EcoSMR

FINNISH ECOSYSTEM FOR SMALL MODULAR REACTORS

CO-INNOVATION 2020-2022

ECOSMR.FI

Outline

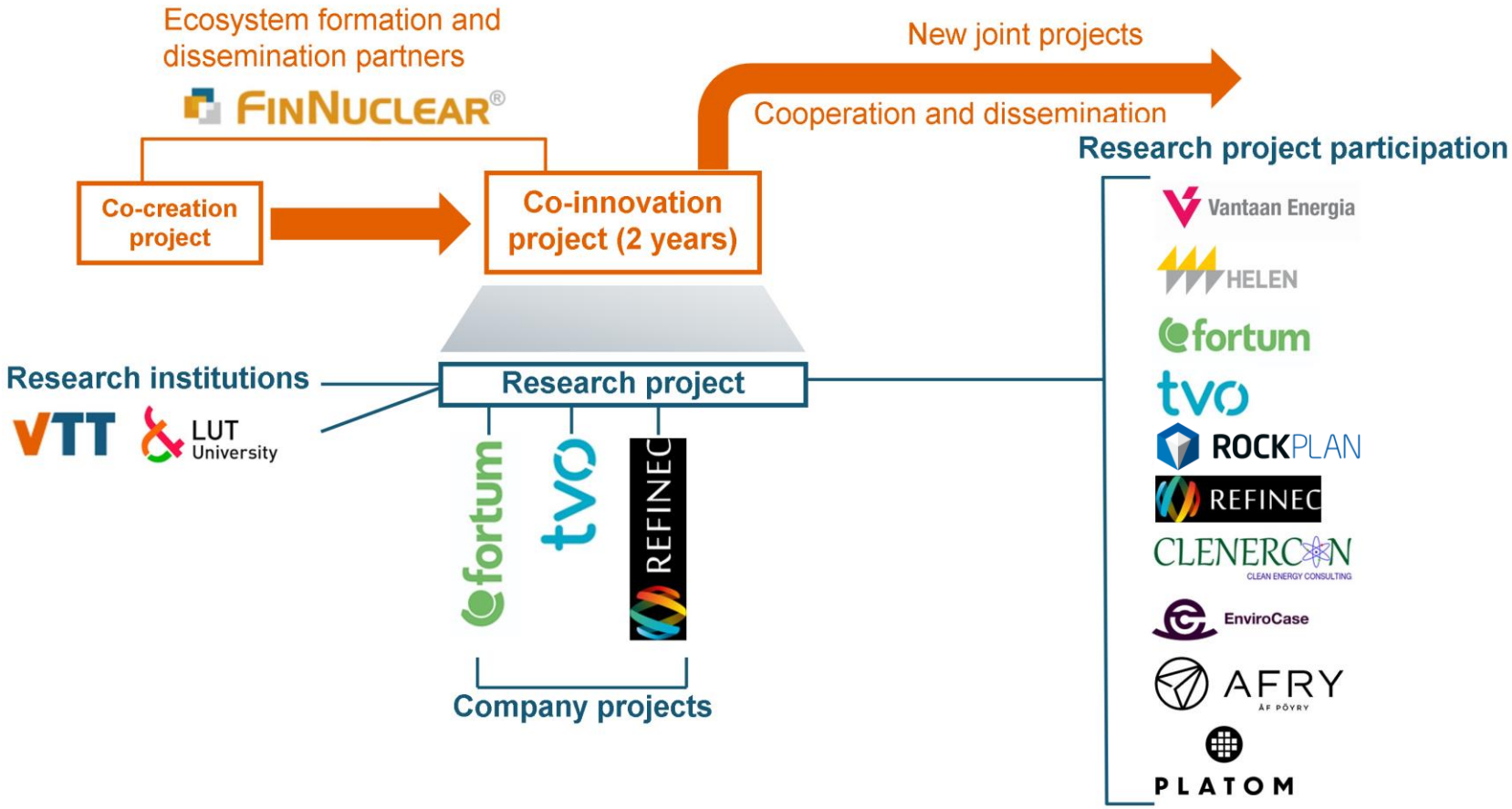
- EcoSMR project and goals
- EcoSMR work packages and some results
- EcoSMR other activities

EcoSMR project and goals

EcoSMR in a nutshell

- EcoSMR is a co-innovation project on small modular reactors funded by Business Finland and coordinated by VTT
  - Business Finland = Finnish government organization for innovation funding and trade, travel and investment promotion aiming to serve the needs of Finnish economy
  - Co-innovation project = joint actions of research organizations and companies
- Duration 2.5 years: 08/2020 – 12/2022
- Funding:
  - Business Finland 70 %
  - VTT 19 %
  - Companies 11 %

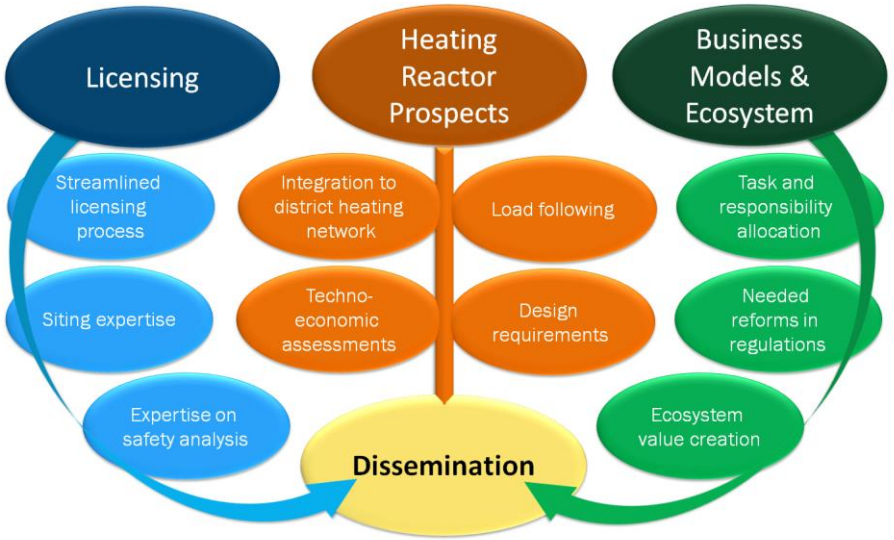
EcoSMR project and partners



EcoSMR goals

- Developing the ecosystem of actors
  - Connecting of Finnish experts and combining capabilities with international offering.
  - Connecting the Finnish ecosystem and international actors.
  - Supporting communication and collaboration between business, research and public authorities.
- Development of key areas of technology
  - Understanding customer needs.
  - Development of selected areas of expertise
  - Focus on the expertise that market will first need.
- As a public project funded by Business Finland and implemented by VTT, EcoSMR acts as a producer and channel of neutral information.

EcoSMR work packages and some results



EcoSMR work

WP	Content
1	Licensing, regulations and design criteria
2	Heat use of small reactors
3	SMR Case studies
4	Business models for future nuclear energy
5	SMR ecosystems
6	Dissemination and international relations
7	Project coordination and management

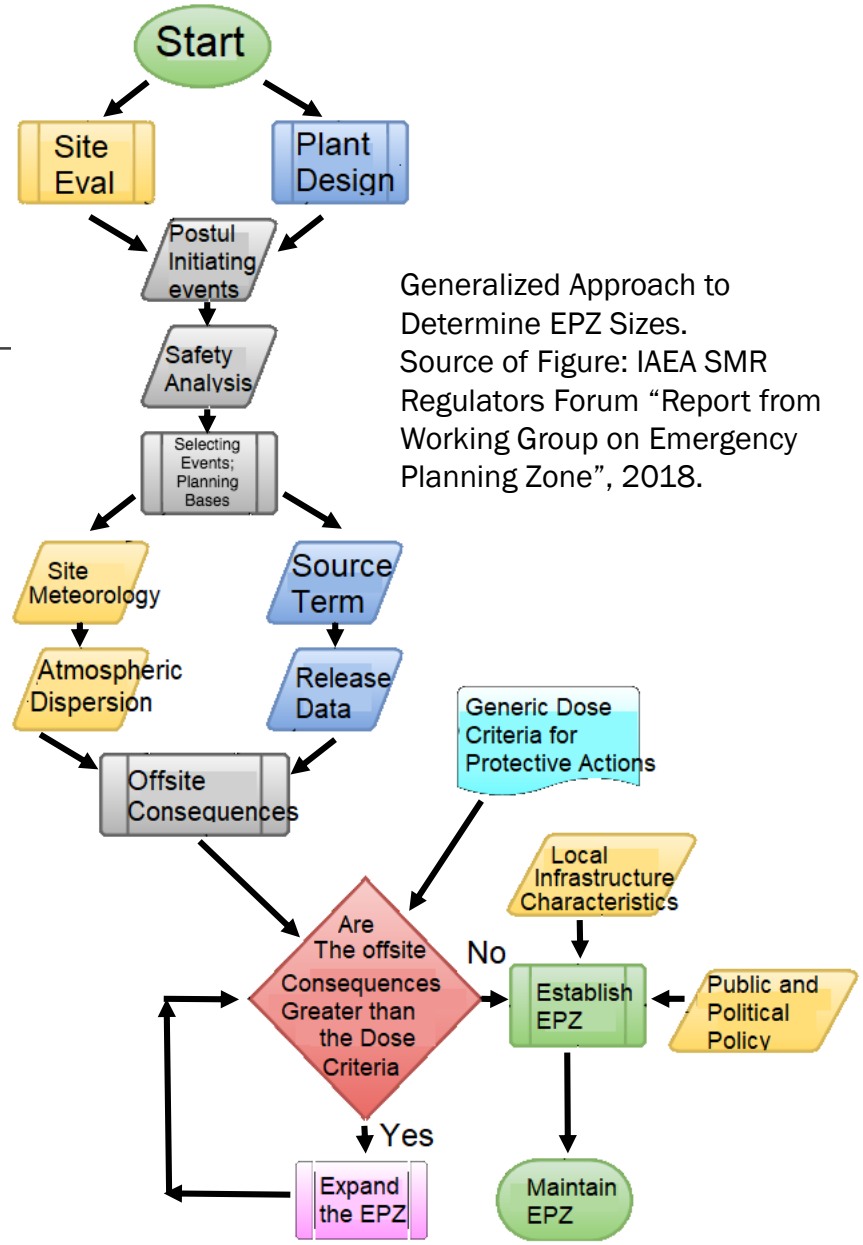
Licensing, regulations and design criteria

- Related questions
  - Standardization
  - Siting close to residential areas (especially in district heating)
- Specific work in EcoSMR
  - Uncertainties in safety criteria and their economic impact
  - Review on SMR siting and emergency preparedness[1]
  - Analysis tools and methodologies for SMR safety analysis

1. Ilvonen, M., ” Review of SMR siting and emergency preparedness”, VTT Research Report, VTT-R-01612-20, 2022.

EPZ determination

- SMR virtues regarding EPZ:
  - Inherent: Small inventory, more heat transfer area per heat generated
  - Passive systems, slow accident progression, decontamination factors
- Possible problems regarding EPZ:
  - New threats (in both directions) from urban / industrial siting
  - Lack of data for PRA (particularly FOAK designs)
  - Multi-module effects
- Some potential methods
  - Simple scaling by thermal power (readily much smaller EPZ than present)
  - Deterministic analysis (selected 'worst case' scenarios)
  - Probabilistic analysis (full scale PSA 1-2-3)

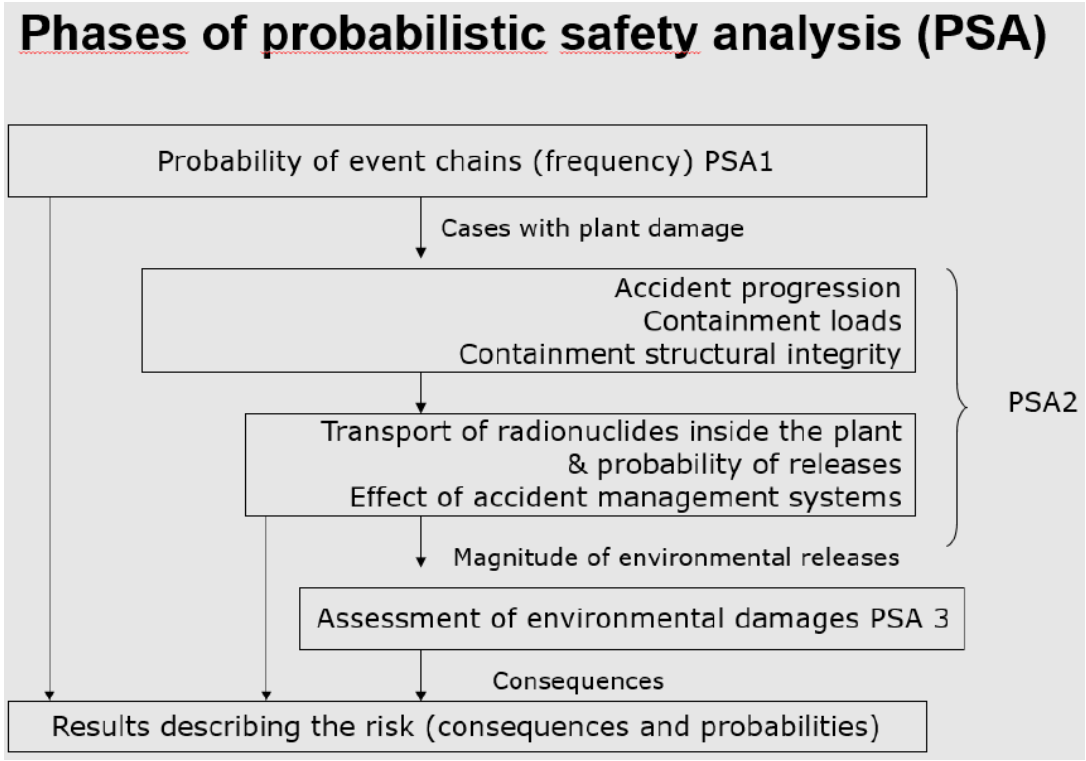


Generalized Approach to Determine EPZ Sizes.
Source of Figure: IAEA SMR Regulators Forum "Report from Working Group on Emergency Planning Zone", 2018.

1. Ilvonen, M., " Review of SMR siting and emergency preparedness", VTT Research Report, VTT-R-01612-20, 2022.

EPZ determination

- Main suggestion from the EPZ work:
  - A really definitive and rigorous way to determine appropriate (‘right-sized’) emergency planning zones (EPZ) for SMR or any other type of plant is the laborious full-scope (i.e. 3-level) probabilistic study (PSA).



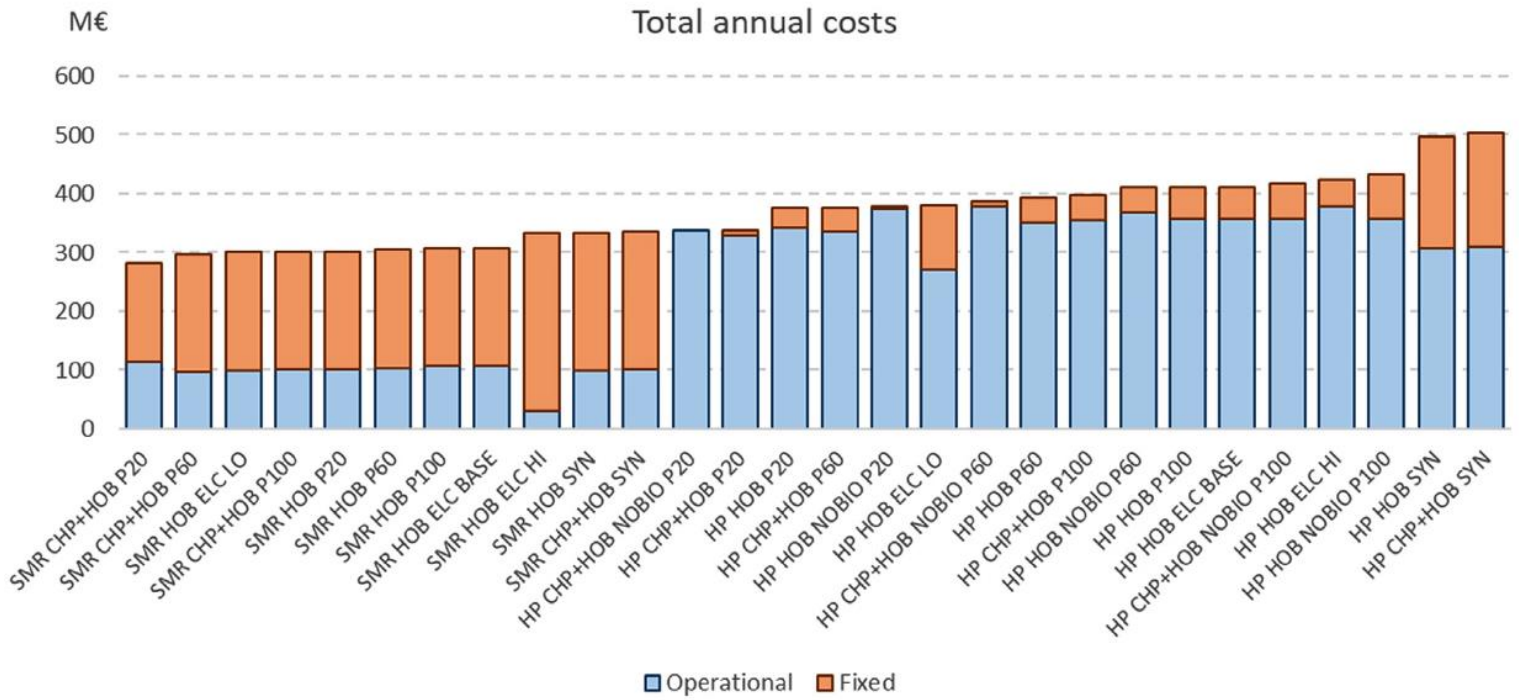
1. Ilvonen, M., ” Review of SMR siting and emergency preparedness”, VTT Research Report, VTT-R-01612-20, 2022.

Heat use of small reactors

- Related questions
  - Competitiveness against other solutions (e.g. heat pumps)
  - Utilization of existing infrastructure
  - Design requirements
- Specific work in EcoSMR
  - Heating reactor investment modelling[2]
  - Analysis tools development for investment modelling
  - Load following capabilities for heating reactors
  - Design requirements for district heating reactors in Finland

2. Pursiheimo, P., et.al., ”Optimal investment analysis for heat pumps and nuclear heat in decarbonised Helsinki metropolitan district heating system”, (2022) Energy Storage and Saving, pp. 80-92.

District heating investment analysis



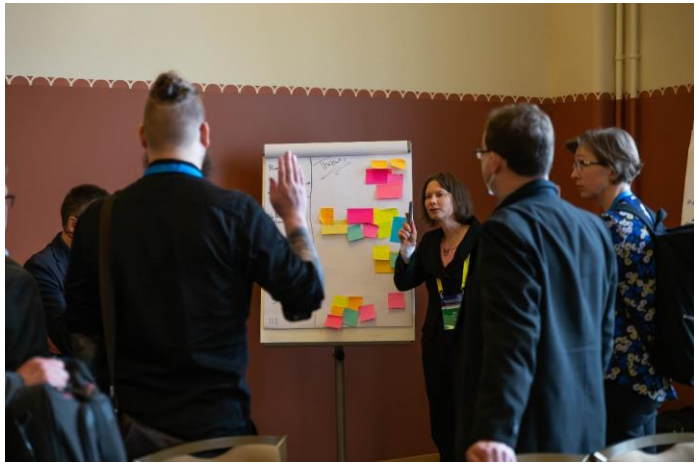
Source of Figure: Pursiheimo, P., et.al., ”Optimal investment analysis for heat pumps and nuclear heat in decarbonised Helsinki metropolitan district heating system”, (2022) Energy Storage and Saving, pp. 80-92.

Business models and ecosystems

- Related questions
  - New business models
  - Responsibility allocation
- Specific work in EcoSMR
  - Round table discussion groups on SMR business
  - Partner interviews
  - Ecosystem activities

Dissemination and international relations

- Goals
  - Dissemination of project results
  - General dissemination on SMRs
- Activities
  - Short webinars
    - Licensing regulatory policies upgrade in Finland
    - Supply chain for district heating in Finland
    - Investment modelling of district heating in Finland
    - Status of district heating reactor design in Finland
  - Long webinars
    - EcoSMR Open Business Day 2021
  - Seminars
    - Nuclear Energy Ecosystems – Open Business Day 2022



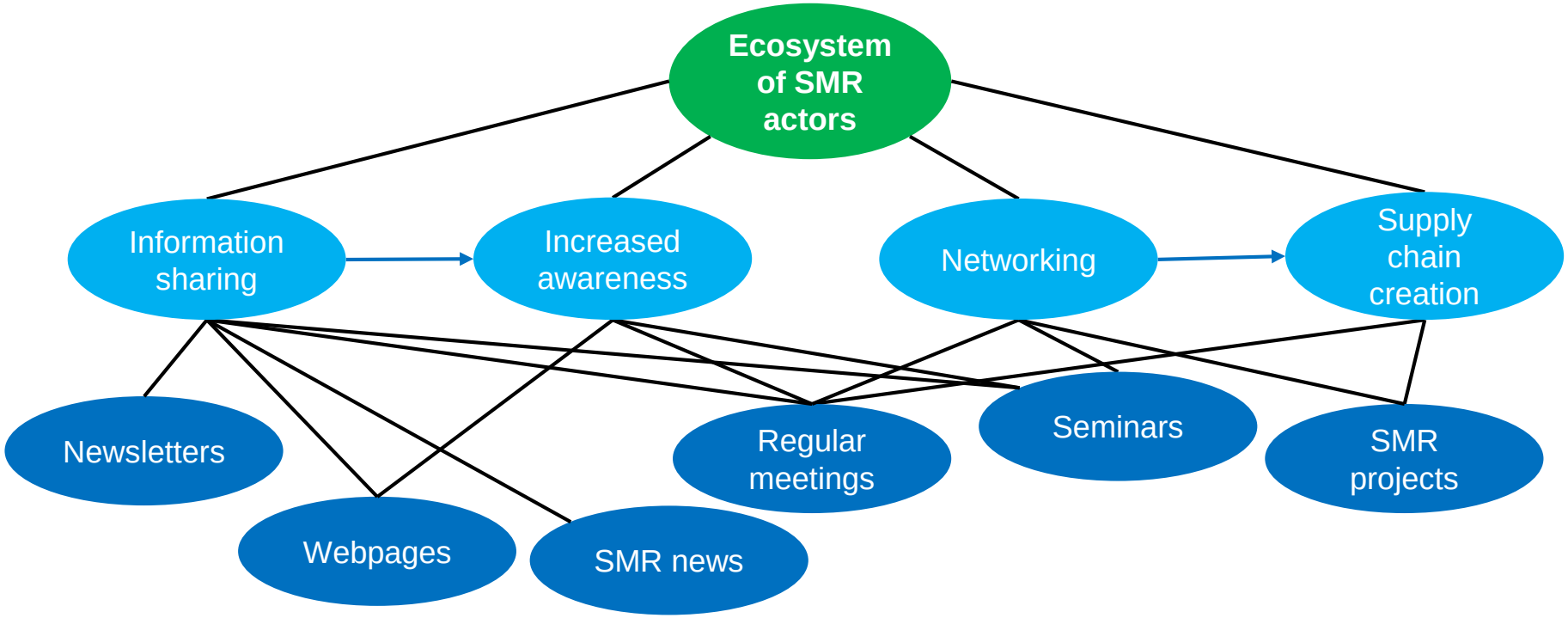
EcoSMR other activities

SMR supplier meetings

Reactor	Supplier	Type	Power [Mwe]	Site	FOAK year
BWRX-300	GEH	BWR	300	Darlington nuclear site (Bowmanville, Ontario, Canada)	2028
UK SMR	Rolls Royce	PWR	470	Great Britain	2029
NuScale	NuScale Power	PWR	n[1] x 77	Idaho Falls, Idaho, USA	2029
NUWARD	EDF	PWR	2 x 170	France	2030s
IMSR	Terrestrial Energy	MSR	190 (400 MWth)	USA	Late 2020s
Natrium	Terrapower	SFR	345	Kemmerer, Wyoming, USA	Late 2020s
MMR®	USNC	HTGR	5-10	University of Illinois, USA	2026 (demo)

1. n = 4, 6 or 12

SMR hub



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https://www.vttresearch.com/en/ourservices/nuclear-energy

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