Transfromation of energy market

"*Compared to US competitors, European industry pays today twice as much for electricity and four times as much for gas".*

Herman Van Rompuy
President of the European Council

"*We face a systemic industrial massacre". "We need a new energy policy".*

Antonio Tajani
Vice President of the European Commission
The Telegraph 8th September 2013

Study scope: Slovak energy market after adoption of relevant EU Regulation

The study of the basic principles of the energy market transformation to clean energy is based on long term (starting in the year 1996) transformation of an existing mid-size 4 000 m^2 office building into nearly zero energy building.

Key findings of the study:

- The different product life cycle in terms of R&D and Innovation are not reflected in financial instruments used and are the rootcauses of massive problems on the energy market
- The market rewarded technology rather than the value delivered by suppliers
- The current regulation practices of the energy market are responsible for market price increases and their causes :
  - in general the regulations shift the investment risk from investors to consumers
  - introduces economic redistribution processes between investors via the energy market
  - creates economic barriers for new investors which limit competition and do not act towards cost savings
- The transformation of existing buildings seems to be the core of the energy market transformation to clean energy. Slow speed of transformation of existing buildings into nearly zero energy building has been observed as a consequence of:
  - adopted energy market regulations
  - lack of real economic incentives for building owners
  - lack of access to the real knowledge of building transformation

Study recommendations:

- In order to establish a new energy market regulatory framework the social cost of carbon emissions in its two forms of green credit and consumption tax should be be used
- The heating market transformation model suggests a shift for the District Heating Companies from holding a monopoly position as energy supplier to their role of safe energy distributor
- The new organisation model of the heating market should be constructed by application of a cooperation/ competition principle which should :
  - Guarantee indiscriminate access both fossil and renewable energy sources on the market based on delivered values
  - Should pay for real values delivered to the market in form of heating, cooling, electricity and green credits
  - The market should be regulated by value of the green credit and related tax imposed on carbon emission creating real incentives for renewable energies and at the same time providing a penalty for using fossil energy with carbon emission production
  - The so called knowledge line of green credits was built as a tool for technology selection

Results of present energy market regulation policy

The EU regulation of the energy market has been deeply influenced by:

1. Deregulation policy which provides access to the energy market also for speculative capital which brought free liquidity
2. New instruments in the form of feed in tariff and preferred access on the energy market which should help finance the research and development of renewable energies technologies and promote co-generation technologies.
3. Introducing new market for carbon emission with cap and trade scheme

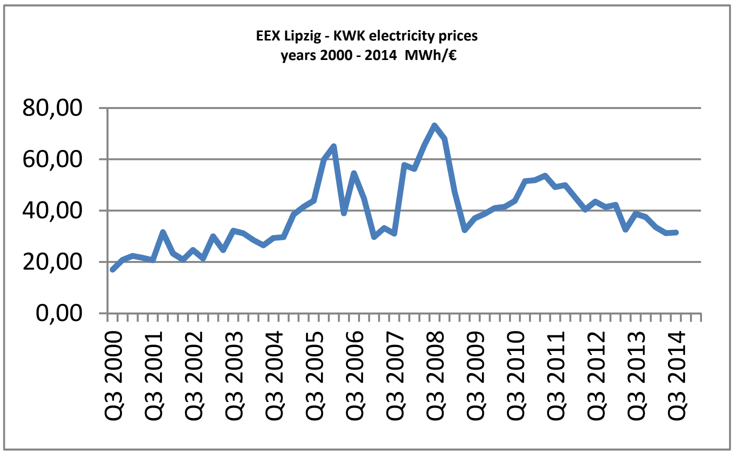
The result of the EU regulation policy over the last eight years was discussed by the European Parliament in May 2013. We hereby present the results of the EU energy regulation policy in their summarised form as formulated by top EU representatives. The result of this regulation policy was clearly articulated by European President Herman Van Rompuy open wide in The Telegraph. In September 2013 he pointed out that EU's top priority was to slash energy costs. "***Compared to US competitors, European industry pays today twice as much for electricity, and four times as much for gas. Our companies don't get the rewards for being more efficient,*" he said.**

The situation of the energy market was commented even more vigorously by Antonio Tajani, the European Industry Commissioner as follows: "***We face a systemic industrial massacre.***" Mr. Tajani warned that Europe's quixotic dash for renewables was pushing electricity costs to untenable levels, leaving Europe struggling to compete as America's shale revolution cuts US natural gas prices by 80pc. "*I am in favour of a green agenda, but we can't be religious about this.****"We need a new energy policy"*** (Evans-Pritchard, A., 2013).

Deregulation policy

EU deregulation policy was realized in order to provide free liquidity for the energy market to create flexible signal prices derived directly from the trade through financial instruments. However the historical chart KWK electricity prices from EEX Leipzig, Germany reveals a large increase in prices peaked in the 2006 and 2008 with the value almost three times higher comparing to the year 2000 with the next fall. The explanation of the price development could be made also by comparison to crude oil market.

The energy crises of the seventies showed that in order to influence the price of crude oil it is necessary to change supplied volume on the market at least for three months of about 10% (Hamilton, 2009). From 2001 till 2006 a transformation of the oil market from production to financial market was undertaken. Between 2002 and 2006 trade of crude oil settled through financial instruments raised four times in volume and reached 2 000 billions USD in 2006 (Greenspan, 2007). Since 2006 the price on the crude oil market has been settled down through financial instruments rather than on price based on demand and supply. Financial instruments allow much more flexible price settings almost on daily basis and change the quality of the market. Instead, the price of crude oil started to be defined through flexible financial instruments on speculative financial market as a result of demand supply generated by the production market.



The analysis of the causes of the 2008 oil crises revealed that during the peak price period almost 90% of all trade was done by speculative capital controlled by the most powerful investment banks in the world. (Masters, 2009). The Master´s analysis also showed that positive influence of speculative capital which provides excess liquidity turns into a destructive role if the volume exceeds about one third of all capital present on the relevant commodity market (Masters, 2010). If the electricity price was in 2008 indirectly derived from the largest energy oil market then this explanation is straightforward. Regulator do not set up the upper limit for speculative capital which could enter without limit the commodity market with the result that the volume of speculative capital present on the energy market crossed the border separating the positive from the negative influence and caused undesired high volatility on electricity market.

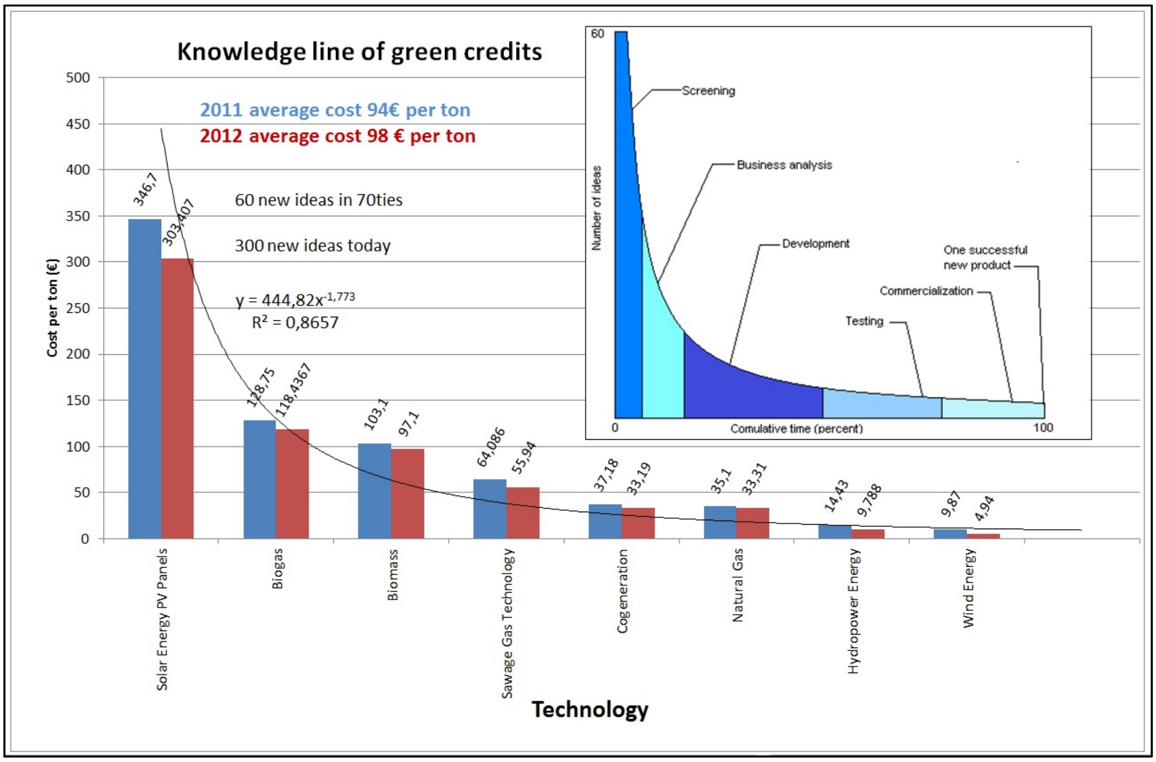
Support of co-generation and renewable energies

The pilot implementation of so called clean energies and concepts was extended and also included support for co-generation systems. The EU regulation of the energy market introduced wide positive discrimination policy by which it provides preferred access of electrical energies to the energy market produced by co-generation technologies and Local Renewable Energy Resources (L-RES). The EU regulation extended support provided for co-generation and L-RES technologies contain also supplementary payment above the market price by an instrument called feed in tariff. The money paid to investors through this instrument is collected directly as part of mandatory distribution fee for the final customer price. In some countries this part reaches about 1/4th to 1/3rd of the final customer price.

Since the feed in tariff is mandatory it naturally behaves the same way as if a flat consumption tax would be applied. The only difference is that it is not collected at government level and it does not enter the state budget. An independent regulator sets up the prices for each selected technology. The impact of such scheme is as follows:

1. It shifts market risk from investor to consumer
2. Different feed in tariffs given to different technologies do not reward the value brought to the market but instead it rewards the technology used
3. Since the electricity, heating and carbon emission markets interfere feed in tariff introduces economic redistribution processes between different investors rewarding one on account of the other
4. Redistribution processes creates economic barriers which prevent fair and non-discriminative access of both fossil and renewable energy sources based on value delivered to the market
5. If three different energy markets interfere with each other and all of them are based on demand and supply trades they consequently create high volatility which hardly damage each of the energy market with extra cost.
6. The even distribution of the collected money per energy unit shifts more families into so called energy poverty, takes free money away from the consumption market and promotes more savings. This is one of the roots of reduced demand on the consumer market.

However, if we ask how much extra cost is necessary to produce clean energy i.e. energy without parallel carbon emission production per unit through different technologies we obtain a completely different picture. Recalculating feed in tariff in the Slovak Republic paid in 2011 and 2012 and expressing how much extra money has been paid for different technologies in order to get clean energy per 1 ton of carbon emission we obtain a so- called knowledge line. We can calculate this extra cost for each supported technology and as an average cost per year. Our calculation showed that in the 2011 94 €/t and in 2012 98€/t has been paid in average respectively. Raising this value from the year 2011 to the year 2012 means that the system does not force investors to reduce the price and the supported scheme negatively stimulates the market.



Moreover there is a large difference for different technologies which deliver the same value – 10 euros per one ton on the bottom side and 350 euros per one ton on the upper side. Comparing the general shape of the knowledge line it is clear that some of the supported technologies are more in terms of R&D interval than in innovation cycle. This implies that the selected instruments for support were not optimally selected. Experience reveals that outside EU suppliers immediately stepped in the market with extra government support. This way feed in tariff supported more competitive suppliers from China than it did support the EU industry.

The Comprehensive Stern report in 2006 pointed out the importance of the social cost of carbon (Stern et all., 2006). The report estimates that it is about 20 times more economically effective to make an investment into technologies and processes and slow down the impact of human economic processes on climate change than to cover the increased costs resulting from the next consequences of climate change. The estimation of social cost of carbon depends on time and has been figured out between 20 USD to 80 USD per ton. If we adopt these figures we can say that the knowledge line for different technologies serve also as a selection tool. It selects technologies which should be financed through R&D principles from technologies which already did enter the innovation cycle and could be financed from the market. The upper estimated cost is between 70€ to 80 € per one green credit.

EU Emission Trading System

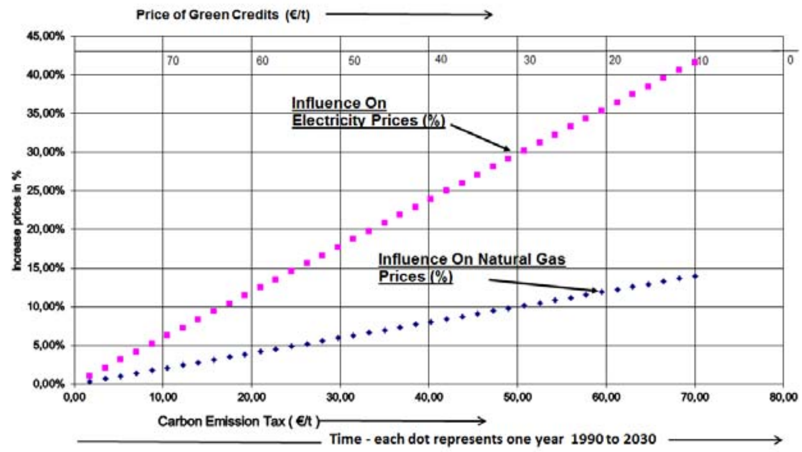
The EU Emissions Trading System (EU ETS) is a cornerstone of the European Union's policy to combat climate change and its key tool for reducing industrial greenhouse gas emissions cost-effectively. EU ETS covers more than 11,000 power stations and industrial plants in 31 countries, as well as airlines. The system works by putting a limit on overall emissions from high-emitting industry sectors which is reduced each year. Within this limit, companies can buy and sell emission allowances as needed. It is believed that this ‘cap-and-trade’ approach will provide companies the flexibility they need to cut their emissions in the most cost-effective way. Creators of the EU regulation had hoped that organizing EU ETS scheme on separate carbon emission market would provide market signal which would drive investment activity. The 2013 cap for emissions from power stations and other fixed installations in the 28 EU Member States and the three EEA-EFTA states was set at 2,084,301,856 allowances. During phase 3 of the EU ETS (2013-2020), this cap decreases each year by 1.74% of the average total quantity of allowances issued annually in 2008-2012. In absolute terms this means the number of general allowances will be reduced annually by 38,264,246.

Over the years the EU ETS market has showed such high volatility in prices that it simply has prevented any sound long term investment. The cap and trade system is based on assumption that it is possible to administratively predict short term economic development which will determine the volume produced and hence prices. Not only past economic history has revealed that this is not possible but also recent insights obtained by applying 'the chaos theory' on economic processes has shown that short term prediction of economic development is more illusion than reality (Ormerod, 1998). The theory has shown that policy makers have available only mid and long term decisions. It is much more important that bodies responsible for market construction will accept the specifics of each created market and precisely define rules and regulations (Tirole, 2014) as opposed to trying and influence short term market development. In this respect the basic decision for the construction of the selected market is a strategic decision and the regulation rules should be regarded as mid-term decisions.

The product which addresses value delivered on the market is not the carbon emission per se but its complementary unit green credit. Having one green credit is to have the property right which allows the owner to produce into the air one ton of carbon emission. Therefore considering the energy market it is necessary to ask the following questions:

1. Is it possible to effectively compete at the same time on heating market as well on electricity market and at the same time on third carbon emission market?
2. If we are going to buy one unit green credit should it be equal the price for one unit of the carbon emission?

The economics of co-generation systems are based on the assumption that competition is on the heating market and therefore the regulator provides support for electricity production in the form of preferred access on a much larger electricity market. Under normal support scheme the electricity market pays only the reproduction cost, no profit. In this way such energy source does not damage competition on the heating market where profit should be generated in a fair manner. Introducing ETS cap and trade scheme the third product has been added. From seven years' experience we see that it is unreasonable to expect that artificially settled down demand supply cap and trade scheme will produce stable investment environment. Rather we see high price volatility. The facts indicate that splitting energy market into its three different products and allowing them to trade and compete separately does not bring stability required for long term investment. The results indicate that at least two products out of three on the energy market must have a predictable trajectory in order to be able to compete on the selected energy form. Let´s select the heating market on which competition should be organised. Parallel supply of electricity and emission on the market should then reflect reproduction cost. These values delivered on the market should follow some predictable rules equal for all competitors. The prices of these parallel products should reflect the reproduction cost of the



technology used. Incentives could be embedded into the prices under condition that each investor will get the same reward for the same value delivered on the market. These principles will lead to technology selection based on economic principles and not on lobbying possibilities.

In order to answer the second question our analysis showed that there is only one point where the value of green credits equals the value of carbon emission. And this is at the point of a 50% reduction of carbon emission produced. The cap and trade system artificially settles down demand and supply equilibrium even beyond 50% reduction point. This could be possible only if one could make short term economic development prediction. Neither theory nor praxis supports this as possibility. Surprisingly relatively simple calculation revealed that if we take as a base year 1990 with 5 574 400 000 tonne carbon emission produced in EU and will model 1% reduction per year we can see that influence on energy price is around 1% per year and in case of natural gas less than 0,5% per year. This is much less than the volatility of the electricity market observed from 2006 to 2010. The calculation also showed that green credit price does not equal the carbon emission price if the money were to be collected from tax imposed on carbon emission. They are much less at the beginning of the transformation. The price tendency of the green credits is in contradiction with tax price. Moreover, part of the green credits reward is paid each subsequent year by market prices itself which should be considered and expressed within the calculation. This model does not include a situation once the technology is paid. Once the investment has been paid it creates extra profit and at the same time an economic space for further price falling as consequence of competition.

The suggested regulation policy is based on defining the value of green credit delivered to the market. From expected volume of green credits it is possible to calculate how much money should be collected through the tax. The regulator will decide each year on the speed of transformation through the value of green credits as incentive and at the same time through value of tax imposed on carbon emission as penalty. Moreover, if the value of the tax imposed solely on carbon emission is too high and will harm the economy, part of the needed money could be collected as general tax revenues. This kind of simple and flexible transformation scheme could bring long term stability and predictability on the energy market. Contradictory trends of the tax and green credits prices including market effects could provide long term needed stability and will reflect the social cost of carbon. The selected value will define the speed of transformation according to society's needs and economic possibilities. Splitting collection of money between taxes imposed on carbon emission and general tax revenue will provide needed flexibility for Member States reflecting the specifics of the economy.

Taking footprint principles (Global Footprint Network, 2013) one could say that the carbon reduction scheme should be mandatory until Member States' ecological footprint exceeds biocapacity calculated for each Member State in global hectares per capita. Once the ecological footprint equals biocapacity the scheme should enter into voluntarily interval for the Member State. Here one can see the role of EU ETS where governments could trade based on demand and supply principles. The reason for such organization is that many policies taken on a national basis could influence the carbon footprint of the country which it is not possible to be reflected through direct trading on EU ETS.

Transformation of the heating market

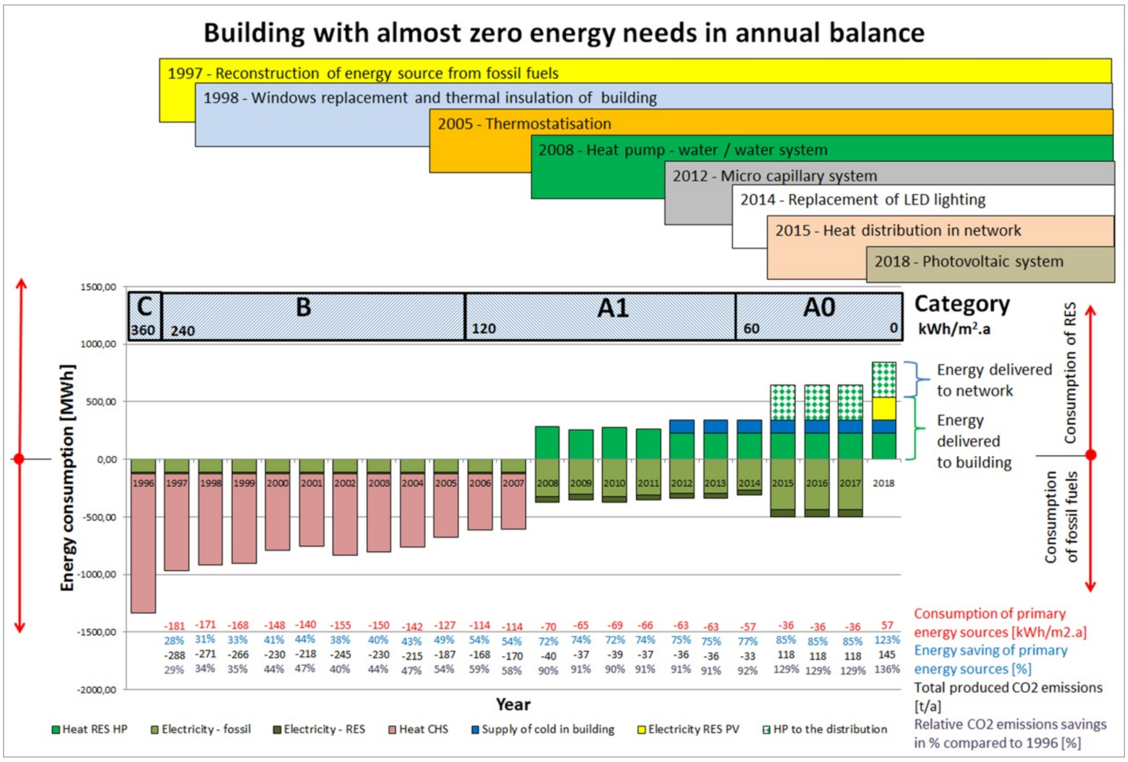
Energy in form of heat represents more than 46% of all energy consumed in the EU. Most of it is used for heating houses. Almost 40% of the energy used in the EU is consumed by houses. Therefore transformation of the houses into so called nearly zero energy houses could be regarded as a strategic approach to the climate change agenda and is at the core of the heating energy market transformation. At the the same time building new domestic L-RES adds to energy security of the EU as it enhance its own energy source base.

Transformation of the office building

The Directive 2010/31/EU Article 9 requires that “Member States shall ensure that by 31 December 2020 all new buildings are nearly zero-energy buildings; and after 31 December 2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings”. The EU regulation DIRECTIVE 2012/27/EU has imposed low energy consumption norms on buildings and defined N ZEB. Success has been recorded on new projects which is less than 1% of the building stock. Slow transformation of the existing buildings to N ZEB with rate below 1% per year reflects the complexity of the problem and is also due to:

a) Lack of accessible know-how for such transformation of SME building owners (WBCSD, 2009).
b) Lack of earnings during the renovation of the buildings in case of operation interruption
c) Transformation into N ZEB means changing the building from a pure static energy consumer into a dynamic status whereby the building is both an energy consumer and an energy supplier. The existing buildings within the city environment interact with the district heating/cooling system and the electrical grid. The integration of Local Renewable Energy Sources (L RES) in buildings will shift the energy system from a small number of centralized mostly fossil energy sources to a large number of L RESs. The present energy market organization does not support non discriminative access of L RES on the market.
d) The analysis showed that it is possible to positively influence eighteen different parameters in architecture and construction design. Moreover plot selection with desired L-RES could improve energy balance for new buildings. For existing buildings only part of eighteen parameters could be improved. Moreover the energy condition for the plot has been already defined. Therefore it is much more difficult to transform the already existing building as to build new one on selected plot with L-RES.

The long term transformation of the already existing office building has been used in order to get practical experience. Starting in the year 1996 till 2006 we have gradually invested into different technologies in order to solve energy efficiency for heating and cooling. In order to convert the building into nearly zero energy building heat pumps, micro capillary ceiling system (already in operation) and photovoltaic technologies (planned) have been selected as strategic technologies.



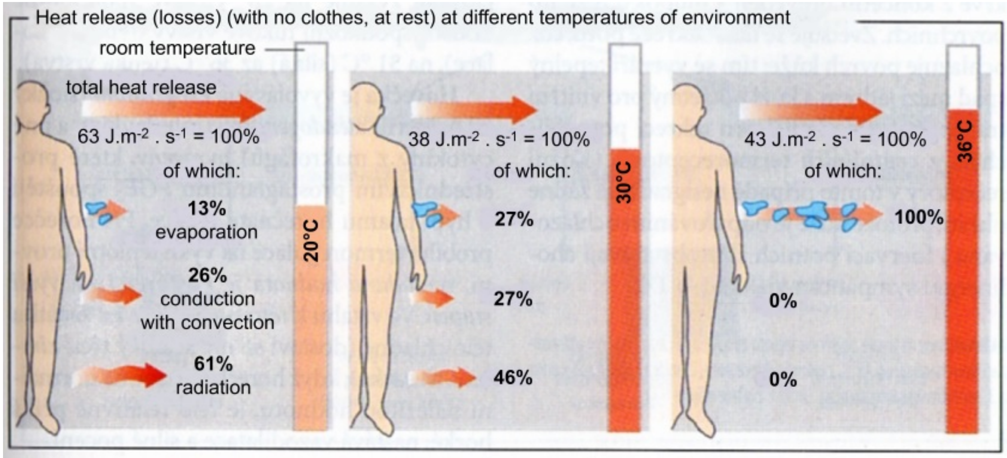
Selected technology mix delivers the following synergic effects for heating and cooling part:

1. Reduces as much as 90% of carbon emission when compared to the year 1996
2. Reduces more than 80% primary energy consumed by the year 1996
3. Reduces technology risk from 1:300 for a brand new technology to 1:5 and less for a market proven best technology used
4. Heat pump technology and ceiling Heat/Cool system introduce higher quality of indoor environment which is more suitable to human physiology. It solves the climate change problem of heat waves during summer season. This solution brings value to end customers in terms of rising productivity at work, cutting impact of heat waves and decreasing probability of human collapse and frequency of illness.
5. Reducing heating temperature in micro capillary system from 55/65 to system 28/32 will allow reducing distribution loss of DHC systems during heating season by half.
6. Excess energy of L-RES could be delivered on the heating market and balanced the energy consumption and supply between building and energy distribution network and reach status of Net Zero Energy Building (N- ZEB) and Plus Energy Building (PEB).

The picture depicts energy consumption of the office building during the years 1996 to 2013 with the plan till 2018. Energy efficiency (EF) parameters shift the office building from C status gradually to A1 status with possibility to reach A0 limits. In order to reach Plus Energy Building a second L-RES in form of PV panels is planned by the year 2018 to 2020 depending on the technology progress. Next generation PV panels should reach 40% yield.

Climate change and heat wave problem

Heat wave problem rose as consequence of climate change. 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). The calculations show that the heat waves during the summer in 2010 caused the death of 55,000 people in Europe (Barriopedro, 2011).

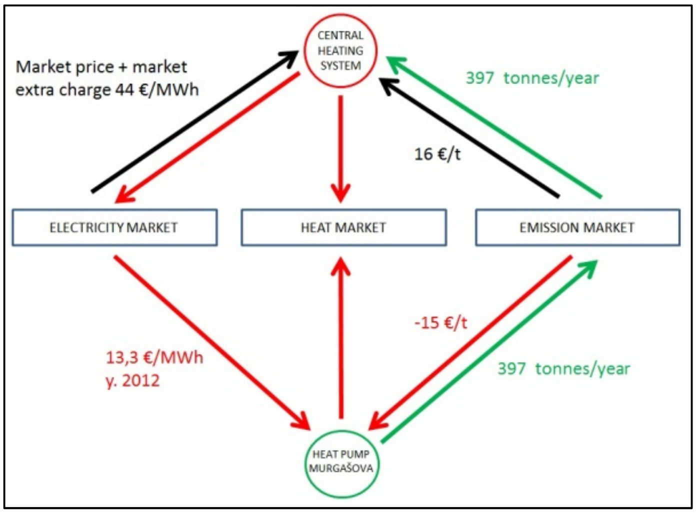


The analysis of the representative sample of 9 European cities with a combined population of 25 million inhabitants in various places of Europe shows that there is a critical minimum temperature during night and critical maximum temperature during the day that determines the beginning of the exposure 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, 2010). A heat wave is determined by the extreme daily temperature T_{app} given by a formula and the lowest night temperature T_{min}. If the heat wave exposes the human for 48 hours and more the problem starts. It is necessary to cut the heat wave exposion on human being in order to balance energy within the body with the environment. Standard air conditioning does not solve the problem since the principle of transporting energy is based on conduction and convection. The air moves with the higher rate than 0,1m/s and this removes thin layer over the skin. The result is that the body is informed that the environment is more cooled as is in reality and regulation closes the skin. Hence the energy produced by human is generated within the body. If the human goes out from such environment he immediately gets wet. The body has no energy balance and is under exposure of internal heat. The other part of this story is that air conditioning removes water from the air and humidity is going down below necessary level. Therefore air conditioning does not suit human physiology. Rather irradiation principle as is provided with ceiling systems solves the problem. If human is inside in door environment equipped with irradiation transport principle during few hours he balances his internal energy with the indoor environment and cuts the impact of heat waves. The heat wave problem is solved if 48 hour exposure of heat waves is interrupted in order to balance the body energy with the environment. It is guessed that six hours could be enough. The productivity of the work in such environment will rise accordingly.

Heat/cool market organisation based on social cost of carbon

In order to organise smooth transformation of the central district heating system based on fossil energy to the system based on renewable energy it is necessary to consider the following basic principles:

1. Difference between pure competitive market and competion cooperative market and its advantages
2. Role of the social cost of carbon emission as a technical and economic vehicle for technology selection and market organisation



Present organisation of the heating market is based on competitive principle and is either natural or under the pressure of lobbyists creating an economic barrier that effectively prevents access of the L RES on the market. This way an economic discrimination of L RES exists. Calculated energy barrier could reach the same value as the energy price itself. Transformation of the energy market to competitive – cooperation market could be solved considering the Collard´s cooperation model with guarantee (Lea, 1987 (1994)). The rules of such organised market will guarantee to each energy supplier that he will be rewarded for energy as well as for delivered green credits. If the market will pay only values which means energy and green credits, the selection of the technology and market regulation could be organised very transparently and simply just to value for each year green credit and consumption tax (in form of carbon tax or broader consumption tax). The users of fossil energy will know what will be the tax imposed on fossil energy and how it will influence their own economic parameters. The value of green credit could set up the speed of the market transformation according to the needs and available resources. This principle removes from the energy market redistribution processes and could organise the non-discriminative access both fossil and RES on the market. It also brings stability on the energy market since the value of the green credits and carbon tax will be known for a long period – the volatility will be largely removed from the market. Shifting the market to cooperative concurrency principle allows the development of flexible services to customer as well. This way building owners will also be naturally attracted in order to invest into L RES and transform their buildings into N ZEB or PEB based on economic incentives principles.

District Heating Companies transformation

More than half of the heating is delivered on the market through Heating District Companies. They operate rather on naturally created monopoly market around the distribution system. The consequence of rising price of primary energy sources and centrally energy production is that the loss in distribution system of DHC companies starts to be a substantial part of the end customer price. This motivates end customers for searching cheaper solution and start to disconnect to DHC systems. This only enhances the problem since fix part of the prices increase.

There are two possibilities for DHC regulation and policy:

1. The first one represents regulator policy in which DHC is kept as energy suppliers on monopoly market. This will gradually force the prices of the energy for end users to the unacceptable high level. This is due to raising fix cost and expected carbon tax even within the present cap and trade policy once the energy supplier cross the given limit. The system will slowly but inevitably go into economic collapse.

2. The second possibility is to shift DHC from position of energy supplier to position of safe energy distributor. This will allow free indiscriminate access to the heating/cooling distribution system both fossil and L-RES energy sources. Fixed cost could be managed in the way that positive influence on it will be immediate once the technology is paid for. The technology life expectancy is about forty years.

In case the second policy approach is adopted a common interest between building owners and DHC companies will be achieved. L-RES constructed directly within the building facilities will serve the local area needs. The technical potential of energy sources will be fully exploited which will significantly improve economic parameters like ROI, promote building renewable energy sources and will decrease carbon emission production.

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