

NUCLEAR ENERGY

FOR



SUSTAINABLE HYDROGEN

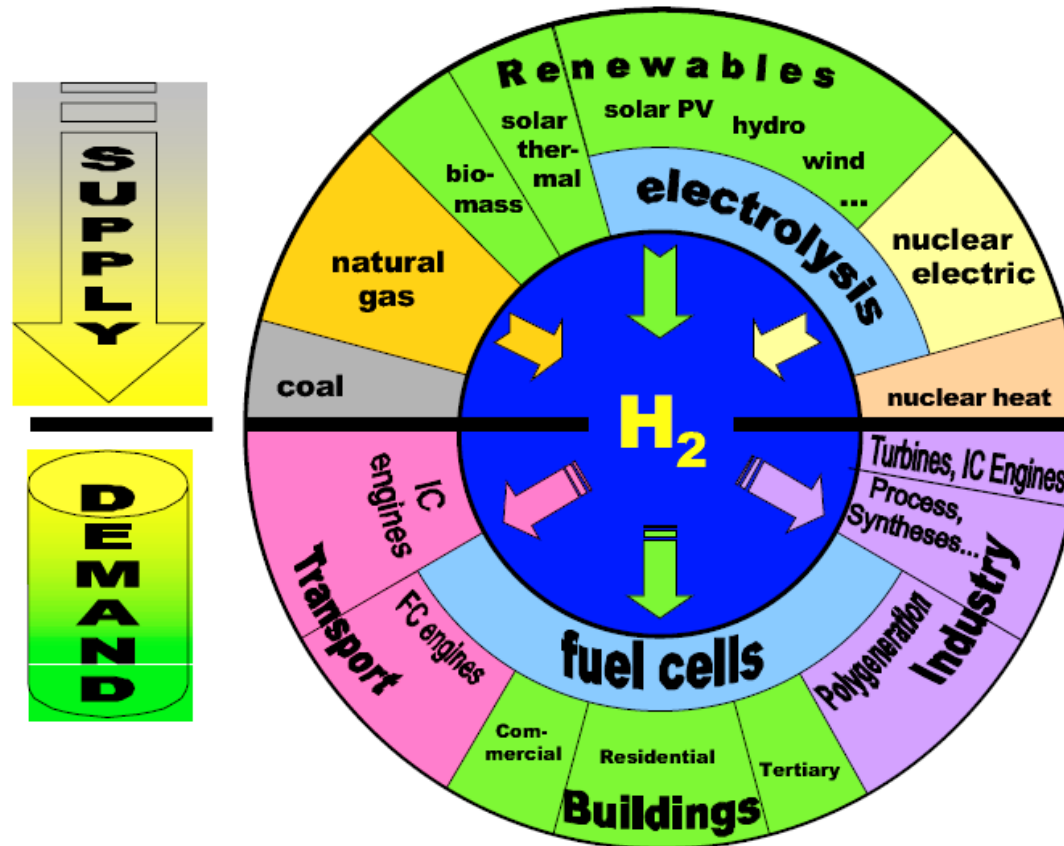
PRODUCTION

Dr.ing. Georgi Gyoshev

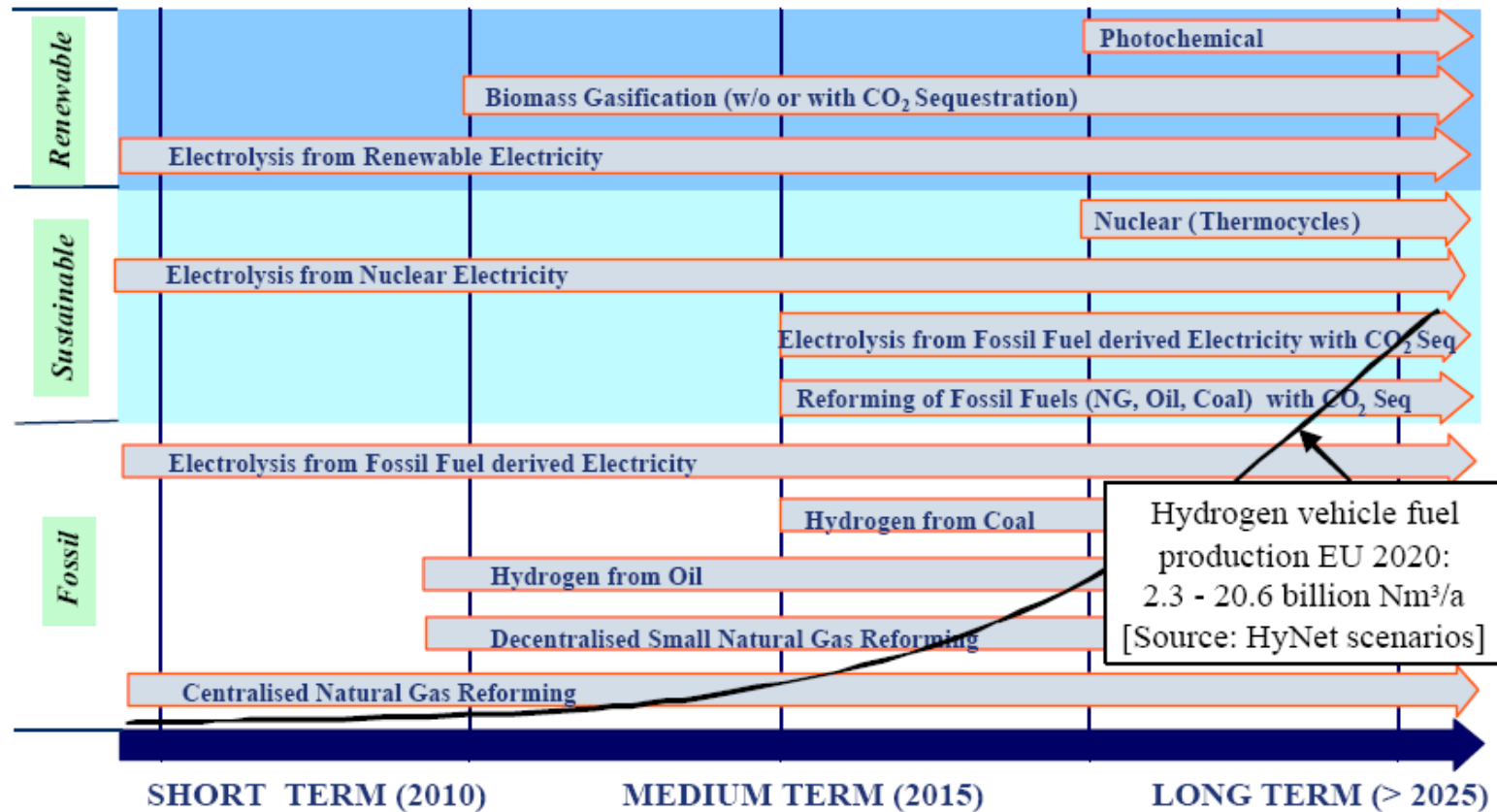
Vice President of BgNS

geoshev@npp.cit.bg

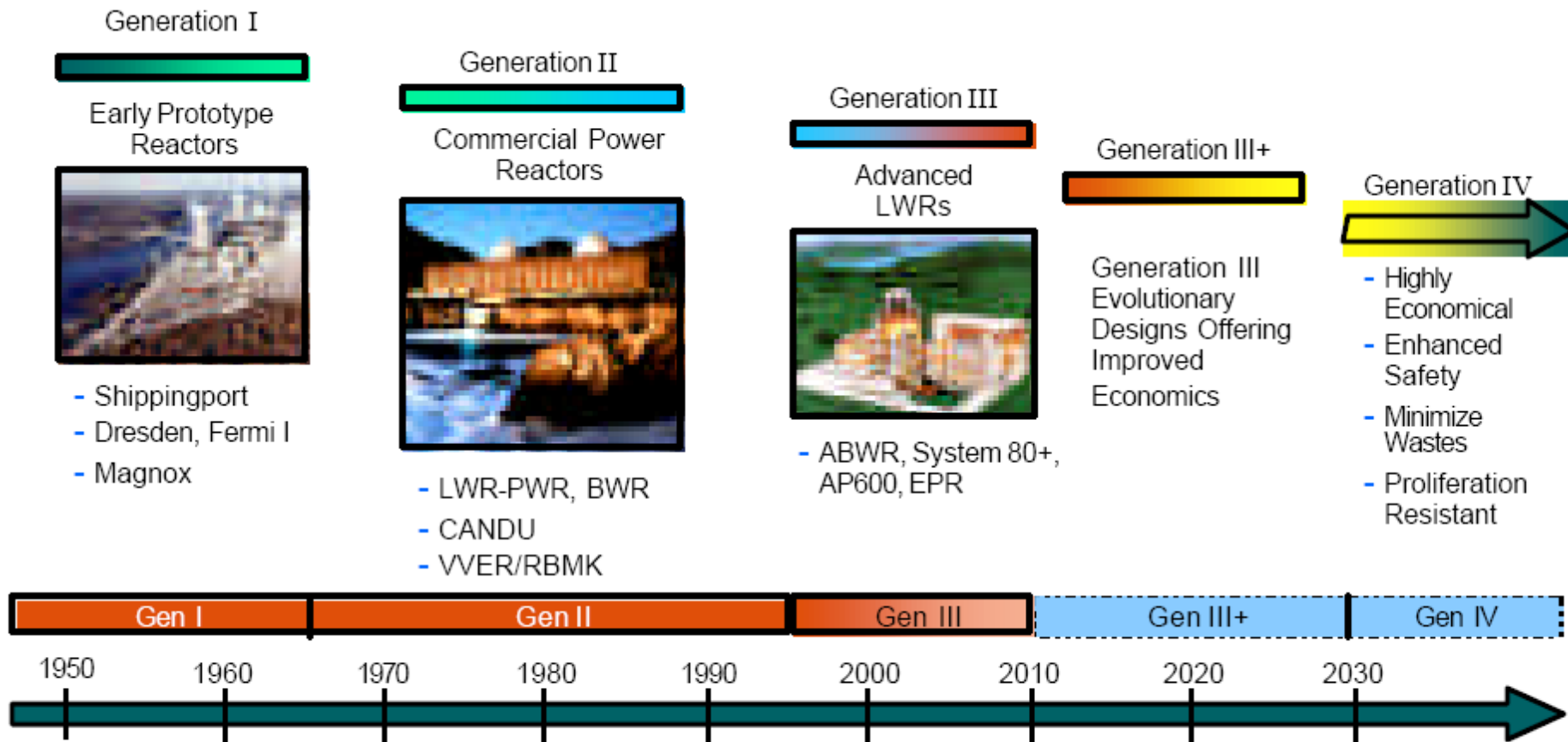
EC Vision for Hydrogen Primary Energy Sources and Applications



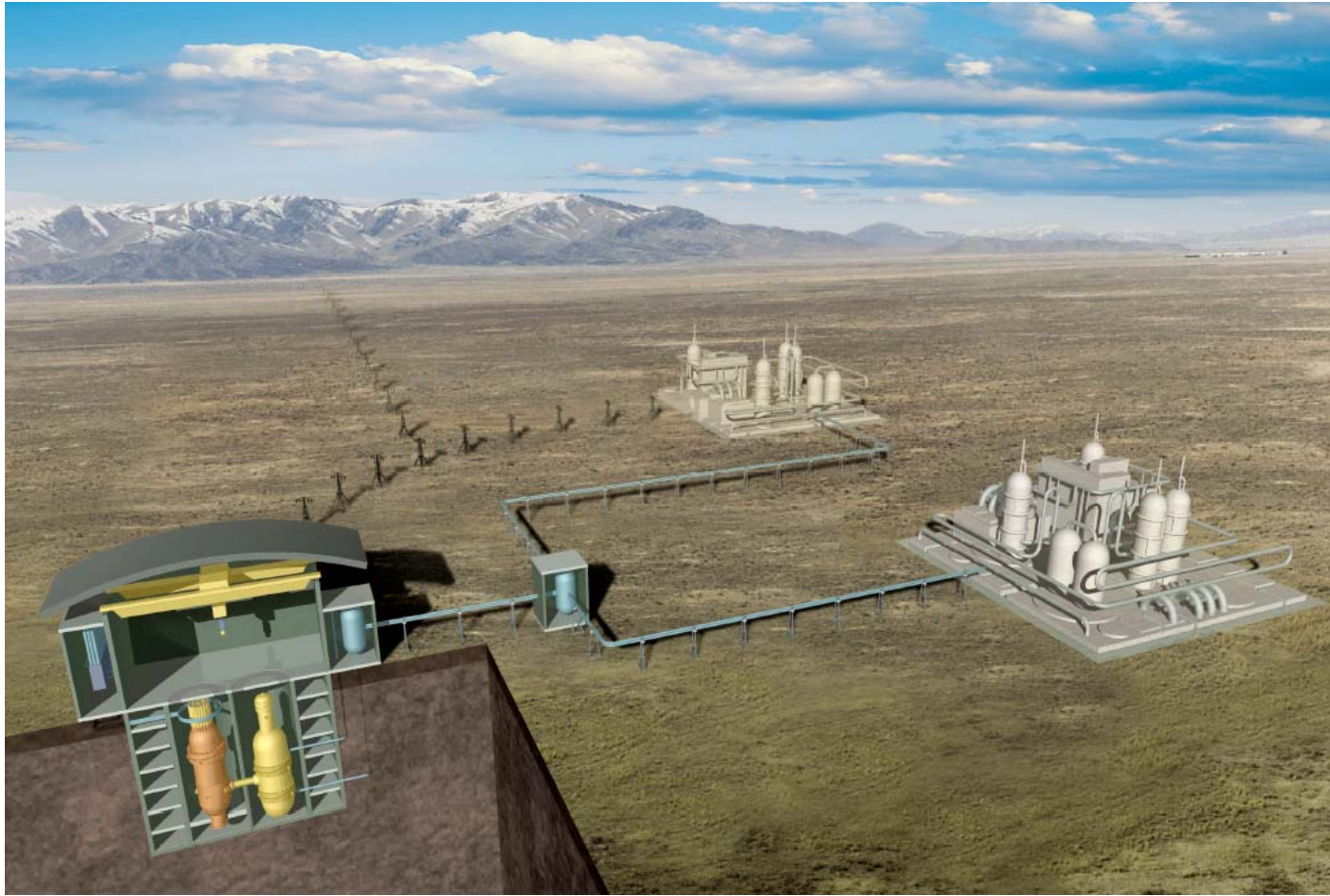
EC Timeline for Hydrogen Production Technologies



The Evolution of Nuclear Power

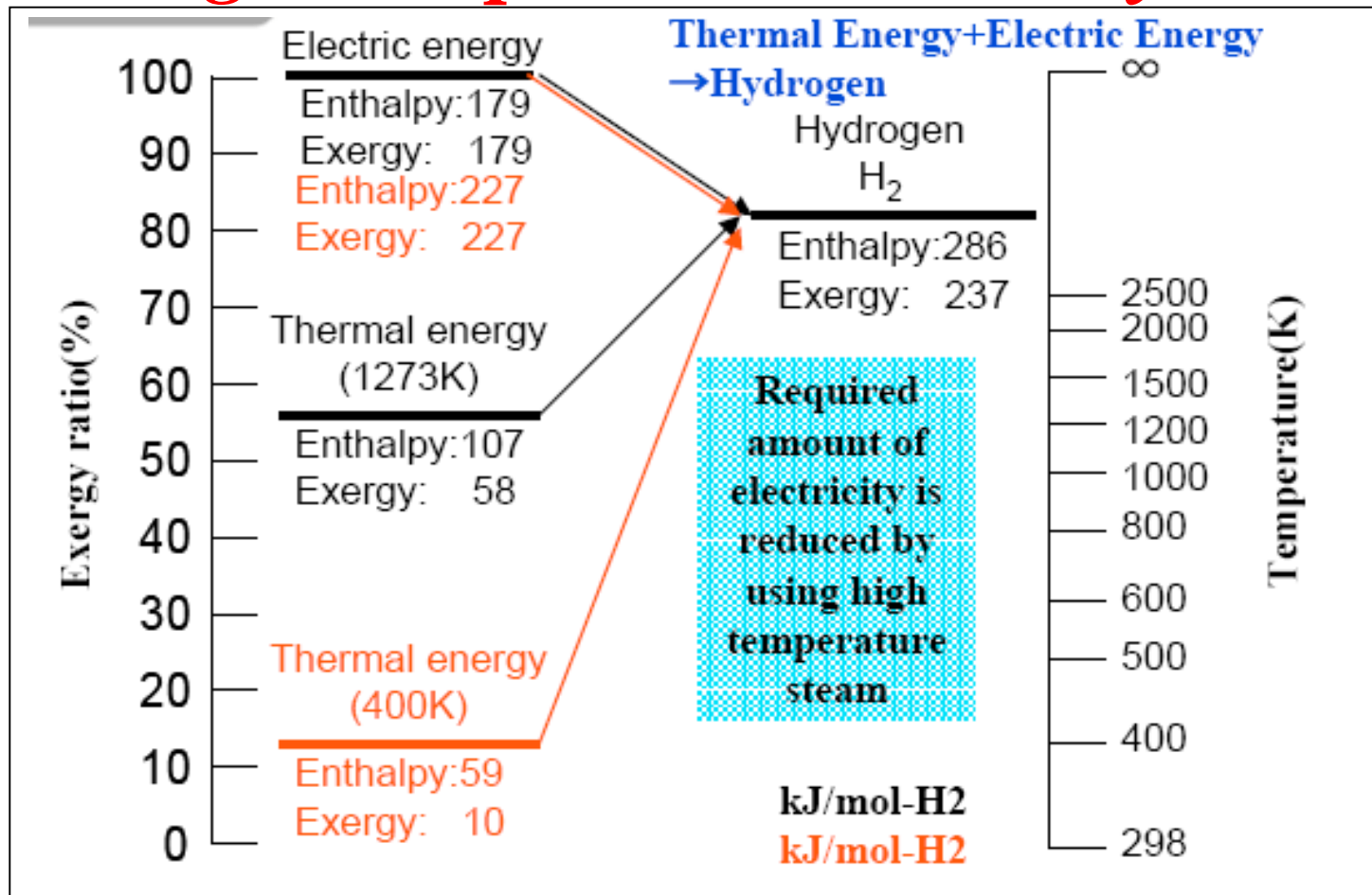


An Artistic View of MHR with Electricity and Hydrogen Production

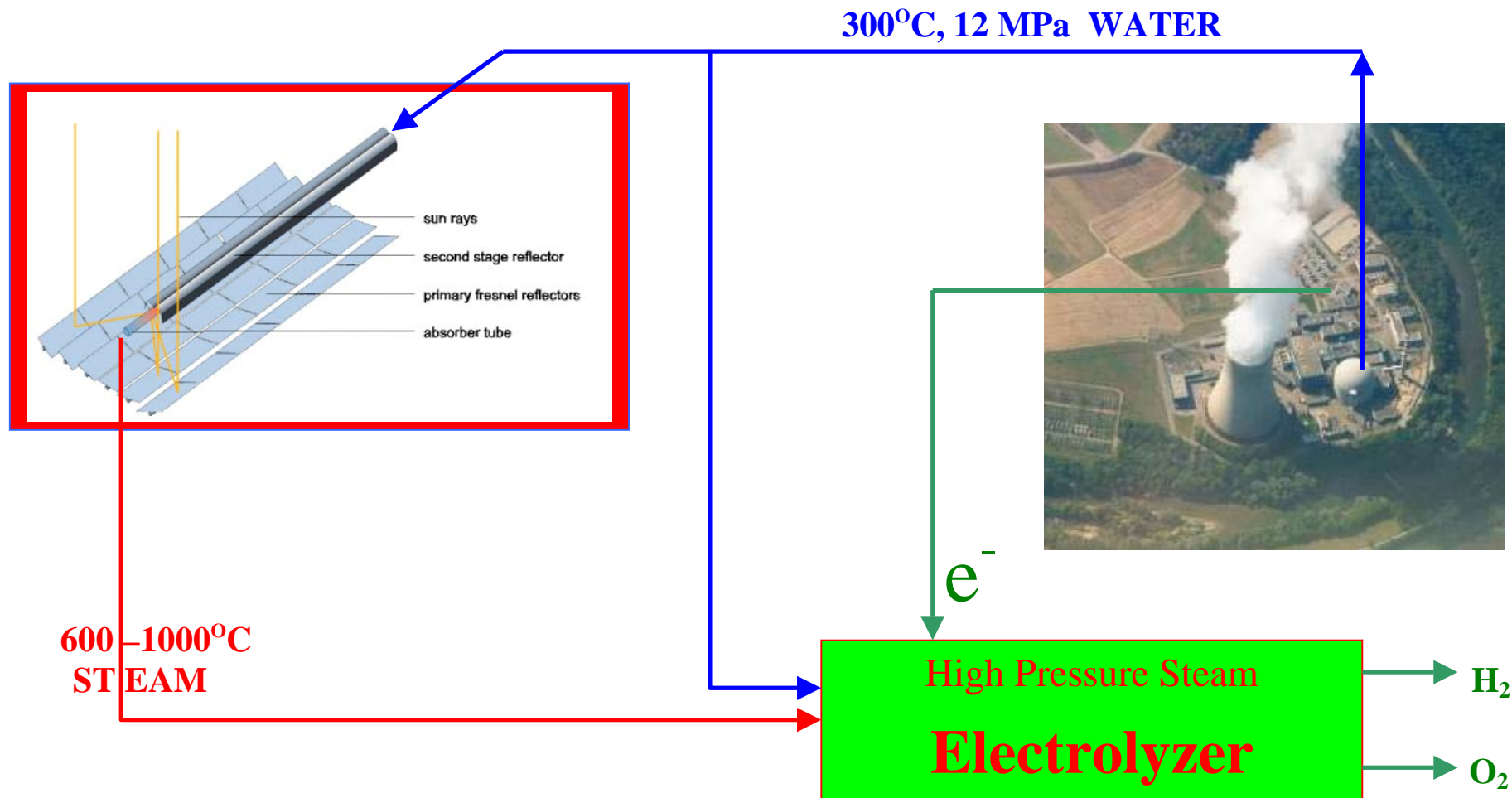


Sofia, 23-26 September 2004, International conference *NEW NUCLEAR POWER IN BULGARIA*

Production of Hydrogen by High Temperature Electrolysis



Nuclear-Solar Energy Hydrogen Production



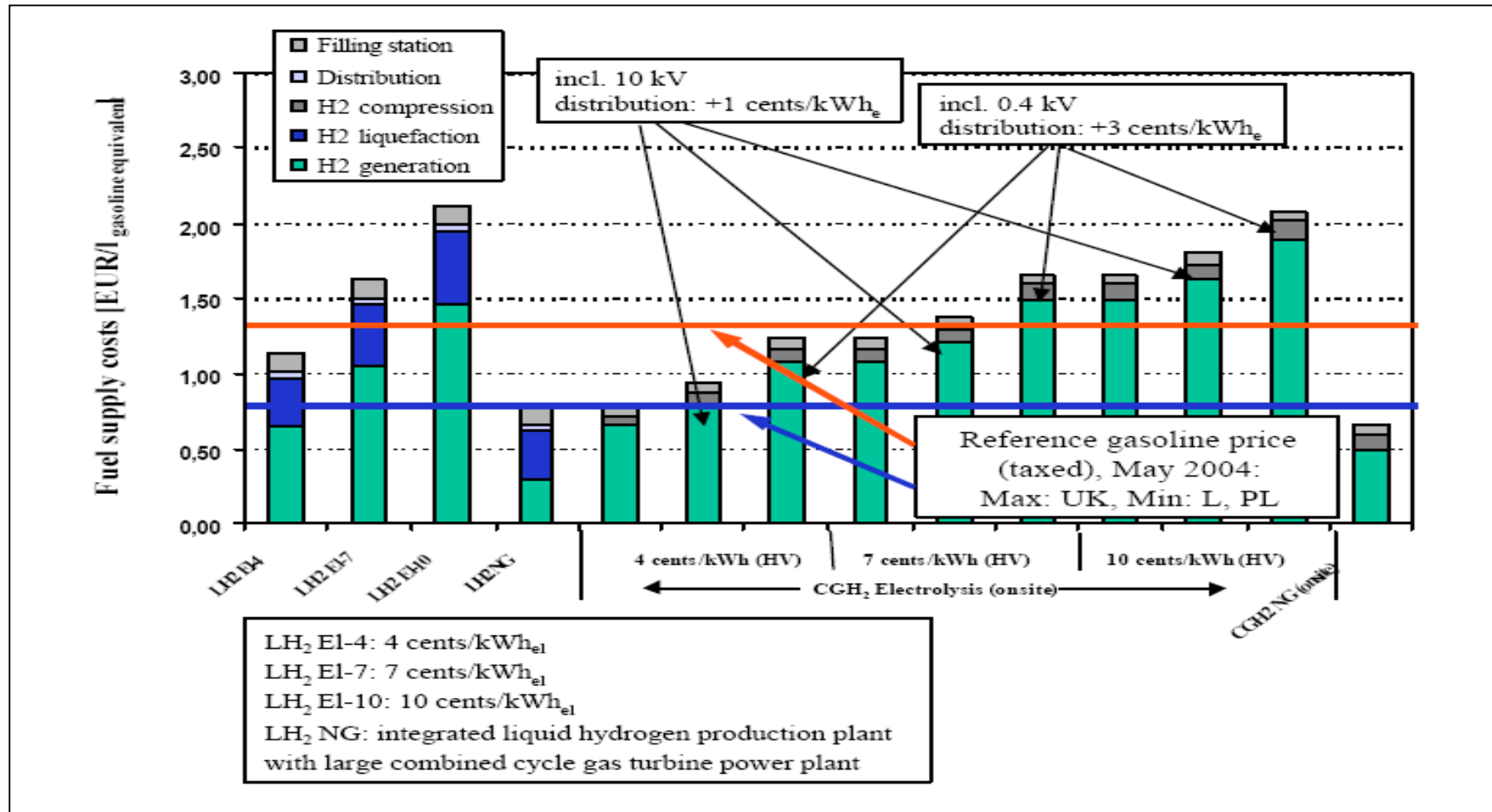
U.S. Technical Targets: Centralized Hydrogen Production by Electrolysis¹

Characteristics		Units	2003 Status	2005 Target	2010 Target
Power Conversion	Cost ²	\$/kg	0.10	0.07	0.03
	Energy Efficiency	% (LHV)	95	96	98
Cell Stack	Cost	\$/kg	0.18	0.13	0.06
	Energy Efficiency	% (LHV)	72	76	82
Balance of Plant ³	Cost	\$/kg	0.04	0.04	0.02
	Energy Efficiency	% (LHV)	98	98	99
Electricity ⁴	Cost	\$/kg	2.00	2.00	1.90
Total	Cost ⁵	\$/kg	2.80	2.50	2.00
	Energy Efficiency	% (LHV)	67	72	80

¹ 1000 kg per day electrolyzer producing hydrogen at 100-500 psi at plant gate. (Modular units can be scaled to utility size applications.)
² Cost reductions reflect development in power conditioning/control.
³ Includes purification and water removal.
⁴ Electricity at \$0.045 per kWh and 95% capacity factor (based on nuclear, hydro, or other renewable integrated electricity, steam electrolysis would have lower electricity and include cost for steam).
⁵ Based on system capital cost of \$400, \$300, and \$150 per kW_e, respectively. Includes O&M cost, labor, and physical plant construction, 15% discount rate, 20-year equipment life.

Note: Capital costs for steam electrolysis would be higher, electricity costs lower, and efficiency higher. The goal of large scale electrolysis technologies is to reach the \$2.00 per kg cost by 2010 and longer range goal of \$1.50 per kg at the plant gate.

EC: Nuclear Electricity is efficient for Mass Production of New Transport Fuel - Hydrogen

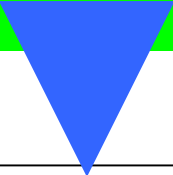
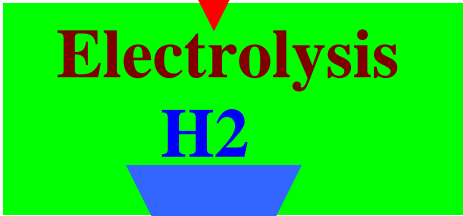


Kozloduy and Belene NPPs

*have chance for Sustainable Hydrogen Production
needful for quick start of H2 ICE Commercial Use*



NUCLEAR ELECTRICITY



*Ford is ready to start Mass Production
of Its H2 ICE Ford Focus C-Max*



INSTEAD OF CONCLUSIONS:

- 1. “Hydrogen has being called "The tomorrow's energy" but the tomorrow is coming...”*
- 2. “...Hydrogen could be produced without CO2 emissions from Nuclear power plants. “*

Loyola de Palacio

Vice-President of the European Commission
Brussels, 10 October 2002

- 2. “Production of hydrogen by nuclear electricity and / or high temperature nuclear heat would open the application of nuclear energy for the transportation sector...”*
- 3. “Using electricity in electrolyzers to produce hydrogen would allow a near-term option for distributed hydrogen generation at the point of delivery to the customer, such as at a fueling station.”*

IAEA-TECDOC-1391

Status of advanced light water reactor designs 2004
May 2004

- 5. “The more we look to the future, the more we can expect countries to be considering the potential benefits that expanding nuclear power has to offer for the global environment and for economic growth.”*

Mohamed ElBaradei

IAEA Director General
June 26,2004

Sustainable development in the 21st Century

