

High Temperature Reactors for deep decarbonisation: the Polish example
From the Gemini+ research project towards demonstration
Brussels – 25 November 2020



Poland nuclear energy development plan

Polish Nuclear Power Programme for electricity generation

High Temperature Gas Reactor programme for nuclear cogeneration

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THE OBJECTIVE OF THE POLISH ENERGY POLICY IS:

To provide energy security, while ensuring competitiveness of the economy, energy efficiency and reduction of environmental impact of energy sector.

Long-Term-Polish Energy policy will be based on three pillars; just transition, zero emission power sector and clean air.



OFFSHORE WIND

about 8-11 GW to 2040

Investment outlays
around 130 bln PLN



NUCLEAR ENERGY

about 6-9 GW

Investment outlays
around 150 bln PLN



LOCALIZED AND PROSUMER POWER GENERATION

Increase of prosumers
actively take part in Energy
market

300 self-sustainable
communities and 1 mln
prosumers till 2030

Polish Nuclear Power Programme

Target

To build 6-9 GWe of installed nuclear power capacity based on large, proven PWR type reactors for electricity generation.

Rationales

Energy security:

Diversification of fuel base in electricity generation sector.

Replacement of old coal-fired power plants with zero-emission dispatchable sources.

Protection of environment and climate:

Significant role of nuclear energy in efforts to prevent climate change.

Nuclear energy is a Polish solution to achieve EU climate and energy policy goals.

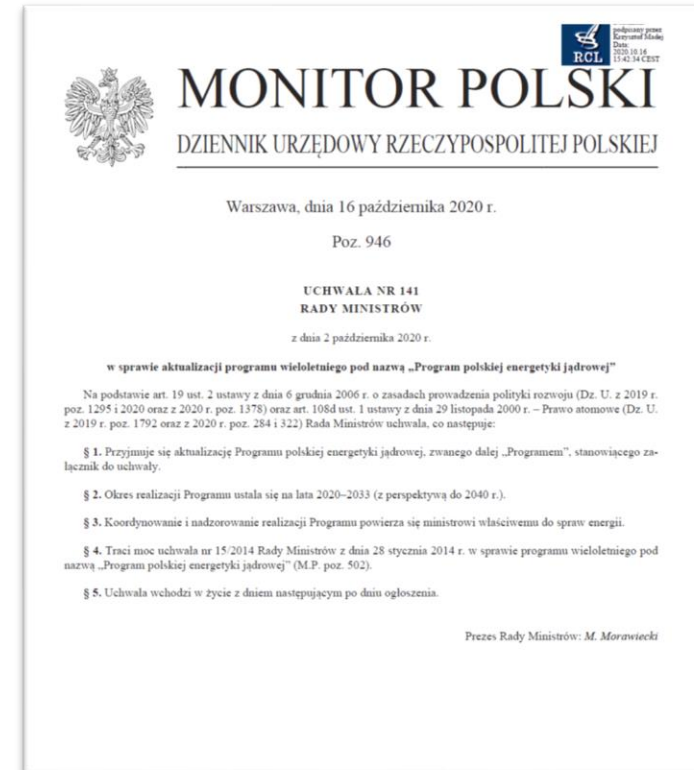
All electricity generation technologies have pros and cons for environment. Energy mix with RES only is unachievable and unrealistic. Mix without NPP means RES and fossils.

Economic benefits:

Stable price over long period of time

Can include district heating and hydrogen production (electrolysis).

Programme updated in October 2020



Polish Nuclear Power Programme

Key elements of nuclear power implementation.

Model (ownership relations):

Project company (51% State's Treasury, 49% Strategic co-investor connected with technology supplier).

One technology for all NPP's.

Technology (reason for large PWR's):

The most extensive experience in construction and operation of NPP.

No history of important radiological accidents.

Common knowledge of PWR technology by Regulators.

More options for NPP siting due to smaller emergency zone.

Competitive supplier market.

Siting: one in North and one in Central of Poland



Polish Nuclear Power Programme



Schedule

2021 – selection of technology for NPP1 and NPP2

2022 – obtaining of an environmental and siting decision for NPP1

2022 – signing an agreement with the vendor of technology and EPC contractor

2026 – obtaining of a construction permit and start of the construction NPP1

2032 – obtaining of a construction permit and start of the construction of NPP2

2033 – the issuance of an operating licence by the Regulator and the commissioning of the first reactor of NPP1

2035 - 2043 every 2 years – the issuance of an operating license and the commissioning of further 2 reactors at NPP1 and 3 reactors at NPP2.

Advanced nuclear technologies in Poland – new opportunities for climate change mitigation

Although priority of Poland is to implement nuclear power programme based on large scale reactors we are aware of potential future benefits of HTR. As a result we initiated the scientific project on HTGR's (especially for industrial cogeneration) with the following objectives:

Decreasing dependence on fossil fuel import

HTGR may be an alternative to replace fossil fuels for industrial heat production. With expected growth of CO₂ tax and low discount rate, the cost of the steam from HTGR could be comparable to that from gas, while having more secure availability and more predictable prices.

Decreasing sensitivity of economy to environmental regulations

Industry dependent on fossil fuels might become less competitive in case of stronger environmental regulations (CO₂ tax, emission limits, etc.). HTGR being a zero emission technology is immune to that.

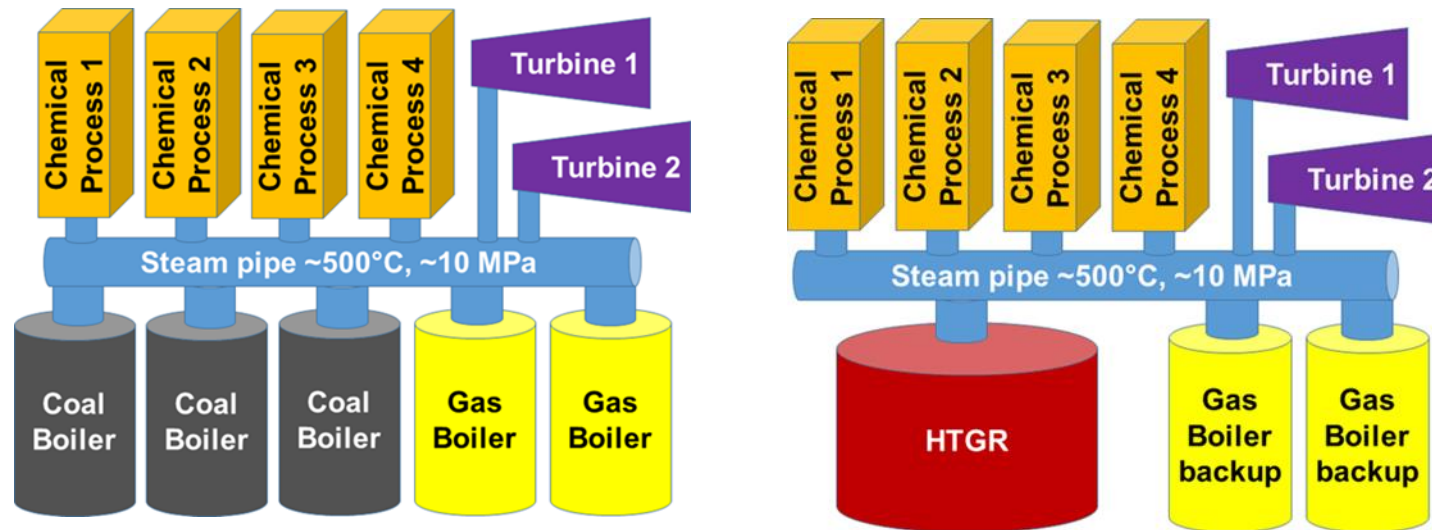
Synergy with multi-GW LWR programme .

Increasing scientific and industrial potential, upgrading the regulatory framework, developing human resources and creating a supply chain, will be beneficial for both HTGR and LWR projects.

Advanced nuclear technologies in Poland – new opportunities for climate change mitigation

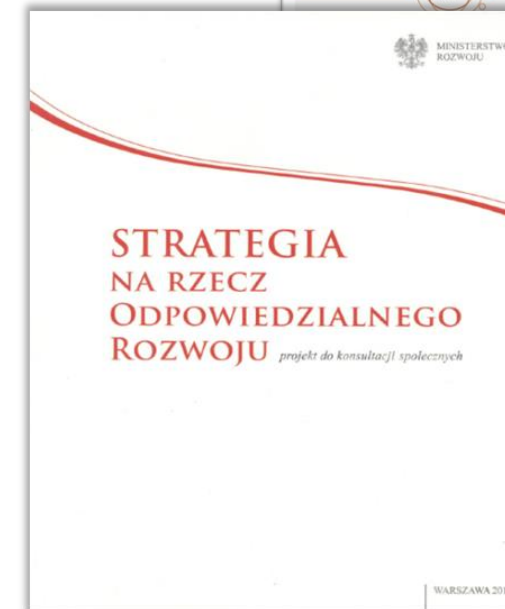
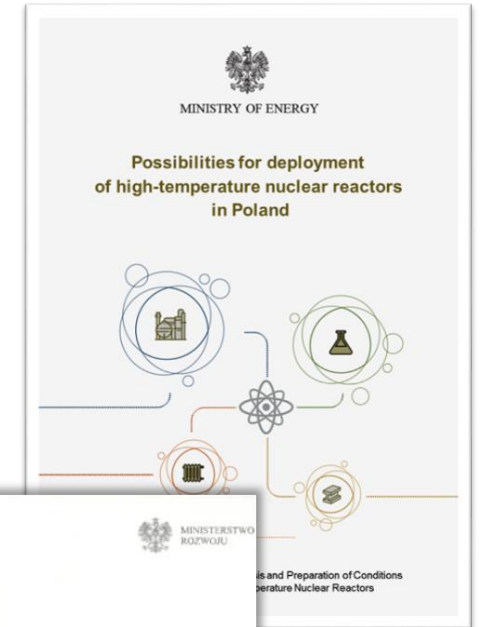
Primary target for HTGR is Polish heat market. Today 100% heat market is dominated by fossil fuels; mostly coal in district heating and coal and gas in industry heat generation. 13 largest chemical plants need 6500 MW of heat at $T=400-550^{\circ}\text{C}$.

Secondary target is the hydrogen production.



Status of nuclear cogeneration activities

- Minister of Energy appointed Committee for deployment of high-temperature nuclear reactors in Poland in July 2016. Report with results of the Committee's works published in January 2018. Minister accepted the report, took note that deployment of HTGR reactors in Poland is desirable and requested Ministry to prepare further steps.
- Strategy for Responsible Development - the governmental program for Polish economic development - adopted in February 2017, contain e.g.: Deployment of HTR for industrial heat production. The project for this action is: Nuclear cogeneration – preparation for construction of the first HTR of 200-350 MWth supplying technological heat for industrial installation.



Status of nuclear cogeneration activities

- The NOMATEN Center of Excellence has received 7 years (2018-2025) of joint financial support (€37M) from the Foundation for Polish Science (FNP) and the European Commission. NOMATEN focus on the studies and development of novel materials, specifically those designed to work under harsh conditions – radiation, high temperatures and corrosive environments.
- In 2019 Ministry of Entrepreneurship and Technology (now Ministry of Development) qualified HTR in the list of National Smart Specializations. This opens a way for NCNR to conduct research in this field with aid from the EU funds, among other things.
- In frame of national strategy program GOSPOSTRATEG the National Centre for Research and Development accepted the grant of about \$5M for joint project of MoE, NCNR and INChT for preparation of law, organization and technical instruments to deploy the HTR reactors in years 2019 - 2022.

Status of nuclear cogeneration activities

What next with HTGR in Poland:

- We have running project connected to HTGR: GOSPOSTRATEG-HTR.
- National Centre of Nuclear Research is gaining knowledge on HTGR technology by strengthening collaboration with Japan Atomic Energy Agency.
- We have strong positive signals for HTGR deployment coming from Polish Government.
- We have also interest from Polish industry, but most of them hold distance due to long development work and lack of positive signals from EU.
- We are working on a new version of national strategic energy program (PEP2040) containing elements of HTGR program.
- We are working on preparation of EUTHER program (design and construction of small experimental HTGR, being also the technology demonstrator) for implementation based on national finance sources.

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Thank you