# A Study on Fusion Power Plant Site Selection in the Nordic Region

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21.10.2025 VTT – beyond the obvious

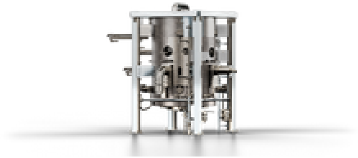
# Scope

- Identify potential locations for a fusion pilot facility Novatron 3 (N3) within the Nordic region: **Denmark, Finland, Norway, Sweden**
- Develop siting criteria tailored to the unique operational and regulatory needs of a fusion energy pilot plant
- Screen potential locations applying the siting criteria and using geospatial data

**Pre-study to be continued** as detailed site investigations with stakeholders

# N3 on Novatron Fusion Group's roadmap

N1



## STABLE PLASMA CONFINEMENT

Validates stable plasma confinement, which is the core of the NOVATRON concept and fundamental to any reactor design. Theoretical validation from world-renowned experts and simulation results have already confirmed the stability of the plasma confinement, making the N1 a crucial milestone in ensuring the foundational technology is sound. N1 is currently operational at the Royal Institute of Technology in Stockholm.

Source: Novatron Fusion Group

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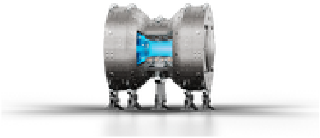

## CORE TECHNOLOGY VALIDATION

Demonstrate fusion and evaluate several Q-enhancement technologies to find the best balance between performance and cost. This groundbreaking fusion experiment will utilize three physical effects to confine plasma: magnetic, electrostatic and RF forces. The N2 platform will test the Deuterium-Deuterium fuel cycle, and operate at up to 25 keV (about 290 million °C), an energy level unattainable by Tokamak or Stellarator reactors. The results will enable a new level of performance and define the configuration of our future fusion reactors. The design of N2 is currently being finalized, and construction is expected to start in 2026.

N2

Source: Novatron Fusion Group

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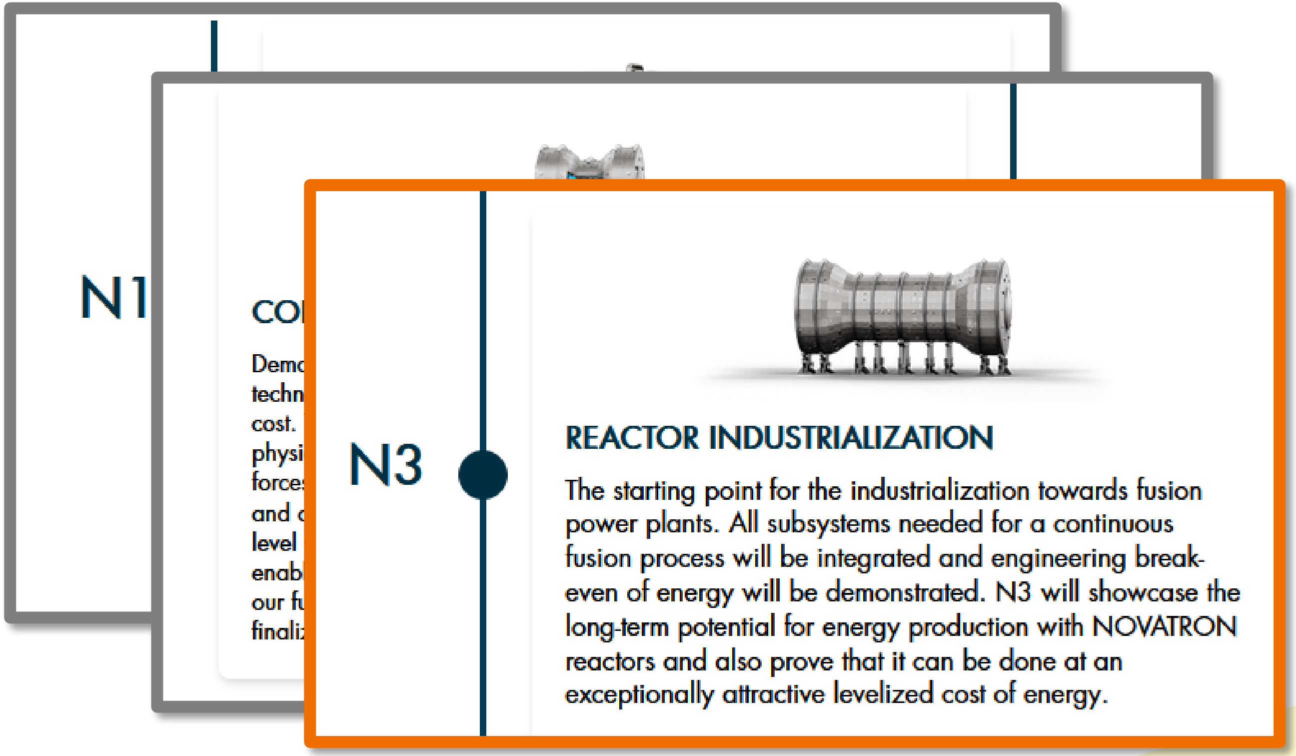


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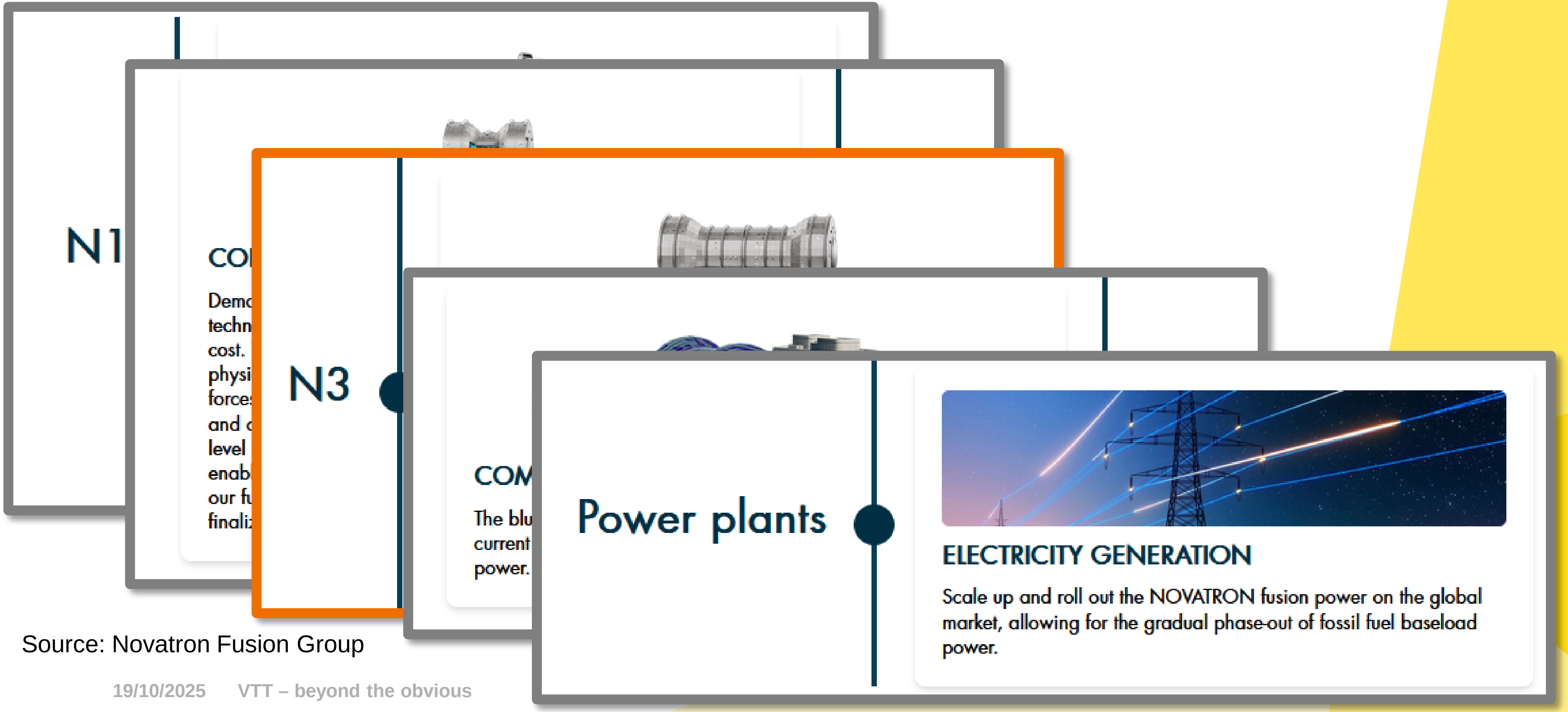



Source: Novatron Fusion Group

# N3 as industrial-scale fusion pilot plant

- Fusion technology is **not only** energy production and climate action!
- Currently, high interest in alternative applications for pilot-scale devices and for the demanding technology developed for fusion
- Rapidly growing business potential in the supply chains for reactor developers
- Great innovation and technology transfer potential

**We believe that countries and regions will compete about fusion facilities as regional investment**

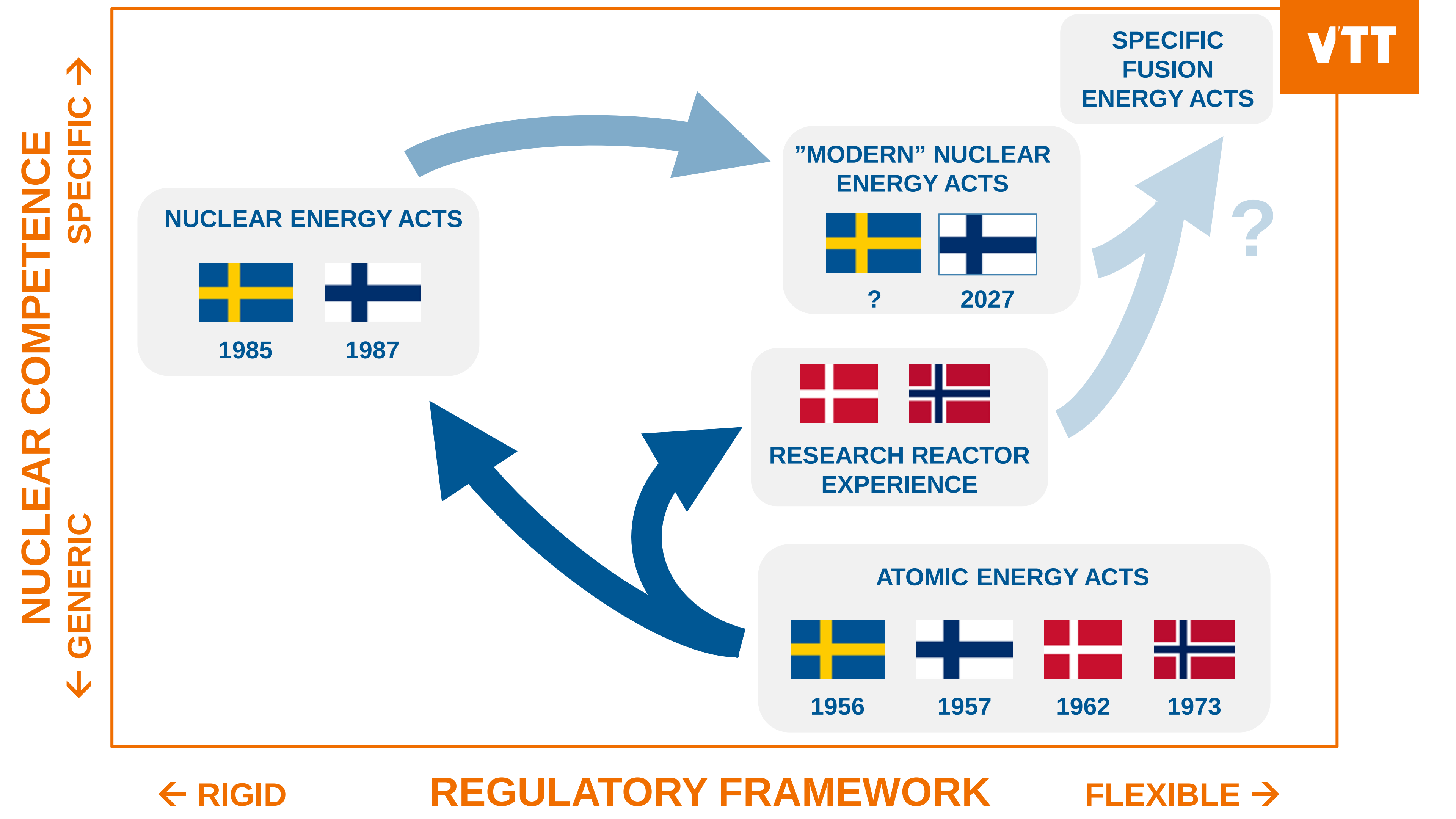
VTT

The regulatory environment for fusion is evolving, with the USA and UK pioneering risk-based, fusion-specific frameworks that differ from traditional nuclear fission regulation.


Image credit: UK Industrial Fusion Solutions Ltd.

None of the Nordic countries currently have a formal national fusion strategy, but Finland and possibly Sweden are advancing regulatory reforms to better accommodate fusion.

The Finnish regulatory approach is moving toward regulating experimental fusion under the Radiation Act, enabling more innovation-friendly licensing from 2027.


SPECIFIC
FUSION
ENERGY ACTS
”MODERN” NUCLEAR
ENERGY ACTS
?
2027
?
NUCLEAR ENERGY ACTS
1985
1987
RESEARCH REACTOR
EXPERIENCE
ATOMIC ENERGY ACTS
1956
1957
1962
1973
NUCLEAR COMPETENCE
← GENERIC
SPECIFIC →
← RIGID
REGULATORY FRAMEWORK
FLEXIBLE →

# Public acceptance of fusion energy in the Nordics is generally favorable but varies by country and is influenced by perceptions of nuclear energy and local engagement.

# Social License to Operate

- Informal “license” granted by local citizens, reflecting trust, legitimacy, and acceptance
- Can be achieved by addressing societal concerns—such as safety, environment, and public health—through ongoing engagement, **not just compliance with legal requirements or regulation**.

| Economical legitimacy | Interactional trust | Socio-political legitimacy | Institutionalized trust |
|---|---|---|---|
| Costs and benefits of the project are shared equitably | Competence, sincerity and responsiveness of **the company and relevant state authorities** in relation to citizens | Legal and regulatory measures **ensure transparency, access to information and participation** | Full mutual trust between the community and organisations |

# Basis for development of siting criteria

- Regulatory framework
- Ensuring safety
  - Radiation safety (deuterium-tritium fuel) → safety zone
  - Environmental protection
  - Safe location considering external risks (e.g. flooding)
  - Emergency preparedness
- Technical aspects
  - Footprint
  - Availability of electricity and cooling water
  - Transport
  - Land-use planning
- Societal factors
  - Fusion strategies in each country
  - Supporting technology infra and fusion research hubs
  - Stakeholder and public acceptability

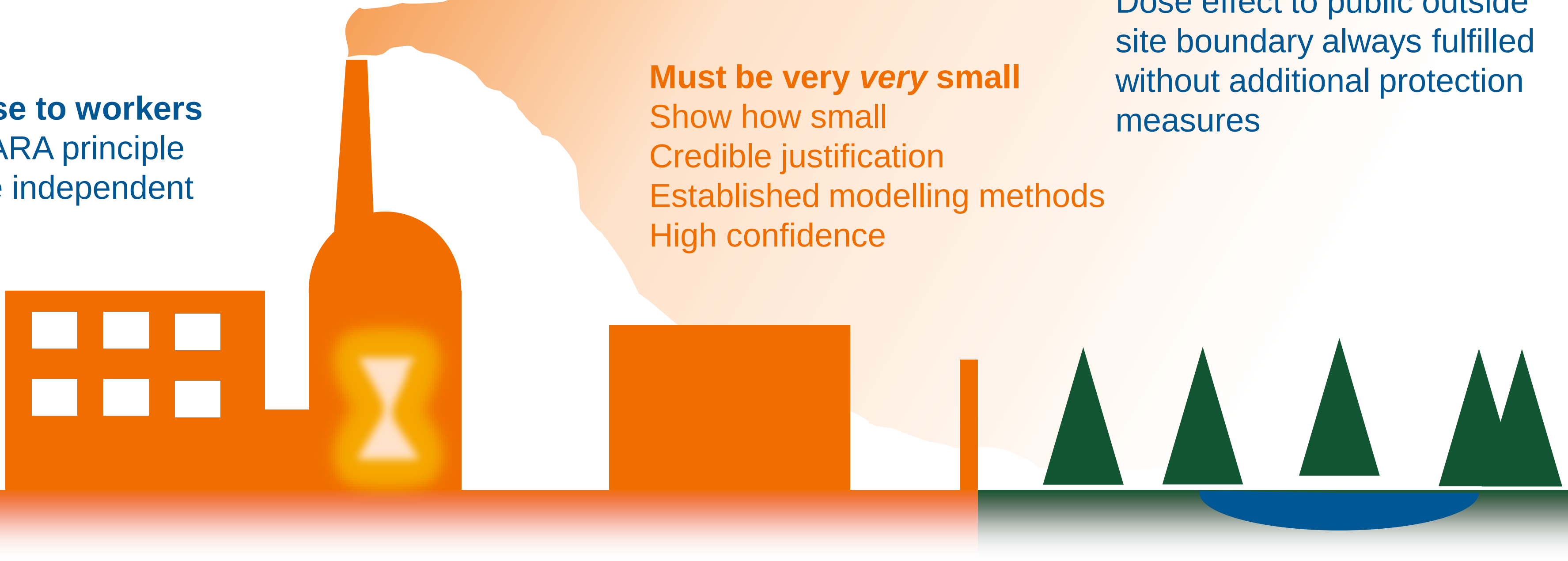
# Radiation safety and emergency planning

**Main concern: tritium**
Losses during normal operation
Releases in accident scenarios
Generally relatively low dose effect

**Dose to workers**
ALARA principle
Site independent

**Must be very *very* small**
Show how small
Credible justification
Established modelling methods
High confidence

**Design target**
Dose effect to public outside site boundary always fulfilled without additional protection measures



# Preliminary siting criteria

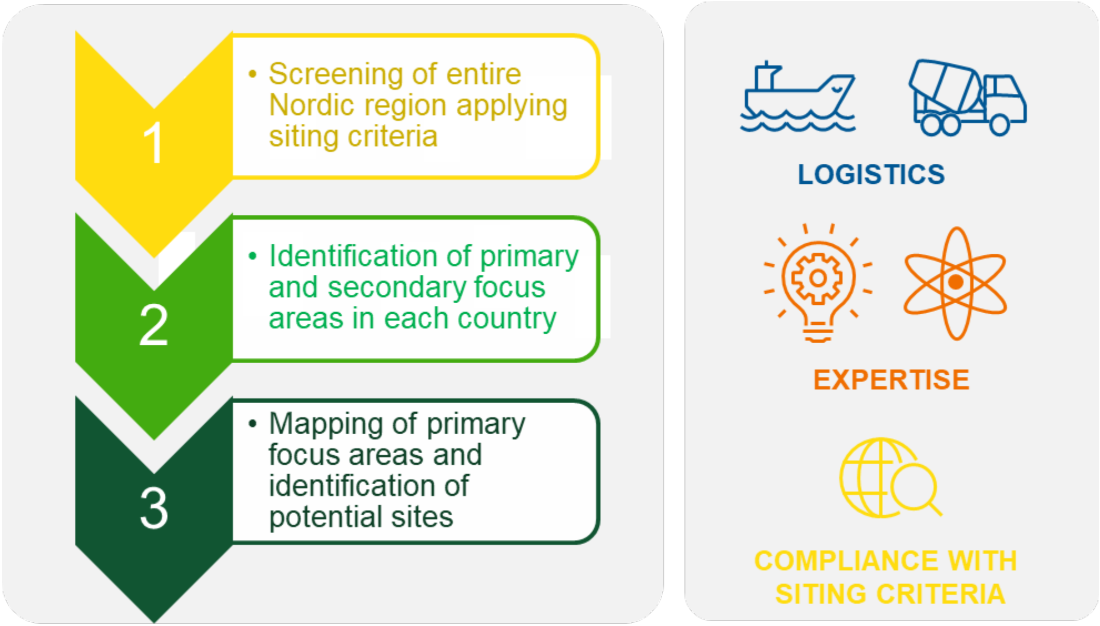
- Preliminary numerical siting criteria:
  - Operating life-time: 20 years
  - Footprint ~ 600 x 600 m including the safety zone
  - Requirement for the electricity grid 100 kV
- Areas excluded systematically in the siting:
  - Groundwater / drinking water supply areas
  - Instable areas (e.g. quick clay areas)
  - Natural resource and cultural heritage areas
- Location with respect to:
  - Ports and road/railroad access for special transports
  - Flooding risk and other external risk areas
  - Industrial or power plant sites
  - Supporting infra and research hubs
- Societal factors

# Exclusion criteria

## Example: Groundwater

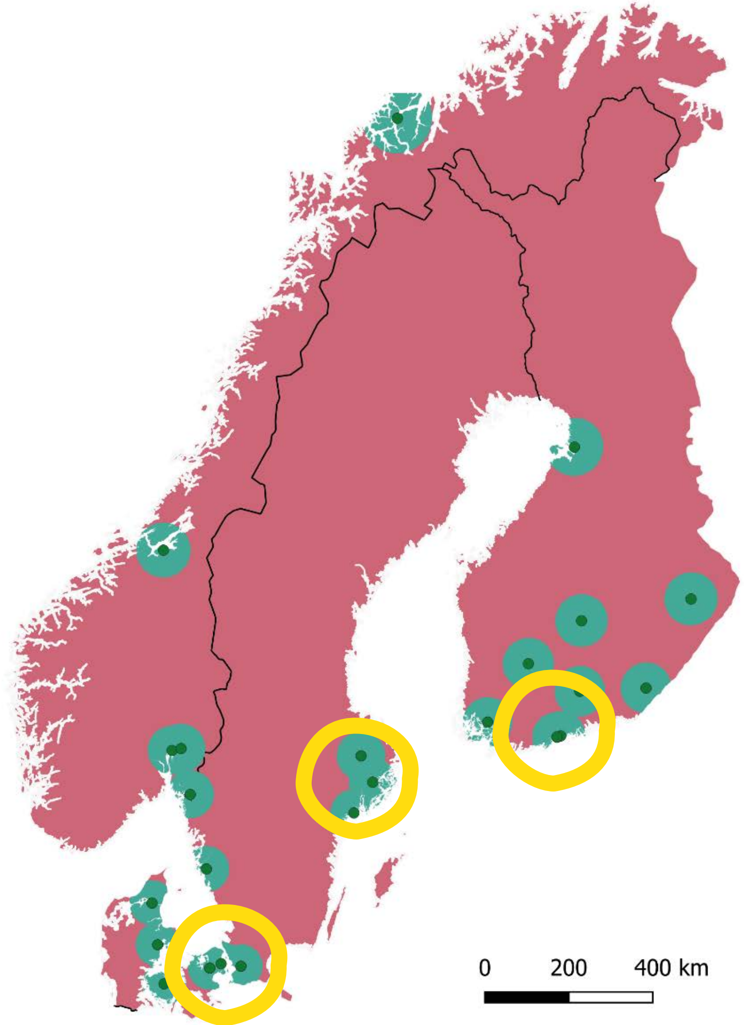
# Our screening process in practice

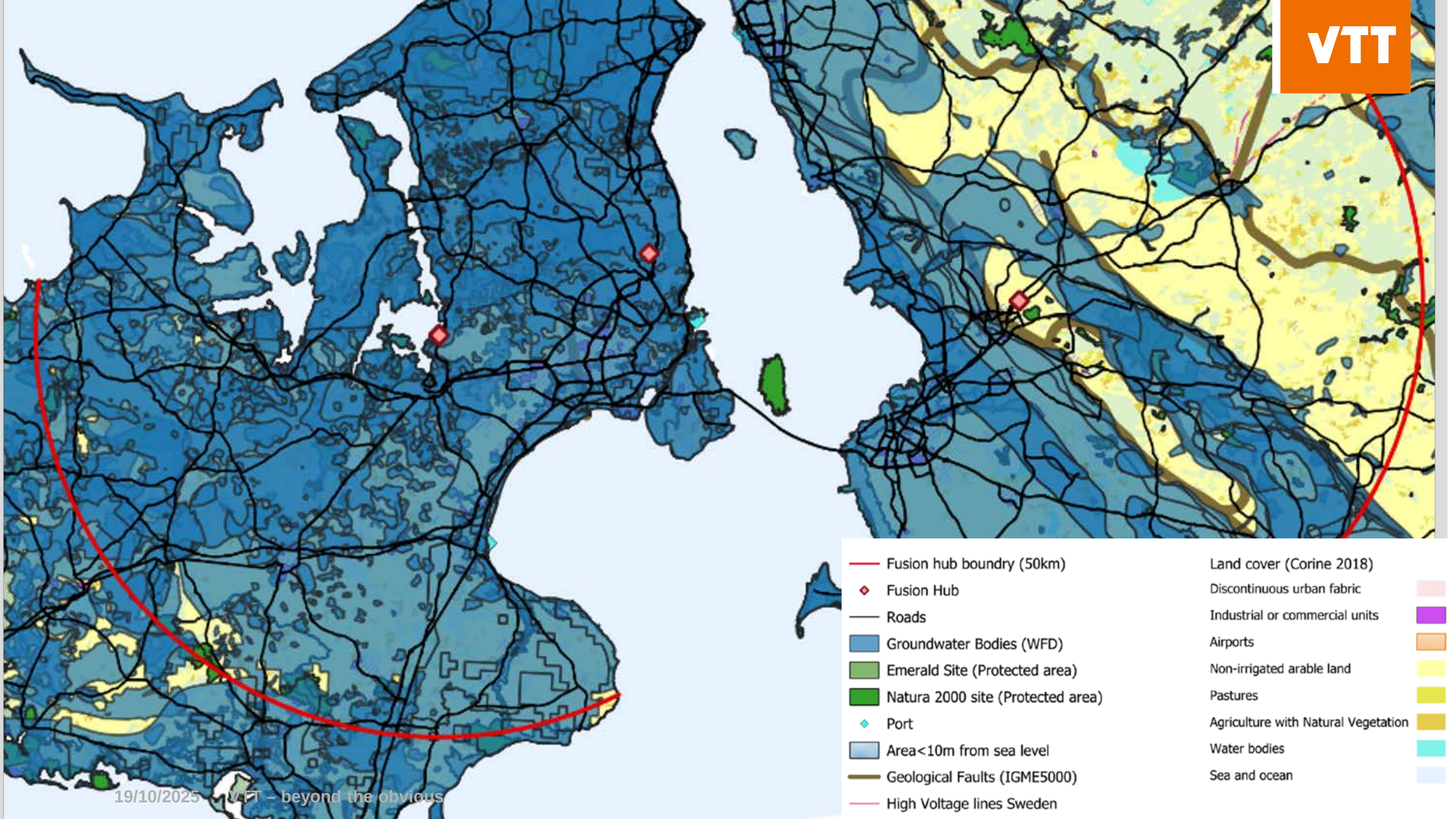
- Not completely mechanical
- Importance of logistics and expertise → Primary and secondary focus areas
- Focus areas not exclusive but an excellent starting point for next phase



# Fusion / technology hubs

- Fusion or nuclear technology research centres
- Universities with physics or nuclear engineering education
- Top-three regions stand out clearly
  - Copenhagen/Malmö
  - Helsinki Metropolitan area
  - Stockholm-Nyköping (incl. Studsvik)
- All of them easily fulfil the logistics criteria




Fusion hub boundry (50km)
Fusion Hub
Roads
Groundwater Bodies (WFD)
Emerald Site (Protected area)
Natura 2000 site (Protected area)
Port
Area<10m from sea level
Geological Faults (IGME5000)
High Voltage lines Sweden
Land cover (Corine 2018)
Discontinuous urban fabric
Industrial or commercial units
Airports
Non-irrigated arable land
Pastures
Agriculture with Natural Vegetation
Water bodies
Sea and ocean

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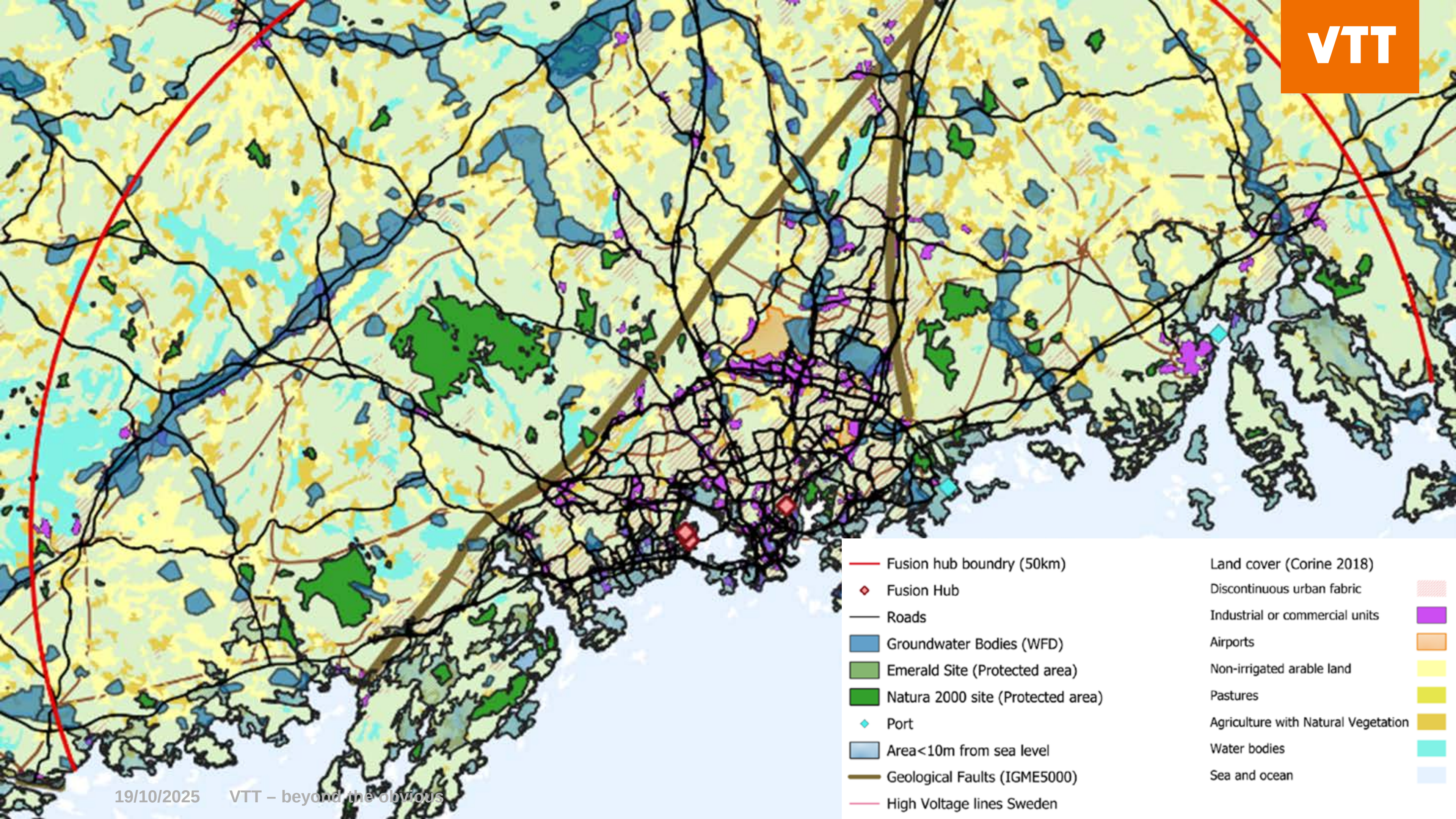
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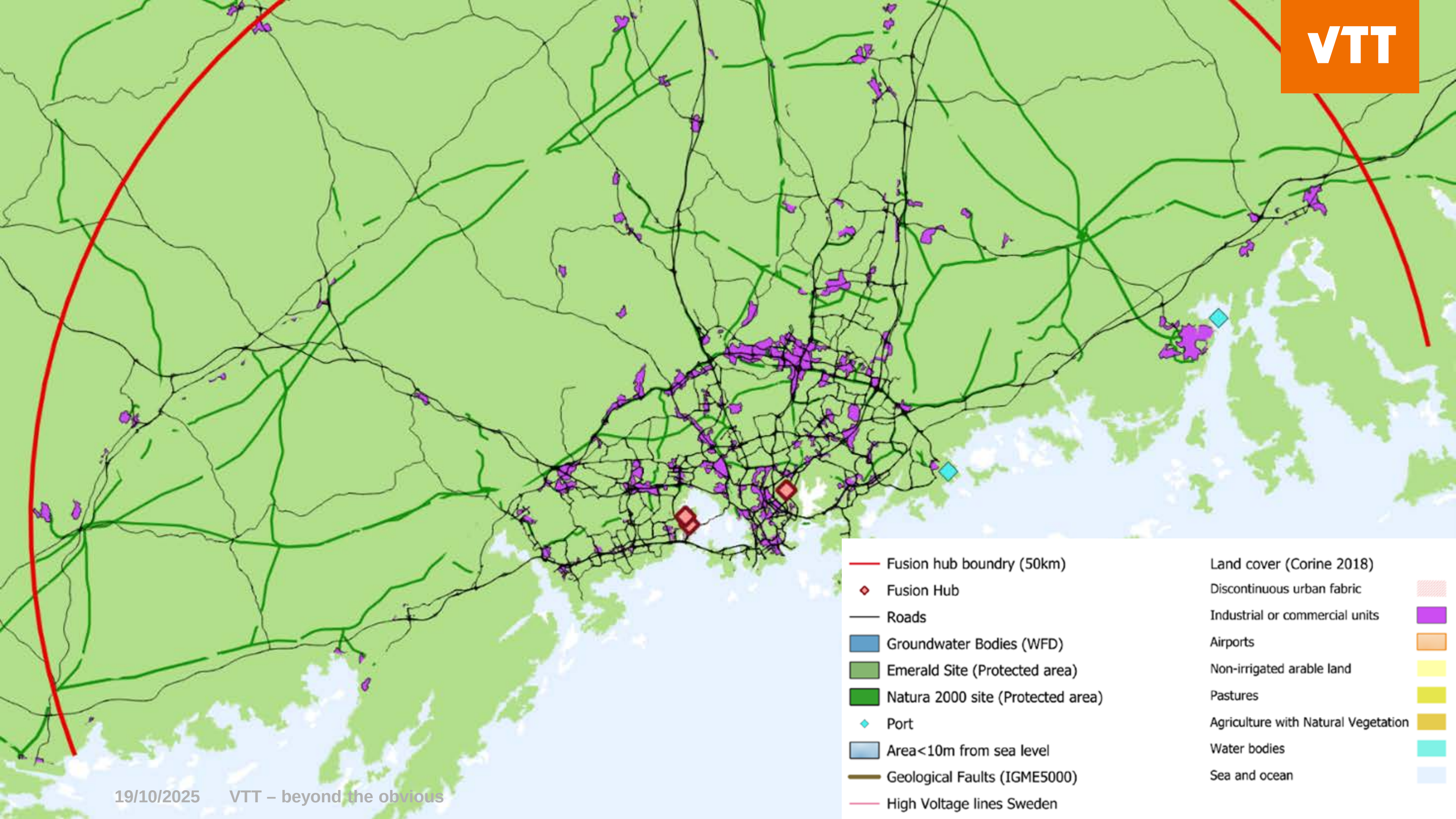
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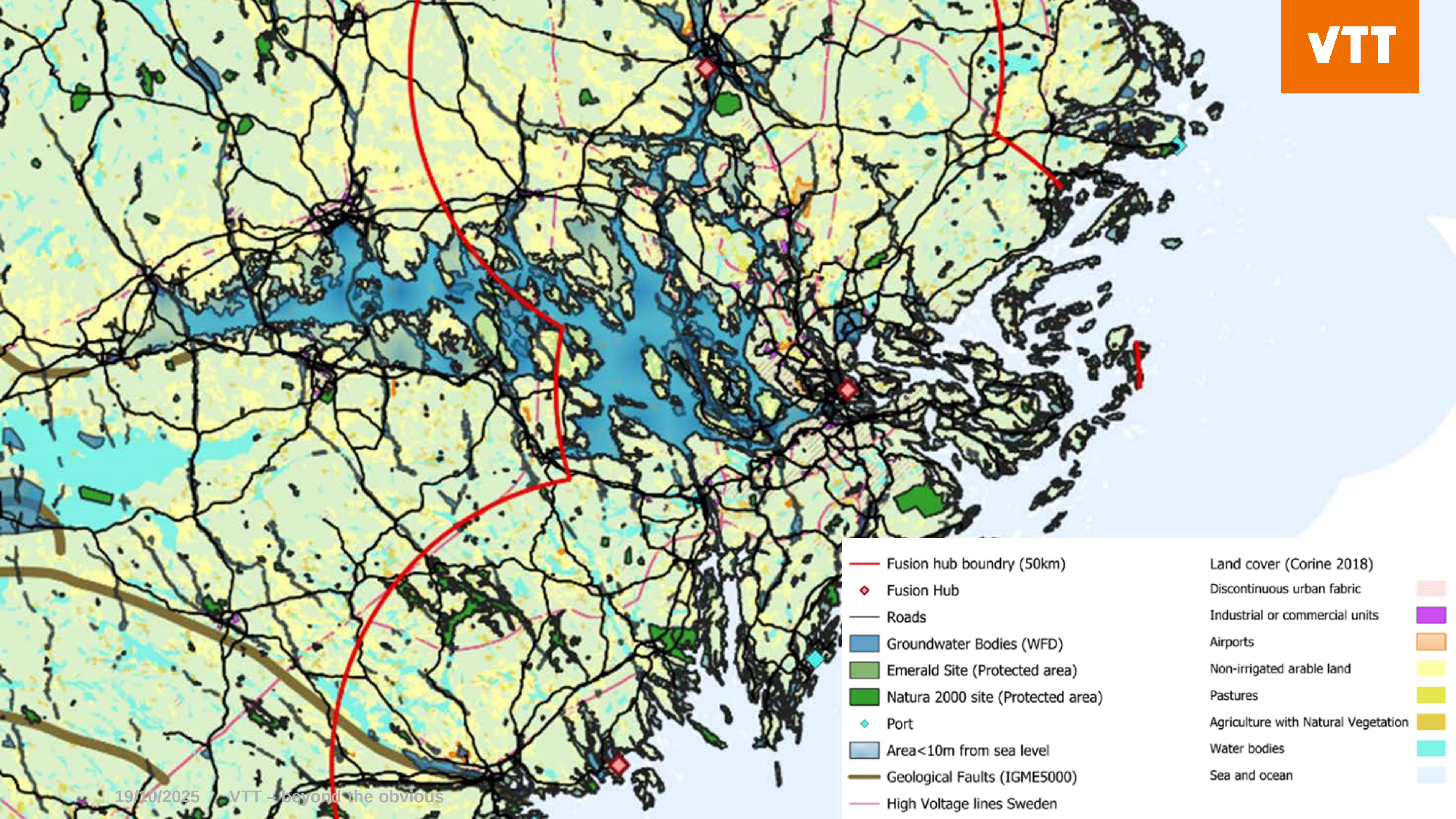
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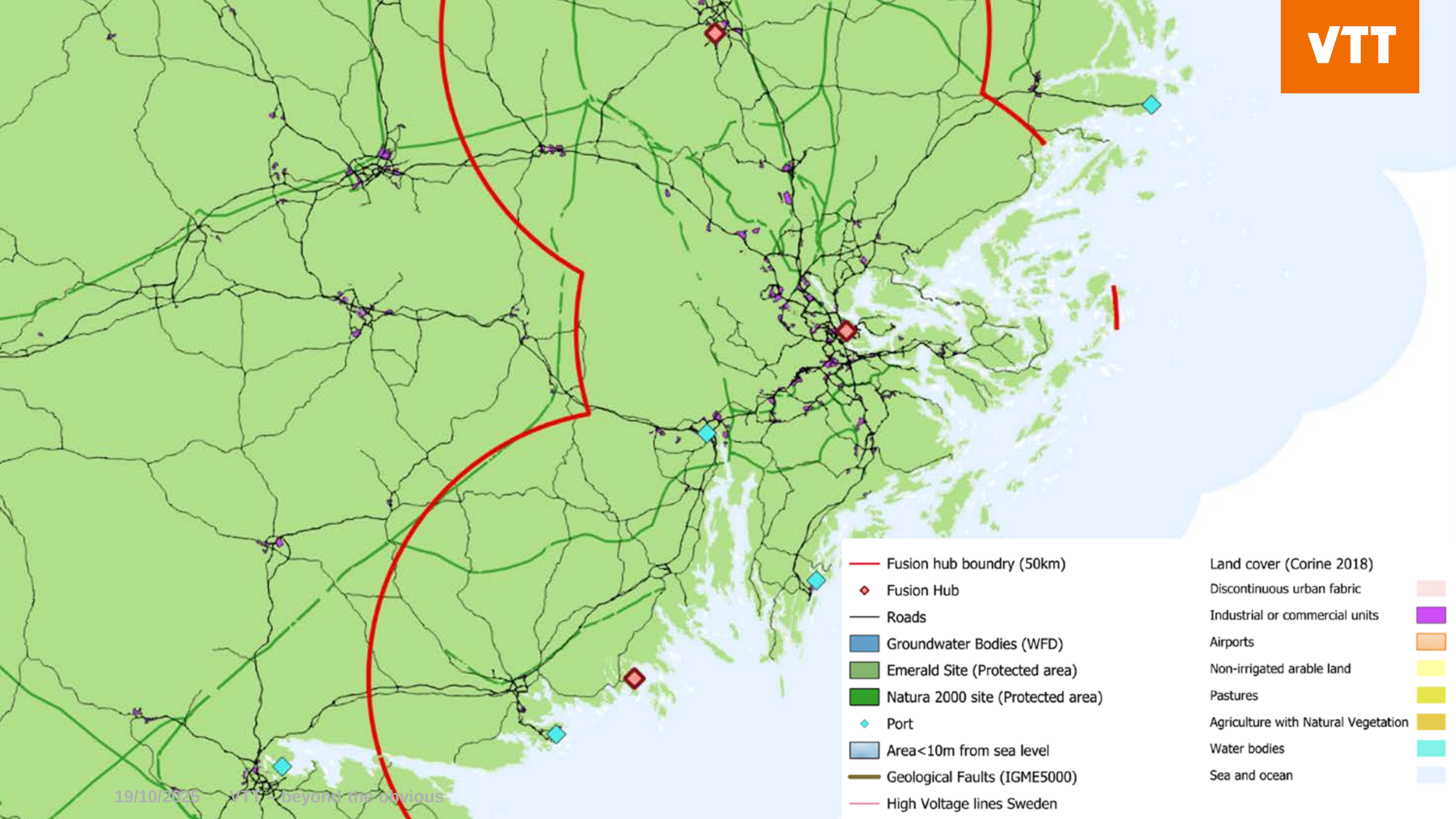
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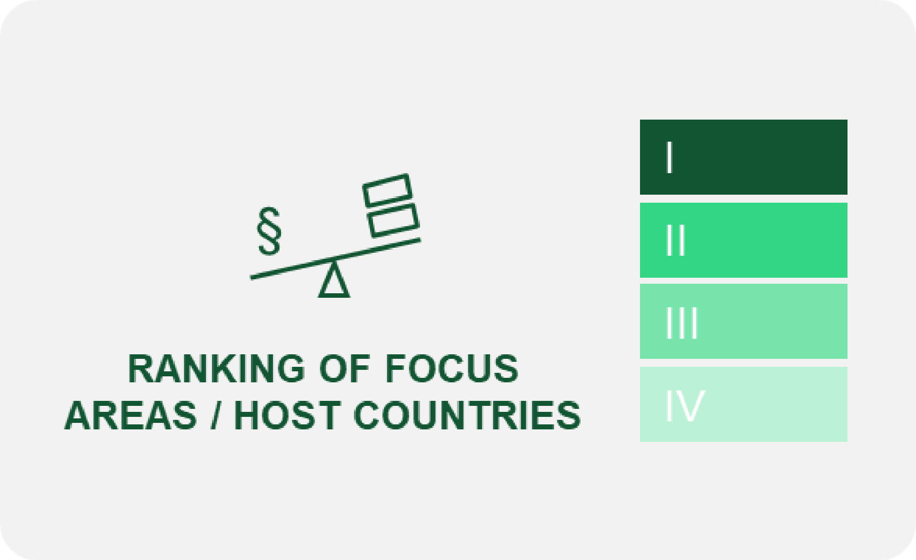
# Clarity in regulation became the decisive ranking criterion across countries

- All countries technically suitable
- Finland: ongoing regulatory renewal is a clear benefit
- Stockholm-Nyköping preferred over Copenhagen-Malmö
  - Regulatory clarity
  - Groundwater criterion



Future siting steps should focus on detailed site-specific studies within the identified primary areas, considering zoning, ownership, and land use.

Illustration: Novatron Fusion Group

# beyond
## the obvious