

SMRs in Finland and nearby

03/06/2021 VTT – beyond the obvious

Small modular reactors

- Traditionally understood as serially produced reactors with generation capacity of 300 MW electric power per reactor
 - To start with a huge range of different designs
 - Various SMRs do not fit into the description
 - UK SMR 470 MWe...
 - BWRX-300 not necessary serially produced...
- SMRs are a popularized umbrella phrase that everyone uses
 - So our task is to look past the name to the potential challenges the future reactors would bring to waste management
 - In order for there ever be a SMR, waste management strategies must be known

Canada:

- Reactor designs in pre-licensing pipeline, e.g. IMSR
- MMR licensing start
- Aims to be SMR technology hub
- Canadian Nuclear Laboratory provides site for demonstrations

United Kingdom:

- Advanced Modular Reactor support
- UK SMR looking for investors

Russia:

- Movable barge SMRs
- RITM-200 ship reactor usable on land also

South Korea:

- SMART light water SMR
- Barge reactor development announced

United States:

- NuScale SMR generic design license
- Several other projects at various stages:
- Natrium
 - Xe-100
 - AURORA
 - BWRX-300

France:

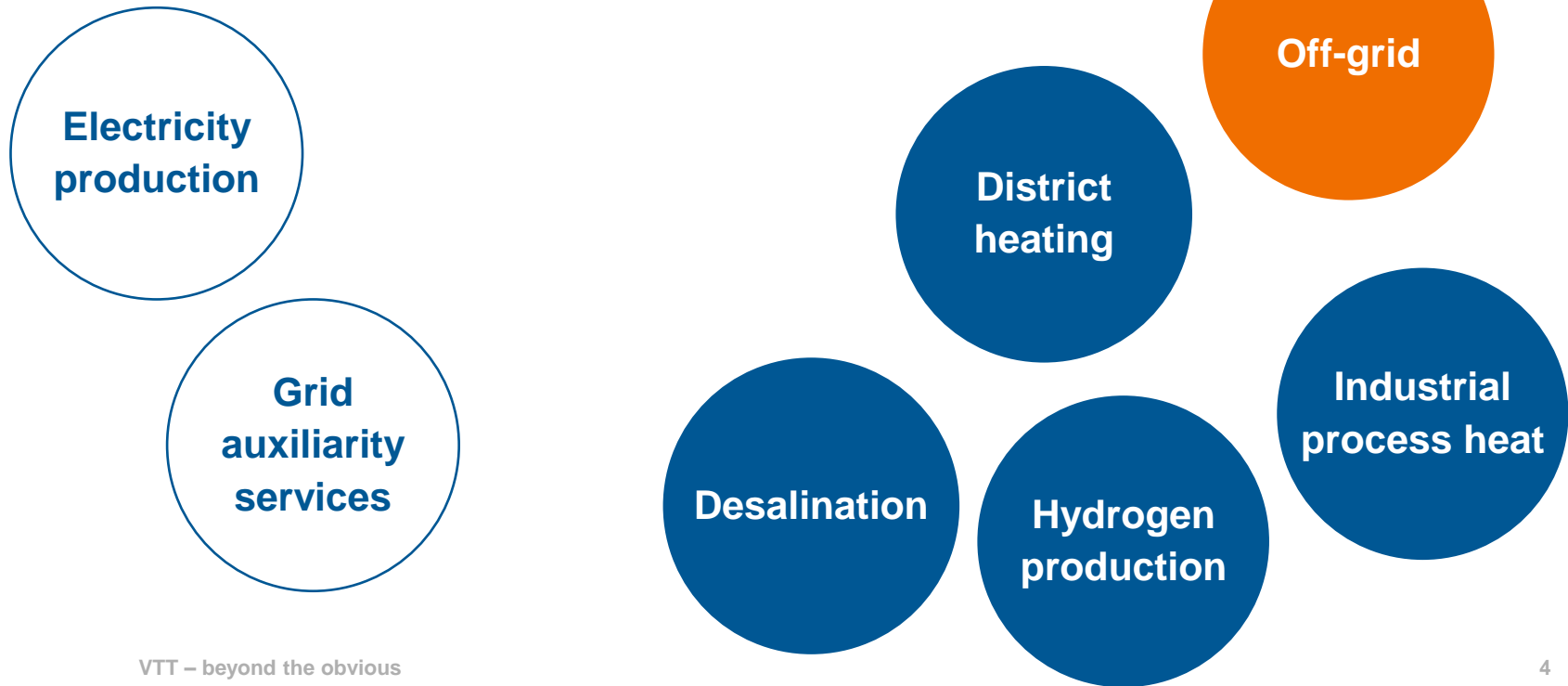
- French SMR developer consortium - NuWard

China:

- HTR-PM dual unit SMR (210 MWe) high temperature reactor under commissioning
- District heating reactor demonstrations
- Various other SMR designs
- Aims for strong domestic and international expansion

Some of the developments shown here

SMRs increase the potential applications of nuclear energy



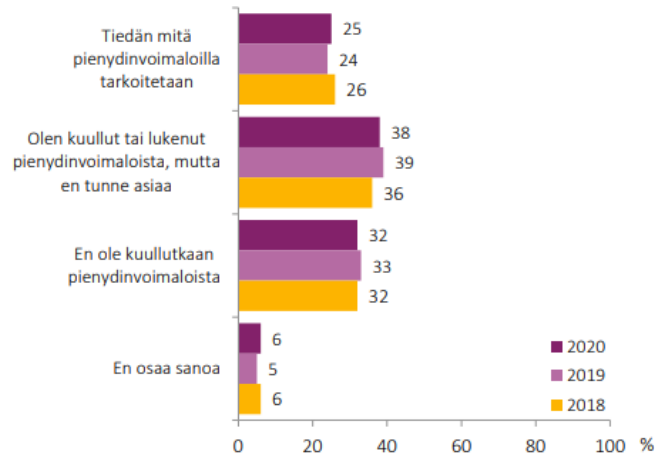
SMRs are also popular

Suomalaisten energia-asenteet 2020

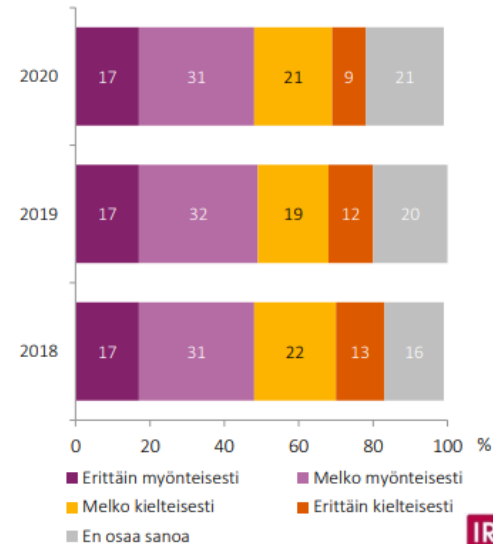
Pienydinvoimat

Kaikki vastaajat, n=1000

Pienydinvoimaloiden tarkoitus



Suhtautuminen pienydinvoimaloiden käyttöönottoon Suomessa



Development in Finland

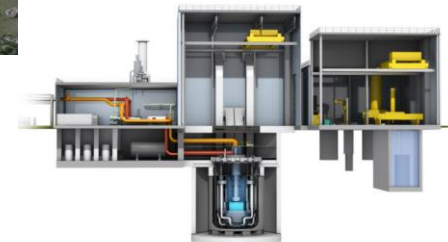
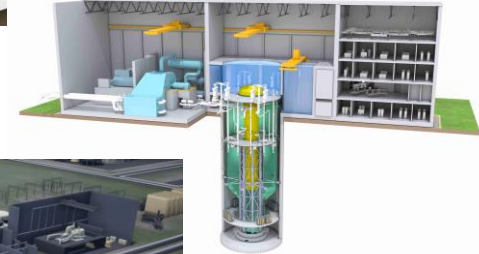
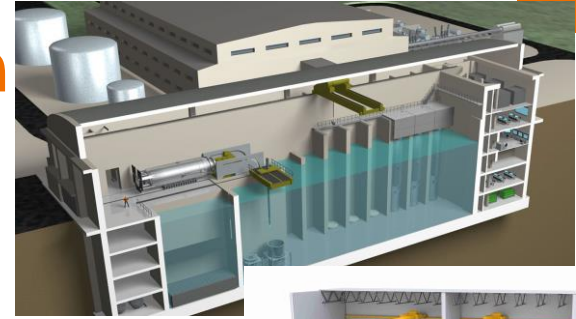
- SMRs have been a source of popular discussion for the past four years in Finland
 - Especially district heating being discussed
- Public projects have to do with reviews, R&D, and initial information gathering and analyses
- Ongoing changes in legislation and regulations specifically mention SMRs and heat use among other topics of interest
- R&D projects ongoing
- Research-led conceptual designs for district heating SMRs

Development in Finland and close by

- Estonian company Fermi Energia aiming to establish a SMR
 - Various designs under consideration
 - NuScale, GEH BWRX-300, UK SMR, version of USNC MMR
 - Range of investors, now including Vattenfal
- Sweden establishing SMR expertise collaboration, lead cooled system demonstrator... altogether at few million euros annually at this point
- Poland funding gas cooled experimental reactor, also industry interest in SMRs especially BWRX-300 and USNC MMR

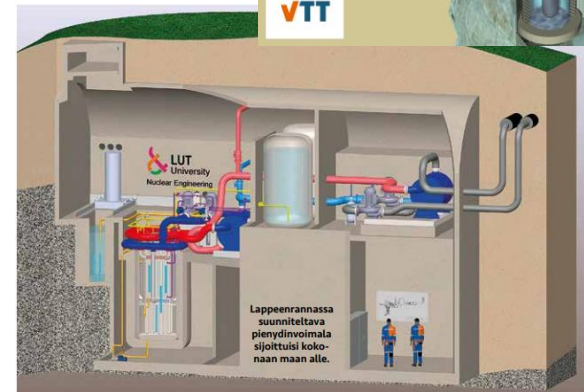
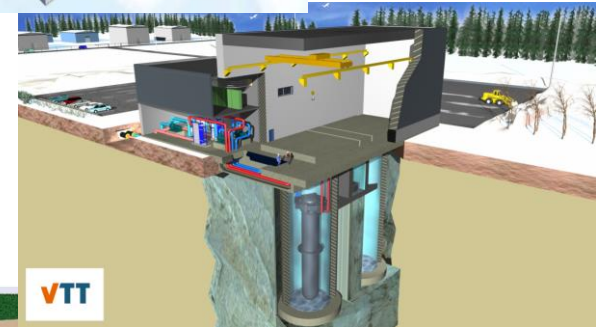
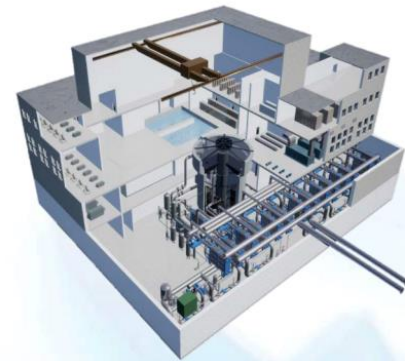
SMRs for electricity production

- In general relatively large facilities
 - Largest SMRs close to Loviisa size
 - Multiple reactors sharing facilities – including waste management
- National support for LWRs
 - French Nuward
 - Nuscale
 - UK SMR
- US Advanced Reactor Demonstration Program
 - Sodium reactor
 - Xe-100



District heating reactors

- Reactors specifically designed for producing district heating
 - LWR technology
 - Smaller in scale than electricity producing reactors
 - More distributed use



High temperature reactors

- Industrial or CHP applications
 - Non-LWR technology
 - Distributed to the place of use
- Gas cooled reactors still generally once through fuel cycle
- Other technologies still represented
 - Sodium and lead cooled
- China, HTR-PM; Japanese HTTR; Polish project; Ultra Safe Nuclear Corporation's MMR...



Questions related to waste management

- Technologies employed
 - Light water reactors versus non-light water reactors
- Centralized power plants versus distributed
 - How small facilities can handle their own waste streams
 - Established nuclear energy using countries vs newcomers
- Even if SMRs and especially non-LWRs are taken into use abroad first, understanding of the issues should be had

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the obvious

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