

Opportunities of SMRs and challenges for licensing

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Ministry of Economic Affairs
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Finland's carbon neutrality target 2035



Prime Minister Sanna Marin's Government programme:

"The Government will work to ensure that **Finland is carbon neutral by 2035 and carbon negative soon after that**. We will do this by accelerating emissions reduction measures and strengthening carbon sinks."

"The Government will decide on the additional actions needed to bring Finland's emissions reduction path in line with the goal of achieving carbon neutrality by 2035."

**Accelerating
emissions reduction**

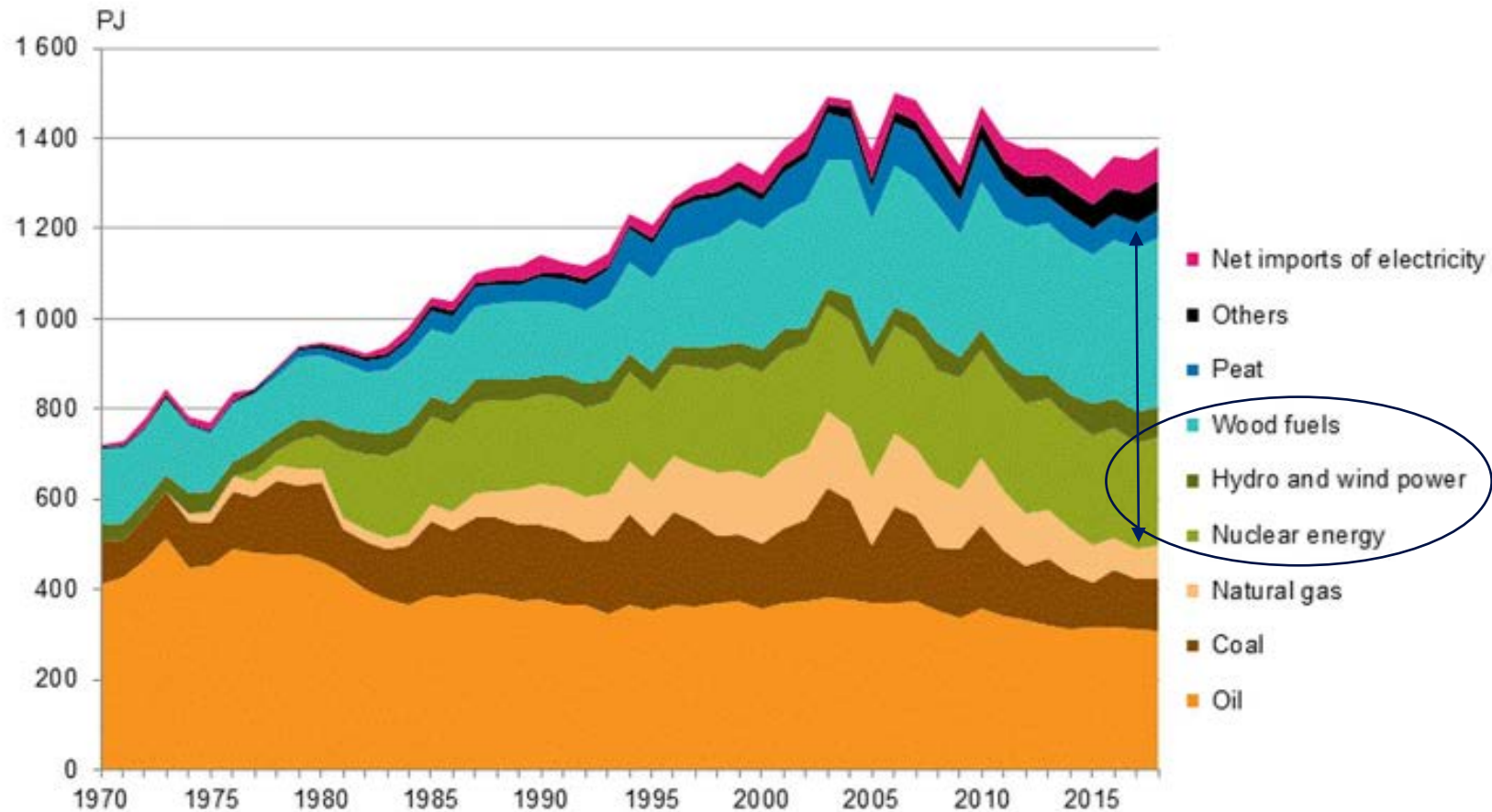
**Strengthening carbon
sinks**

**Energy and
Climate
Strategy
2021**

The Challenge: Net emissions must decrease fast

- Emissions: industries, transport and energy system integration key factors
- Carbon sinks: forestry and land-use as key, in future also CCUs

Total energy consumption 1970-2018



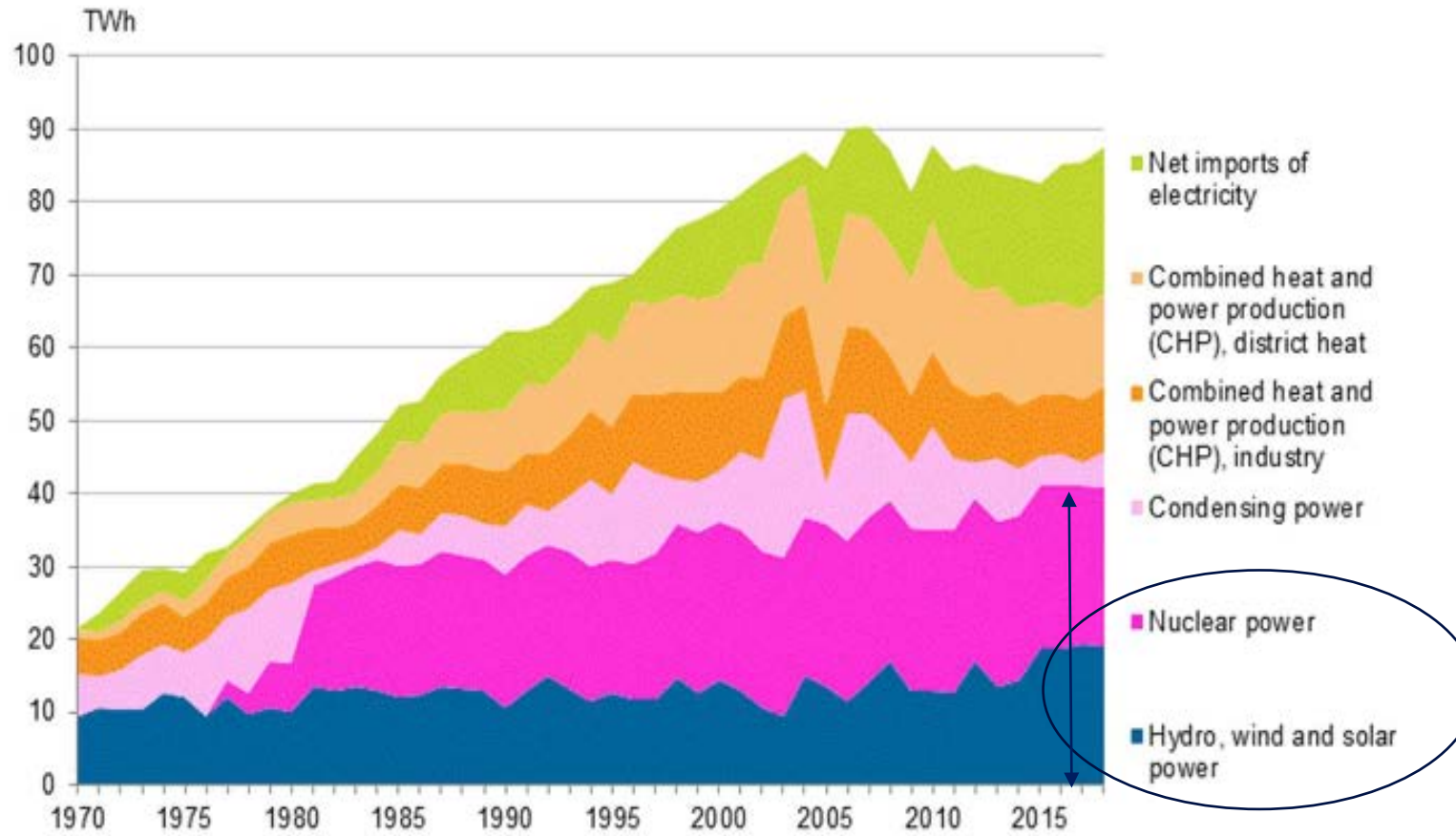
**Banning of coal,
banning of peat...**

22 April, 2020

Statistics Finland

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Electricity supply 1970-2018



22 April, 2020

Statistics Finland

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Finnish national nuclear energy R&D in a nutshell

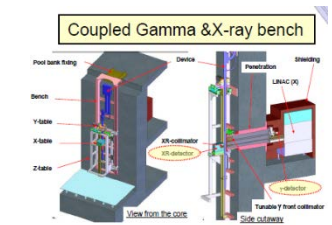
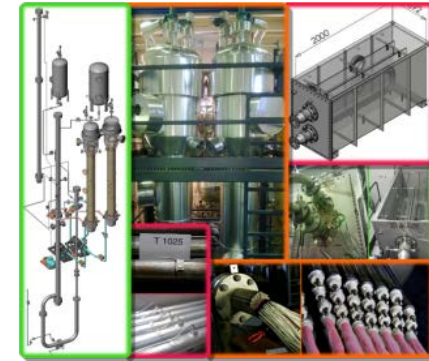
Building a strong domestic expertise

- **National ability to use nuclear energy independently**
 - Independent assessment of safety by industry
 - Independent assessment of safety by STUK
- **Principle of continuous improvement**
- Importance of **research** in legislation, funding for **infrastructure** in R&D programs:
 - VTT Centre of Nuclear Safety, Hot Shells, Main focus before end of 2020
 - LUT thermal hydraulic test facility, Main focus after 2021
 - JHR national contribution and test programme preparation.

Typical distribution of nuclear research in Finland, annual volume million 75 – 80 euro.



- Nuclear waste management outside the KYT2010 Programme
- KYT2010
- Reactor safety outside the SAFIR2010
- SAFIR2010
- Fusion
- Others



+ International co-operation NKS, OECD/NEA, IAEA, EU/Euratom



...from the webpages of IAEA:

- SMR ability to meet the need for **flexible power generation** for a wider range of users and applications and **replace ageing fossil fuel-fired power plants**.
- SMRs display **an enhanced safety performance through inherent and passive safety features**, offer better upfront **capital cost affordability** and are **suitable for cogeneration and non-electric applications**. **Options for remote regions** with less developed infrastructures and the possibility for **synergetic hybrid energy systems that combine nuclear and alternate energy sources**.
- SMRs are advanced reactors that **produce electricity of up to 300 MW(e) per module**, are deployable either as a single or multi-module plant, and are designed to be built in factories and shipped to utilities for installation as demand arises.
- There are about 50 SMR designs and concepts globally. **Most of them are in various developmental stages** and some are claimed as **being near-term deployable**.

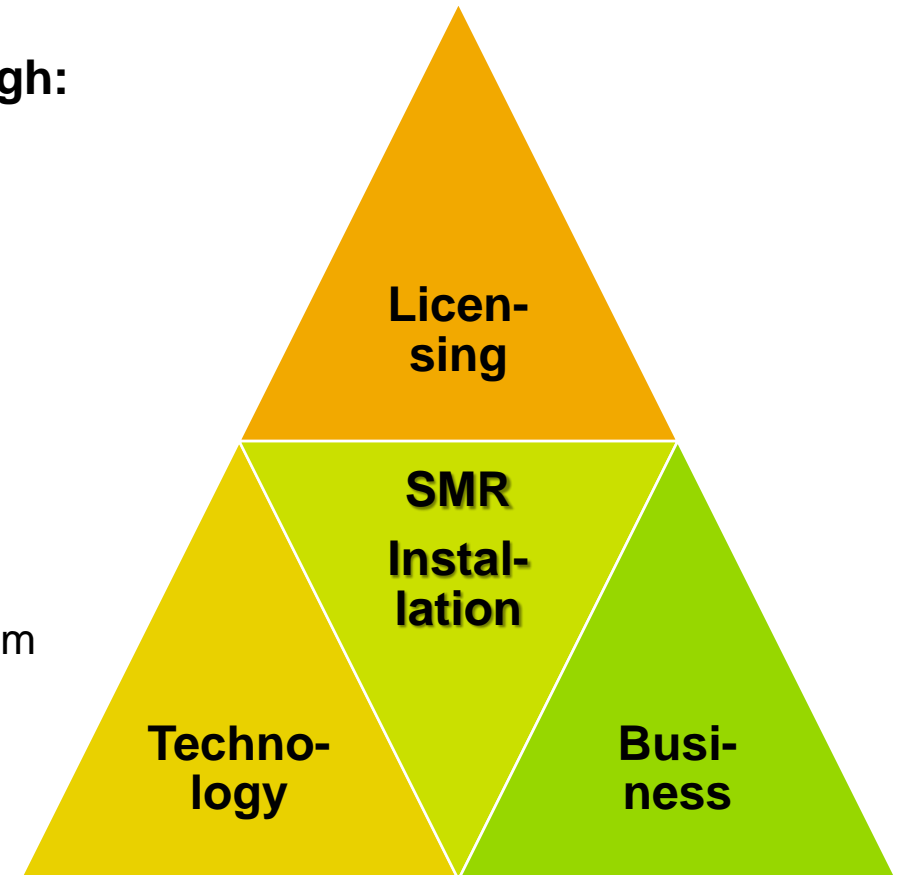


Interest in Finland especially for heat production but also for flexibility and co-generation.

SMR a new type of (nuclear) energy production



- **SMR technologies are widely presented today with various concepts and reactor capacity ranges.**
- **No real commercial breakthrough yet but potential is high:**
- **TECHNOLOGY**
 - Technology readiness
 - Manufacturer(s)
 - Plant supplier for a modular concept
- **LICENSING**
 - Licensing; Requirements and Enabling
 - Infra; human resources, siting, acceptance for the energy system
- **BUSINESS**
 - Economically feasible with a reliable business concept

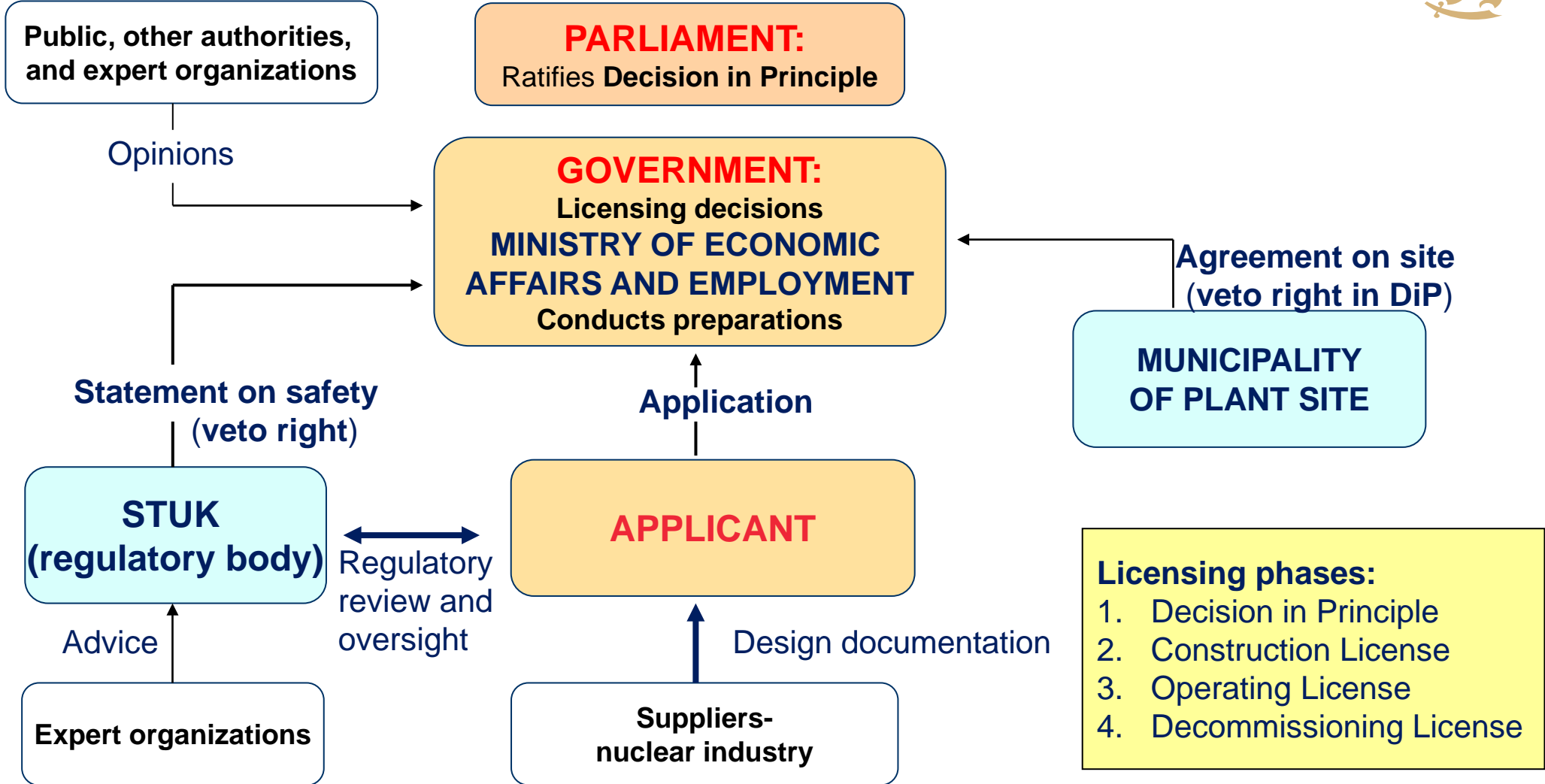


SMR TEAS project funded by the Government



- **A governmental project to support the SMR licensing needs (SMR TEAS) will start in spring 2021 (bidding phase ends in January 2021).**
- **Steering committee is led by MEAE and consists of several ministeries (environment, social and health, internal, foreign...)**
- **Main goals of the SMR TEAS project:**
 - NPP Site – new issues in site selection and criteria for safety and security, in Finland no site license is existing today.
 - Technology development – licensing of new technologies, passive safety systems, modular units
 - Nuclear materials and fuel cycle – handling processes and safety issues, level of expertise needed, safeguards, nuclear waste management (today the power companies have organised their own waste management processes and installations).
 - Other?

Case Finland: Main parties in licensing of nuclear facilities





Ongoing R&D activities / VTT and LUT

BF-EcoSMR

- BF (technology agency in Finland) funding for 2 years
- **Business targeted network of partners.**
- **Analysing business models, requirements and licensing for industrial purposes.**
- **Feasibility studies for piloting SMR technologies.**
- **More information VTT: Ville Tulkki.**

EU-ELSMOR (VTT)

- Euratom ELSMOR-project coordinated by VTT (Towards European Licensing of Small Modular Reactors)
- ELSMOR targets **systematical methods to ensure the safety of new and innovative reactor concepts.**
- **Project studies the readiness of European experimental infrastructures and modelling tools to contribute to analyses of passive safety systems of SMRs**

Ongoing R&D activities / VTT and LUT



BF-EcoSMR (LUT)

- LUT work focuses on **licensing and regulatory oversight issues** of SMRs as well as heating applications, namely, developing a proposal as a **reactor concept for a Finnish district heating reactor**. Important part of the project is to chart the potential for domestic manufacturing of the reactor components.

LUT – MOTEL TEST LOOP

- MOdular TEst Loop, SMR Test loop started in Lappeenranta 2019.
- MOdular Test Loop with its first configuration representing a typical SMR operating at natural circulation and equipped with a helical coil heat exchanger.
- First tests are being performed in the beginning of 2021.
- **EU-McSAFER (coordinated by KIT, 13 partners)**
 - The main objective of the McSAFER project is the advancement of the **safety research for Small Modular Reactors (SMR) by combining dedicated experimental investigations and numerical simulations**. LUT leads the work package on experiments and conducts tests utilizing its SMR test loop MOTEL. In addition, LUT contribution includes numerical simulations ranging from system thermal-hydraulics to CFD and neutronics.
- **EU-PASTELS (coordinated by EDF, 11 partners)**
 - Aims to increase **the knowledge of passive safety systems**, specifically Containment Wall Condenser (CWC) and the Safety Condenser (SACO) via dedicated experiments and numerical simulations. LUT contributes the project by performing experiments with the PASI test facility.





SMR – new type of concept and licensing

- **By 2020 a growth in the interest – especially in heat production in Finland (banning of coal and ambitious climate targets)**
- **Several topical R&D initiatives and projects started**
 - Authority (Ministry), Regulator (STUK), Research (VTT, LUT), Industry (Business Finland, Fortum, TVO, Helen, etc...)
- **Business Case?**
 - Interest from the industry to invest and to participate in the supply chains
- **Licensing creates new issues?**
 - Requirements / Enabling
 - Optional paths for licensing (site, type)?
- **Renewal of the FI Nuclear Energy Act – ongoing work**

- **Human capacity and resources availability**
- **Organising Nuclear Waste management and funding**
- **Nuclear Liability issues**

Thank you

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