Summary of the Civil Experts' Report on the Hungarian National Climate Change Strategy

Supported by:

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Edited by:
Péter Kardos, Zoltán Fodor

Core Writing team:
Erzsébet Beliczay, András Lukács, Lázár Pavics, Zoltán Szabó
(Levegő Munkacsoport)

Ada Ámon, Zoltán Fodor, Péter Kardos, Zsolt Kazai, Zsuzsanna Király, Nelli Tóth, Kati Varga
(Energia Klub)

Additional contributors:
Dr. András Jánossy, Ernő Kiss (Thézeusz Alapítvány), Gabriella Pál

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1. Introduction

Climate change is already taking place. Today the question is not whether or how climate change could be avoided but if the human race could prevent it from turning into a global catastrophe. In scientific circles it is considered evident that climate changes at a quick pace as the consequence of the presence of greenhouse gases in the atmosphere due to human activity. Therefore, sooner or later all countries must face the problem of both emission reduction and adjustment.

The aim of this study is to contribute to the solution of problems resulting from the lack of data and of methodology by critically analysing the materials currently available for the Hungarian National Climate Change Strategy to be formulated. Furthermore, the study also strives to provide a perspective which is indispensable for starting the implementation of an effective strategy.

Climate Change Strategy shall contain reduction of emission and adjustment with equal emphasis. These two areas can be opposed by no means and it is of utmost importance that they shall be tackled in one strategy document. In this case they strengthen each other due to their synergic effects; they make the sets of actions cost-effective and integrated.

Based on the data and analyses gathered by this study, the conclusion that may be drawn is that Hungary is fully capable of achieving emission reduction targets expected to be more ambitious in the long term than today.

As international and our own investigations reveal, there is a way to accelerate emission reduction dramatically, which is primarily based on enhancing efficiency and promoting the use of renewable energy sources, and by adopting this method Hungary would perfectly meet the reduction targets being set at the moment, and the country would be able to enjoy all economic, environmental protection and prestige advantages of this means.

National green organizations as well as representatives of several other fields participated in the conduction of this study. The Energy Club environmental protection organization fulfilled coordination and editing tasks with the support of the British Embassy, Budapest.

2. Emission Reduction Principles

2.1. Long-term Emission Reduction Targets

It is a generally accepted basic principle that catastrophic climate change occurs in the event of average temperature exceeding pre-industrial average temperature by more than 2°C. In order to prevent this and reach emission reduction targets, the Environmental Council of the EU has already made a decision based on widely recognized research results: by 2025 a reduction of 15-30%, until 2050 a reduction of 60-80% need to be achieved.

Expected costs of emissions-reduction are greatly outweighed by economic damage caused by catastrophic climate change produced by the lack of emissions reduction; therefore, out of economic considerations, quick and effective emissions reduction is a first priority.

Setting long-term targets and keeping these targets permanent are of profound significance in order to prepare Hungarian strategic documents and plans to be developed by economic players. Economic advantages of permanent targets are dwarfed by temporary advantages resulting from uncertainty or short-term targets.

The basic principle in connection with decision-making procedures is that, from among reasonable possibilities, one must be considered which results in the least greenhouse gas emission in the atmosphere.

Countries achieving stability in terms of these long-term targets the earliest are the ones where the realization of emission reduction investments is commenced the earliest. On the one hand, this means an advantage in competition in the long run, and on the other hand, performance fulfilling commitments on emission reduction at all times generates large national income with competent management.

Based on Hungarian potential data, it may be stated that such a policy does exist which can be implemented and as a result, the emission reduction target of 15% until 2020 and 70% until 2050 as compared to 2000-level can be achieved. This means a reduction of 44% and 80% in relation to the Kyoto base year.

> *"After Hungary recognized that the fight against climate change cannot be successful without the reduction of emissions and furthermore, Hungary is aware that the emissions in the following decades are of key importance concerning the mitigation of climate change, additionally, considering the long-term advantages of quick and effective actions, Hungary emphasizes that long-term, clear and above all, permanent targets ensure efficient planning for economic players and the application of reduction techniques is stimulating; therefore, the following long-term targets are set:*
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> - *Article 12 1(a) of the UNFCCC, taking land use also into consideration, maximizes emissions, in accordance with the national greenhouse gas inventory, at a quantity of 66.3 $MtCO_{2eq}$ in 2020; moreover,*
> - *The annual inventory of greenhouse gases based on Article 12 1(a) of the UNFCCC, taking land use also into consideration, maximizes emission at a quantity of 23.7 $MtCO_{2eq}$ in 2050."*

Arguments supporting emissions reduction are persuasive:

- At an international and European level, Hungary already has existing and after 2012 will have commitments on considerable emissions reduction.
- Hungary has established a favourable political and moral position at international as well as European level.
- It facilitates international participation in knowledge and technology transfers promoting emissions reduction.
- It generates significant national income thanks to flexibility mechanisms.
- Regarding the issue globally and from a moral perspective, this is the only solution, and there is no other alternative.

2.2. Direct, Short-term Economic Advantages

Due to flexibility mechanisms of the Kyoto Protocol, Hungary can gain direct economic advantages between 2008 and 2012. The emission rights difference between actual emission and committed emission amounts in the Kyoto Protocol can be traded by means of international trading of quotas. This quantity is calculated from the amount of greenhouse gas emissions reduction as the consequence of industrial structural change in the 1990s, on the one hand and from the amount of reduction to be achieved within the framework of the

current emissions reduction strategy, on the other hand. Every implemented emissions reduction means additional *so-called Assigned Amount Units* (AAU) tradable by the State.

It is essential that the total national income deriving from the trading of Assigned Amount Units shall be utilized for emissions reduction. By means of effective management, economic burdens resulting from emissions reduction can be relieved or can be decreased significantly.

3. Energy Policy Principles

The National Climate Change Strategy must, first and foremost, keep sustainability in mind. Although a Sustainable Development Strategy is not yet available, requirements resulting from sustainable development shall be included in the Climate Change Strategy since, in their absence; Climate Change Strategy would become meaningless.

3.1. Sustainable Development

There are several definitions of *Sustainable Development* but probably the definition below provides the most accurate summary:

„Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. "

(World's Scientific Academies Declaration, Tokyo, 2000)

3.2. Sustainable Energy Strategy

Measures taken in order to mitigate climate change have an effect on sustainability at the same time, as well. Taking the fact into consideration that approximately three quarters of anthropogenic greenhouse gases are related with energy production; obviously, energetics and the implementation of its related strategy will decisively influence the future control of emissions. Climate Change Strategy devised under the aegis of sustainability is particularly aimed at *the energy strategy in Hungary also to be formulated under the aegis of sustainability.* This is evidently the basic principle of not only this document but also that of the Energy Strategy and of the Sustainable Development Strategy whose design is in progress currently. In the event sustainability is set as a general target it would include climate protection, as well.

Nevertheless, it must be kept in mind that in the event decarbonising targets set for climate protection are met only by themselves, in some cases the sustainability principle may be compromised, therefore, the problem needs to be addressed in a broader sense of sustainability. Taking all the above into account, the definition of *Sustainable Energy Strategy* may be provided as follows:

"A long-term strategy document within whose framework the energy system satisfies energy demands in a sustainable way, or in the absence of sustainability it guarantees that the energy system shall reach a state satisfying sustainability criteria as the result of adopting this strategy."

Needless to say, it is also possible to investigate sustainability in economical or social terms; however, if sustainability is examined in the long-term (in 100 years' magnitude), environmental sustainability must be in harmony with the other two aspects.

It is therefore a basic principle that in the event of all energetic investments a balance needs to be achieved for the complete life period and a cost-effectiveness assessment must be carried out.

3.3. Basis for Sustainable Energy Strategy

Hungarian energy supply may reach a near-sustainable state by 2050 with the help of currently explored and known potentials and a comprehensive strategy including compliant regulations.

- National energy consumption must be decreased with minimizing energy waste and enhancing the efficiency of energy consumption. At present there is no information available regarding these two potentials; based on magnitude estimations, 30% may be realized using this strategy within the time limit.

- National energy production shall be based basically on renewable energy sources. Sustainable state would mean a rate of 100% of renewable energy source; however, regarding the long term investment in energetics, the expected useful life of existing power stations, and the optimal time period of implementation, this target is not realistic and thus cannot be met within the timeframe of this strategy. According to our up-to-date knowledge, the potential of national renewable energy reaches the magnitude of 500 PJ on an annual level.

- The joint utilization of the above two potentials and the adoption of an appropriate policy would lead to an approximate reduction of 73% concerning energy emission (as compared to the level in 1985-87). Furthermore, taking the latest population projections into consideration, energy emissions may be reduced by 93% by 2050. In terms of specific emissions, this means 2.5 and 0.8 t/head/year energy emissions. The difference arises from the renewable potential per head.

- Sustainable energy strategy is designed to satisfy sustainability criteria by efficiently tackling the issues of security of supply, economy and national strategy of energy policy, and hence set long-term targets.

- If sustainable energy strategy promotes the achievement of sustainable state, this would mean not only environmental sustainability but also economic and social sustainability, as well. At the same time, dependence on imports would cease and therefore security of supply would strengthen.

The conclusion drawn from the principle of sustainability is that long-term sustainable energy strategy leaves us with no other alternative.

4. Energy Supply and Consumption – Current Situation and Expected Trends

The current national energy supply system does not comply with sustainability criteria from several aspects. The volume of energy originating from renewable energy sources consumed in Hungary as primary energy source in 2005 was 56.9 PJ which is 5.2% of the total energy consumption (1,153 PJ in 2005). That is to say, currently our energy demand is satisfied by non-renewable energy sources at 94.8%.

As for non-renewable energy sources, nuclear energy contributed with 51 PJ representing 4.7% considering the total primary energy consumption. Consequently, 90.1% of our energy demand is met by the combustion of coal and other compounds containing carbon.

Furthermore, Hungary's dependence on imports is great. Almost 60% of primary energy sources are imported from abroad.

5. Energy Emissions Reduction Potentials

Along the fundamental principles of sustainable energy, national energy emissions reduction potentials can be divided into two major groups.

- National potential of renewable energy sources whose majority[1] operates without emitting net greenhouse gases during energy production.

- Efficiency boosting potential applied during energy production and consumption reducing the carbon intensity of the whole energy system.

The investigation of potentials, trends and possibilities led to the recognition of a special policy which makes the achievement of the targeted energy emission reduction of 44% by 2020 and the targeted 80% reduction by 2050 possible in Hungary by utilizing the national maximum potential of renewable energy sources together with energy efficiency.

The national potential of renewable energy is 2.5 times the current Hungarian primary energy consumption. The technically recyclable renewable energy potential is around 500 PJ/year which is expected to further increase considering the previous speed of development of certain technologies. There is no reliable data available concerning energy efficiency potential, accessible estimates provide a rate of 30%.

At the investigation of reduction potentials it is also truly essential to emphasize that the cost-profit assessments shall be carried out for the complete life period under the aegis of sustainability, and the implementation of a project or a set of projects shall be evaluated based on the findings.

5. Special Political Tools for Energy Emissions Reduction

The special political tool-set for emissions reduction is supported by three main pillars: the inclusion of externalities ("carbonising" prices), the strengthening of technological innovation and encouraging public awareness.

5.1. Inclusion of External Costs

Two main tools may be used effectively: one of them is the collection of external costs as tax, and the other is the emissions trading system characteristically based on market mechanisms which can be found already among the flexibility mechanisms of the Kyoto Protocol.

During the inclusion of external costs the fundamental principle is that such a combination of possible tools shall be selected which means the lowest possible total cost for the society.

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[1] *With the exception of biomass combustion and hydro-electric power plants with large storage facilities where there is also direct emission.*

Generally speaking, it must be mentioned that the applied systems shall remain stable in the long run since they only operate efficiently in that case. In the event stability and long-term permanency are absent, this may cause considerable economic damages and thus the targeted emissions reduction cannot be fulfilled.

5.1.1 Greenhouse Gas Tax

The following conditions must be observed for the optimal operation of effective greenhouse gas tax:

Universality

This tax must affect all areas of economy equally where greenhouse gases are emitted. Not a single area can be missed and taxation shall not be disproportionate. The basic principle for this taxation is the fee for atmospheric pollution since the atmosphere cannot receive unlimited amount of greenhouse gases. Consequently, atmospheric pollution shall appear as a cost during economic activities; therefore, when emission occurs, a tax proportionate with this emission is payable.

Long-term Planning

Emission reduction targets must be set for long-term and be made clear in order to perform efficient operation. The regulatory framework must be established in a way that, if possible, it remains stable for decades within the timescale of the strategy.

Clear Taxation System

In order to guarantee transparent and traceable operation, it is indispensable to terminate cross-financing and support systems connected to consumption or production. The system would remain impossible to evaluate, comprehend and inefficient without these measures; moreover, extra administration would require additional resources. This is why a clear taxation system is necessary which would transform market processes in accordance with real supply-demand by the inclusion of externalities. Endowments and cross-financings distort this natural balance. The current, typically consumption-based support scheme related to natural gas should be transformed and spent on beneficial, long-term efficiency boosting instead of, for instance, simply heating it built-in natural gas price. Aids with social character must be independent from the consumed amount.

Adequate Taxation Philosophy

Taxation philosophy focuses on lower taxation of beneficial measures (e.g. carbon-dioxide tax instead of income tax). Taxing positive instead of negative measures is also beneficial from a taxation moral aspect. National income resulting from taxes obviously decreases economic resources, therefore, implementation should go parallel with the decreasing of other taxes (e.g. taxation of positive measures vs. income tax) in order to avoid harmful effects.

5.1.2. Emissions Trading

Emissions' trading achieves reduction based on market principles in a self-regulatory way. This, however, can be realized only if the assigned amount units in the system are determined properly. In order to achieve marked emission reduction, the following criteria must be met:

Keeping freely granted rights at a low level

The low level of emission rights ensures necessity in the market. No emission reduction investments would commence, if this did not occur. On the other hand, considerable State income can be generated with enhancing emissions trading.

Coherence must be ensured with the potentially applied taxation system so that universality shall not be harmed

In the case of mixed systems, special attention must be dedicated to sectors affected and not affected by emission trading system. In the event of differentiation, implementation of universality must be supervised.

Long-term planning due to industries with long-term investment cycle

Taking into account that the investment cycle of the energy sector and sectors covered by EU-ETS may reach decades in magnitude, it is of utmost importance that the basic principles and reduction targets of the EU-ETS shall be fixed in the long run in order to ensure long-term planning. For this reason, long-term emission reduction target values of the Climate Change Strategy serve as the basis of determining the above targets.

5.2. Stimulating Technological Innovation

Technological innovations can be facilitated with direct support. The two focal areas affected by emission reduction are the research and development of renewable energy sources and the research, expansion and optimal use of energy efficiency potentials.

- Compulsory acceptance and price support of electricity produced from renewable energy sources and supported in the network
- Marketable “green” certificates
- Tax relieves
- Investment capital support
- Granting favourable credit lines
- State guarantee
- Direct support with tendering procedure

5.3. Encouraging awareness

Proper disclosure of information and education is indispensable for the operation of the previous two tools since without the social acceptance of tools applied for emission reduction – i.e. without permeating society – it is much harder to establish the conditions required for efficient operation. Information must relate to the phenomenon of climate change, its risks and consequences, as well as the description and operation of tools applied for the mitigation of its effects.

It is essential that everyone can measure the damaging effects of their lifestyle and a basis for comparison is available so that new social behaviour and new habits can be developed for adopting a conscious lifestyle. This requires the design of minimum standards and a

communication strategy and the State and municipalities must show inspiring examples to be followed.

In order to reach the proper level in terms of social acceptance, the development of a separate action programme is recommended. Specialised workshops should be organized for communication and PR experts, teachers and media within the framework of this action programme. Consequently, extensive knowledge could be accumulated based on previous knowledge together with knowledge extension led by these workshops which would be sufficient for the development of communication and education methodology.

6. Emission Reduction Potentials in Transport Sector

In Hungary the participation of transport sector is 21% considering direct energy consumption, but taking ancillary, supporting services into account, participation reaches a rate of 36% in terms of total energy consumption. Therefore, evidently this sector represents the most significant part in Hungarian energy consumption. Furthermore, similarly to the international tendency, the energy demand of the transport sector is increasing significantly.

In the past decades the energy consumption of the transport sector increased at the fastest pace in the European Union. While in 1960 its share of total energy consumption was only 16.7%, by 2003 this rate reached 31.6%. Road transport consumed 83.3%, air traffic proportion reached 11.5%, while rail transport stood at a mere 2.7%. A similar progression is witnessed in Hungary, as well, and this trend is expected to continue in the future. The energy consumption in the transport sector of the EU15 countries increased by 15.3% in 2003 as compared to the 1995 rate, while during the same time period in Hungary the increase in energy consumption of transport reached 36.4%. That means the intensity of increase in Hungary was almost 2.4 times bigger compared to the EU15 average. This value includes the distortion due to the proportion shifted to energy intensive forms of transport.

7. Special Political Tools for Emission Reduction in Transport Sector

Three approaches have been adopted for emission reduction.

7.1. The Technocratic Approach

The technocratic approach includes the development of vehicle park and transport infrastructure. Experience shows that these are not effective methods in the reduction of emission since transport costs are distorted due to the relatively low prices not including externalities, all developments generate growth. The growth of transport is currently controlled by its infrastructural limitations not by its costs. *This is why all developments of this character produce exactly the opposite of the desired effect and cause emission increase as the result.* Therefore, the technocratic approach in itself proves to be insufficient; nevertheless, adopted together with other regulatory instruments substantial emission reduction can be secured. Its adoption thus, can be considered only together with other instruments and its efficiency needs to be assessed in all cases because of complex interaction patterns.

7.2. Change in Transport Structure

The second possible solution is the change in transport structure, i.e. satisfying constant transport demands by more energy-effective modes of transport, i.e. *modes that reach one*

performance unit with lower energy consumption. This change shall be promoted with economical, legal and technical tools as well as information activity.

In case of carriage of passengers the replacement of vehicle transport by non-motorized form (bicycle, walking), changing private vehicles to public transport, and selecting rail transport or coaches instead of air traffic (especially in short distances) also belong to this group.

Generally, it is evident that the highest energy efficiency is ensured by rail transport under Hungarian circumstances; therefore, the most important element in the change of transport structure is the development and modernization of railway infrastructure. As for short-distance, local transport, it is the non-motorized form of transport – bicycle, walking – which guarantee the highest efficiency and thus the lowest level of emission.

7.3 Reduction and Replacement of Transport Demand

The reduction and replacement of transport demands also means a sort of change in structure, however, not replacing one form of transport by another, but changes in other areas influencing transport. The following belong to this group:

- Increasing local production and consumption instead of long-distance delivery,
- Ensuring local employment,
- Stimulating local cultural and intellectual activities for local residents' interest,
- Halting and reversing urban expansion,
- Additional municipal political measures in order to shorten the distance between place of residence, place of work, place for shopping, etc.,
- Rationalizing carriage of goods, adopting modern logistics methods more widely (in order to carry the same amount of goods with less transport),
- Promoting teleworking and distance education,
- Speed limits.

This aspect thus includes such instruments which decrease transport volume in general and transport performance. It goes without saying that milk needs to be transported to the shortest distance if it comes from the cow grazing just outside the village. This is evidently an extreme example, since this solution is not feasible in Budapest, for instance. Nevertheless, people must be encouraged to buy fewer products carried from several thousand kilometres. What is more, economic instruments and effective organization can help in reducing the distance of carriage of goods even within Hungary and it must also be promoted that more goods could be carried at one time. In several countries the government provides assistance to transport operators so as to implement more effective carriage of goods in terms of energy consumption.

7.4 Comparison of Methods

At a national economical level only the second two ("Change in Transport Structure" and "Reduction and Replacement of Transport Demand) of the three theoretical alternative methods listed can actively contribute to the enhancement of energy efficiency and increasing energy saving. Certain elements of the "Technocratic Approach" may provide help but they are not at all decisive. According to our calculations, at constant expenditure level energy saving would be more substantial as the result of change in structure than by the internal rationalization and modernization of the same activity. The remaining elements of the "Technocratic Approach" seriously impede reaching the set target.

7.5 Overall Proposals

One of the most urgent actions in the area of energy efficiency boosting in the transport sector is to cut off direct and indirect financial supports or at least reduce them to a tolerable level.

Regulations must be gradually tightened in a way that in the case of every form of transport the regulations would approach currently strictest regulation (so, for instance, the transport safety rules referring to road transport would make as many accidents with personal injuries acceptable specifically as in terms of rail transport). Organizations responsible for supervision need to be strengthened; their certificates need to be broadened, and fines should be increased.

8. Situation and Expected Change regarding Residential Emissions

According to Hungarian statistical data of 2004, there are 3.75 million households representing 38% of primary energy consumption. The greenhouse gas emission produced as a result is one third of the total national emission. This is why one third of emission saving in the household sector appears in the amount of national emission reduction.

The total energy consumption of households did not change considerably in the past decade. The consumption of electricity is moderate – at around an average of 1% – but its increase sped up from the turn of millennium, which can be explained by the massive increase in the number of household appliances as well as the ever more widespread use of air-conditioning equipment. Its trend is not very apparent since following the flooding of the market with household appliances and due to the significant increase in electricity price the consumption of electricity may easily start to decrease. The uncertainty of this increase is well illustrated by the dramatic drop of 2004.

The heating of households is dependent on natural gas to a large extent. 58% of households have direct gas heating, which is the consequence of the disproportionately high rate of support of the price of natural gas and gas heating installation.

9. Reduction Potential of Residential Emissions

Generally, it must be noted that no extensive research has been conducted targeting the surveying of Hungarian energy efficiency potential. Available data are either old or rather outdated.

In order to formulate this strategy based on energy efficiency potential such a research paper would be essential since the development of targeted and ambitious action plans is doubtful if the research is missing.

The largest chunk of residential energy efficiency potential is connected to heating since it is the heating that creates the highest level of residential energy demand with 70% if the energy demand of transport is not taken into consideration. However, the most recent comprehensive study on this area was conducted in 1993 examining possible energy saving in households.

Hungarian households have extremely bad insulation characteristics. According to the data of the Energia Központ, 80% of all households have a heat transfer coefficient over 0.7. Our estimates show that with the proper insulation of these households 76 PJ energy or approximately the same amount of 7% greenhouse gas emission could be saved.

The modernization of heating systems also means additional significant potential. According to our estimates, with the improvement of the heat transfer coefficient this would result in an accumulated saving of 110 PJ energy consumption, which would reduce national greenhouse gas emission by roughly 10%.

In relation to electricity, the efficiency of household appliances can also be investigated. The widespread use of energy label helps in realizing that there can be enormous differences between similar household appliances concerning their energy consumption.

As no reliable Hungarian analyses are available for the definition of total energy efficiency potential of households, the estimates of the Green Paper on energy efficiency may be used for reference. According to the data in this Paper, the total energy efficiency is estimated at a rate of 27% of the EU25 average, i.e. the highest of all sectors. The potential in Hungary is presumed to be significantly higher, which signifies that the residential sector is where intervention is most urgently demanded.

10. Tools for Residential Emission Reduction

Reduction in residential emission is based on boosting energy efficiency and promoting energy saving. For this means such instruments need to be implemented which stimulate the residential population to efficiency boosting.

The EU Action Plan for Energy Efficiency and the *32/2006/EC Directive* (Energy End-use Efficiency and Energy Services) present effective instruments; these served as the basis for possible intervention areas.

Potential Estimation

The energy efficiency potential of Hungarian households must be surveyed. This is the first step and with this knowledge the action plan for efficiency improvement can be prepared.

Preparation of Hungarian Energy Efficiency Action Plan

With the possession of knowledge considering the potential, strategic targets can be defined with a minimum of 2% annual energy saving, as our current estimates show.

Management of Public Information Offices

A network of public information offices needs to be run since, as experience shows, this is one of the most effective ways of quick disclosure of information. Here it is possible to establish a personal relationship, thus really valuable information is exchanged. These offices would have a twofold role: besides supplying technological information to the public, they could also gather information first-hand concerning planned and realized energy efficiency investments; consequently, they would have an important role in the monitoring activity of an energy efficiency action plan.

Municipal Sample Projects

Municipalities present the realization of energy efficiency investments through sample projects. Therefore, they can provide real help in the implementation of investments.

Education

Raising awareness is one of the key elements of the energy efficiency action plan since a considerable amount of energy can be saved only by means of changing habits. Moreover, it is essential to learn about technologies boosting energy efficiency.

Training Experts

Within the framework of experts' training, attention must be paid to the training of energy auditors, constructors, and energy engineers since a national action plan can only be effective if there are sufficient intellectual resources and a really large number of experts is available for the implementation of many minor projects. Subsequent to the termination of energy investments, these trained professionals need to be employed in the supervisory system.

Labelling Household Appliances

The labelling of household appliances must be extended to all equipment, including electric kettles, computers, televisions and all appliances with a standby function, chargers, as well as office/street lighting managed by municipalities. The fundamental principle is to reveal the energy efficiency of all equipment to the consumer so that the product with the highest level of efficiency could be selected.

Energy Labelling of Facilities

The energy labelling of buildings must be introduced as soon as possible. Since facilities and flats are part of a really long investment cycle, this is an extremely urgent task. Flats and houses being built nowadays are going to be part of the national housing park for a longer period than the term of this strategy, so this is one of the most immediate tasks which can produce impressive results in the long term.

Informative Invoicing

Consumers should pay according to their actual consumption. Invoicing systems must therefore be designed in a way so that information would be disclosed to all consumers so that they could assess the energy efficiency of their own households based on the ranking for their current consumption and consumption references.

Stimulating Energy Efficiency Investments

Energy efficiency investments shall be promoted with the help of direct support besides the above. It is significant in connection with these investments that only actual, well measurable and certified energy saving shall be supported. At the development of support systems, longer investment cycles must be kept in mind.

12. Horizontal Integration with other National Strategy Documents

It is indispensable, in order to meet targets set by the Strategy, to display strategic connection points and the "descent" to the Strategy in other national strategy documents. Taking into account that a part of these documents has already been completed, their coherence with the Strategy must, by all means, be investigated during their overview. On the other hand, in the case of strategies whose development is in progress, experts of the fields concerned shall be informed about strategic focus of connected fields, so that these would be included within the strategy in an appropriate and consistent way.

This, at the same time, creates an opportunity for the strengthening of integration between national special politics and strategies. In its absence, the Strategy itself would not be able to reach the targets set.

Horizontal integration affects the following strategic points:

Greenhouse Gas Reduction

All elements which enhance the reduction of greenhouse gas emission belong to this group. Examples include efficiency boosting, use of renewable energy sources, change in structure, and reorganization of transport, their support or their effect experienced only indirectly. During the determination of strategic focus, the reduction of greenhouse gases must always have special emphasis similarly to the relation with the National Climate Change Strategy.

Social Adaptation

Those adaptation strategy focuses belong under the terms of social adaptation which enhance the preparation of society and the adaptation to climate change. The developments of further education and education programmes belong here in line with the requirements of industries stimulating the new reduction of greenhouse gas emission, as well as the adaptation-like approach of architectural and infrastructural developments.

Agricultural Adaptation

Agricultural adaptation means the preparation of agriculture and its adaptation to new challenges generated by climate change.

Greenhouse Gas Tax

Strategic elements connected with emission trading system and tax for internalizing external costs belong under this heading.

Technological Innovation

Technological innovation forms a group of strategy elements which support technologies stimulating greenhouse gas emission and promotes related research and development.

Social Permeation

Strategic elements related to the broadening of the knowledge of society, of changing habits and attitude enhancing the social permeability and acceptance of National Climate Change Strategy and further expanding the capacity of social adaptation.

Biosphere Adaptation

Strategic elements promoting the adaptation of natural environment and ensuring the conservation of national natural environmental values.

13. Education and Encouraging Awareness

It is indispensable that both our and future generations would be aware of the reasons, consequences and possible measures for the prevention of climate change. Without possessing

this knowledge, people will continue the energy wasting lifestyle which endangers the safety of their own existence in the long run.

13.1 Education and Schooling

Children's minds are extremely receptive to new information, therefore, the subject of climate change shall be included in the national curriculum for secondary, as well as for primary schools.

The National Curriculum must cover the following areas by applying proper language and details adjusted to the age group of primary and secondary school pupils:

- Climate change, greenhouse effect
  - *Process description, reasons*
- Origin of greenhouse gases, procedures producing these gases
  - *Main emission areas, emission levels*
- Expected effects of climate change on global and regional level in the decades to come
  - *Helps in adaptation and lifestyle planning*
- Decarbonisation process, renewable energy sources, energy saving, energy efficiency
  - *Possibilities to mitigate climate change*
- Adaptation possibilities and practical knowledge (for extreme weather conditions)
  - *For the safety of possessions and life*
- Major elements of Hungarian National Climate Change Strategy (at grammar school)

Information and gathered knowledge related to climate change must be circulated to a broader audience in higher education institutions, and they must form an integral part of further educational programmes, as well. Education at this level needs to enter into details explaining the connection between climate change and certain areas and fields. The chief target is to make participants perfectly aware of the effects political, economical or legal decisions exert on the climate.

13.2 Increasing Knowledge and Awareness

Besides educational facilities, knowledge must be spread among young and adult population, as well. It is imperative because the measures to be taken in order to mitigate the effects of climate change and the effects of climate change themselves are not decades away but are present today. **Intense social awareness is indispensable for the effective adoption of the National Climate Change Strategy**. The instruments for improving knowledge and heightening awareness may be as follows:

- Documentaries and informative short films
- Presentations and series of lectures
- Effective media communication (television and radio broadcasts, Internet)

- Active cooperation of environmental protection civil organizations.

During the change of climate the number of extreme weather phenomena increases. However, preparations can be made in advance and the necessary measures may be taken with the help of accurate forecasts and providing relevant information to the public. **The communication of warnings shall be more widespread in the future.** The spreading of knowledge concerning extreme weather phenomena and connected adaptation possibilities provides the individuals with opportunity to guarantee the safety of life and possessions. It would be practical to inform the public continuously of extreme weather conditions via television ("headlines") and the Internet.

14. Research Priorities

The Strategy relies on various Hungarian research areas to a great extent. These research papers shall provide valuable information also in the future for the further development of the Strategy as well as for the development of periodic action plans; therefore, the Strategy identifies the following research area priorities:

- Regional climate research;
- Synoptic climatologic research of extreme or unseasonable weather conditions;
- Ever more accurate forecasts in order to devise adaptation strategy;
- Surveying and research of Hungarian efficiency potential;
- Most accurate determination of Hungarian energy efficiency potential, exploring energy saving possibilities to formulate reduction strategy;
- Mapping Hungarian renewable energy potential;
- Energy potential available due to renewable energy sources and its accurate definition in time and space in order to draw up reduction strategy;
- Development of technologies enhancing energy efficiency (for emissions reduction);
- Latest developments in insulation technology;
- Modernization of heating systems;
- Research of building equipment modernization;
- Development of passive construction techniques;
- BAT research in energy production and consumption;
- Research of technologies concerning optimal and sustainable consumption of renewable energy sources (for emissions reduction);
- Generation of heat with renewable energy sources;
- Research related to solution of problems with scheduling wind-power stations;
- Improving efficiency of generation of electricity and heat with solar-power and geothermal energy;
- Research of implementation of electric system capable of responding to new challenges (integration of electricity from renewable energy sources, decentralization);
- Development of hydrological forecasts (for adaptation to flood);
- Development of (nowcasting) meteorological forecasts (adaptation to extreme weather conditions).