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Future energy must be abundant, reliable, clean, safe, and cheap. The problem has to be considered in complex, and not only no of the listed above requirements can cancelled but on the contrary, many additional requirements should be added. The requirements, in general, contradict each other and cannot be met independently. Mathematically we have a multi-objective optimization problem, were the importance of each factor must be evaluated on the basis of techno-economic analysis.

The global future energy problem is reduced finally to that of energy sources, systems for power generation, transmission distribution, power systems stability and control. Approaching the global problem is an extremely complex task that needs a profound research in fundamental and applied sciences: mathematics, physics, new materials, advanced sensors, big data etc., and original engineering solutions.

Renewables – solar and wind are considered today to be the main sources of future energy. The common feature of them – intermittency, that leads to the necessity of inclusion into future energy systems energy storage. Intermittency will also result in instabilities of energy systems that in turn leads to the necessity of development of new control and automation systems, new sensors, new control methods - like big data. Taking these novelties in future energy system into account, the evaluations of costs of wind and solar energy become more sophisticated. According to some studies of EROI (energy return on invested energy), solar panels are unprofitable. Other studies result in opposite conclusions. The only we may conclude, that many fundamental questions concerning our knowledge of future energy remain unanswered. Wind and solar will not cover the growing energy demand. New physical solutions are necessary to provide the world population by energy in the future.

In the presentation an overview of main future energy challenges is given.