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THE ENERGY SOLUTIONS WE SEEK

Dear participants of the Conference,
members of Montenegrin Academy of Sciences and Arts.

It is my great pleasure to address you at the opening ceremony of the Conference.

The energy problems have many faces. Many countries feel it is vital to their national security to have access to clean, affordable, available and accessible energy such to link it to economic prosperity. There is no any dough that there is great potential for geo-political conflicts due to need to provide domination on energy market. But, we have experienced in the last few decades that the major problem behind providing an adequate energy service is in climate change. These days more often we talk on the problem of climate change rather then energy. Both issues are very much related since production and use of energy is the most responsible for generation of greenhouse gases and therefore climate change. We do have scientific evidence that the variation in sun radiation contributes to the climate change even ten times less compared to what the human being contribute, mainly in the area of energy transformation, in this process.

If we continue to use energy in the way we have been using it one might expect very serious problems. These problems, mainly recognized as the rise of average temperature, would be manifested in many areas. Suc, during the lifetime of youngest grandchildren generation many of the forest all over the world are predicted to die. The reason will be even mild increase in temperature due to effect of GHG which will result in less frosts which would be not strong enough to kill Pine Bark Beetles, which will rapidly multiply and kill the forest. It is enough only increase of few degrees centigrade for this to happen. Furthermore, few degree of increase in temperature will significantly influence desert borders. The movement of deserts does not recognize countries borders. This might result in many tensions between nations.

Still hidden but very serious problem is with a lot of carbon in the soil of northern tundra in Siberia and Canada. This carbon was deposited there by trees and vegetation. When those trees and vegetation died there were not plethora of microbes that actively recycle this carbon into carbon dioxide and methane. Few degrees of increase in temperature would be enough to activate those microbes such that they start producing CO_2 and methane in quantities manifold greater that the human is doing now. At that point there will happen runaway effect. It is very difficult and at the moment not possible to predict how this process is going to affect the planet Earth. Not going in many more details I have to mention that there are large quantities of methane situated in the water in Siberia and north Canada. This methane is trapped in the water by the ice cover. It is very realistic that few degrees centigrade of increased temperature will result in melting these covers what will cause that methane to start flowing into atmosphere. Only 3% of its concentration in atmosphere is enough to blow up the planet Earth.

All these treats come from the possible increase of the average temperature what is primarily result of human activities in particular in energy domain. That is why energy problems are in the focus of our civilization. Certainly, not only because of it, but because we have to provide enough energy for growing world economy as well as for increasing number of population. We all do have great hope in restructuring energy industry and energy use such to even reduce concentration of

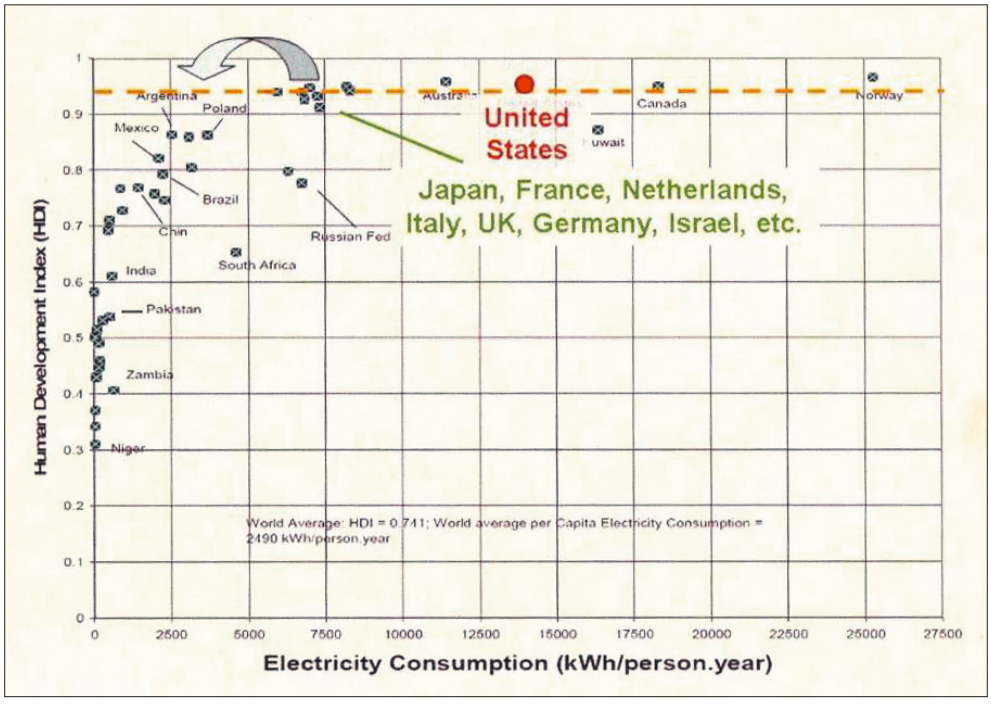

Figure 1. Human developed index

GHG in atmosphere. This is in fact the only solution if we want to survive on this planet.

Energy efficiency contributes in the most straightforward way to achieve this solution. It has been proved, especially in very developed countries like USA that the energy consumption does not have to be directly related to economic growth like Human development Index shows. Let me, for example, mention only one case. An average American refrigerator is by world standard huge. It was 18 cubic feet in mid 1970 s, and now 22 cubic feet. Energy efficiency has in the same period gone down by factor four. It was possible by using better insulating materials what resulted in smaller compressors, what is major cost of the refrigerator. This save in energy in total is equivalent to twice the total production of wind, solar, thermal and photovoltaic installed today in USA. There are many instances like this.

Source	Kilograms of carbon per MWh produced
Nuclear fission	4
Wind	8
Hydro	8
Energy crops	17
Geothermal	79
Solar	133
Gas	430
Oil	828
Coal	955

Source: British Royal Academy of Engineering (2006)

Figure 2. Carbon production in relation to type of energy

Obviously clean energy is something we want to practice more then what we do it today. Clean energy is mainly what we think when we say renewable. Although there is no totally clean energy renewable do produce significantly less GHG compared to traditional fuels like fissile. The state of art of the renewable, its benefits and effect on energy systems as well as on environment will be discussed in large by the very recognized speakers today. Let me just stress that thinking on energy systems one has to take in account that the renewable are not any more only part of decentralized systems, but very much incorporated in centralized networks. The investments in renewable has increased tremendously worldwide. 2/3 of all investments in energy sector last year were in wind energy. It is great pleasure that central and south east countries countries have started serious investments in renewable.

Last but not least let me wish you pleasant stay in Montenegrin Academy of Sciences and Arts and very fruitful conference.