbacks has been realised.

Table 1
Parameters of the object - adjustment of source, comparison

Parameters of the building	Year 1996	Year 1997	Units
The heat loss of the building	195	195	kW
The required heating water flow	16.8	16.8	kg/h
Temperature gradient of heating water	65/55	65/55	°C
Heat consumption for heating *	800	611	MWh
Heat consumption for water heating **	88	No measuring	MWh
Total heat consumption ***	888	611	MWh
Heat savings during heating *	-	23.6	%

Note:
* In 1996 the heat consumption for the heating and hot water was measured together. The separation of the heat used for heating and for the hot water (HW) is determined by the technical calculation. The consumption for heating is actually measured in 1997.
** In 1996 the heat consumption for the hot water was calculated. In 1997 the water is locally prepared in flow electric heaters without measuring it. Therefore it is not shown in comparison in following years.
*** The heat consumption together in 1996 UK + HW. It was only the consumption on UK in 1997.
**** Heat consumption for heating is compared to the reference year 1996.

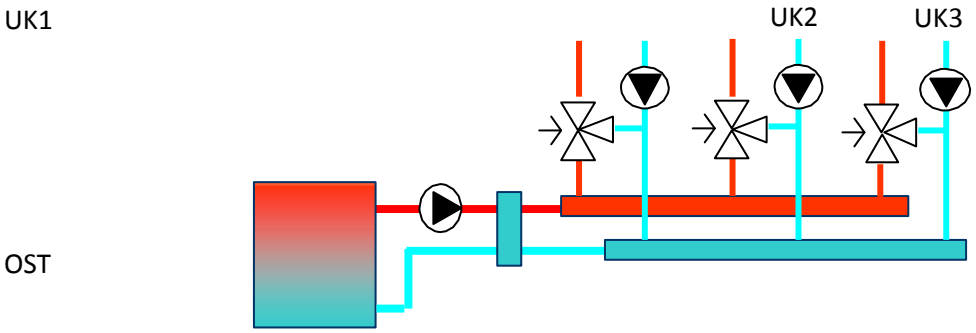
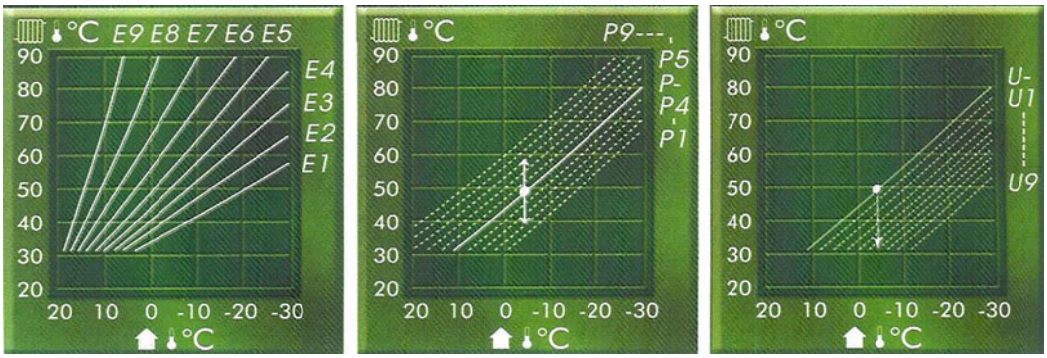


Figure 11. The realisation of equithermic regulation of heating for each heated branch separately.

The dependence of the temperature of heating water on the temperature of external air is actually calculated according to a selected curve. An example of the way of calculation of a heating curve is given in the figure 12. The equitherming curve E4 corresponds to the building characteristics (influenced by heat loss, accumulation ability of the building and the characteristics of heating system). The required outlet temperature of heating water is 65°C at the temperature of air of -13°C. The temperature of heating water for other external air temperatures is recalculated accordingly. A parallel shift of the curve is not required. The curve shifts by the value U2 for setback mode at night or weekends. It means the decrease of the temperature of heating water, in the given case by 6°C.
The heat consumption measurements savings for heating at the level of 23,6%. – Figure 21 compared to the initial state in1996.



Equithermic curves Parallel shift of the curve Shifts of curve for setback Figure 12. Graphical example of heating curves and an option of the correction for setback modes of heating are presented.

CHANGE OF THE SYSTEM OF WATER HEATING

The method of heating and the supply of hot water depend on:

- A type of the object, volume and frequency of hot water consumption (HW)
- A source of heating and its suitability for the heating of HW
- Distribution loss and necessity of circulation piping
- Necessity to carry out the disinfection by overheating the system against the emergence of Legionella bacteria.

The heating was originally realized in the hot water tank directly in the heat exchange station. The distribution lines using galvanized pipes lead into sanitary facilities on each floor of the object. Supply points in the main building are centralized in two centres. Each of them has an independent riser pipe with circulation. Point of supply represents mainly washbasins and sinks. In the extension of the building there are other sanitary facilities concentrated one above the other in two centres.
Hot water was originality supplied by the means of circulation in the year 1996. The distribution lines were insulated only by mineral felt with the thickness of 5mm. Such insufficient insulation and continuous circulation caused a high heat distribution loss. It is reflected into a high energy demand for heating and supply of hot water. The calculated heat consumption for the heating of HW and power for circulation pump for 1996 is = 88 MWh/year.
Based on the calculation, 11 MWh/year electric energy is needed in the newly replaced–local heat water system. The local heating means the disconnection of distribution lines of HW from the central source and the installation of instantaneous electric heaters in the place of washbasins and sinks.

REPLACEMENT OF WINDOWS AND INSULATION OF ENVELOPE STRUCTURES

Windows replacement and building insulation was realised step by step method. First the window has been replaced. Corresponding wall with replaced windows was insulated as the next step. Each wall of the building has been reconstructed. After considering the fact that the envelope structures contain not only the skeleton filling but also the insulation with the thickness of 5cm and subsequent layer of ceramic hollow glazed blocks as it is seen on figure No 3 and 4, the project documentation determined that the polystyrene insulation with the thickness of 8 cm is sufficient. The complex insulating permeable system Baumit with the thermal insulator from polystyrene façade insulation boards was used for the realisation. The original windows were replaced by plastic windows with double glazing.

Table 2
Parameters of the object - insulation, comparison

Parameters of the object	Year 1997	1998-2004	Units
Building heat loss	195	135	kW
The required heating water flow	16.8	14.5	kg/h
Temperature gradient of heating water	65/55	58/50	°C
Heat consumption for heating	611	444	MWh
Heat savings during heating	-	27	%

HYDRAULIC REGULATION

Hydraulic regulation is a process aimed to provide the redistribution of circulation medium transporting the energy from the source to supply points by the means of pipe distribution lines. We can use the assembly or fittings in the system to set the required parameters. The conditions for the economic operation is the achievement of required parameters of internal environment, the elimination of heat gains from outside and inside building sources and the minimisation of the costs needed for production and heat distribution. It also ensures the faultless uptime without noise effects.

A hydraulic regulation ensures:

a. equal (required) heating in all heated spaces in relation to the type of space, way and time of operation,
b. elimination of heat gains that serves to avoid the overheating in the space and as the consequence saves the energy regarding the accumulation of building constructions and heating system,
c. hydraulic stability within the varying pressure conditions in the system,
d. the ability of a user to influence his consumption by controlled heat energy usage with the minimal impact on other consumers.

The regulation of required output (temperature) in the place is provided by:

a. a required size of radiator (current or new type radiators are considered in the calculation)
b. required flow rates of heating water into a radiator (it is provided by the risers 'valves and valves on radiators that are pre-set as given in the project)
c. the temperature of heating water (provided by the SOURCE of HEAT based on the external temperature by the means of equithermic regulation with the timing programme of heating operation)
d. water flow into a building (provides the SOURCE of HEAT on the basis of the project)

Consideration of heat gains in the room and required temperature

a. Installation of thermostatic head on the valve and setting to the required temperature. Thermostatic head (TRH) is a regulator with the ability of setting the required air temperature in the range of 5 – 26°C.

   5°C – frost protection - if the valve is closed, it closes the water flow in a radiator; if there is a temperature drop, the valve opens and lets the water enter the radiator and keeps the temperature of the air at 5°C.

26°C – represents maximum allowable temperature of the air. If the temperature is lower than the set temperature of 26°C, the whole radiator heats, TRH fully opens the valve. If the temperature is higher than 26°C, TRH closes the valve and it does not heat. Even when TRH is fully opened at 26°C, this temperature does not have to be reached, because the water from the source is regulated in order to reach the max. 23-24°C. TRH does not produce the heat, only keeps it or reduces what is supplied from the source of heat.

b. A common operational state in the room is around 20-22°C
Example: TRH set at the temperature of 20°C which means that temperature requirement is 20°C in the room.

- if the temperature in the room is 20°C and less, the whole radiator heats
- if the temperature in the room is 20-22°C, only an upper part of the radiator heats,
- if the temperature in the room is 22°C or more, the radiator does not heat

There can be an inaccuracy within the required temperature during the operation, if the TRH is influenced: covered by curtain, it is close to the another source of heat that heats the head or there is incorrect position of the head (then TRH does not read the temperature in the room but the temperature of their own surrounding that can have a different temperature).

Different options of regulation of heater bodies

1. Basic regulation is depicted on figure 13 - 1. The technical solution consists of a regulatory radiator valve with pre-setting without thermostatic head. In this case:

   a. *a-uniform* regulation in all rooms is achieved,
   b. elimination of overheating,
   c. the possibility of heater closure

2. Standard regulation is depicted on the figure 13 – 2. The technical solution consists of a thermostatic radiator valve with pre-setting. In this case:

   a. a uniform regulation in all rooms is achieved,
   b. elimination of overheating,
   c. the possibility of heater closure
   d. elimination of heat gains,
   e. the possibility of pre-setting the required temperature

3. Comfort regulation is depicted on figure 13 – 3. The technical solution consists of thermostatic radiator valve with pre-setting + regulatory adjustment. In this case:

   a. an uniform regulation in all rooms is achieved,
   b. elimination of overheating,
   c. the possibility of heater closure
   d. elimination of heat gains,
   e. the possibility of pre-setting the required temperature
   f. possibility to assembly and disassembly of the heater during the operation,
   g. the reduction of noise level of the valve (a part of pressure is constricted by adjustment)

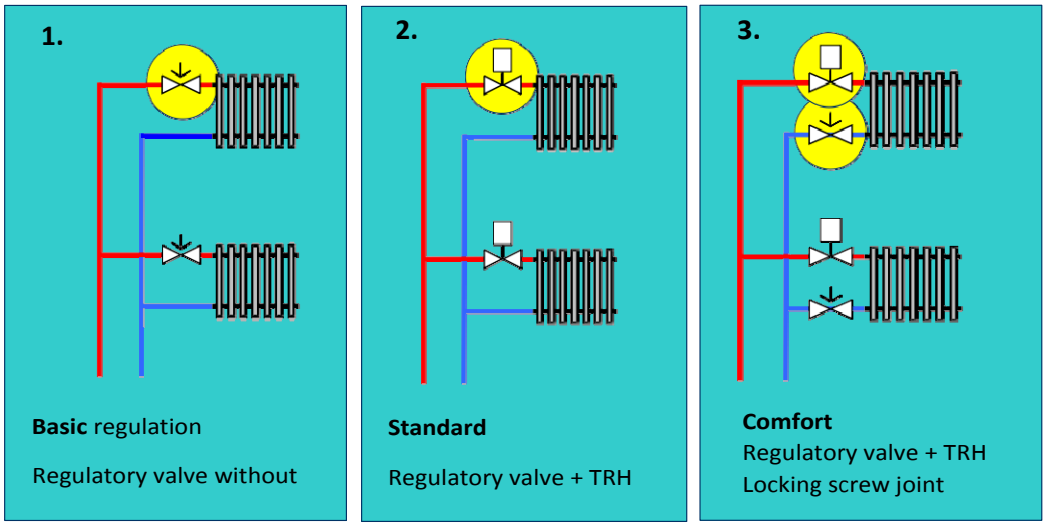


Figure 13. The pictures represent schematic of different regulations of heating systems on heaters. (TRH is thermostatic head fitted to the regulatory radiator valve).

The option No 3 is used for regulation of the radiators in the described office building.

Different possibilities of the regulation of the uptakes

The task of the regulation of horizontal distribution lines is to provide the required amount of heating water into uptake pipes. The regulation must take into account:

a. maximum energy output of heaters that it supplies,
b. position of uptake pipe (it is necessary to consider the orientation to the cardinal points, which depends on the heaters,..)
c. a type and parameters of horizontal distribution of heating.

1. Basic regulation: STATIC – figure 14 – 2

   Technical realisation consists of a pre-set riser´s regulatory valve with option of measurement. It provides the required distribution of the heating medium into individual riser pipes by pre-setting of the valve. It enables the measurement (control) of flow. It does not provide the protection against the changing parameters.

2. Standard regulation: DYNAMIC – figure 14 – 3

   Technical realisation is the same as above enhanced by relief valve RV. The solution provides the same features as above. Moreover it allows the elimination of increased differential pressure of uptake pipe by releasing the flow, the reduction of noise of radiator valves, the reduction of the efficiency of distribution lines by increasing of the temperature of a return pipe.

3. Comfort regulation: DYNAMIC – figure 14 – 4

Technical realisation is the same as in the standard regulation enhanced by controller of differential pressure CDP connected by a capillary. The features of dynamic option are enhanced as follows:

a. the elimination of increased differential pressure of uptake pipe by constricting,
b. the reduction of noise of radiator valves,
c. the rise of efficiency of distribution lines by reduced temperature of a return pipe

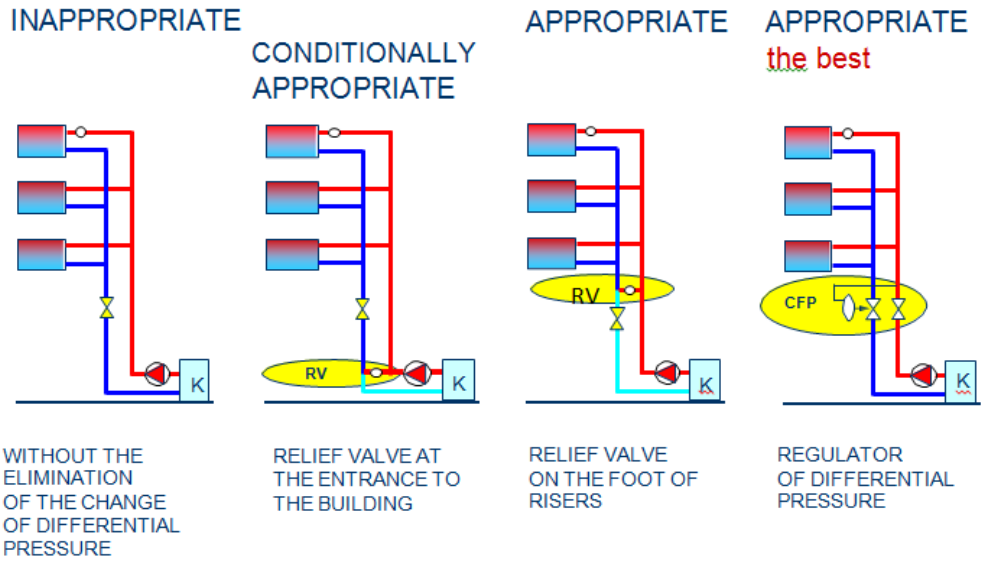


Figure 14.The different options of regulation of heating systems on risers

The system is realized comfort dynamic regulation variant. Technology is located at the foot of the risers in the building, similar way as it is depicted on the figure No 14 - variant "4", regulator of differential pressure.

Benefit of hydraulic regulation

- removal of overheated and under heated conditions in the rooms
- option of individual regulation of each heater
- minimisation of the consumption of circulating heating water which reduces the energy consumption
- together with the equithermic regulation of heat sources it minimises total energy consumption for heating. The measured savings in operation on the heat supply due to hydraulic regulation represent 15% (a difference between 2002 and 2005 – figure 21.

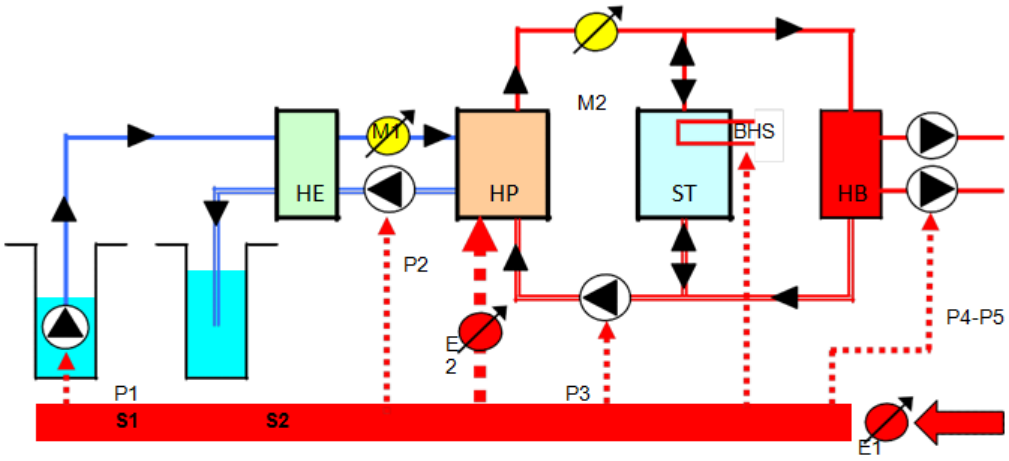
REPLACEMENT OF THE HEAT SOURCE

The above mentioned modifications were focused on the improvement of energy efficiency, i.e. the reduction of heat consumption for the heating of the building, its optimal production and supply.
The modifications were realized in the following areas

- construction part = improving the thermal-insulating characteristics of the building, especially the envelope structures
- modification of the heat source = the realisation of the optimisation of heat supplies by the management of the heat source using the setbacks of heating
- modification of the system of heat supply = uniform heat supply into the heaters with the option of heat gains elimination by the means of hydraulic regulation and the implementation of thermostatic heads

Technical possibilities of the technologies that provide the energy efficiency and are economically justified have been fully exhausted. Another reduction of primary energy and CO_2 emissions within the preservation or improvement of internal climate was realized by the replacement of heat source. The fossil energy has been replaced by local renewable hydrothermal energy source. The replacement results in reduction of operational cost.
The feasibility study accompanied by business analysis proved that heat pump system based on local renewable hydrothermal energy seems to be perspective system with economic advantage.
The construction and architecture of the building and its technical characteristics enabled this alternative.

- existence of a dug well with the water capacity up to 12 l/s
- the realisation of sink wells is simple and economically undemanding within the space of a building
- the building is insulated and hydraulically regulated; it decreases the required output of the heat source
- because of the insulation, the current heating system with radiators is operated in reduced temperature zone of 58/50°C. This condition enables the application of the heat pump in an economically effective way.



ENERGY FOR THE OPERATION OF DEVICES - ELECTRICITY FROM PUBLIC DISTRIBUTION

KEY:

HE HEAT EXCHANGER SOURCE	**BHS** BIVALENT / BACKUP HEAT
HP HEAT PUMP WATER/WATER RECHARGE WELL	**S1-2** SOURCE SUCTION WELL/
M1-2 HEAT METER	**HE** HEAT EXCHANGER
E1-2 ELECTROMER	**P1** PRESSURE PUMP IN WELL
ST STORAGE TANK OF HEAT ROOM	**P2-3** CIRCULATION PUMPS - MACHINE
HB HEATED BUILDING	**P4-5** CIRCULATION PUMPS - OBJECT

Figure 15. Depicted scheme of the connection of a heat pump water/water. The renewable energy source transforms heat from water to conditions suitable for heating by radiators in bivalent connection in the office building.

The stages of the realisation of renewable energy source

- **Preparatory phase**
  - Feasibility study confirming the suitability of the application of local renewable energy source supplying heat
  - Defining the conditions of the connection to electrical system with the supplier of electricity (the possibility of consumption and attribution of favourable electricity tariffs) as the driving power for the system operation with a heat pump
  - Defining of conditions of connection of bivalent source (current discharge station of the building that supplied the building with the heat) if there is not satisfactory output of the heat pump or as a backup in case of failure
  - Construction of seepage tanks and hydro-geological assessment of yield of pumped well and flow rate of seepage tanks - project phase
  - Processing of energy balances
  - Selection of a suitable type and size of a heat pump
  - Independently assessed parameters were reliability parameters, lifetime parameters and the way of monitoring of these parameters by a producer processing of project documentation

- **Realisation of renewable source**
  - realisation of machine room with a heat pump

- connection of all related media (water, electricity, heating distribution lines)
- realisation of the system of measuring and control of the activity of the source with HP
- putting the source into operation

- **Operation and assessment**
  - a design and installation of measuring equipment for individual system elements with a HP
  - assessment of measured data
  - optimisation of operation = corrections in the process of regulation, technical adjustments for the purpose of improvement of total operational efficiency and prolongation of the lifetime of the machine room equipment with a heat pump
  - realisation of regular operational controls of equipment and maintenance

Table 3
Technical parameters of the machinery room with HP

Climatic conditions:	
Place:	Košice
Average external temperature in heating period:	+3.0 °C
Regional design temperature:	-12 °C
Altitude:	220 m asl.
The number of days in heating period:	225 days

Table 4
Technical parameter of applied heat pump

Thermal pump Waterkotte 5136.3		
Heat output at 0°/35°C: **95.3 kW**	Electric input: **24.8 kW**	Coefficient of performance
Heat output at 0°/50°C: **97.7 kW**	Electric input: **28.5 kW**	Coefficient of performance
Refrigerant: ecological refrigerant R 407 C		
Compressor: Waterkotte, the number of switching cycles 66,000 to 90,000; mean time between failures 1 per three years		

REPLACEMENT OF EXCHANGER SYSTEM FOR HEATING/COOLING

The idea about the modification of heating system followed from the requirements:

- to increase the efficiency of heat production by the means of heat pump
- to create the preconditions for the implementation of new technologies of end heating and cooling micro-capillary systems
- to heat by the system more favourable for the human physiology and therefore increase the quality of the internal environment of the building
- to use the energy potential of the well even for the option of passive cooling
- to significantly reduce the parallel production of CO2 emissions
- to reduce the operational costs connected to the operation of heating and cooling
- to create the conditions for the realisation of solar power plant with the option of the realisation of a building with zero energy balance with distribution networks
- to create the conditions for metering the energy from the heat pump to the balance of a country monitored by the EU

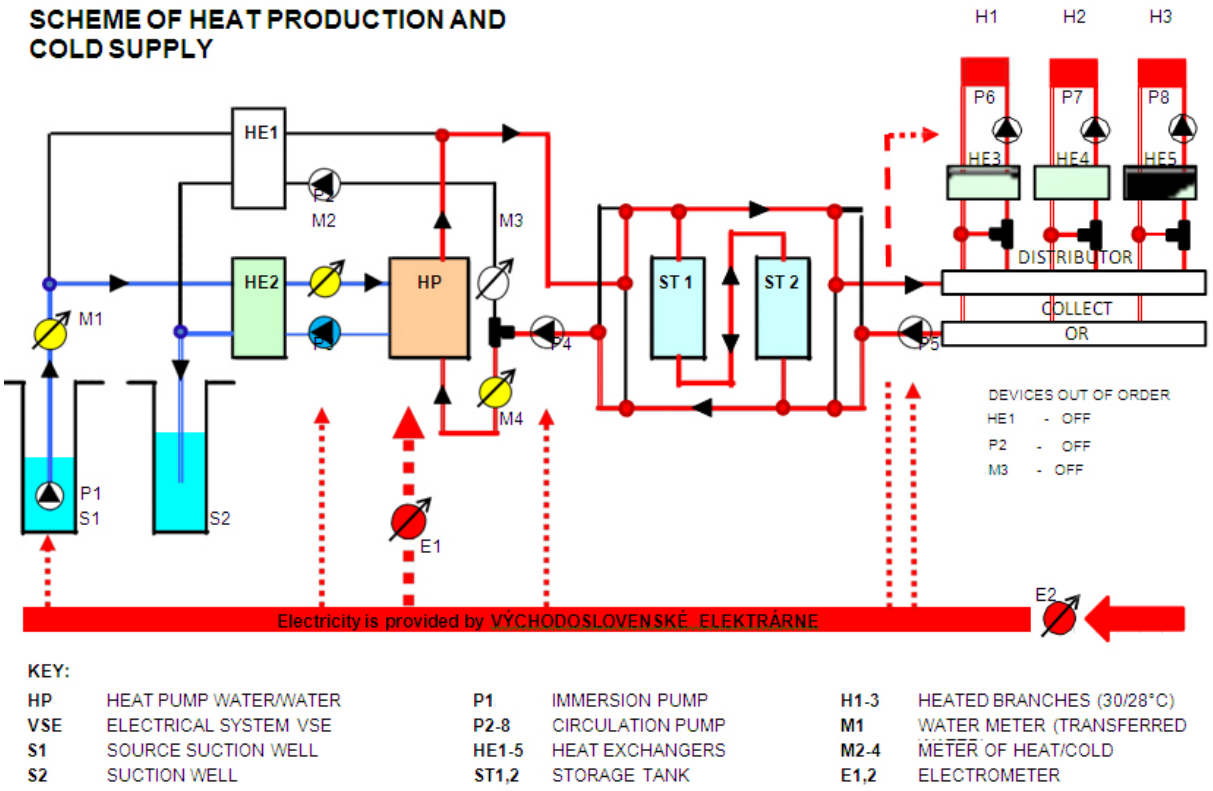
The description of radiant ceiling system of heating/cooling

A fundamental difference to the conventional heating system is in the way of transfer of the heat and the cold. It is the large-scale low-temperature radiant heating with the option of "high temperature" cooling. The system consists of distribution pipes of small diameter of 3-12 mm with appropriate spacing according to type of the area that forms the heating / cooling element. It can be installed either as a part of ceiling construction when the pipes are plastered in or in the soffit below the ceiling. The soffit makes possible to use the solution with ceiling tiles or the arrangement of the pipes on the drywall ceiling. The way of the installation of the pipes influences the heating and cooling output, the way of positioning of connecting pipes and the way of regulation and design. A dry capillary matting system was chosen in the described building that was reconstructed in full business operation. It is placed in the soffits in a form of perforated aluminium sheet cassettes.
The heat supplies the space by radiation. The radiation affects the surfaces, especially floors and the equipment in the room. As a result, the air is heated by the heated surfaces. In case of cooling, the cold is again provided by radiation. In both cases, the heat supply happens at minimal air circulation without draught. Air venting is usually provided by infiltration and natural ventilation through windows. If there is a demand for higher intensity of venting, it is possible to transport the air to the false ceiling (if the capillary mattings are installed in the soffit) and the air can be supplied through the holes in the soffit (so called perforated ceiling without diffusers). In combination with ventilation it is positive that cooling respectively heating output is provided by the radiant system and the ventilation is not limited to the intake of ventilation air. It significantly reduces the demands for the dimensions of the pipes, size of ventilation units and the ventilators performance.

Adjustments in the machine room after the installation of ceiling system

The application of the system of ceiling heating/cooling required the adjustment in the machine room as there were differences in the previous system of supply of the heat to the radiators. Original heating by radiators is depicted in figure No 15 and the designated system of ceiling heating/cooling in figure 16 and 17, respectively. The devices that were added are as follows:

- A heat exchanger HE2 for the cold take off from the well water
- Addition of another accumulation tank into series in order to reduce the number of switches of heat pump and suction pump in the well
- Interconnection of heat storages that provide the option of charging and discharging in the heating mode from the top, in the cooling mode from the bottom. A different mode from the top/bottom requires the layering of the water in the tank according to the temperature
- Installation of separating heat exchangers HE3, HE4, HE5 due to the used capillary mattings in the ceiling from other metal distribution pipes. The lack of oxygen barrier in plastic distribution pipes causes the diffusion of oxygen through the walls of the pipes that can cause the corrosion of metal pipes and equipment in the system.



KEY:

HP	HEAT PUMP WATER/WATER	**P1**	IMMERSION PUMP	**H1-3**	HEATED BRANCHES (30/28°C)
VSE	ELECTRICAL SYSTEM VSE	**P2-8**	CIRCULATION PUMP	**M1**	WATER METER (TRANSFERRED
S1	SOURCE SUCTION WELL	**HE1-5**	HEAT EXCHANGERS	**M2-4**	METER OF HEAT/COLD
S2	SUCTION WELL	**ST1,2**	STORAGE TANK	**E1,2**	ELECTROMETER

Figure No 16. The scheme of the connection of a heat pump water/water in the system of the energy transformation in the form suitable for the supply of heat to the office building. The principle of the heating of the building is depicted.

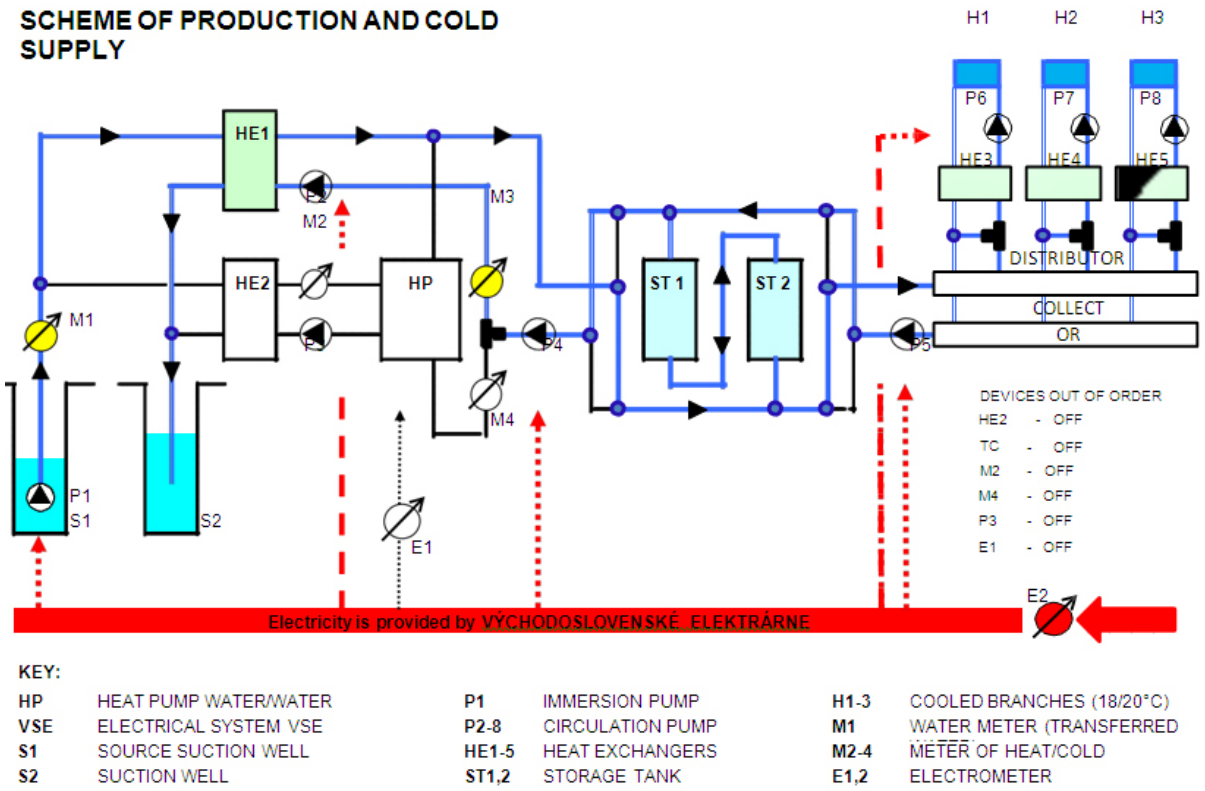


Figure No 17. The scheme of the connection of a heat pump water/water in the system of the energy transformation for the supply of the cooling in office building. The principle of the cooling operation is depicted.

An important impact of radiant system has the temperature gradient of the heating medium (32/30°C) or cooling medium (18/20°C). The reduction of the thermal gradient from 57/50°C to 32/30°C enables to increase the coefficient of performance (COP) of the heat pump. Measured data from the operation of heating is confirmed by the values:

- Heating in the operation with radiators 57/50°C (COP=3.9 SPF=3.1) - measured
- Heating in the operation with capillaries 32/30°C (COP=5.5 SPF=4.1) - measured
- Passive cooling with micro capillary ceiling system 18/20°C (EER[1]=11.2) - measured
- Active cooling with the SPLIT system for comparison » (EER=cca2.7) - calculated

The replacement of radiators via micro capillary ceiling system resulted in improvement of the value SPF by 32%. The measured data showed that the micro capillary ceiling system has during summer cooling period better EER performance of about 310% in comparison to SPLIT system. From the point of view of performance both energy and economy as well, the combined system consisted from local heat pump hydrothermal renewable energy source and micro capillary ceiling system represents one of the most effective methods that can be used in real conditions of buildings supply. The reason is that the low temperature energy transmission of the micro capillary ceiling system either during winter season or also during summer season allows more effective operation of the renewable energy source as it is in case of radiators.

[1] EER – stands for Energy Efficiency Ratio This parameter is used in order to describe energy efficiency during cooling summer season

The efficiency of the energy source is markedly higher thanks to the low temperature of heating water in comparison to conventional heaters. Their temperature gradient is around 60/50°C. Cooling is provided by the medium temperature (17°– 20°C). Within such a "high" temperature of the medium, we can use the water from the well or the ground temperature as a source of cold, because their temperature is 15°C in the summer.

The crucial fact is that we do not need to produce the cold, what reduces the costs of cooling only to the pumping work of the cold transport (= passive cooling). The amount of this energy can be positively influenced by a suitable technical solution and a design of the system. Eventually removed heat from the cooling of the spaces can be transformed into the heating of hot water needed for the operation of the building.

QUALITY OF INTERNAL ENVIRONMENT AND HUMAN PHYSIOLOGY

Combination of modern technologies and the standard technologies help to increase not only energy efficiency but also quality of internal climate. Implementation of such new technologies into building operation provides real answer to such phenomena as a climate change. Related issues of heat waves are linked to the increased risk of a human collapse. Up to 25,000 people died because of the heat waves occurrence during summer 2003 in the countries of the European Union ((Brücker, G., 2005)[3]. The calculations show that the heat waves during the summer in 2010 caused the death of 55,000 people in Europe (Barriopedro, D., 2011). [2]

The analysis of the representative sample of 9 European cities with the total population of 25 million inhabitants in various places of Europe shows that there is a critical minimum temperature during night and critical minimum temperature during day that determines the beginning of the exposure to the environment of a heat wave. It is characterized by an increased risk of a human collapse resulting in death. Under exposure of the heat wave the risk growth in the EU varies from 7.6% to 33.6% in the relation to the corresponding city (D´Ippoliti, D., et all 2010) [4]. A heat wave is determined by the extreme daily temperature T_{app} given by a formula (1) and the lowest night temperature T_{min}.

$$T_{app} = -2.653 + 0.994(T_{air}) + 0.0153 (T_{dewpt})^2 \quad (1)$$

T_{dewpt} is dew point temperature.

A heat wave occurs if:

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

We can demonstrate on the example of thermal regulation of a human, that a human represents autopoetic system and the fact that his biological body is not extracted out of surrounding environment. The increased risk of organism collapsing occurs when the surrounding temperature reaches the critical value during 48 and more hours. Then the conditions that are incompatible with the human existence can be created, which causes the collapse of an organism from the heat and in an extreme case even the death.
Thermal regulation of a human organism keeps the temperature of the core of the body at the level of 37˚C. The temperature goes down through the body towards the outside and towards the feet. The lowest temperature within the body is in legs = 28˚C. The balance between the human organism and the environment is kept by three mechanisms of the energy exchange. The decisive mechanism - two-thirds - is created by the mechanism of radiation at the external temperature of 20˚C. Mechanisms of conduction and convection form 26% share, the remaining part 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 a human 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 with the speed 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 thermo receptors placed in the top layer of skin. The body is not able to heat the micro climate in the places when the skin is continuously cooled by the airflow. On the other side, the cooled flowing air cools the building constructions much slower and therefore their temperature is higher than the air temperature. Thus the component of the energy exchange by the radiation is significantly lower. The thermo receptors therefore provide misrepresented data about the temperature (lower) to the control centre of thermoregulation.

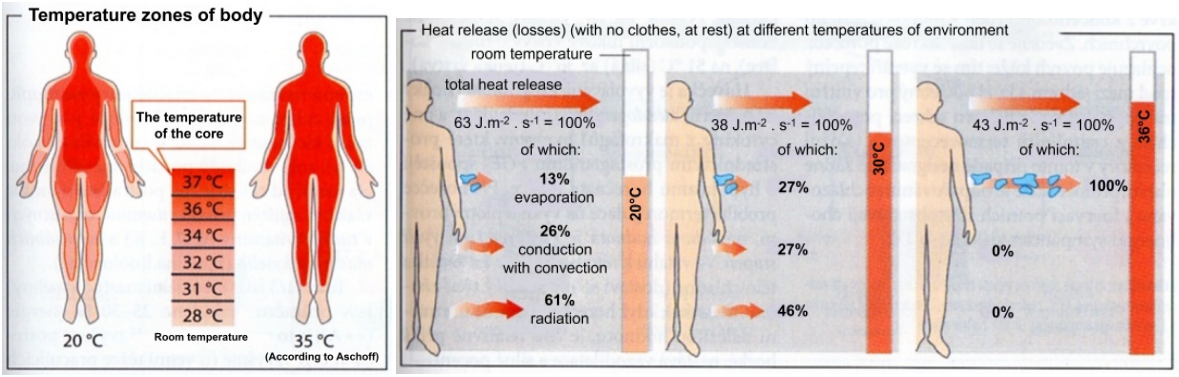


Figure No 18. and 19. Human thermal zones and energy transport mechanisms

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 outside of organism. The internal thermo receptors inform the control centre of the temperature about the actual state of the temperature of the core of an organism. This allows using sympatikus and somatic nervous system to actively manage the exchange of energy with the environment described above by energy transport mechanisms. Distorted information in case of cooling by the convection and the conduction leads to the situation that an organism keeps the heat in the body as a consequence of the fact that the person feels cold mediated by the peripheral thermo receptors of skin. Hence, the energy exchange between body and external environment does not happen. If the person stays in such environment for one hour or more the heat is accumulated within the body. In the case that such person leaves the building cooled with the air flow, he immediately sweats once he enters the external environment.
The situation is completely different in case of transport of energy through irradiation. Such system transport firstly heats/cools the constructions and surfaces of furniture etc. Then, as a second step the construction and surfaces of the furniture heat/cool the air. Therefore the systems of radiant ceiling heating are suitable also for cooling, while they use the same energy transport as is a decisive element of energy transport in the human physiology. Using such systems means improvement of the quality of internal climate in comparison to the quality of internal climate provided by SPLIT systems during summer cooling season. One of the reasons is that system with irradiation transport of energy is able to comply with the requirement of thermal comfort for the parameter of the air ≤ than 0.1 m/s. The split systems are not able to comply with it as a consequence of the principle used.

Similarly, the radiant ceiling system does not cause the reduction of relative air humidity as happens with split systems and radiators. On the contrary to the floor heating system that is rarely suitable only for partial cooling, the large-scale radiant ceiling heating systems are usable even for cooling if a carrier medium is a liquid up to the 4m height of the ceiling.

The use of large-scale radiant system of capillary matting for heating and cooling means the reduction of heating temperature of the media which results in the growth of energy efficiency of the heat pump and the shift of the factor SPF 3 for radiator to 4.5 within the heating and the reasonable 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.

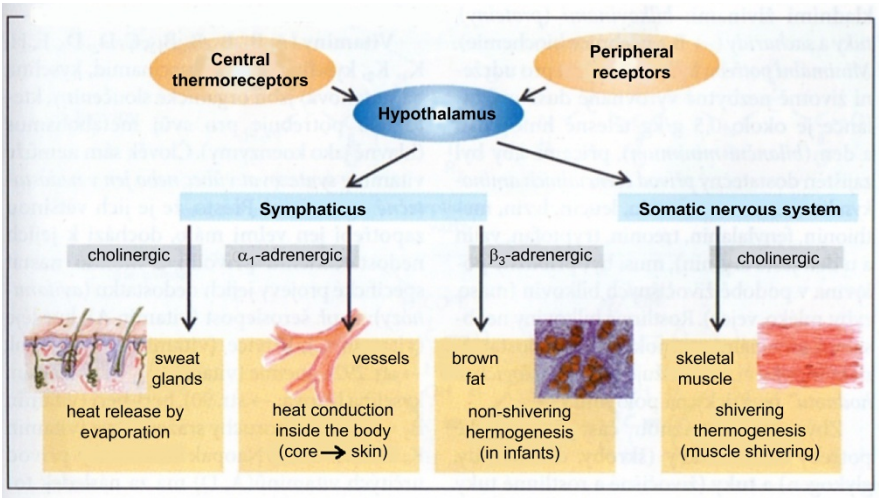


Figure No 20. Control of human thermoregulation

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

1. *expansion of provided range of services by cooling*
2. *To provide the transport energy while respecting the human physiological characteristics in a decisive part by a radiant component*
3. *Synergy effect of technical and ecological parameter is achieved using renewable geo-thermal energy source and a large-scale radiant ceiling heating system of end elements in the form of micro-capillary system.*

3.3.5. INTERPRETATION OF ENERGY TRANSFORMATION RESULTS OF OFFICE BUILDING

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. Experimentally gained data also enable to interpret the physical parameters and correctly understand weighting parameters of social preferences expressed in the consistent form of a model of building with zero energy balance. The reference state of the building is the one from 1996 with corresponding parameters.

The system boundary of the building can be studied in the following logical connections of physical, economic and ecological parameters.

IMPROVEMENT OF PHYSICAL PARAMETERS OF ENVELOPE CONSTRUCTIONS

The application of the modern technologies of envelope structures of the building together with the technologies of energy management shows that we can achieve the savings at the level of 73% within the solution of energy efficiency of heat consumption. In such a case the primary energy in the form of electricity that is necessary to drive the heat pump is not included in the energy balance because the supplied energy for the heat pump drive does not pass the envelope structure in the form of heat, although it passes the economic part of system boundary of the building. Consumed energy for the heat pump drive does not contribute to the heating of the building. The heat is calculated to the standardized consumption by the means of day degrees. The development of the heat consumption from 2002 to 2006 shows the necessity of the realisation of the hydraulic regulation that would eliminate the human factor on the side of heat supplier, who tries to realize the maximum supply even though there is not the need for it from the point of view of actual climate conditions.

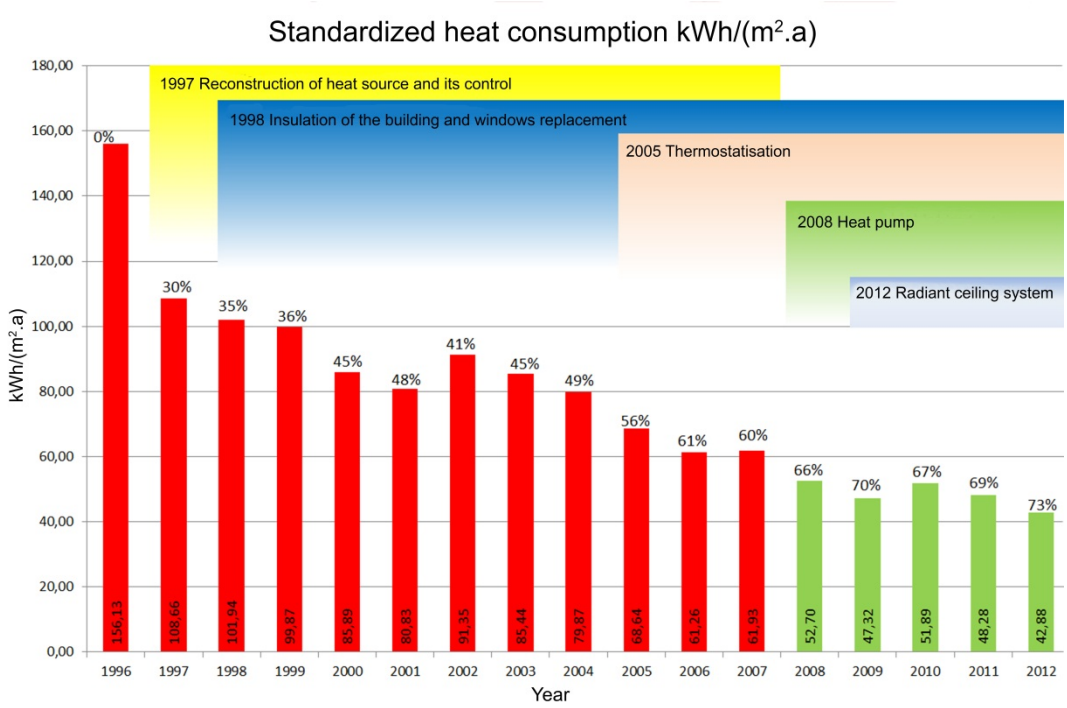


Figure 21. Standardized heat consumption in the office building

ECONOMIC PARAMETERS

National economic level of solution is characterized by the achieved level of savings of primary energy sources entering the system boundary of the building to the level of 87% reaching the consumption state of 29.4 kWh/ (m^2.a) for the heat and 64 kWh/ (m^2.a) together with other mandatory items of the energy consumption related to the operation of the building operation. 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 and does not enter into the economic costs. It will remain so until the state imposes the tax on the energy removed from the well water.

Chart 5. Energy balance of office building in 2012

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 cooling	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 5 shows the evaluation of the balance of all consumed primary energy sources with the achievement of the consumption of primary energy sources of 63.98kWh/m².a. A simple replacement of lighting devices by LED lights brings the building into the zone of the consumption of 60 kWh/m².a.

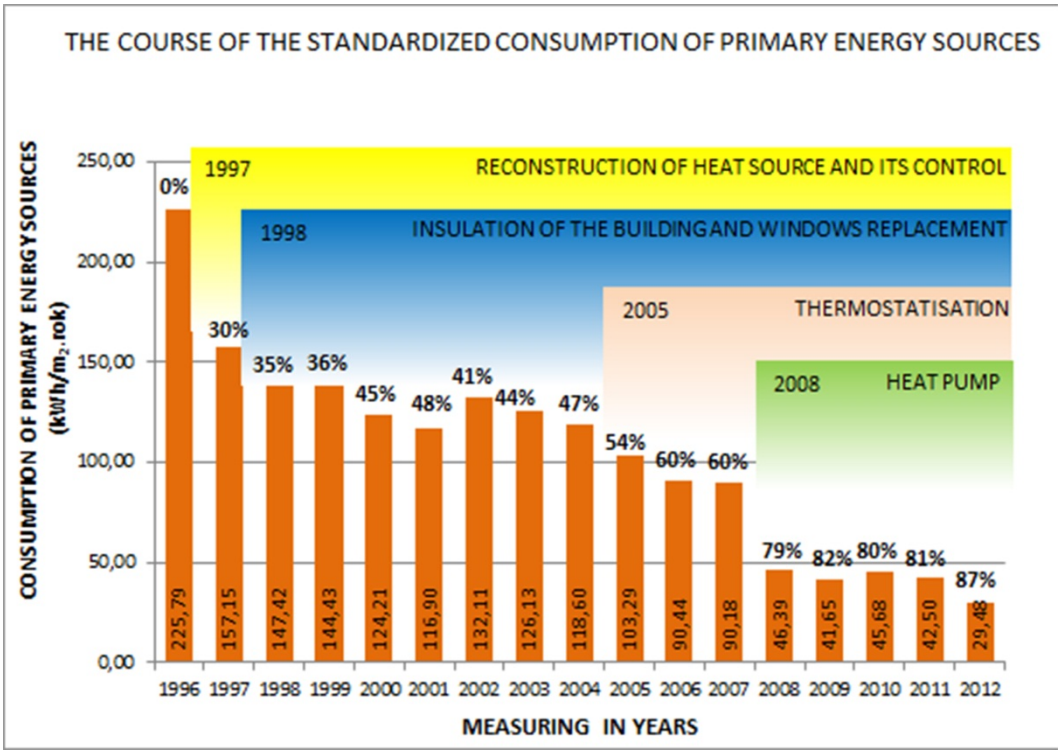


Figure 22. Standardized consumption of primary energy sources for providing the heat in office building

ECOLOGICAL LEVEL OF ACHIEVED STATE

Ecological level of solution is characterized by the achievement of 96% of savings of CO_2 emissions. The realisation of a building with zero energy balance with a corresponding energy supply from the local energy source makes it possible to achieve the state where the gained saving in CO_2 emissions is increased by 177 t in comparison to 1966.

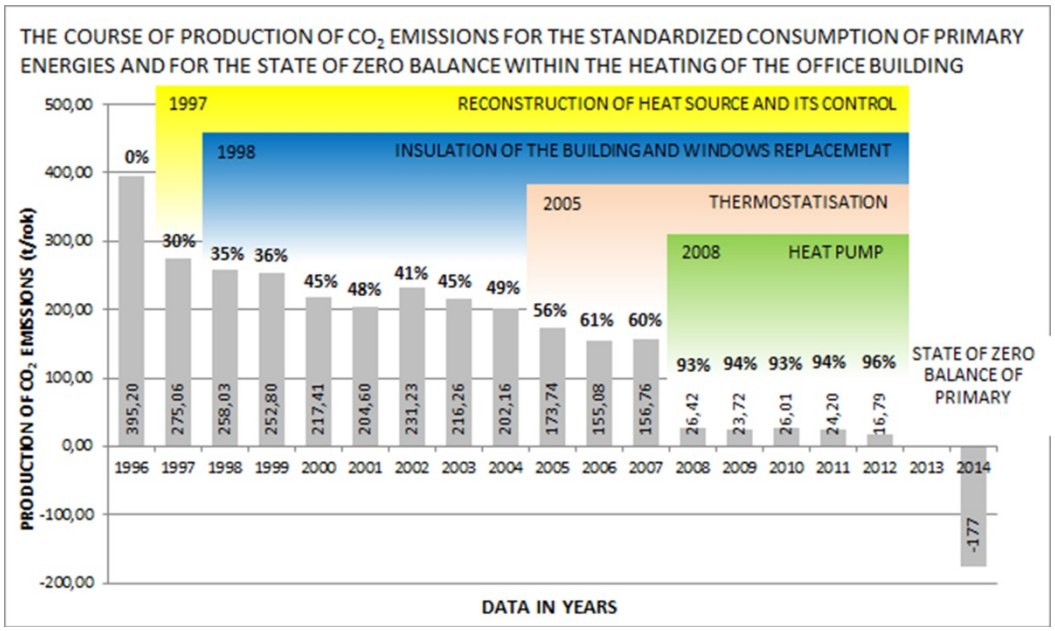


Figure 23. The CO_2 emissions for standardized consumption of primary energy sources in the office building

LEVEL OF INVESTMENT

The investment level is characterized by the solution with the investment return below the level of economic breakeven point for each technology used. Apart from the technologies of radiant ceiling system of heating the investment return within other used technologies has been achieved from the energy savings. The investment return within the radiant system of heating and cooling is gained from the expansion of the range of functionality by an important change in the quality of internal environment which also influences the competitiveness of the building on the market and thus also the level of average occupancy. The energy transport is provided by a radiant component of energy in a decisive part helping to expand the range of services in a building by cooling and thus solve the work efficiency increase, the reduction of ill health and provision of resistance to heat waves that in the extreme increases the risk of organism collapse and death of up to 30% in the case of occurrence of heat waves. It eventually means the increase in labour productivity of persons working in the office building.

3.3.6. COMPLEX ENERGY LEVEL OF TRANSFORMATION OF OFFICE BUILDING

Complex model of the transformation of the office building in Murgašova Street no.3, Košice includes the technologies designated for the improvement of the energy efficiency while supplying the building with the heating and cooling and also the technologies increasing the energy efficiency while supplying the building with the electricity. Only after achievement of corresponding parameters of the energy efficiency we proceed to the transformation of the energy from the conversion of fossil energy source into the sources of renewable type. The advantage in Slovakia is the fact that the factor of CO_2 emissions is in the energy mix of the electricity at the level of 0,23 t/ MWh. Therefore, the replacement of the heat source where the heat is produced by a district heat system with more than 50% coming from coal by the renewable geo-thermal energy source is advantageous when aiming for the reduction of CO_2 emissions.

The technology development in the last decade of the 20th century and the first decade of the 21st century enabled to solve the issue of energy efficiency in supplying the building by the heat and cooling in an economically efficient way. Similarly, the technology of a heat pump meets the criteria

of long-term technology verified by the market and provides the solution with the investment return of the required quality measured by parameters of COP, SPF and parameters of reliability and lifetime. Synergy effects are achieved by the implementation of the micro capillary ceiling radiant system of cooling and heating. Doing this is resulting in the improvement of the quality of internal environment and also in the reduction of the energy consumption. The measurements and subsequent data analysis shows that it is realistic to expect achievement of a whole-year performance factor SPF ~ 7. The initial heat consumption in the reference year 1996 was 8 times greater than the electricity consumption. The solution of energy efficiency with the subsequent solution of the transformation of the supply by local renewable energy for heating and cooling represented the logical progress of primary orientation on the heat transformation and the extension of provided services by the supply of the building by cooling. Gradual development of infrastructure for the electricity that also uses the technologies focused on the energy efficiency and the elimination of human factor create conditions for the transformation of the electricity supply for the building in the form of the construction of a solar power plant.

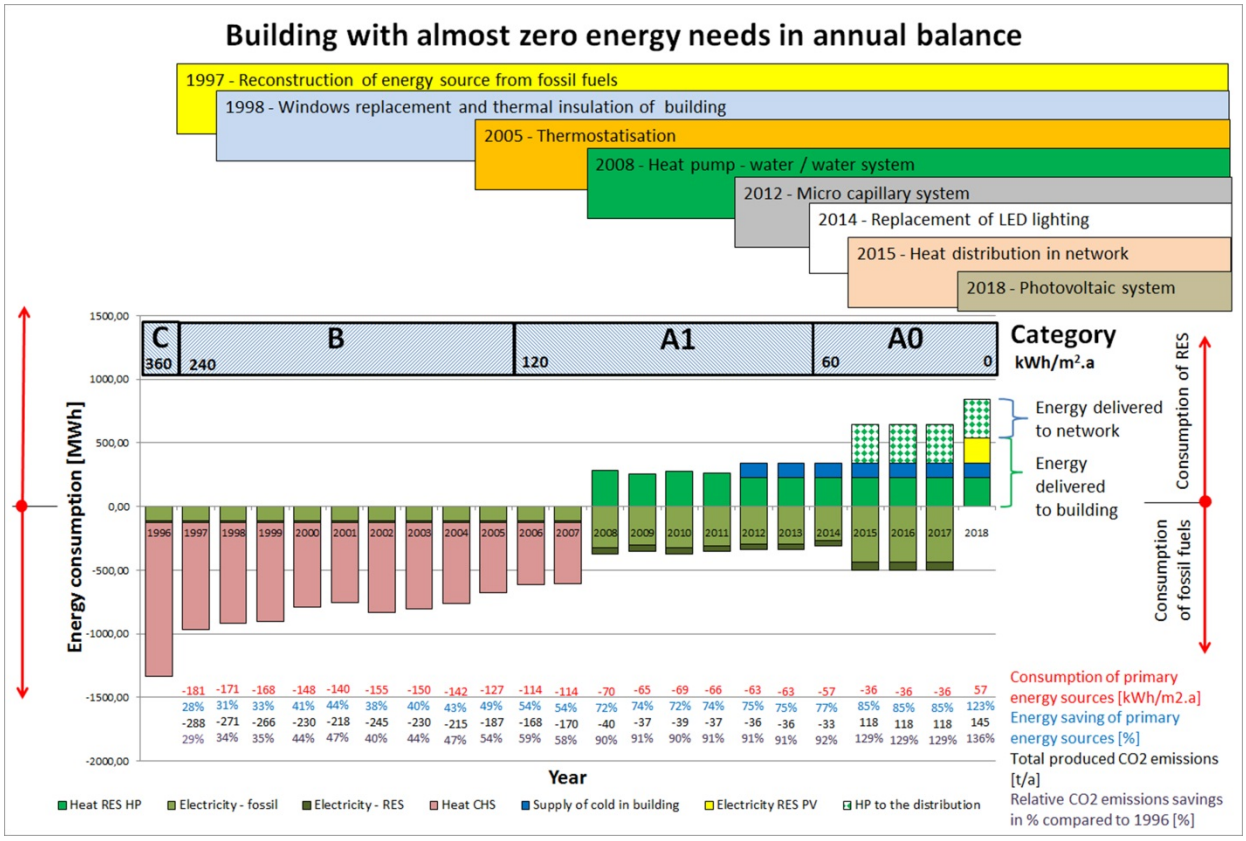


Figure No 24. A complex graph of the course of the transformation of the office building into a NET zero energy building

The fact that technologies applied for the supply of the building with the heat and the cooling represent the solution for climate changes was also very important at the level of buildings in two layers:

- Social layer - reduces the consumption of CO_2 emissions by more than 90%
- Local layer – it counteracts the heat waves by produced quality of internal environment in the summer for the people that work inside the building. If the heat waves occur they represent the risk of a human organism collapse in the range of 7 to 33%.

In the case of electricity supply of a building, there are gradual partial arrangements made related to the energy efficiency. In order to make introduction of solar power plant as economic as possible these arrangements must be done before the replacement of the electricity grid. For example modern technologies of lightning installed together with the sensors that detect the movement of people in the corridors saves a lot of electricity. There is the project designed for the elimination of a human factor within the operation of electrical appliances by the means of individual measuring of the electricity consumption in every room separately. A significant reduction of the electricity consumption is represented by the installation of LED technologies planned in 2014. There are the following facts that are delaying the decision about the realisation of solar energy to 2018-2020:

- There are no accumulation systems on the market that enable the accumulation of energy on the level of buildings and ensure the quality of supply in 24 hour cycle
- Technologies of the smart grid and their implementation into operation is expected in 2020
- Investment return of solar power plants will be achieved in 2014-2015 for the technologies with the efficiency of photovoltaic cells of 20% and more
- Doubling the efficiency of photovoltaic panels is expected around 2018 at the level of 40% to 45% together with the achievement of investment return
- There is an assumption that the suppliers of technologies will solve the problem of higher harmonized waves in a standard way
- Nowadays, the quality and efficiency of inverters and related technology is still developing
- An important role plays the fact that investments have to be distributed over time if they have to be realized from internal sources of the building
- The building will be able, after the construction of photovoltaic source, to cover its whole energy consumption for the operation within the energy balance and also supply the distribution network with the heat of 350 MWh what also covers the consumption for building use (circa 120 MWh per year) and reaches the state of zero energy balance.

3.3.7. CONCLUSION

The realisation of the well-considered plan of the building transformation within accepting the technical development and economical state of technologies enables to transform the building in a reasonable time horizon of 20 to 25 years with the investment return from the own sources of the building. Moreover careful planning and cooperation with the tenants allows transformation of the building without interrupting their operation. A decisive factor of the transformation is the increase of the building value, namely:

- On the social and ecological level by the reduction of accompanying production of CO_2 emissions while supplying the building with energies
- On the level of the increase in quality of internal climate by providing lower ill health and higher labour productivity and substantial reduction of the risk related to the fatal collapse related to the exposure to heat waves as the consequence of climate changes.
- On the economic level where the reduced operational costs linked to supplying the buildings with energies creates the resistance of the building against the risk of the fossil fuel energies price increase after the shift towards the down slope of global Hubbert curve.
- The rise in the quality of internal environment increases the competitiveness of building on the market

These facts harmonize the society's interests with the individual interests of a user and the interests of the investor on the economic base of advantageousness of the solution for all concerned.

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4. Is idea of social system fading away?

Interview concerned social security published in June 2013

SOCIAL SECURITY SYSTEM

Dušan LUKÁŠIK acted as the head of analytical work on the Pillar II pension reform in 1999 - 2002 and as an advisor to the Ministry of Labour, Social Affairs and Family of the Slovak Republic. His opinion that changes to details can destroy good systems will be explained in detail during an interview, by Anna Komová.

The issue of the social system in Slovakia has become a current topic for discussion again. The deficit of the Social Insurance Agency has substantially increased, social systems, together with public money need solutions. The question remains, what is the best solution for Slovakia.

Very often the issue of social system includes solutions that simplify the problem into black and white views, and are often subject to objectives of a particular governing party. Unreasonable money paid out on commissions in 2004 - 2005 amounting to billions of Slovak crowns implies the misuse of political decisions for the benefit of individual interest. Throughout the period of eight years one could hear opinions that the Pay-as you-go insurance system needs to be eliminated and the capital fund increased, while on the other hand, it was said three years ago that the labour revenue was higher than the revenue from the capital fund, therefore the capital fund functioning needs to be stopped, or at least restricted. As usual, extreme solutions are not the suitable ones and provide just a restricted view of the problem, while in the case of the social system, it appears its purpose and implementation seem to be fading away. The main task of social system is to solve social risk of a citizen and his family. The social risk and its categories are precisely defined by the law. The reason why social system is so complex relates to the fact that the complex system of social relations interacts with comparably complex economic system of the Slovak Republic, being connected with economic environment in the rest of the world. These systems dynamically interact whilst at the same time the economy system itself is dynamically evolving. To grasp complexity of such development requires both abstract thinking, in order to define essential parameters of such system, and prognostic analysis methods. Moreover, with modern instruments of capital market and risk management, the complexity is yet to become greater.

There has long been a debate in media on "profitability of first or second pillar". What is your opinion on this issue?

This question was ridiculously raised by media. The initial solution for social system was to fund social risk continuously in so called Pay-as you-go system, including pension, disability or widow's pension and other social risks related to loss of income. The aim of the initial system was to economically finance such social risks so that the society has lowest possible expenditure in order to fulfil the given criteria for benefits coverage. This shall minimize expenditures as a whole, while maintaining basic standard of living of citizens who are facing social risks. The issue of social system needs to be solved in such a way as to motivate an individual - a citizen by suitable means, to prevent misuse by citizens and, at the same time ensuring fulfilment of its purpose. The idea of social system is not to provide luxury, but ensure a dignified living for everyone who is experiencing a particular risk, being classified as a social risk. The way the issue of social system suitability or non-suitability has been discussed in debates in Medias; there were two different groups of proponents. We can say that arguments that the public heard from them had no value at all, moreover, that they had no relevant sense as to the social system solution whatsoever. These arguments were based on accounting principles, with politicians counting votes they would receive at the end, and not how to solve the problem of sustainable social system throughout dynamic demography changes and economy development. The reason is that solving the social system must be based on activating the inner strengths of the social system in order to influence positively formation of the labour market and to promote establishing and sustaining the three-generation

family. The importance of social system to anyone is that he encounters it before birth, through his life, and even after death.

Let's go back to the social system solutions. What is the basic purpose for the Pillar I and II being solved?

The basic purpose for the Pillar I and II being solved lies in several essential facts. First of all, a good solution harmonizes motivation of an individual and required level of social solidarity. This comprises of a merit principle and principle of a redistribution which expresses social solidarity between individual income groups. An ordinary traditional social system, having been proved by years and functioning in many countries, is based on contributions derived from a minimum wage up to the three times of that wage on the part of income. On the part of expenditure it is important to ensure a minimum pension of 1.2 times of the minimum wage for people with lowest income. Unless redistributing resources, the contribution from minimum wages fails to ensure this. In essence, there are two solutions only. If we maintain the merit principle on the part of pension and we shall continue to pay out pensions at 1:3 ratio, as it is in case of contributions, then the social system fund needs to be raised by general tax. The result would bring higher costs of labour and lower competitiveness of our economy. Such was the solution introduced by the second Mikuláš Dzurinda government. The Pillar II based on individual savings means more expensive social system and strengthening merits in the Pillar I means greater pressure on economic sources. The result is that the financial sources of the social system are running out, hidden and without being noticed by a common citizen. After a couple of years the social system deficit will be visible, as it was in 2009, even though experts were aware of it at the time of its implementation. A solution to increase contributions 4 times the minimum wage has two effects: it increases a part of labour costs and a part of a labour with higher income will become demotivated, under the misinterpretation of money being channelled into the system by a citizen. Moreover, such raised problems are impossible to solve this way economically, as evidenced by facts of 2009.

How can the social system deficit be solved?

First of all we have to clearly state that the mandatory contributions into the social system are imposed by the constitution and thus restrict the employers in how to handle their assets, as they are obliged to pay contributions and tax if they want to employ a worker. Basically, for an employer it makes no difference whether it is a contribution from employee's gross wage or a mandatory tax from an accounting point, in both cases it represents an expenditure for the employer. The employer is obliged to comply with these conditions under the threat of property distraint. In this context, the money paid in the form of mandatory contributions imposed by a state, is always public money. What happened at implementing the Pillar II was that the public money, used in social security system, was suddenly divided and it was said, in contradiction to any logic, that it was private money that is to be channelled into private accounts and shall be the subject to inheritance, even though the money is the contribution of which is imposed by law and enforced by coercive measures. This step substantially increased expenditure on social system. The social system is drawn without being noticed, while the solution of 2004 was introduced without the information about future increases in taxes and contributions in advance, so that the shortfall in the social system would be covered. The next significant moment was when the second government of Mikuláš Dzurinda increased the benefit from the insurance social system above the community agreement, which is valid through the active life of a citizen. It was popularly called the merit increase. The social system thus faced a significant problem, because citizen had been working for it, for instance, 40 years under the community agreement on redistribution principles 3:1 on entry in form of contributions, with solidarity redistribution 2:1, and all of a sudden, the social system is being changed on part of expenditure to almost 3:1 ratio. A person shall attain such right when he retires, yet for the period of 40 years when he participates at creating financial resources through the employer's payments, he or she was creating them on part of expenditure under the 2:1 ratio. It is the problem of increased expenditures and the problem of a constitution principle on attaining the rights. For the period of two years since its establishment, the Pillar II has been transformed from initial saving system for pension into a hybrid of saving and insurance system. If the most suitable for a community is the cheapest system, then the Pillar II is undoubtedly the best solution from the economic point of view, being based on insurance principles, the same applies for the insurance system, with redistribution mechanisms from

3:1 to 2:1 ratio. This is one of the most fundamental aspects of a solution that would cut the social system expenditure, yet keep its purpose. An individual account enables to accurately express the merit of an individual under the balanced solidarity, that can be easily checked by an individual. Furthermore, the distribution of risk between the labour revenue and the fund revenue as a source of the pension shall remain as well as insurance principles with applicable degree of solidarity for other social insurance benefits.

There are discussions in the political circles on postponing the retirement age to 65. Is such solution necessary?

We conducted these calculations in period 1999 and 2000. Various social economic models proved that the average age of Slovak population has increased by eight years, in contradiction to the initial conditions of the social system, coming to conclusion that it is crucial to find solutions to financially cover longer life expectancy. Various analyses have proved that Slovak women live eight years longer than men, and women with children live statistically longer than those without. These are facts. However, is it possible, yet correct, to increase retirement age by administrative means without having to consider current health of a citizen. Should it be assessed again by a civil servant? How much grievance will it cause? It is obvious that the free decision made by a citizen needs to be strengthened. It is him who knows best his economic situation, health and motivations. It's been evidenced that to shift such competence to a citizen is far better solution, so that he himself can freely evaluate his situation and objectives, once having fulfilled criteria imposed by the law. Discussion on suitability or non-suitability of the Pillar II included also issues whether to have 10 or 15 years-limit for contributing into the Pillar II. Such question from system solution point of view makes no sense. The only important thing here, as for the social system, is the period of mandatory contributions into the social system, and thus accumulating resources in the social system. It does not really matter whether it is the first or the second pillar. It seems that the minimum is 35 years provided that if the average age increases so does this condition. Once this condition has been met, the Pillar I and II must be tested whether accumulated sources are equal or more to 1.2 times the minimum wage calculated to cover mean life expectancy for the given age. Once this condition has been met, a citizen can decide whether to continue to work or not or whether to continue to work and contribute money in his or her account. This allows creating approximately 10-year interval between 55 to 65 years when it is up to people to assess their then current health and financial conditions, and they themselves shall decide on when and how to retire. Upon reaching the age of 65, a citizen shall be assessed whether there is a sufficient amount of money in his or her account, or whether they shall be entitled to claim a benefit from the social system or social support system. It is quite right to agree with the opinion that the administrative shift of the retirement age to 65 needs to be turned down. The above mentioned solution represents a very elegant way how to approach the people and concern their needs and merits when building up resources of the social system, and of their own, too. Please, take note, that 35-year period of active contributions into the social system does not include the period of a person being unemployed. A citizen must try hard to preserve a job through continuous education and qualification in order to remain attractive in the labour market. An individual account simply requires the people to be active on their own.

There has been criticism related to changes of contributions into the Pension Fund Companies and criteria how to evaluate efficiency of such funds. Can we say that the reason for people losing 20 to 40 % growth in the stock market is due to amendments to the legislation?

Such opinions were published according to retrospective calculations of shares revenue conducted by authors of such opinions, saying that if we had invested into the shares we would have made profit of the above mentioned value. The authors of such analysis assume that they can anticipate the price for shares when going up. I have just two comments to these bizarre analyses. When the second pillar was introduced, the entities had to include in their promotional materials information that the revenues of the past are not guarantee of the revenues of the future. Those who carefully monitor principles of capital market know that the probability of being able to forecast that shares will go up or down is 4 per cent. Thus there is 96 per cent probability of wrong anticipation. These are facts based on specialist literature. All of these "visionaries" are like the wise generals after the lost war. The core of problem that brought the changes to legislation is the change of risk. While before the

changes had been made in legislation it was a citizen who bears all the risk connected with investment, now the Pension Fund Companies are bearing the most part of the risk. But, if it is the Pension Fund Company making decision on investments, why is the citizen being held responsible when he has no influence over it whatsoever? Moreover, a person, making mandatory contributions into the Pillar II each month, is not a voluntary contributor who can stop the payments whenever he wants to. His contributions continuously flow to the account. The crisis of 2008 on financial markets clearly proved that private sector cannot secure even private financial sources, nor it can secure the public money. As in the USA, the EU countries are those who redeemed from public money private banks and financial institutions, or participate in order to redeem the country debt via higher tax payments. When the banks show profits, the revenue is distributed into the private sector in the form of sky high benefits for managers and dividends for shareholders and when the banks are in trouble, the people's taxes cover the loss. Basically the same problem is with Greece. Misconduct of Greek civil servants, incapability of Euro officials and Commissioner, together with rating agencies and bad risk management in private banks resulted in that all Eurozone citizens have to pay through public resources in order to solve this problem. Once again it is the Eurozone public sector repaying insurance to private bank through Greek accounts. Criteria of Eurozone fail to be met and even if we can see some efforts to find the best possible solution to this problem, the pressure from people shall reach such grade that the truth will have to be told and offenders will have to be held responsible. Not just from political point of view. Another scenario is that financiers having received public money which saved their banks shall continue to drink to the Eurozone tax payers at the most expensive Hotel Paris in Monte Carlo, what actually did happen, or they will organise one week party in California as experienced in USA. Here lies also the problem of the Pillar II. First of all, the Pillar II transforms the hidden deficit to be economically expressed and recorded in the financial books. Since many Eurozone countries have only the Pay–as-you-go insurance scheme, the deficit is not recorded in the books, even if it often comes up to 3% GDP. At the same time, the Pillar II assets should be secured against inflation. Because a person, on behalf of whom an employer has been contributing, after 40 years does have the right to receive at least the same value in return when claiming a retirement benefit. This security must be implemented by an administrator of accounts. However, the private sector cannot secure the scope of real public resources that the Pillar II has and will have (around 1 GNP). It simply has no instruments to do it. But the state does. The AIG, the biggest financial institution in the world, went into serious financial troubles near bankruptcy and would have been dissolved with all its fatal consequences of domino effect had there not been hundreds of billions of US dollars provided from the USA state budget. I am therefore not surprised that Pension Fund Companies are not willing to insure assets against inflation, since it proves to be a serious system problem. On the other hand, the insurance based not only on inflation rate but also on wages increases as being the case in the Social Insurance Agency means nothing but increase in expenditure and has no real justification, apart from lobbying the social partner. Try to imagine going to a bank. If you want to borrow money you must prove your solvency, you even need to possess a property to secure the loan. In addition, you have to pay interest, composing of two elements; first one evaluates money up to the rate of inflation and the second part is profit of the bank. That's how a common bank treats people. In case of the Pillar II, the state established a bank where employers pay mandatory contributions (for employees - citizens) imposed by the government as part of the condition under which it is possible to employ people. The Pension Fund Companies borrow money from these accounts claiming that they bring higher value to the money. And they do take charges for this. Indisputably, they should pay back money including the inflation rate (only then they return what had been borrowed) and charges should be derived from the share of the profit. Moreover, they should be able to issue assets guarantee to the level of the inflation rate. Wages increase appreciation represents an unreasonable requirement. As you can see, even a complex problem can be simple, when put clearly. Concerning your question, the Pension Fund Companies were free to invest, especially when the stock market bottomed out, as it was in 2008 and at the beginning of 2009. In the second half of 2008 the top investors in the world sold bonds and closed financial positions (except what was necessary to hold liquidity positions) and invested in stocks in order to protect their money for next 10 to 15 years against inflation, which had been expected in one or two years' time, and should last

several years. Our Pension Fund Companies did exact opposite. They sold stocks and created bond and financial positions. Only time will tell whether it's been the right strategy or not. However, it's been a free decision made by managers of the Pension Fund Companies, thus the responsibility shall rest with them, be it good or bad. It's ridiculous to assume that to sell stock was due to a change of legislation. It's worth noting that if it is Germany or France facing a dilemma of whether to save banks with poor risk management or to indebt public fund system, they opt for indebting the public fund system, currently being the Eurozone. This is also connected with the problem of newly issued money. To withdraw it from circulation means potential loss of the bank sector liquidity. Who shall bear responsibility for possible collapse of banking system that had just been saved? We can learn from the past that such dilemma has always been solved by inflation. The problem of Greece having been solved by another wave of public sector loans simply proves the thesis of applying the long-term solution to the increased monetary base by inflation. Many investors observe such risks more clearly than ever before. Particularly in the USA they do.

Let's go back to the social system reform, concerning demographic developments. What does your experience of the past imply?

Our models of 1999 up to 2000 have clearly shown that unless the situation has been solved, the social system shall create a deficit in public finances of around 2 % GDP. It's the system characteristics of an insurance social system in combination with demographic development. It's been evidenced that dividing system into the Pillar I and II, with 9 per cent channelled into the Pillar II, enhances transforming the social system in a 35 year-long period, where the first 10 years are critical (as) to the stability of the social system. In essence, we should be grateful to the madam minister of labour, social affairs and family for her efforts conducted to stabilize the Pillar II system, even though some significant changes have not yet been implemented. On the other hand, our solutions included arguments that it is complete nonsense to make one generation carry all the burden of economic transformation alone. To transform the social system we have proposed special type of bonds issued by the state, which would be due in 75-year term with interest equal to the rate of inflation plus 1 per cent. This deficit of social system, currently hidden, is possible to be paid off in 75-year term. The problem here lies in the fact that in case of Pay-as-you-go system the deficit is not yet recorded in the books, even though the deficit has been accruing. I am sure, that the situation in Greece shall finally raise this issue and it will be obvious that this problem concerns many countries in the EU. The fact that we don't record it in the books does not mean that it's not there! That's why the debate about the imbalance between the Pillar I and II causes nothing else but problem which gradually uncovers and gets covered again, and gets passed on future generations. The already solved problems shall come back again. Unless we set up an intergeneration solidarity structural fund from the state assets and bonds meant for the pension reform only, we may have problems to find sustainable solutions to the social system. It's also a matter of whether the public money meant for the social system is the money to operate within the free capital circulation, as required by the EU. Slovakia currently offers financial stimuli from the public resources amounting to 15 per cent for foreign private capital. At the same time II. Pillar sends abroad free of charge own public capital. From economic point, this is a complete nonsense that significantly damages public money and financial position of Slovakia as a whole. The current way of solving the social system is unsatisfactory, yet possible to be transformed, upon system adjustments, in order to create positive stimulus and significantly shape the labour market through individual accounts. Such solution will support the creation of family and help them to sustain it under the three-generation model. The social system, however, fails to provide this, or provides it to a limited extend.

Can you clarify the idea of active formation of the labour market and family?

The idea is based on the fact that what is anonymous, without any direct connection with people is later misused or causes demotivation. Generous social systems made people consider children only from an emotional point, not an economic one. The emotional point is very often already met with the first child. It causes demographic problem in many countries, largely in those where the pension scheme provides 50 per cent and more in the form of retirement benefits. It is not the own child, yet the anonymous sack of money provided by a country that ensures the pension. It's been evidenced that this is the key to demography problem. Under such generous security social system a

child is not needed anymore, the child that would take care of parents as it expressed in Three Coins fairy-tale. Instead, all of us anonymously shall put the money together. We all just have to work and pay contributions. The child is not needed anymore to secure pension. It is the same with the system of unemployment. We all put money together in one fund, with only a proportion receiving them back. Once again, there is anonymous relation between payments and a claimant. Unfortunately, there is a whole range of cases of people refusing to work, for less money, preferring to claim benefits instead. Not even mentioning motivation towards the lifelong education to stay attractive in the labour market. As soon as there is an individual account we can solve the social system by dividing the risk, connected with unemployment, into an anonymous common fund and individual account of a person. Thus, if a person is acknowledged that a part of unemployment benefit is paid from his or her individual account, he or she shall think twice as whether to "eat up" their retirement benefit. Moreover, the incentive to broaden education and working habits shall be enhanced. It is very similar with creating the three-generation family economic ties. If we channel a part of a person income tax of a child, after it entered employment, into the account of his or her father or mother, then parents will be motivated economically to have a child at an earlier age and they will invest into a child's education, influencing in this way the amount of income tax that would be channelled into their accounts in the form of retirement contribution and hence benefit. To have a child, or more children, won't be enough, the children will have to work, and with better education they will have higher salaries. This, of course will influence the type of education chosen towards the one that ensures real opportunities for employment in the labour market - in other words, subjects having no real value in the labour market will naturally disappear. With the economic view, the parents will be naturally motivated to have children and invest into their education providing for them real opportunities in the labour market. In this way, as it was in the past, we shall create three-generation families, applying economy proved by generations as written in the Three Coins fairy tale.

You have been engaged with the social system for a long time. When did you actually realise the need to solve it?

We invested in the Gescia company in 1994, concerned with the Pillar III, the supplementary pension scheme. We were interested in middle and long-term investment sources. I started to be concerned with the social system reform itself in 1999. First solutions were proposed at the beginning of 2000, lying basis for the idea of dividing the social system into the Pillar I and II. The process of solving has been subject to many adjustments and long-term tests were necessary. In 2001 it was obvious that the issue requires a major public discussion. Upon reaching an agreement with former minister Magvaši, we distributed material to all concerned to start discussions. It was interesting to observe a whole range of those who want to solve this issue. A whole range of solutions to the social system has been presented. For me it seemed like a great laboratory where ideas and principles are being tested and evaluated carefully. It's more efficient to analyse coming ideas and solutions and to slowly build a social system that would be consistent. I did not dream in 2000 that someone would be driven by greed so greatly and would make people believe that the individual account turning into saving account is positive thing and the insurance principle, with redistribution allowing to fully cover social risks defined by legislation, would be dropped. Furthermore, that people would be deprived of making free choice, violating the equality of opportunities with further impact on their rights as to the amount of retirement benefit claimed. As I have already mentioned, it is the matter of 35-year period, where efficient solution requires at least three generations bearing the economy burden. That's why we have to approach the process with patience, caution and great deal of arguments. Otherwise, if we make mistakes it might be costly in the future to eliminate them. Not many public finance areas are as complicated as the social system is. The social system represents a half of the public finances. Even an elephant can be eaten when consumed in small pieces. That's why the social system should be the topic for public discussions, we should return back to its main purpose and step by step analyse various possibilities and solutions. It's an issue requiring around six years of methodical work, applying solutions proven by the past in order to create integrated system for the benefit of a single person, family and society. Unless a nationwide agreement can be reached, this issue is practically unsolvable, as evidenced by the current situation.

HONORS
Transformation to sustainable society

5. PROPOSAL TO SOLVING THE CURRENT ISSUE OF PENSION SYSTEM AND ISSUES RELATED TO SOCIAL PENSION

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5.1. Summary

The legislative intent discussed by the government of the Slovak Republic on 7 August 2007, no. UV-5450/2002, evaluated two different models. Model A which is based on innovative principles of distribution functions between public and private sector and Model B based on pure concurency model run only within the private environment. A current Pillar II. of the pension system in Slovakia has been created according to the Model B in the year 2004. Since goverment selected Model B solution this in the same time brought a whole range of anticipated problems that relate to the Model B , as having been proved by the 1999 - 2002 analysis.

The proposed Model A solution in the form of the Pillar II. transformation according to the legislative intent, solves a substantial part of problems that relate to the compliance with the principles of equality, expenditures and cost of the Pillar II system, return of assets of the Pillar II and problems connected with the Social Insurance Agency liquidity and with the public finance and state debth consolidation. Its main concern is to reasonable allocating the Pillar II functions between the public finance and private sector.

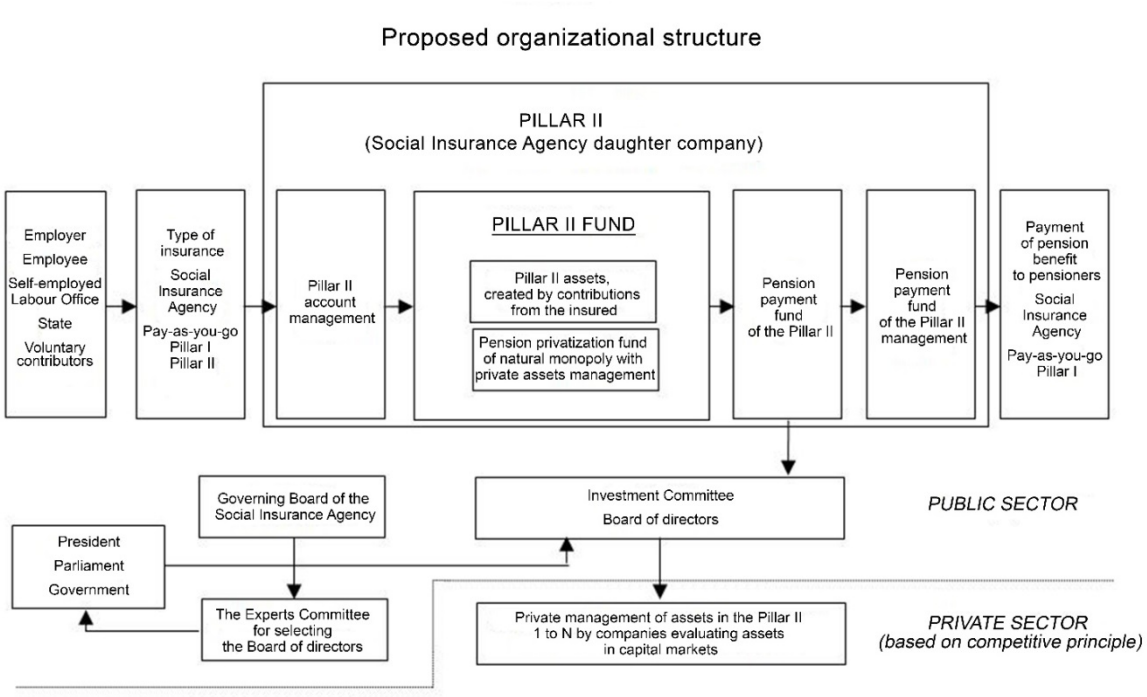

Figure1. Proposed organisational structure according Model A

Keeping the Pillar II accounts with financial cover amounting to 9 per cent provides a solution for equal distributing the risk between labour revenue and revenue from capital fund. At the same time it provides a condition in order to solve demography problems, which is more less a problem known as tragedy of commons including free ride problem. Recognizig these problems many countries like Hungary or Portugal simply canceled Pillar II and asset transferred into the public finance. Reduction of the contributions to the Pillar II has been done in Slovakia. However, reduction of the contribution into the Pillar II does not solve problems of the system. This step only partially solves the problem of the Social Insurance Agency liquidity and of the public finance consolidation.

5.2. Introduction

A long term problem of demography with dependancy ratio falling down has required to create the back up assets in order to form a source of future pensions. Individual accounts and asset on them could be a useful instrument suitable to solve free ride problem. Accounts in the pay-as-you-go system (PAYG) have the registration nature. In the capitalization Pillar II the accounts are financially covered. In ordedr to find proper solution extensive analysis of the different pension systems commenced in 1999. On 7 August 2002, the Government of the Slovak Republic discussed the legislative intent and approved further work on capitalization pension saving pillar (The Ministry of Labour, Social Affairs and Family, 2002). After two years, the amendment to Act on Social Insurance passed in 2004 and Act No.43/2004 Coll. on Old Age Pension Saving System came into force.

Seven years after, the Ministry of Labour, Social Affairs and Family declassified and published inflation adjusted the Pillar II fund returns. What the theoretical analysis anticipated in the years 2000 - 2002 has finally been proven (1), (2) (3) (4). A structure of the Pillar II according to Act No.43/2004 Coll. on Old Age Pension Saving System has naturally led to the funds loss in profits. Such loss is not due to decreased market efficiency, yet the loss in profit is caused by wrongly established system, in contradiction to the Ministry of Labour, Social Affairs and Family recommendations of 2002. Expected losses occurred as a consequence of the Pillar II structure according to act No. 43/2004 Coll,. The calculations have been done to ultimu 2011. The calculated Pillar II funds loss against inflation reached almost 12% and against conservative model based on 2% annual real returns loss of Pillar II funds reached 30%. Based on analysis of various modles all these figures for a Model B has been anticipated already in the year 2000. In reality the situation is given in the figure No 2.

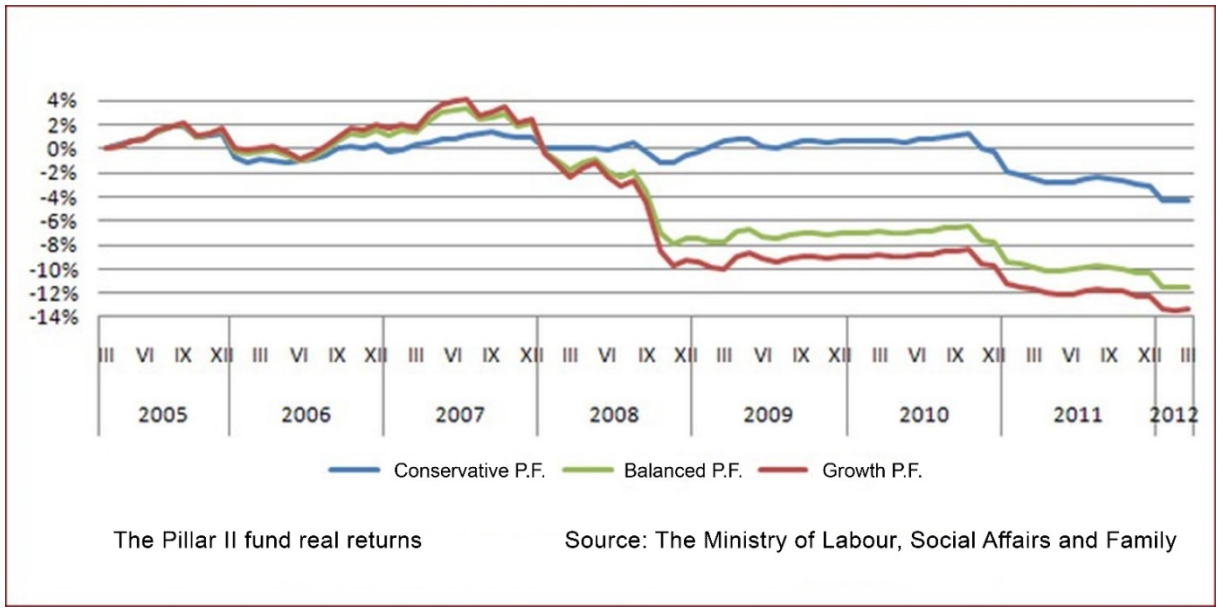

Figure No 2. The Pillar II finds real returns

The roots of this huge loss are due to consequence of following main findings:

1. *There is no market with the Pillar II accounts. Therefore, an incredible amount of SKK 9 billion were spent on marketing and commercials and Pension Asset Management Companies (DSS) providers, without having any value for people.*
2. *According to the Ministry of Labour, Social Affairs and Family, depreciation of the funds' assets amounting to 4.86 billion euros is 4.36 % in conservative pension funds, 11.65% in balanced*

pension funds and 13.62% in growth pension funds against inflation, average of 11.98% in total amount of EUR 661 billion as of 31 December 2011.

3. *Assets have however been depreciated against conservative parameters by 2% above inflation rate on average by 30.27%, in total by unbelievable EUR 1, 471 million*
4. *Fund assets have been depreciated by 33.27%, being EUR 1,617 million, against standard amount of 3% appreciation above inflation, used in the OECD analysis* and documents of the Ministry of Finance.

The following calculations show that the Pillar II funds have been suffering a loss against inflation basically since its establishment, with even deeper deficiency since 2008. Upon closer examination we can see that unfavourable results are caused by ineffective system distribution of functions in the Pillar II between public finance and private sector, and partially by guarantee imposed on the fund management companies of the Pillar II. According to authors, a state may not simply terminate the guarantee to a person upon dividing the mandatory pension system and transfer such guarantee to a private sector. People, who pay mandatory contribution into the Pillar II, must be granted certain guarantee by the state, just as it is in the Pillar I based on PAYG principle. Great Britain dealt with similar situation in the 1990s, when pension funds incurred loss of up to 40% as a consequence of incorrect regulations. Finally, such losses had to be paid to people in the form of approved claims for pensions. In addition, the financial crisis of 2008 - 2010 proved that the private sector fails to secure public finance within the pension system, on the contrary, the public finance were used to save the private sector, including the biggest financial institution in the world, the AIG.

Profit/loss calculation in the Pillar II funds against inflation and against conservative annual returns of 2% and OECD model of 3% annual returns.

as of 31 December 2011	Assets value net		Amount of monthly contributions	Profit/loss against inflation	Value of assets	Value of 1% assets	Value of assets, unless evaluated by inflation	Loss	Loss with 2% appreciation		Loss with 3% appreciation in accordance with calculations made by	
	parameter		%	%	%	€	€	€	%	€	%	€
	Net value of assets in a conservative fund											
	53.00.	AEGON	0,025%,									
	130.20.	Allianz	0,025%,									
	153.80.	AXA	0,025%,									
	36.40.	Poštová banka	0,025%,									
	34.60.	ING	0,025%,									
	99.30.	VÚB	0,025%,									
	507.30.	**In total**		**-4.3.**	**95.7.**	**5.30.**	**530.09.**	**- 22,79**	**-18.75%**	**- 99,37**	**-26.58%**	**- 140,91**
	Net value of assets in a balanced fund											
	119.60.	AEGON	0,025%,									
	483.50.	Allianz	0,025%,									
	310.90.	AXA	0,025%,									
	72.60.	Poštová banka	0,025%,									
	169.30.	ING	0,025%,									
	242.40.	VÚB	0,025%,									
	1,398.30.	**In total**		**-11.5.**	**88.5.**	**15.80.**	**1,580.00.**	**-**	**-26.35%**	**- 416,33**	**33.87%**	**535.15.**
	Net value of assets in a growth fund											
	325.40.	AEGON	0.025%									
	940.90.	Allianz	0,025%,									
	837.70.	AXA	0,025%,									
	158.80.	Poštová banka	0,025%,									
	329.50.	ING	0,025%,									
	363.90.	VÚB	0,025%,									
	2,956.20.	**In total**		**-13.4.**	**86.6.**	**34.14.**	**3,413.63.**	**-**	**-28.00%**	**- 955,82**	**35.84%**	**1,223.44.**
31 December 2011	**4,861.80.**	**DSS in total**					**5,523.72.**	**-**	**-**	**1471,52**	**1,617.68.**	
Average loss in %								**-11.98%**	**-30.27%**		**33.27%**	

Table 1 Calculations of the Pillar II losses in comparison to inflation, conservative model of the assets appreciation by 2% above inflation rate and to a model used by OECD and the Ministry of Labour, Social Affairs and Family with appreciation of 3% above inflation.

A solution to the Pillar I and II, in accordance with Act No. 43/2004 Coll., suggests inefficient distribution of functions between public finance and private sector, out of which the following shall arise:

a) The construction of the Pillar II according to Act No.43/2004 Coll. Creates moral hazard for the insured people. Because of this a free decision of a person in the course of selection of a particular pension asset management company in the Pillar II has been damaged. The result is

inequality among people, having impact on their property rights which means that people draw different pension benefits despite having contributed the same amount into the system. Most likely, this contradicts the Constitution of the Slovak Republic, Art. 12 (1) and 13 (3).

b) There is a responsibility of the state against insured people. This responsibility must be expressed in proper regulation and guarantee. The solution must solve this relation between insured people and state and between state and asset manager if the asset management lies outside public finance. At the end the allocated asset must be guranteed at least aginst loss due inflation or better in the same way asi s guaranteed PAYG system of the Pillar I.
c) In mandatory Pillar II there is no market with the accounts management. This market has been artificially established. This prevents taking advantages from economy of scale concerning account management. This lead to a consequence of higher expenses for the system.
d) The artificial competion on the level of account management in the same time monopolise the asset on the account in fovour for the asset manager. It introduces conflict of interest between account and asset management. Many analysis indicates that this is the main reason why effective competition on the level of assets management is not possible, consequently decreasing assets returns, whilst the assets management monopolises assets for their own benefit
e) It is not possible to eliminate conflict of interest in the structure of Pillar II according the Model B, consequently decreasing assets returns
f) In the present structure financial reserves in the Pillar II accounts are impossible to be accounted in the public finance and thus the state debt amounting to EUR 4.86 billion and permanent consolidation of public finance amounting to around EUR 700 million per annum is impossible to solve, having to increase costs for public finance debt. Decreasing contribution from 9% down to 4% is not a systemic solution
g) Increased costs on debts service (higher interests due to higher debts of the state) amounting to EUR 300 to 400 million as it is anticipated for the period of 7 years

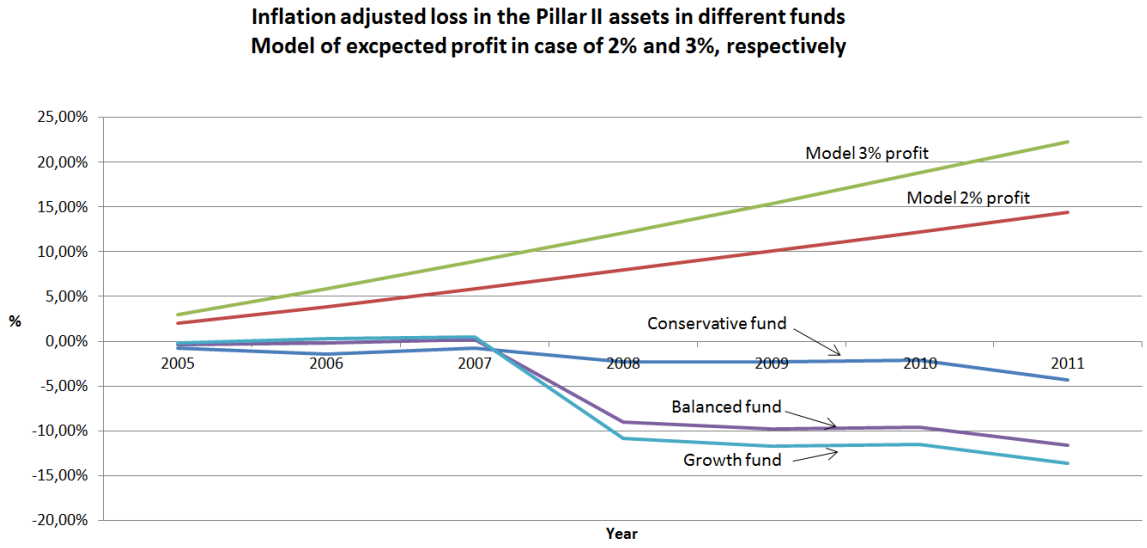

Figure No 3.

5.3. Problems that require solution

To solve problems connected with social system in the Slovak Republic, we hereby propose the following:

1. To solve the issue of accepted level of solidarity and merit principle in the social system, upon having to comply with the minimum costs criteria, under ILO recommendations 3:1 ratio as for the contributions and reduction as for the benefits with not properly set merit principle, in order to ensure pension benefit equal to 45% (50%) of average wage during the period of 35 (40) years of having to make contribution into the system.

2. To divide the pay-as-you-go system into the Pillar I and II, having to keep individual accounts in the Pillar II and financial cover of assets in the Pillar II with optimal division of functions between public finance and private sector with solving the following:

    a) Expenditures connected to accounts management and assets management
    b) Return of assets
    c) Guarantee of the state to people and of the private sector to state
    d) Liquidity and solvency of social system
3. To solve of tragedy of commons and free rider problems:
    a) In the labour market
    b) With human capital having been formed

4. To squeeze down the risk when people start families with more children, representing a separate part of the problem

5.4. Proposed solutions

Only with individual accounts is it possible to approach the problems of free riders, either in the labour market or with human capital formation. The main purpose for dividing the PAYG system into the Pillar I and II is to distribute risks between workforce returns and capital returns. In the 40-year long run, the workforce returns shall reach 2-3% (6) and capital returns 3-4% (7) above inflation. Pension system divided into the Pillar I and II under act No. 43/2004 Coll has included a whole range of drawbacks which, in combination with solidarity on a side of expenditure, brought a full range of problems into the system in the period of 2003 – 2005. They can be summarized as follows:

A principle of solidarity, expressed by 3:1 on the side of income with reduction 1:2 on the side of expenditure, was weakened by politically motivated strengthening of the merit principle on the site of expenditures. This makes pressure on an income side. The result of such weakened solidarity is that there is insufficient amount of resources; moreover pension benefits differ unreasonable more in amount, leading to financial expenditures being increased with all its consequences of positive feedback. **An increased ratio to 1:4 and considered increase to 1:5 shall result in increasing the financial cost. Rise of the cost of labour will result in rise of the unemployment. Increasing number of unemployed people will increase expenditures of the system**. **This way a positive feedback will start to operate**. Some employees with higher salaries will become self-employed or they establish their own companies, pushing their salaries down. As a consequence, the measures shall miss the aims. Therefore, an effective solution seems to be to return back to solidarity with the 1:3 ratio on the income side, with pension benefit amounting to 45% to 55% of average wage, depending on the number of years contributing into the system (35 - 45).

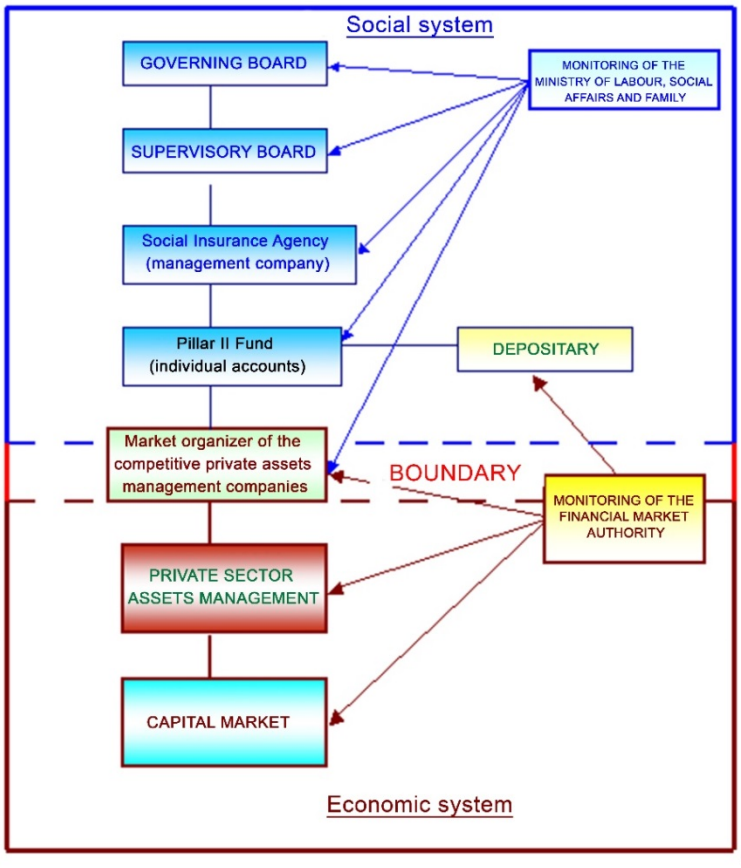

Figure No 4. Systemic distribution of functions between public finance and private sector

Upon dividing the social system into the Pillar I and II, having to allocate the functions between public finance and private sector wrongly, the insured citizen - the Pillar II contributor is forced into the situation of moral hazard. The risks that the state should be responsible for, as it is in the Pillar I, were passed on a citizen, through the private sector. Contributions that the citizens paid into the Pillar II, upon having been ordered by the state, are free of any guarantee, and if, then only in a limited way. People are not aware of such risk, and even if, they do not have the right instruments, or knowledge, to manage it. The state secured risks in the Pillar I and valorises pensions every year, yet the risks in the Pillar II shall remain unsecured due to wrong distribution of functions. The private sector does not dispose of any instruments to secure risks connected with public finance in the Pillar II. Since the state did not require the guarantee from the Pension Asset Management Companies for adequate appreciation of assets, all the investments were carried out at the citizen's own risk. Upon implementing guarantees imposed by the state on asset management companies, the risk of investments, thus returns of the funds, have substantially decreased. It is worth noting here that the loss in profits, due to currently set system, were envisaged by analytical materials in the period of 2000 - 2002 (1) (2) (4) (8) (9) and were the main subject for discussion at the conference on pension system reform taking place in June 2002 in Bratislava (3) Such disastrous results of assets appreciation are not due to the crisis, yet due to the wrong construction of the system, in particular due to unproper allocation of functions of the Pillar II between the public finance and private sector.

The analysis above resulted in the Ministry of Labour, Social Affairs and Family proposing to government to adopt a plan A, called also the Canadian model, on 7 August 2002. New Government, however, adopted a current Model B, called also the Chile´s model, based on act No. 43/2004 Coll. (10). Results of such construction of the PillarII has been analysed in 2007. The results were

presented by Mr Maroš Kondrót at the National Council of the Slovak Republic in December 2007 (11) (12). Summarized problems of the Pillar II pointed out to high losses and proved analysis of 2000 – 2002 period.

Present reduction of contributions into the Pillar II to 5% level basically fails to solve any major issue, except for an immediate liquidity of the Social Insurance Agency and a partial decrease of the public finance deficit.

5.5. Solutions to the current problems are to be summarized as follows:

1. To strictly define social risks in legislation and fix it in order to provide stability of the system

2. To introduce balanced solidarity and merit principle to the pension insurance system, in accordance with the ILO recommendations, with the contributions of 3:1 at the entry and 2:1 at the output, having to minimize expenditures for securing the system, and thus ensure the economy competitiveness in the Slovak Republic. To provide financial resources to the social system from contributions and eliminate, or minimize, income from general tax.

3. To harmonize the Pillar I and II with the Constitution of the SR and ensure that with the same amount having been contributed into the system the people are guaranteed the same pension benefit. The public finance principle implies non-existence of a market with the accounts management in the Pillar II. Solving one account management shall solve the following:
    a. It uses economy of scale and thus substantially reduces costs of account management
    b. It eliminates a conflict of interests with account and assets management, thus increases assets returns
    c. Having a third subject in between the account management and assets management solves the conflict of interest and introduce into asset management real competitiveness, thus it substantially increases the yield of the assets
    d. It establishes equality between people and harmonizes legislation with the constitution principles contained in Art 12 and 13 of the Constitution of the Slovak Republic
    e. Upon deciding the accounts management within the public finance, the state may set effective guarantee for the Pillar II accounts that equals to the Pillar I guarantee, having to create a system with exactly defined contribution up to the scope of guarantee. Returns above the state guarantee represent the defined amount of contribution.
    f. Upon deciding the accounts management within the public finance, the public finance debt can be cut by EUR 4. 86 billion and the public finance can be consolidated permanently by around EUR 700 million per annum, leaving the principle of financial cover in the Pillar II unchanged. (Indicating data to ultimo 2011)
    g. Upon managing accounts by one administrator it is possible to achieve cost of the system as much as 0.2% of assets per annum

4. Upon introducing competitiveness in the assets management in the Pillar II system the returns is expected to appreciate of 2-3% per annum or more

5. The discribed distribution of the functions between public finance and private sector allows the state to offer guarantee on the individual account of Pillar II in the same way as it does in the Pillar I.

6. Establishing the intergeneration solidarity fund as part of the Social Insurance Agency shall solve the problem of the Social Insurance Agency liquidity.

7. If an agreement is reached then it is possible to set the same level of solidarity at the entry in either Pillar I or II, having to reduce costs spent on system and increase competitiveness of the Slovak Republic economy on international markets

8. It is reasonable to separate the assets management from the accounts management by the third subject - Investment Committee and thus solve the conflict of interests and at the same time separate public finance from the private sector, having to increase assets profitability

9. Solving solidarity in the system suggests a period of 37 years of contributing into the system. ***This gives the citizens an opportunity to freely decide when to retire,*** if the following criteria are met:
    a. They actively contributed into the social insurance for the period of 37 years
    b. Their calculated pension benefit amounts to 1.2 times the minimum wage for his or her individual length of life

10. The number of years of contributing into the system is worth to connect to the medium life expectancy

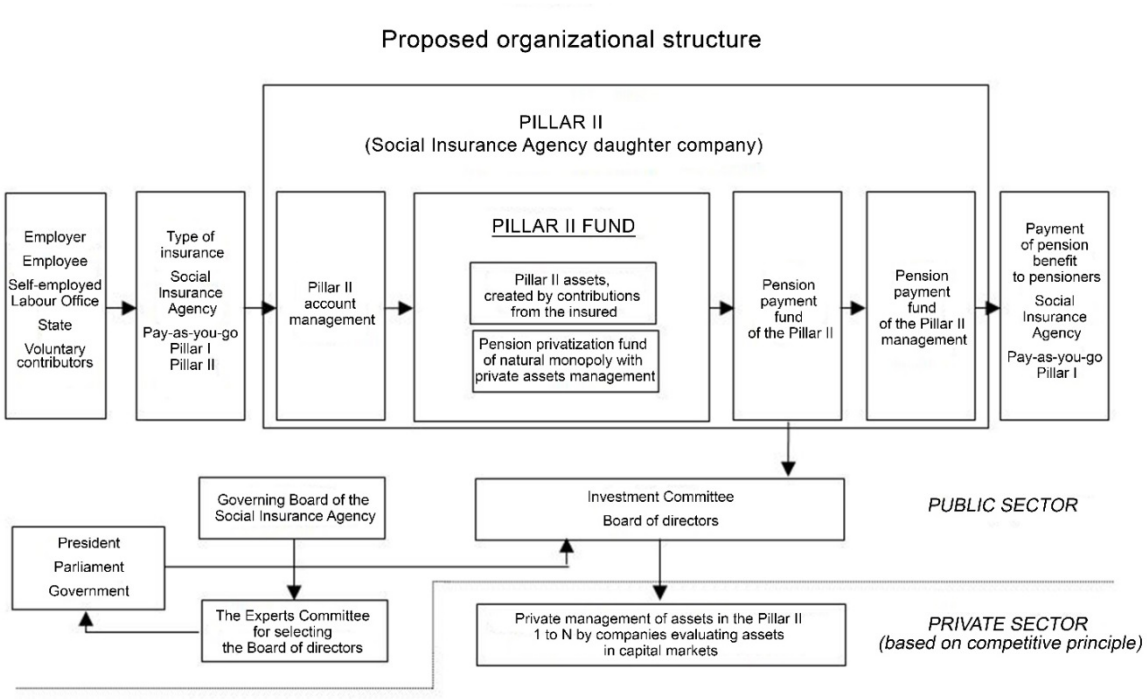

Figure No.5. Proposed organizational structure of the Pillar II.

The main purpose for contributions of 9% : 9% contributions meant balanced division of risks between capital returns and workforce returns. The reason is that workforce returns in the 40-year long run reach real 2% to 3% (6) and real capital returns reach 3% to 4% (7). With 2% capital appreciation above inflation the wage refund can amount to 45% during the period of 35 years, if cost of the system in form of charges are no more than amount to 0.1 %- 0.2 % of assets per annum. Reducing contributions into the Pillar II and keeping it as it is now does not solve the problems of

wrong allocation of function between the public finance and private sector. Only after the right allocation of the Pillar II function is it possible to eliminate the free ride problem in the social insurance system both in the labour market and as a problem to form a human capital.

5.6. Problem of demography

A significant problem of the social system represents decreasing reproduction of society, called the demography problem. In a three-generation family the property intergeneration redistribution of sources takes place on individual levels among the family member. The children were obliged to secure pension for their own parents through family's property. Events occurred on statistical base of the past connected with social risks lead to establishing public goods in the form of a social system. An individual risk of a person, covered by own child and his or her ability to create values, had been changed and distributed among a number of anonymous children living in the state. Out of sudden, an own child's participation at creating future sources for the parent becomes insignificant. Until that time a child had been fulfilling both emotional and economic function. In a modern PAYG social system, however, economic function of a child is fading away. In the course of two generations the results have shown that one child fulfils emotional function for the parents and since the economic function for parents had lost its importance, many families became fairly happy with one, or two children maximum. Reproduction of society is on average at a rate of 2.1. Therefore families with fewer children create a problem for society, being addressed in economy as a free rider problem.(13) As soon as the problem of living singles or couples less childe or having only one-child spreads further, it brings a problem of the public goods sustainability in the form of a social system (13). The problem of demography, as it is in the social system, enlightens the economic function of a child. We can say that only the system of altruism, without any individually motivated stimuli, is unsustainable from a long term point of view (14). All systems of altruism without any guarantee or economic motivation have failed (15). The public goods comprises of social, and mainly pension system that we all bear responsibility for, but to such insignificant extent that no one considers creating other sources, except for financial contributions. Singles and families with fewer children than the 2.1 reproduction rate are responsible for the free ride problem. Their pension benefits depend more or less on other children rather than on their own. Investments to bring up two or three children are several times higher than financial contributions into the pension system paid by an individual.

This free ride problem is connected also with the level of knowledge acquired by the child, out of which the amount of remuneration shall arise in the labour market. Unless parent invest into their children sufficient amount of resources for education and skills in order to get ability to create values according to the labour market demands, the children would fail to find a job (even if they graduated and were awarded a title) and they would do not create real values. On the contrary, they are inconvenient due to having to increase unemployment and many times it is necessary to provide other sources for their requalification. The socially non-adaptable citizens represent an extreme for society.

It's been evidenced that the income tax revenue could be taken as an objective indicator for showing amount of human capital having been produced. Construction could be created that way that part of next income tax of a parent´s child would create an economy stimul for parents in form of benefits having been paid into their individual account. This could be an economic motivation for the parents to start a family earlier, families would have two or three children, and most of all, and parents would invest in such education as to enhance child's opportunities in the labour market. The other part of the solution lies in the fact that the volume of 18 years expenditures being spent in order to have a child is more less the same as contribution during working time to social system, pension part of it. Statistic agency In Czech Republic estimated it in the range of 50 000 € to 70 000 €. The free ride problem would be solved if all participants to pension system will pay the same social solidarity adjusted amount of money regardless whether they invest into the child or into the social

system. In order to equalize the expenditure for all involved a special contribution to social system should be impose on singles or children less couples. A problem of moral hazard, crated in the construction of the social system by the state, would be substantially eliminated in long run. It has many consequences. For example when the child will decide about his/her further study the right question of the parents should be "what will you do to ensure living for me during my pension period?" instead of present question which generally is as follows "from what source you are going to live?". Such principle is reasonable to restrict to 3 or 4 children in a family proposing that 10% of a pension benefit should come from an income tax per child. This would mean that 20% to 30% of a pension benefit for a parent comes from an income tax of his or her own children. We can assess that the number of years contributing, through a natural person income tax into the account of his or her own parent, would be within 15 to 20 years. Moreover, it would motivate young people to start a family at an earlier stage having two or three children and invest into their proper education.

5.7. Merit principle and solidarity in the social system

Documents published by the Ministry of Labour, Social Affairs and Family with the aim of providing basis for discussion identify two main problems that the society has to find answers to. To what extent do we want to have a pension system based on merit principles and to what extent should be based on principle of solidarity and besides this to what extent do we prefer relatively more generous system with higher pensions in the future, and therefore ready to bear higher tax burden. We can jointly formulate the questions as follows:

"Is it better for a society to have more expensive pension system or is it better to have a pension system which provides decent life covered with all the social risks arising, with the lowest possible costs, which will be guaranteed to the citizens by the state?"

Social risks are exactly defined in terms of features and cost. The social system provides exact information how much expenditures must be available in order to cover the cost of such risk which will ensure decent life of those who are exposed to certain social risk. Naturally social risks are of random character. Not every risk can be exposed on an individual. Therefore, the insurance principle solves such systems on a collective level with much lower costs than the individual saving systems, which are not able to provide enough sources for covering such social risks. Another substantial reduction of the social system costs can be achieved through the combination of solidarity and merit principle. They represent two trends, contrary to each other. Therefore it is necessary to find a balanced and harmonized solution to bring the two trends together. The merit principle is based on an idea to keep reasonable economic motivations in the system for those individuals with higher income. Some social and pension insurance benefits, such as old-age or disability pension are differentiated depending on amount of contributions having been paid by an individual. On the other hand a solidarity principle suggesting a redistribution of sources, which substantially reduces costs of system. Upon harmonizing solidarity and merit principle we can achieve such solution that ensures the lowest possible costs of social system, generally accepted by society. This shall ensure higher competitiveness of economy in international goods, services and investment market. A balanced system, recommended by ILO, represents a system based on 1:3 ratios, while the system provides pension benefits amounting to 45% of average wage after the period of 45 years of having to pay contributions into the system and 50% after 40 years of contributing. The system must at the same time prevent rise of the input costs from the point of view of social system in form of useless expenditures because such pressure will immediately increases pressure for entry costs. This makes the system more expensive hence it will lower the competitiveness. As a consequence, the number of unemployed people will increas and therefore income into the social system will decreas which implies that the entry costs are rising, having impact on competitiveness of economy. Such positive feedback for increasing the expenditures and

costs has a negative impact on competitiveness of economy. Therefore, any increase to expenditure on social system must have sound grounds and must be financially balanced.

Like any other system, permanently sustainable with a man in the centre, also the social and pension system must be formed in such a way as to consider human character and emotions (17) (18) (19). A well planned system must, in addition to setting a social role, include both a motivation element which identifies an individual with social aim, and a repressive element which punishes those participants in the system who break the rules.

Nature has developed through evolution such systems that allocate sources (human and material) with the maximum efficiency, well expressed by organization of the hunt for a big animal (14). Economics described such systems as systems of altruism with guarantee (20), or as organizing cooperative and competitive market (15). In case of social and pension system it means to harmonize those problems that contradict each other, that is the individual merit with collective solution to the problem. The main aim is to establish such system with lowest possible costs that would guarantee covering the social risks to each person. Moreover, the solution must guarantee that each participant to the system has both a repressive element and economic motivation in order to be an active participant in accordance with its functional structure. In order to maintain competitiveness in the market, it is vital for any economy to have the lowest possible costs related to labour. This means preserving reproduction in form of human capital, i.e. number of children, health of population and acquired knowledge in order to create values.

The Constitution of the Slovak Republic guarantees the citizen freedom. On the other hand the state has the right to restrict freedom by legislation unless such restriction solves the problem of society. When restricting freedom and legal rights, the legislation must consider its main purpose and apply it only when aiming at particular target. Under the same conditions, all people must be equally restricted and duties and rights must apply to everyone equally. On the other hand there is a state which according to law has to give guarantees to its people, the guarantees which meet the Constitution principles.

First question that needs to be answered is whether 45% (50%) wage compensation during the period of 35 (40) years of making payments into the system and minimum of 1.2 times the subsistence minimum for the retirement after 35 years of having to contribute into the system means a decent life for people who retire.

Second question is whether the period of 35 years of active contributing into the social system, under the medium lengths of life represents adequate criteria in order to claim pension benefit from the social system. This ensures freedom of choice for people when making the decision to retire within 57 to 65 years of age.

Third question is whether solidarity, expressed in the form of contributions restricted to three times the minimum wage at the entry and with reduced pension of 45% to 50% of the pension benefit at the output, shall represent good enough motivation for every person and entities when creating collective sources of the pension system public goods. We hereby note that decent life connected with social risks is ensured by the lowest level of social contributions.

5.8. The free rider problem and labour market

A number of employees in the labour market are not interested in increasing their qualification and in case they lose job they are not willing to find a new one. The free rider problem comes to light when unemployment allowances from an anonymous collective account, where each employed person contributes, are being paid out. In Singapore and Malaysia, the solution is based on fact that a part of unemployment allowances is paid from an individual account. Motivation of a person to remain attractive in a labour market is thus connected with his or her pension benefit (21), and if substantial part of that pension benefit is used at the productive age then it is substantially decreased when person retires.

5.9. An issue of political presentations

An idea to separate a former pay-as-you-go system of pension insurance into the Pillar I and II, with individual accounts, has not been target to solve problems of solidarity and free rider problem. In this form of Model B together with other details has proved that this construction is not able to solve the social system at all.

First, the pay-as-you-go system experienced unreasonable cancelation of balanced solidarity and merit principle at the output during the period of 2002 – 2006. This results into necessity rise up the contribution ceiling which increased from 1:3 to 1:4 in the period of 2007 - 2009. As a result, cost tight to social system have unreasonably increased hence competitiveness has decreased.

A substantial problem of the pension system was the pension reform suggesting separating the social system into the Pillar I and II, the process which was lacking for any reasonable allocation of functions between the public finance and private sector. As a consequence, there is moral hazard for people, high costs, low returns, and conflict of interests when managing accounts and assets and failure to provide people with guarantees. Applying saving principle (no solidarity only merit principle) in construction of Pillar II rised very serious problem since calculation shows that about 60% of the contributors to Pillar II do not fulfill the criteria of 1.2 times the minimum wage. This will need to increase the general tax expenditures. In addition, Model B does not solve the most fundamental problem and that is the equality between people participating in mandatory system in accordance with Art. 12 and 13 of the Constitution of the Slovak Republic.

5.10. The pay-as-you-go system and the Game theory and human character

The PAYG system is based on mandatory altruistic principles under which all participants are obliged to build up sources of a social system. However, the Game Theory has proved that mandatory altruistic system, though pure, is not stable from the long term point of view. Unless it includes individual motivation stimuli, harmonized with common targets, it shall collapse as a consequence of constant increase in the number of free riders. On the other hand, if the system does not include motivation stimuli then the solutions, lacking such stimuli just on the basic level of social system benefits (known as the contribution bonus in Slovakia), fail to provide motivation for people and probably therefore none of the countries have introduced it. If we want to solve motivation and its forms, we have to consider the following:

1. Motivation based on the amount of contributions
2. Motivation based on creating human capital - the number of children and their education, capabilities to create values paid by market
3. Combination of both

5.11. Conclusion

The whole range of anticipated problems that relate to the non-systemic pension system transformation has been introduced via construction of Pillar II based on Model B putted down as part of legislative intent discussed by the government of the Slovak Republic on 7 August 2007, no. UV-5450/2002. These problems have been indicated as results from extensive analysis held in period 2000 to 2002. Model A from legislative intend solves a substantial part of problems that relate to the compliance with the principles of equality, cost of the Pillar II system, return of assets of the Pillar II and problems connected with the Social Insurance Agency liquidity and with the public finance consolidation. It concerns the reasonable allocation of the Pillar II functions between the public finance and private sector.

Keeping the Pillar II accounts with financial cover amounting to 9 per cent provides solution for the distribution of risk between labour revenue and revenue from capital fund. At the same time it solves the problem of demography which is known as the problem of tragedy of commons and the free rider problem in economy. Reducing contributions into the Pillar II does not solve problems of the system, only partially it solves the problem of the Social Insurance Agency liquidity and of the public finance consolidation.

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