

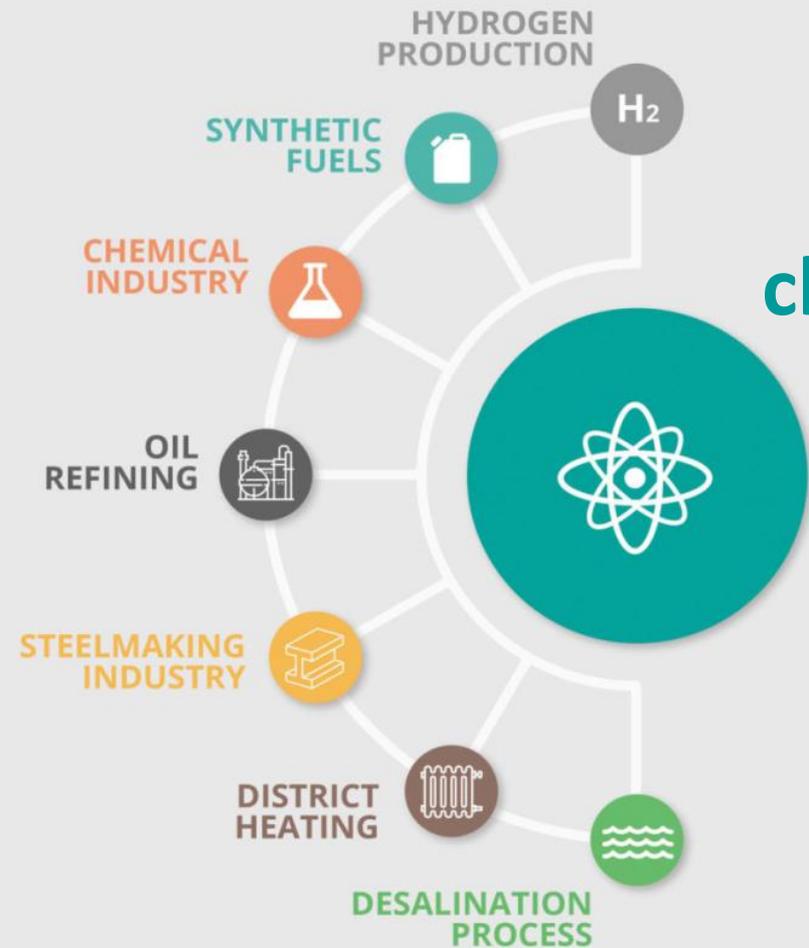
# High Temperature Gas-cooled Reactors: clean energy beyond electricity for Poland

**Grzegorz Wrochna**

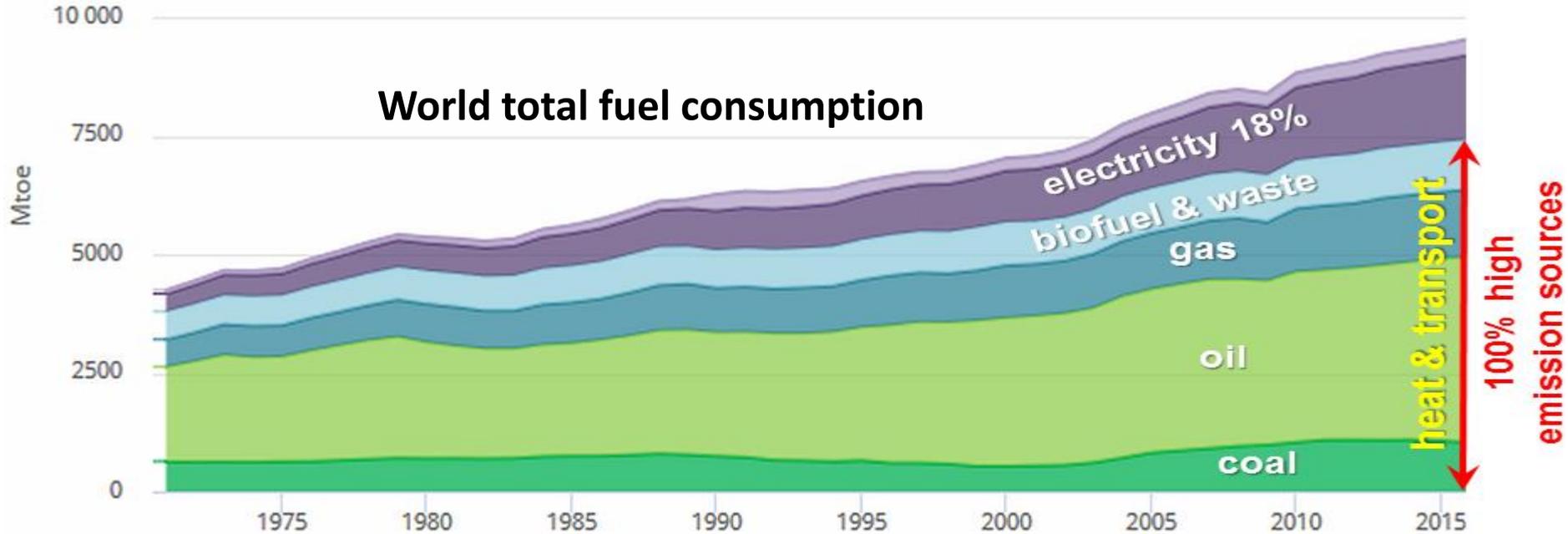
[g.wrochna@ncbj.gov.pl](mailto:g.wrochna@ncbj.gov.pl)



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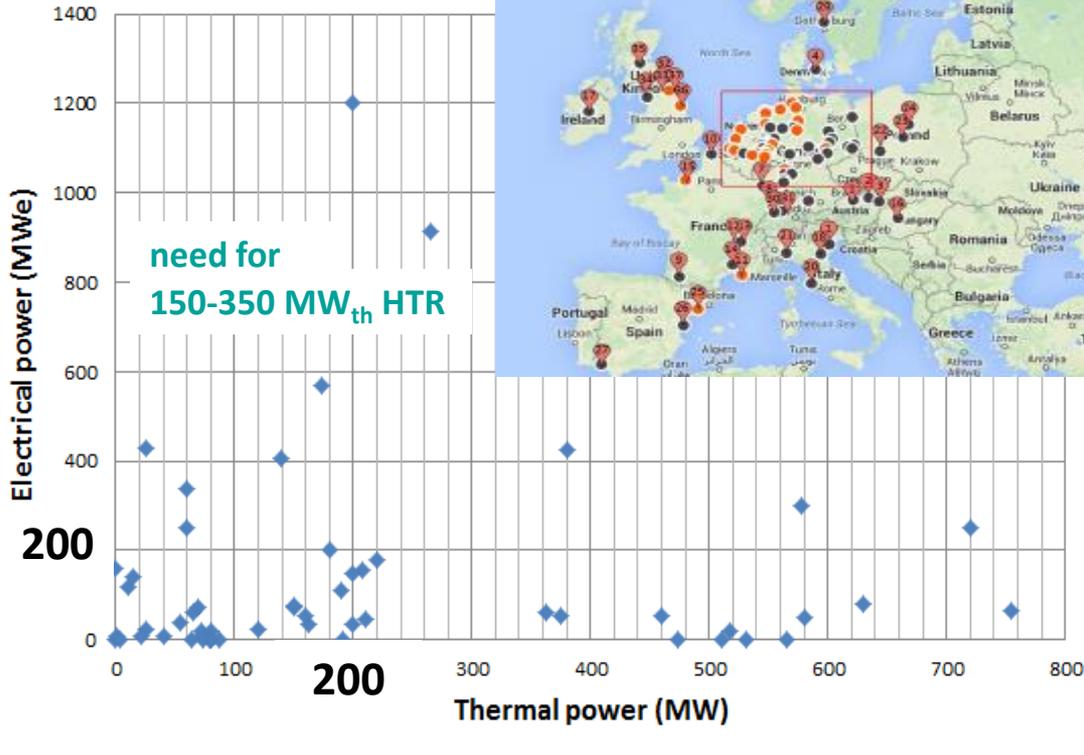
# Clean energy challenge - beyond electricity



- Reducing to zero emission from electricity production would solve only 1/6 of the problem
- Industry needs high temperature heat ( $>500^{\circ}\text{C}$ )
- Synthetic H-rich fuels for electric cars with fuel cells is the future of transport ( $>700^{\circ}\text{C}$  heat needed to produce them)

# Industrial heat demand

- Sample of >130 sites in Europe
- Mostly chemical industries



## Case for Poland

- **13 largest chemical plants** have installed today 6500MW of heat at  $T^{\circ} = 400-550^{\circ}\text{C}$
- They use **200 TJ / year**, equivalent to burning of >5 mln t of natural gas or oil
- **165 MW<sub>th</sub> reactor output fits all the needs**
- Estimated market by 2050  
PL: 10-20, EU:100-200, world: 1000-2000
- Possible replacement of 200 MW<sub>e</sub> cogeneration units in future
- Increasing interest in  $T=500-1000^{\circ}\text{C}$  for H<sub>2</sub> production

# Analysis of HTGR potential for Poland

Minister of Energy in July 2016 appointed

„**Committee for deployment of high temperature reactors**”.

Chairman: G.Wrochna

**Members from:**

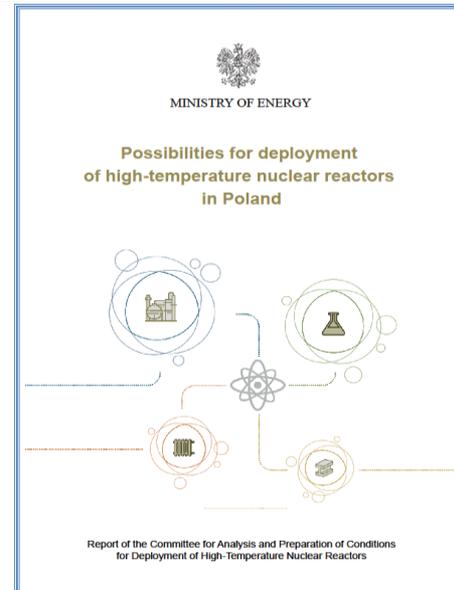
- Nuclear R&D: NCBJ
- Engineering: Energoprojekt, Prochem
- End-users: Azoty, Orlen, Enea, Tauron, KGHM

**Associates:** PAA (regulator), NCBR (R&D funding agency), PKO BP (bank)

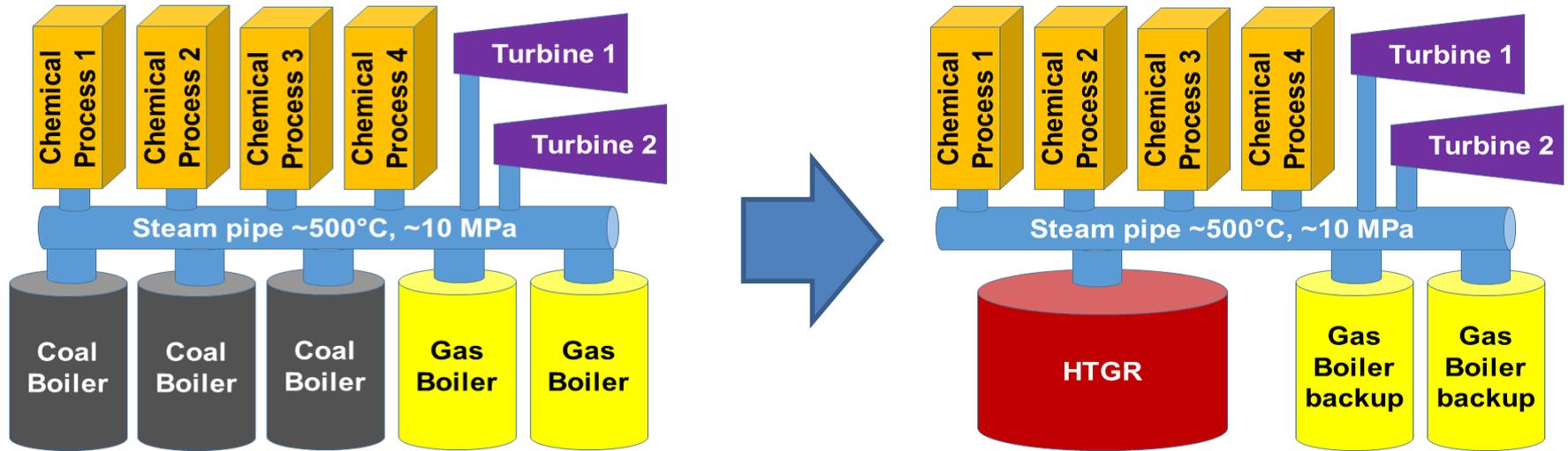
Report published January 2018: [tiny.cc/htr-pl](http://tiny.cc/htr-pl)

Minister of Energy has given a green light to implement the conclusions.

18 MPLN (~4M€) for GOSPOSTRTEG project to prepare legal, licensing & TSO framework



# Industrial heat from HTGR

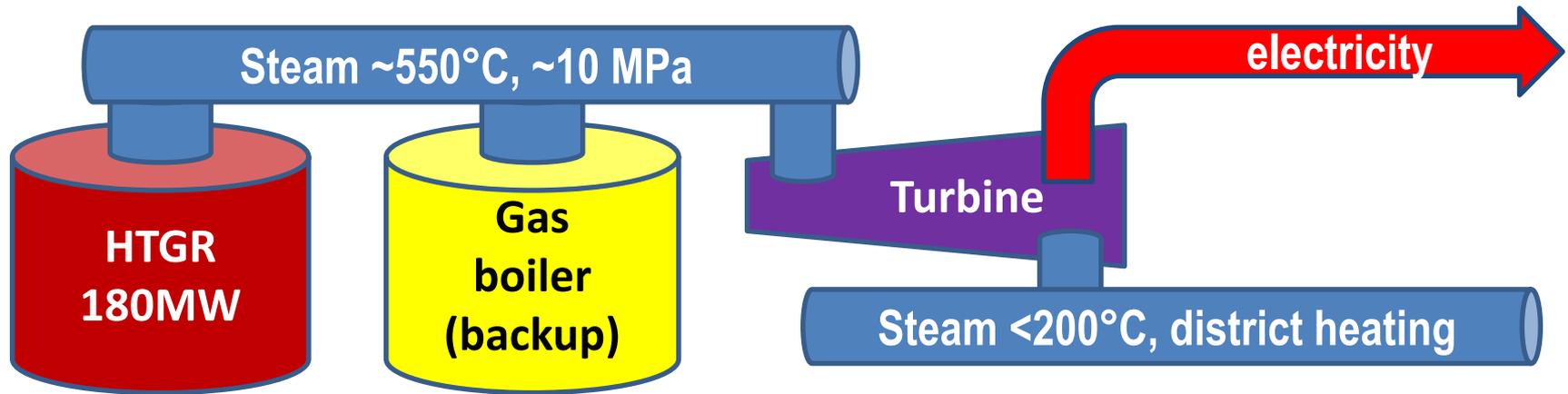


- Industrial sites use ~500°C steam networks
- Need to exchange old boilers with HTGR
- Electric island already there
- HTGR parameters matching standard boilers:

**540°C, 13.4 MPa, 230 t/h, 165 MW<sub>th</sub> (+10% for internal use)**

# HTGR for cogeneration plants

- ~80 coal-fired cogeneration plants <200MW in Poland
- **Replace with what?**
  - Large (>1000 MW<sub>e</sub>) LWR do not fit, because the plants are distributed, often close to habitated areas
- **HTGR (+ gas boiler backup) is a good solution**



# HTGR in strategic documents in Poland

Ministry of Development on 14 Feb. 2017 published  
„**Strategy for responsible development**”  
- the governmental plan for Polish economy grow

List of energy actions contains:

**Preparation of HTR deployment for industrial heat production in cogeneration, using industrial & scientific potential of Poland. Support for Polish R&D on materials for gen.IV reactors.**

„**Energy policy of Poland till 2040**” – (draft published Nov. 2018) mentioned HTGR as possible source of industrial heat.

HTGR technology included Dec. 2018 in „**Smart Specialisation Strategy**”.

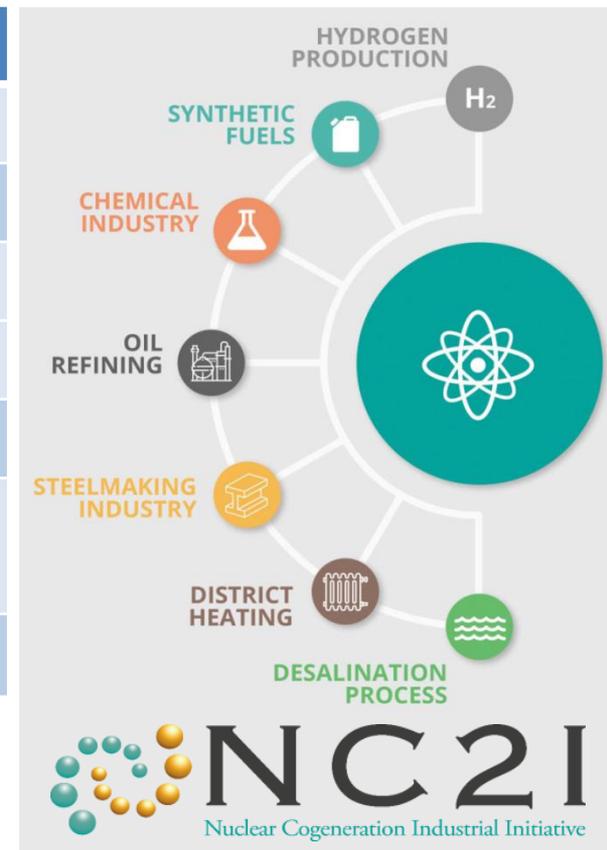
European High Temperature Experimental Reactor (EUHTER) of 10 MW<sub>th</sub> at NCBJ submitted to „**National Roadmap or Research Infrastructures**”



# HTGR related projects lead by Poland

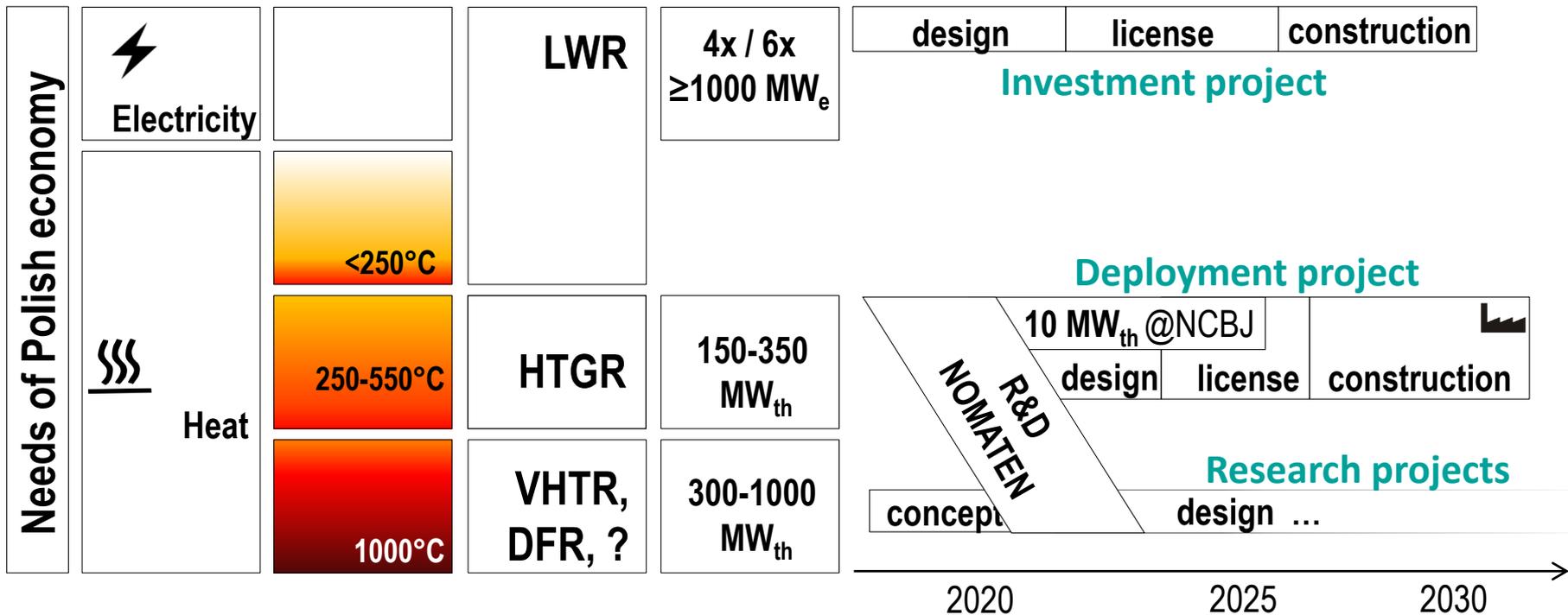
Project	Dates	mln PLN	mln €	
HTRPL	2012-15	6.5	~1.5	national
Gospostrateg-HTR	2019-22	21	~5	national
NOMATEN	2019-26		~40	NCBJ,CEA,VTT
NOvel MAterials for ENergy				
NC2I-R	2013-15		1.8	Euratom
GEMINI+	2017-20		4	Euratom with JAEA
<a href="http://www.gemini-initiative.com">www.gemini-initiative.com</a>				
HYDRO-GEN IV	2020-23	to be submitted to Euratom		

Euratom projects prepared within European  
**Nuclear Cogeneration Industrial Initiative (NC2I)**,  
 branch of Sustainable Nuclear Energy Technology Platform



[www.nc2i.eu](http://www.nc2i.eu)

# Nuclear Roadmap of Poland



**HTGR's are not to replace large LWR's! They address different market niche.**