



VTT

R&D needs for non- power uses of nuclear energy

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Motivation – nuclear energy beyond electricity production

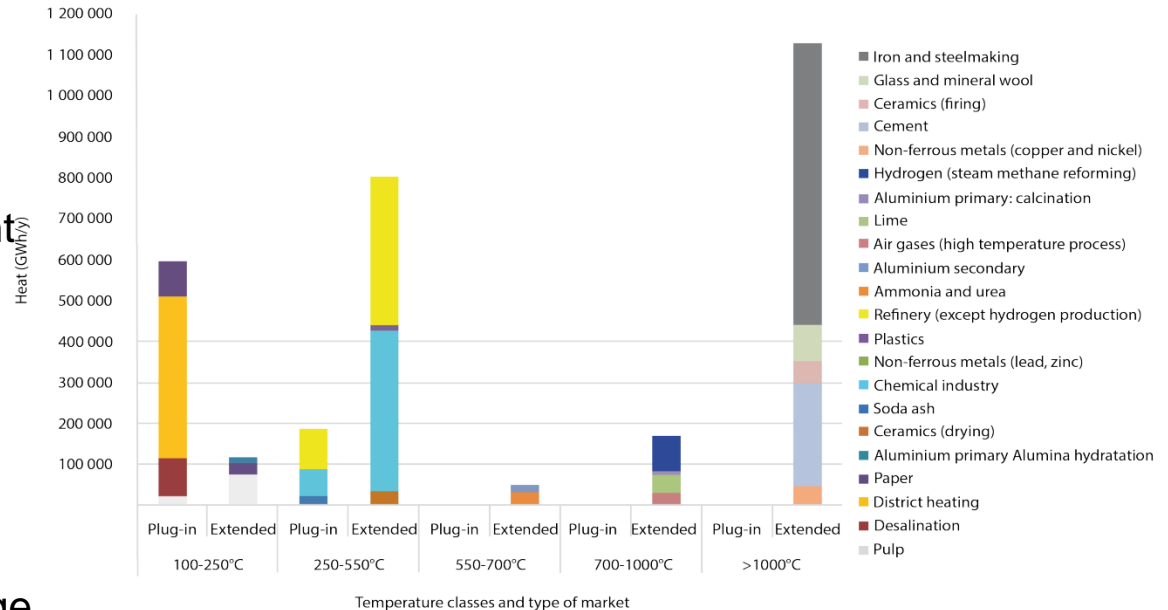
- Nuclear cogeneration has accumulated experience of 750 reactor-years worldwide.
 - Mostly these are in the form of combined heat and power production, with a small fraction of heat generated used
 - to provide district heating to communities close to NPPs
 - steam supply for paper mill, cardboard factory, salt refining as well as seawater desalination.
- Recent changes to the electricity market have pushed nuclear energy community to also consider diversification to their energy service portfolios from sole electricity production
- SMR are good candidates to answer wide variety of energy needs

Potential uses of nuclear heat

- District heating/cooling
- Process heat for industrial uses
 - May have limited in scope unless temperature boost is applied
- Hydrogen production
 - Coupling to HTSE or to thermochemical cycles
- Direct air capture applications
 - CO₂ either sequestered or used as a e-fuel feedstock
- Desalination

Use depends on the temperature of the heat

- Temperature used by different processes differs
 - Opportunity for different reactor technologies
- N.B. highest temperature shown
 - Opportunities in e.g. pre-heating, hydrogen production also with lower temperature range



[NC2I-VISION-PAPER_Final-version_Web.pdf \(snetp.eu\)](#)

The research question

- Lots of work being done in developing novel nuclear reactors (SMRs, AMRs)
- Lots of work being done in process industry optimization of processes and development of new low-carbon processes
- While these two would have a lot to gain from each other, not all development currently is necessarily synergistic

- Aim to find the relevant needs for integration of nuclear and non-nuclear fields with R&D
 - Understanding of possibilities and limitations necessarily also would assist in development of "both sides"

High level questions

- Development of specific SMR/AMR designs aiming to be used in heat production / cogeneration role
 - Public acceptance for such new nuclear energy applications
- Research on the potential issues in co-siting nuclear reactors with the heat users (industries, municipalities);
 - Safety requirements specific to collocation (e.g. nuclear combined with a hazardous chemical plant)
 - In the end depends on regulatory approach
- Country-specific interaction of nuclear regulations to regulations governing chemical industries (e.g. Seveso directive) when facilities are co-located.
 - Co-licensing of two facilities?

Some specific R&D gaps

- Technical coupling technologies between nuclear plant and heat use facility
 - Development of experimental platforms to qualify interactions between SMR and non-nuclear technologies
 - Both physical and virtual
- Analysis for requirements for heat, cold, hydrogen and power to X applications
 - SMR designs and integration to answer to the specific use cases
- Analysis covering:
 - Technical performances (operability, manoeuvrability, flexibility)
 - Economical evaluations and safety analysis for the hybrid systems
- Assessment methodology, tools, etc

In the big picture, SMRs and AMRs for these applications should be built

- Development of specific SMR/AMR designs aiming to be used in heat production / cogeneration role
 - Or adaptation of a developed one
- Public acceptance for such new nuclear energy applications is vital
 - Colocation, physical connection (no matter with how many heat exchangers in between)...
- Impact assessment (energy security, policy, industrial leadership etc.)
 - Novel products need markets and/or innovation support
- This all is built on proper understanding through R&D

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the obvious

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