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Analysis of Sweden's Nuclear New Build Value Chain

POWERING THE FUTURE

Revised November 2025

EXECUTIVE SUMMARY

Sweden stands at a pivotal phase in civil nuclear energy development, presented with opportunities and challenges as it evaluates expanding its nuclear capacity. The Swedish Government has commissioned Business Sweden to map the domestic value chain for new nuclear build, pinpoint gaps and international dependencies, and to assess the economic impact of a nuclear new build in Sweden. To answer these key questions this report is structured around five comprehensive chapters:

1. Value chain deconstruction
2. Supplier mapping and gap analysis
3. Impact assessment
4. Business case for establishment
5. Recommendations

1. VALUE CHAIN COMPOSITION

Sweden's prospective new-build programme spans six well-defined segments: Development, Construction, Primary Circuit (the nuclear island), Secondary Circuit (the turbine island), Balance of Plant (BoP) and Switchyard (illustrated in Figure 1). This framework gives a simplified but intuitive overview of the value chain with clear product categories, including an estimated cost division across the project-life cycle.

DEVELOPMENT	CONSTRUCTION	PRIMARY CIRCUIT *Nuclear Island*	SECONDARY CIRCUIT *Turbine Island*	BALANCE OF PLANT	SWITCHYARD *Grid connection*
Feasibility study	Planning and scheduling	Reactor pressure vessel (RPV)	Steam turbines	Condenser	Transformers
Reactor Design	Preparation and Excavation	Reactor internals (core)	Condenser	Cooling Towers / Heat Exchangers	Switchgear
Project Design	Construction	Steam generators	Moisture Separator Reheaters	Pumps	Transmission lines
Licensing	Installation	Pressurizer	Feedwater System	HVAC systems	
	Building Materials	Reactor coolant pumps	Instrumentation and Control* (spans Secondary Circuit and Balance of Plant)		
		Containment Structure			
		Fuel supply system			
		Supporting components and services (including internal electrical grid and motor driven pump systems) (spans Primary Circuit to Switchyard)			

Figure 1. Value chain deconstruction
* The separation of Instrumentation & Control (I&C) between the rest of the plant and primary is a deliberate design principle in nuclear power plants, rooted in safety, regulatory compliance, functional specialization, and system reliability. In most nuclear projects, the I&C systems for the primary circuit Tier 0 OEMs as part of the reactor island. In contrast, the I&C systems for the rest of the plant are typically provided by industrial automation vendors or local integrators.

2. SUPPLIER MAPPING AND CAPABILITY GAPS

Across the six new-build segments Sweden brings world class strengths, most visibly in Switchyard followed by Balance of Plant and large scale civil works. Nordic neighbours further reinforce project management and integration skills. Yet critical international dependencies remain. Sweden lacks heavy forging and manufacturing capabilities for the Primary Circuit and the consulting and engineering firms still lean on international Tier 0 OEMs for detailed reactor and project design. The picture below shows the summary of the capability assessment for Sweden and Nordics as well as the international dependencies (gaps).

	DEVELOPMENT	CONSTRUCTION	PRIMARY CIRCUIT *Nuclear Island*	SECONDARY CIRCUIT *Turbine Island*	BALANCE OF PLANT	SWITCHYARD *Grid connection*
	~10% of costs*	~40% of costs	~15% of costs	~15% of costs	~15% of costs	~5% of costs
Swedish capabilities	Moderate capabilities	Moderate capabilities	Limited capabilities	Limited capabilities	Moderate capabilities	Strong capabilities
Nordic offering (incl. Sweden)	Moderate capabilities	Strong capabilities	Limited capabilities	Moderate capabilities	Strong capabilities	Very strong capabilities
International dependency	High dependency (reactor core design)	Moderate capabilities (management experience for nuclear projects)	Full dependency	High dependency (turbine)	Moderate capabilities (nuclear graded products)	Low dependency

Figure 2. Capability assessment
*These figures are indicative estimates based on international benchmarks and conducted interviews of typical nuclear new build projects; actual cost distribution can vary significantly depending on reactor type, delivery model, local capabilities, regulatory environment, and site-specific conditions.

Below, figure 3 presents a selection of the key-players in the Swedish ecosystem relevant to nuclear new builds, spanning the entire project lifecycle from early development through to grid connection. An identification of a total of 173 Swedish companies that could take part in a new nuclear new build project was made during the study. It highlights a wide range of domestic and regional actors with varying degrees of nuclear relevance and readiness.

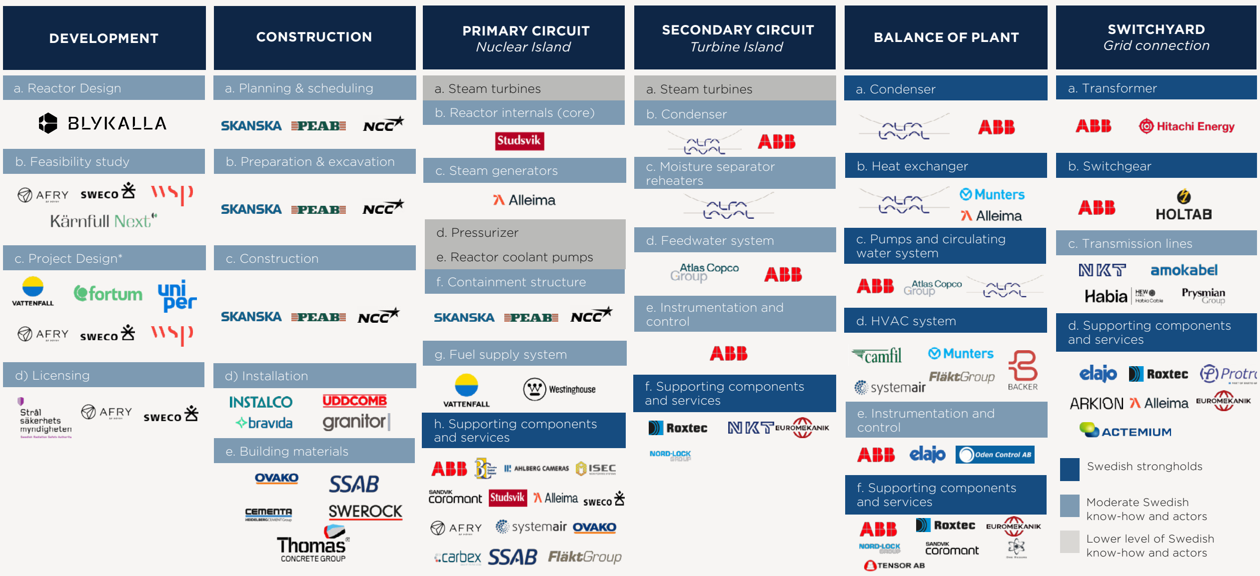

Figure 3. Selection of companies in the supplier mapping of the Swedish value chain

3. ECONOMIC AND EMPLOYMENT IMPACTS

The economic and employment impact assessment assesses the KPIs; Domestic CAPEX, Impact on GDP and number of Full-Time Equivalent, which represents the total number of full-time jobs created, or supported in Sweden (1 FTE = One full-time job sustained for one year). The Impact on GDP and Number of FTEs are a sum of direct and indirect output (Direct = Directly related to the project, Indirect = Across the value chain).

This assessment is done for a 1 200 MW large-scale reactor (LSR) and 300 MW small modular reactor (SMR).

A SINGLE 1 200 MW LARGE-SCALE REACTOR (LSR) COULD:

• Anchor ≈ SEK 50 billion of domestic capital expenditure
• Inject ≈ SEK 40 billion into Swedish GDP (Direct and Indirect)
• Create roughly 33 500 FTEs (Direct and Indirect)

A 300 MW SMALL MODULAR REACTOR (SMR) COULD:

• Anchor ≈ SEK 12 billion in domestic capital expenditure
• Inject ≈ SEK 9 billion into Swedish GDP (Direct and Indirect)
• Create about 7 500 FTEs (Direct and Indirect)

The analysis also shows that knowledge-intensive activities (licensing, design, R&D) offer the best GDP-per-SEK return while civil construction is by far the biggest employment engine (creates most FTEs).

4. BUSINESS CASE AND LOCALISATION THRESHOLD

Public plans, permit applications and feasibility studies suggest an outline 7–10 GW (see Figure 4 below) of potential capacity across the Nordics and Baltics. However, the financial framework approved by the Swedish parliament covers 5 GW, but the Swedish road map for new nuclear targets a total additional capacity of roughly 10 GW by 2045.

To incentivize Tier 0 (and Tier 1) suppliers to partially or fully localize module factories in Sweden or the Nordics, is it critical to achieve a substantial (estimated > 7 GW) regional pipeline of projects. Exceeding this threshold is likely to over time enable a higher degree of domestic sourcing of nuclear products and services and allow Sweden to capture more project value aside from civil works and selected non-nuclear products.

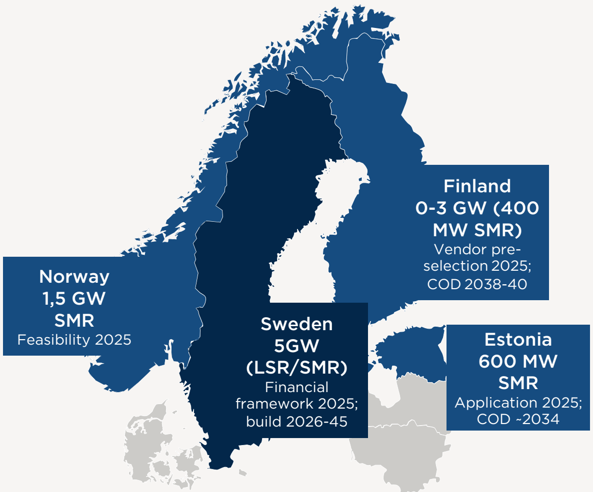

Figure 4. Planned development of nuclear new build in Norway, Sweden, Finland and Estonia

5. RECOMMENDATIONS

The recommendations from the gap analysis suggest how to increase the opportunity for higher domestic content as follows:

- **Enhance technical nuclear specific competencies:**
  Engage with Tier 0 OEMs early, secure strategic partnerships for critical reactor and turbine components, and actively build nuclear-specific skills through targeted domestic and international projects
- **Develop project management and workforce capabilities:**
  Strengthen national frameworks for project management, implement targeted workforce training programs, and streamline regulatory processes for efficient execution
- **Position Sweden as a regional nuclear hub:**
  Create and promote packaged nuclear specific offerings (Balance of Plant, I&C, Switchyard), attract international manufacturers to Sweden, and develop Nordic collaborative export initiatives

Recommendations from Impact Assessment and Business Case show how to achieve the best return on investment as follows:

- **Prioritise knowledge-intensive sectors:**
  Direct investments towards high-value R&D, engineering, and professional services to maximise GDP impact
- **Maximise employment through construction:**
  Increase domestic participation in nuclear-related construction to substantially boost job creation
- **Secure long-term economic commitments:**
  Establish long-term agreements for turbine islands and Balance-of-Plant components to ensure sustained economic benefits

By strategically addressing these capability gaps and prioritising high-impact investment areas, Sweden can solidify its position as a global leader in nuclear energy development.

1. INTRODUCTION

The report was developed during April-June 2025

Sweden's energy landscape is undergoing a significant transformation, driven by ambitious climate goals, increasing electrification demands, and the need for a secure and sustainable energy supply. Nuclear power, known for its reliability and low carbon emissions, is once again becoming a central part of Sweden's future energy strategy.

Against this backdrop, the Swedish Government has commissioned Business Sweden to map the domestic value chain for new nuclear build, identify gaps and international dependencies—particularly the extent to which suppliers in neighbouring countries can complement the Swedish value chain—and assess the economic impact of nuclear new build in Sweden. The assignment has been carried out in dialogue with the Swedish Energy Agency (Energimyndigheten), and with input from relevant stakeholders in the nuclear sector.

This report presents an analysis aimed at understanding and optimising Sweden's role in nuclear new build projects, covering both Large-Scale Reactors (LSRs) and emerging Small Modular Reactor (SMR) technologies.

The analysis comprises five interconnected phases:

1. VALUE CHAIN ANALYSIS
Outlines the nuclear value chain across six clearly defined segments: Development, Construction, Primary Circuit, Secondary Circuit, Balance of Plant, and Switchyard, to ensure clarity on project scope and responsibilities.

2. SUPPLIER MAPPING AND GAP ANALYSIS
Identifies Sweden's existing industrial capacity, highlights areas of strength, and pinpoints critical gaps, particularly in nuclear-specific technologies and systems, emphasising areas dependent on international suppliers.

3. IMPACT ASSESSMENT
Quantifies the economic benefits, including GDP contribution and job creation potential, of nuclear build-out scenarios, enabling targeted investment and policy decisions.

4. BUSINESS CASE FOR ESTABLISHMENT
Evaluates the strategic threshold for localising module production, assessing Sweden's potential to host regional manufacturing hubs for nuclear components, contingent upon achieving a specified production capacity.

5. RECOMMENDATIONS
Recommends focus areas and next steps to further strengthen Swedish content across the nuclear value chain.

This report is intended to provide the Government, as well as other stakeholders – including decision-makers, industry leaders, and international partners – with practical insights to strategically position Sweden as a central actor in the global nuclear sector currently under development.

The conclusions are based on a mixed-method approach designed to capture both the breadth and depth of Sweden's nuclear supply landscape:

- **Stakeholder interviews:**
  More than 30 interviews with companies across all six value chain segments covering Swedish, Nordic and global Tier 0-2 suppliers as well as national and Nordic and European industry associations
- **Desktop research:**
  Review of academic journals, peer-reviewed research papers, government reports, corporate filings and publicly available feasibility studies
- **Internal expert network:**
  Input from Business Sweden's senior expert network in supply chain and nuclear sector

2. VALUE CHAINS – LSR AND SMR

Large-Scale Reactors (LSRs) represent the established generation of nuclear power plants, typically characterised by an electrical output exceeding 1000 MWe. These reactors, much larger than modular Small Modular Reactors (SMRs), are designed to provide substantial and consistent baseload power to the grid, a capability also offered by SMRs at their respective scale.

2.1 TECHNOLOGY

LSR AND SMR TECHNOLOGIES

Large-scale reactors (LSRs) play a significant role in Sweden's nuclear landscape. Key industry players such as Westinghouse and EDF are actively engaged in the Swedish market, underscoring the importance of established reactor technologies alongside emerging SMRs. While SMRs offer potential advantages in modularity and deployment speed, LSRs remain central to Sweden's current and near-term energy strategy. A brief overview of the LSR and SMR technologies provides a comprehensive perspective on the region's nuclear energy prospects.

LSRs involve complex and often bespoke on-site construction, demanding significant infrastructure development and substantial upfront capital investment for projects to materialise. Due to their size and complexity, these projects often face long timelines and delays. The construction of LSRs is site-intensive, with major components being assembled and integrated directly at the power plant location. This approach, while capable of delivering large blocks of power, entails intricate engineering, extensive regulatory oversight, and a longer overall project lifecycle compared to their smaller, modular counterparts.

LSRs are the conventional backbone of many nuclear power programs globally, typically generating 1,000 MW or more. The vast majority of these operate on proven technologies, primarily Pressurized Water Reactors (PWRs) and Boiling Water Reactors (BWRs), both of which are Light Water Reactor (LWR) designs, and Pressurized Heavy Water Reactors (PHWRs). The financial challenges associated with LSRs include high upfront capital costs and associated financing risks. Insurance for civil nuclear risks can involve high premiums and complex coverage conditions. As a result, government involvement through mechanisms such as loan guarantees, grants, and production tax credits is often employed to mitigate risks and encourage private sector participation. Financing models typically involve risk-sharing arrangements among technology suppliers, project developers, government entities, electricity purchasers, and financial institutions.

Despite these challenges, the long operational history of LSRs demonstrates their proven reliability and contribution to national energy security. Their considerable power output makes them highly effective for decarbonising large grids, replacing significant fossil fuel capacities with a single plant. Furthermore, the established regulatory and supply chain ecosystems for LSR technology, built over decades, often provide a degree of familiarity and stability for large-scale energy planning.

While their upfront financial commitment is substantial, the long operational lifespan of LSRs, typically 60 years or more, allows for significant electricity generation over time, contributing both to long-term energy reliability and the meeting of climate goals.

Small Modular Reactors (SMRs) are generally defined as reactors with a capacity of up to 300 MWe per module (although some designs reach 470 Mwe). In keeping with their name, these will often feature modular construction and enhanced passive safety systems. The modular aspect of SMRs derives from the design philosophy where major components and systems, particularly the Nuclear Steam Supply System (NSSS), are manufactured in a factory setting as standardized modules that are then transported to the deployment site for assembly. This approach aims to reduce on-site construction time and, in the future, achieve cost reductions through the large-scale, repetitive manufacturing of standardised units—once designs become more widely adopted and standardised across the industry.

Successful SMR deployment will necessitate adapted workforce skills, particularly in manufacturing and module integration, and require supportive policy frameworks, regulatory adaptation and innovative financing models in order to become a mainstay of the Scandinavian civil nuclear landscape.

Cost remains a central challenge for the future of SMRs. The economic rationality differs significantly from that of traditional LSRs, relying heavily on the potential of mass production. SMRs inherently have a lower total capital cost per unit compared to a LSR which is a primary driver of interest. However, this does not necessarily suggest that SMRs facilitate cheaper costs to produce electricity.

The lower absolute capital cost per SMR unit is often cited as a major advantage for financing. Raising capital for an SMR based project is perceived as more manageable than funding a new gigawatt-scale LSR project. Moreover, the modular nature of SMRs also allows for incremental capacity additions (wherein one or two modules could initially be built and then more could be added as demand grows, or financing becomes available). This phased approach lowers the initial investment burden and allows revenue generation from the initial modules to potentially help finance subsequent ones.

Through an interview with one SMR developer, it was highlighted that for private sector involvement in nuclear new build in Sweden, (SMRs) are perceived as offering a more accessible pathway compared to traditional large-scale reactors. The scale of capital expenditure (CAPEX) associated with SMR projects is considered to be at a level that can be addressed within typical corporate investment decision-making processes, contrasting with the substantial financial commitments and potential geopolitical influences often intertwined with large reactor projects. This characteristic positions SMRs as a potentially more viable option for private developers looking to enter the nuclear energy market.

Financing new nuclear power, whether Small Modular Reactors (SMRs) or Large Scale Reactors (LSRs), faces significant hurdles. Private investors are wary of the risks associated with unproven SMR technologies, and the huge upfront costs and long construction times of LSRs. One interviewee pointed to the challenges of placing civil nuclear risks on the insurance market and high premiums. The interviewee suggested that "owners and component manufacturers need to get together and work out who is taking each risk". With complications arising from these risks substantial governmental support is likely to be essential, particularly for early projects, to mitigate these risks and attract private capital.

Categories include:

LIGHT WATER REACTORS (LWRS)

This category encompasses designs that utilise water as both a coolant and a neutron moderator. Major components are housed within the reactor vessel, simplifying the system and eliminating large primary circuit piping. Examples include technologies of Rolls Royce SMR, NuScale and SMART. One Swedish leader in LWR technologies posited that this technology is advantageous owing to what they labelled a 'proven supply chain, proven fuel technology and proven waste repository solutions.

Objectively, the alignment of Light Water Reactor (LWR) with existing Nordic nuclear capabilities suggests potential advantages. Given Sweden and Finland's extensive history of operating LWR nuclear power plants, it is reasonable to infer that their respective regulatory authorities, the Swedish Radiation Safety Authority (SSM) and the Finnish Radiation and Nuclear Safety Authority (STUK), possess established regulatory experience and institutional knowledge relevant to LWR technology. While specific SMR designs will require thorough review, this existing familiarity with the fundamental technology could potentially offer a more understood pathway for licensing compared to entirely novel reactor designs. Furthermore, the operational experience within Sweden and Finland with LWRs provides a foundational understanding for SMR operation. An existing Nordic supply chain supporting the current LWR fleet may be adaptable for some SMR components and services. Finally, the history of LWR operation in the Nordics suggests a degree of public and political familiarity with this technology.

HIGH-TEMPERATURE GAS-COOLED REACTORS (HTGRS)

HTGR designs employ a gaseous coolant, typically helium, and graphite as a neutron moderator. Their capability to achieve high operating temperatures (in excess of 750°C) presents opportunities for enhanced thermodynamic efficiency in electricity generation and the provision of high-grade industrial process heat. Examples of HTGR-based SMRs include X-energy's Xe-100 and China's HTR-PM. Objectively, the Nordic region (Sweden and Finland) currently lacks established regulatory frameworks, widespread operational experience in commercial power generation, and mature supply chains specifically for High-Temperature Gas-cooled Reactor (HTGR) technology.

MOLTEN SALT REACTORS (MSRS)

The Nordic region has an emerging presence in Molten Salt Reactor (MSR) technology, with at least one developer (Seaborg) located in Denmark. However, established regulatory frameworks, widespread operational experience in Sweden and Finland, and mature supply chains for commercial MSR deployment are not yet in place within these countries. While there is interest in exploring advanced nuclear technologies, the commercial deployment of MSRs in the Nordics would likely require significant development in these areas.

FAST NEUTRON REACTORS (FNRS)

FNRs are characterised by their operation with a fast neutron spectrum, thus eliminating the need for a neutron moderator. These reactors typically employ liquid metals, such as sodium (Sodium-cooled Fast Reactor - SFR) or lead (Lead-cooled Fast Reactor - LFR), as coolants. FNR technology holds promise for fuel breeding, extending nuclear fuel resources, and the transmutation of long-lived radioactive waste products. Examples of FNR SMR designs include GE Hitachi's Natrium and ARC-100. Objectively, the Nordic region (Sweden and Finland) currently lacks established regulatory frameworks, widespread operational experience in commercial power generation, and mature supply chains specifically for Fast Neutron Reactor (FNR) technology. The nuclear programs in both countries have historically centred on thermal neutron reactors (LWRs).

SMALL MODULAR REACTOR (SMR) DESIGNS BEING CONSIDERED IN SWEDEN AND THE NORDICS

Sweden and its Nordic neighbours in particular Finland and Norway are actively exploring the potential role of SMRs in their future energy systems, driven by the needs for increased clean power capacity, decarbonisation and sustained energy security. The below section shall explore the mature explorations within Sweden and the Nordics of SMR technologies.

SWEDEN

Vattenfall is evaluating SMRs for potential new nuclear construction, particularly at Ringhals. In its assessment of SMR technologies, Vattenfall initially considered six vendors and now has shortlisted two: (Rolls-Royce SMR and GE Hitachi's BWRX-300). In addition to Vattenfall, other key players are involved in Sweden's evolving nuclear landscape. For example, Blykalla has announced plans for SMR deployment within Sweden, reflecting growing industry interest. Meanwhile, Fortum is conducting an ongoing preliminary study to evaluate the feasibility and potential of new nuclear projects in the region. These combined efforts underline Sweden's commitment to advancing its nuclear capabilities alongside broader Nordic collaboration.

FINLAND

Finland is actively exploring the deployment of SMRs. The ability of SMRs to provide a consistent and low-carbon heat source is well-aligned with Finland's ambitious climate goals and its existing district heating infrastructure. Steady Energy, a spin-off from VTT Technical Research Centre of Finland, are playing a significant role. Their specific SMR design is tailored for heat production, operating at lower temperatures and pressures compared to reactors designed solely for electricity generation. Steady Energy has ambitious plans to begin construction of its first commercial SMR for district heating as early as 2025 , with potential locations identified in major urban centres like Helsinki, Kuopio, and Lahti. Furthermore, they have already signed letters of intent with prominent energy companies like Kuopion Energia and Helen, outlining the potential for deploying multiple district heating reactors from 2030 onwards.

There are other key players present within the Finnish SMR landscape, however. Indeed, following a two-years feasibility study examining new nuclear prerequisites in Finland and Sweden, Fortum announced in March 2025 that it would deepen collaboration with three technology providers. Two of these offer conventional LSRs (EDF and Westinghouse-Hyundai) and one offers SMRs: (GE-Hitachi with its BWRX-300). Fortum has noted that SMRs like the BWRX-300 could be particularly suitable for co-location with industrial facilities or for supplying district heating networks. Fortum anticipates that new nuclear capacity could potentially come online in the Nordics in the second half of the 2030s at the earliest provided market conditions and regulatory frameworks are favourable.

NORWAY

While currently without commercial nuclear power, Norway is making significant strides in exploring SMRs, largely spearheaded by Norsk Kjernekraft . This company is actively identifying potential deployment sites such as Halden, Øygarden, and Vardø, and has formed strategic partnerships, including one with Swedish SMR developer Blykalla to evaluate their SEALER design.

Beyond these efforts, the collaboration between the municipalities of Aure and Heim to potentially develop up to 1500 MW of nuclear capacity through multiple SMRs highlights the ambition for larger-scale deployment. The potential for SMRs to supply power to remote communities and energy-intensive industries, complementing Norway's extensive hydropower, is a key driver. Furthermore, the consideration of SMRs aligns with Norway's long-term energy security goals and its commitment to exploring diverse low-carbon energy sources. The ongoing governmental review into the feasibility of nuclear power, with a report expected in April 2026, underscores the seriousness with which Norway is considering different technologies as crucial components of its future energy mix.

TECHNOLOGIES AND VENDORS ALIGNED WITH SWEDISH INDUSTRIAL CAPABILITIES

The following SMRs are currently being evaluated:

GE Hitachi's BWRX-300, a 300 MWe natural circulation Boiling Water Reactor has been shortlisted by Vattenfall and selected as a preferred technology by Fortum.

Rolls-Royce SMR has also been shortlisted by Vattenfall. Rolls-Royce have emphasised its integrated power station design, modularisation strategy, and use of proven PWR technology. It is also advancing through the UK's Generic Design Assessment (GDA) regulatory process.

Different SMR technologies and vendor partnerships offer varying degrees of alignment with Sweden's industrial strengths:

- **LWR-based SMRs (e.g. Rolls-Royce SMR, GEH BWRX-300):**
  These designs, shortlisted by Vattenfall, offer a direct path to leveraging existing Swedish capabilities. The BWRX-300, being a boiling water reactor, aligns particularly well with Sweden's historical BWR fleet experience. There are significant opportunities for Swedish companies to participate in the supply chain for components like turbines, generators, heat exchanges, valves, electrical systems, and balance-of-plant equipment, as well as providing construction, installation, and engineering services. The Rolls-Royce model, emphasising factory production, could potentially align with Swedish advanced manufacturing capabilities if module fabrication or assembly were localised.

- **Advanced SMRs (e.g. Blykalla SEALER):**
  The development of domestic advanced reactor technology like Blykalla's lead-cooled SEALER presents a different kind of opportunity. While requiring development of new expertise, success in this area could position Sweden as a leader in a niche but potentially high-value segment of the future nuclear market building unique national competence in areas such as liquid metal handling, advanced metallurgy for corrosion resistance and specialised component manufacturing.

- **General Modular Construction:**
  There is potential to establish factories for component manufacturing or module assembly with Sweden, particularly if a multi-unit "fleet" deployment strategy is pursued. Such a strategy would likely involve phased production targets, site selection aligned with industrial hubs, and efforts to develop a skilled workforce and secure supply chain capabilities. Kärnfull Next's vision of "SMR campuses" also implies significant local construction, integration, and potentially co-located industrial activity.

2.2 VALUE CHAIN DECONSTRUCTION

The journey of establishing a new nuclear power plant is a complex undertaking, best understood as a sequential value chain encompassing distinct phases and involving a multitude of specialised actors. The diagram below offers a visualization of this chain.

DEVELOPMENT	CONSTRUCTION	PRIMARY CIRCUIT *Nuclear Island*	SECONDARY CIRCUIT *Turbine Island*	BALANCE OF PLANT	SWITCHYARD *Grid connection*
Feasibility study	Planning and scheduling	Reactor pressure vessel (RPV)	Steam turbines	Condenser	Transformers
Reactor Design	Preparation and Excavation	Reactor internals (core)	Condenser	Cooling Towers / Heat Exchangers	Switchgear
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Licensing	Installation	Pressurizer	Feedwater System	HVAC systems	
	Building Materials	Reactor coolant pumps	Instrumentation and Control*		
		Containment Structure			
		Fuel supply system			
		Supporting components and services (including internal electrical grid and motor driven pump systems)			

Figure 5. A visualization of the deconstructed value chain
* The separation of Instrumentation & Control (I&C) between the rest of the plant and primary is a deliberate design principle in nuclear power plants, rooted in safety, regulatory compliance, functional specialization, and system reliability. In most nuclear projects, the I&C systems for the primary circuit Tier 0 OEMs as part of the reactor island. In contrast, the I&C systems for the rest of the plant are typically provided by industrial automation vendors or local integrators.

Tier 0 (defined in Section 3.1) Original Equipment Manufacturers (OEMs) are positioned at the very top of the nuclear power plant supply chain. These are typically large, multinational engineering and technology corporations equipped with extensive expertise and resources. Their primary role is to lay the foundation for nuclear new build projects by designing, engineering, and supplying the fundamental, integrated components and core technologies. They are crucial for developing the complete plant design, particularly the complex Nuclear Island (Primary circuit) and Turbine Island (Secondary circuit), which are critical during the construction phase. The strategic technology choices and system integration approaches defined by these Tier 0 providers as well as with input from the client during the development phase have a profound impact on the entire project trajectory.

At the foundational stage, the Development phase lays the intellectual and regulatory groundwork for the entire project. This phase is characterised by in-depth feasibility studies that assess the viability and suitability of a potential project. In addition, the development phase involves an intricate design process that includes the selection of optimal technology and conceptualizing the plant's architecture as well as the critical tasks of securing necessary licenses and adhering to regulatory frameworks. Decisions made at this juncture will shape the entire trajectory of the new build.

Following the conceptualization and regulatory approval of the Development phase, the project progresses into Construction. This phase marks the commencement of tangible, physical realisation and involves site preparation, extensive excavation work and the general construction of the plant's building and secondary infrastructure. This precedes the installation of the more specialised and core systems of the plant.

The diagram further delineates the critical systems that are integrated during the broader Construction phase. The Primary circuit (Nuclear Island) represents the very heart of the nuclear power plant. This encompasses the nuclear reactor vessel itself, the control rods that regulate the nuclear fission process, and the primary coolant system responsible for transferring the significant amount of heat generated within the reactor. The integrity and precise engineering of the Primary circuit are paramount to the safe and efficient operation of the entire facility.

Subsequently, the diagram identifies the Secondary circuit (Turbine Island) as the next crucial stage in electricity generation. This system takes the thermal energy transported from the primary circuit and converts it into mechanical energy through powerful steam turbines. These turbines, in turn, drive the generators that produce the electrical power. The efficiency and reliability of the Turbine Island are key determinants of the plant's overall power output.

Beyond the core energy conversion systems, the Balance of Plant (BoP) encompasses all the essential supporting infrastructure required for the plant's continuous operation. This includes vital cooling systems — which, depending on the local climate and water availability, may include readily recognisable cooling towers. However, in countries like Sweden, such towers are less commonly used due to the abundance of naturally cold-water sources and the favourable climate for alternative cooling methods. It is important to note that, unlike in the 1970s, there are currently only a few suitable sites along the southern Swedish coast, where electricity demand is highest, where new nuclear power plants can be built. While building new plants is possible, these limited locations present a significant geographic constraint that influences the feasibility and design of cooling infrastructure today. The BoP also includes water treatment facilities to ensure process water quality, systems for the safe handling of waste, and various auxiliary buildings that support day-to-day operations.

Finally, the Switchyard (Grid connection) represents the critical interface between the newly generated electricity and the broader power grid – typically the national power grid, though smaller reactors may connect at lower distribution levels. This is where the high-voltage electricity produced by the plant is stepped up and transmitted into the grid, making it available for distribution to end-users.

These distinct components, while part of the overall construction endeavour, highlight the specialised engineering and installation required for each critical system within a nuclear power plant.

OPERATING PRINCIPLES OF PRESSURIZED WATER REACTOR PLANTS

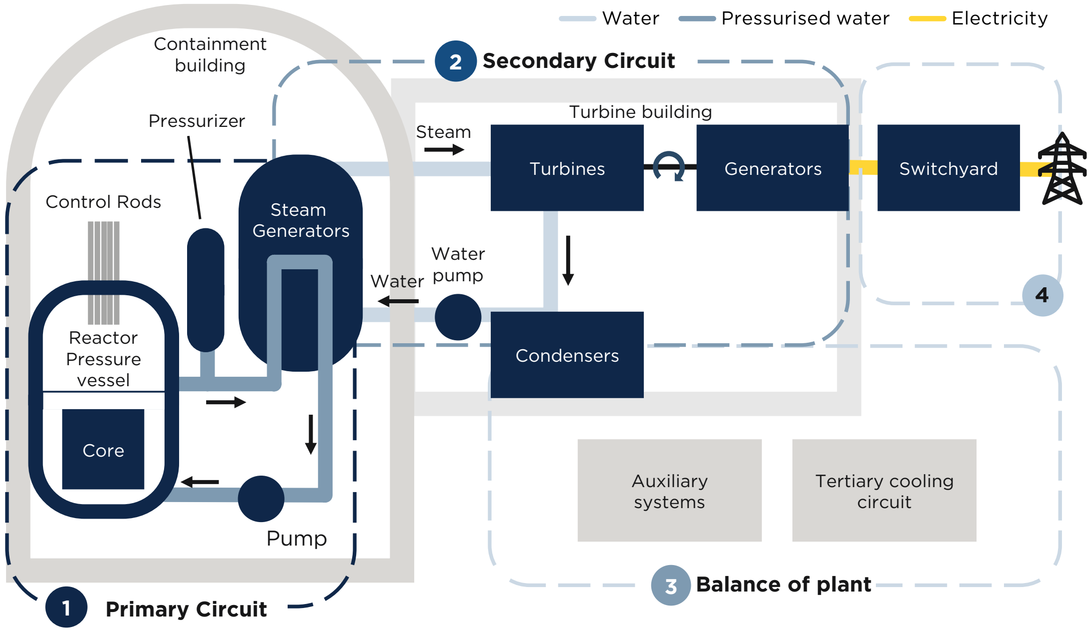


Figure 6. Diagram of a nuclear power plant organised into three main sections and flow paths
Note: Diagram based on a Pressurized Water reactor plant (PWR), but also applicable to Pressurized Heavy-Water Reactors (PHWR) and Boiling Water Reactors (BWR)

Nuclear power plant projects, whether involving Small Modular Reactors (SMRs) or the more established Large-Scale Reactors (LSRs), follow a broadly similar lifecycle. This includes essential stages from initial development and complex construction of key components like the nuclear island, turbine island, and balance of plant, through to the critical post-construction phase of testing and operational readiness. Delving into further detail, the phases can be further divided into the following sub-categories, each-encompassing a distinct set of activities and considerations. This structured breakdown provides a more granular understanding of the complex journey from initial developmental stages to the eventual connection to the electrical grid. Each sub-phase plays a vital role, contributing to the overall safety, efficiency and successful implementation of a nuclear power project.

2.2.1 DEVELOPMENT

The development phase includes three sub-steps: feasibility study, design and licensing. It is the stage where the foundation for the entire nuclear new build is set.

This phase covers the earliest decisions that determine the viability of a project and seeks to answer key questions including which technology to use, how the plant should be configured, how to secure a license, and how to ensure regulatory compliance. It includes feasibility assessments, site and environmental studies, development of the safety case, system architecture, and detailed engineering.

Actors involved range from Tier 0 OEMs who bring reactor technology and design authority, to national utilities who act as developers and sponsors, and engineering firms who deliver the technical drawings and compliance packages. EPCM (Engineering, Procurement, and Construction Management) firms do not typically lead this phase but may contribute toward the end as the design transitions into construction readiness.

FEASIBILITY STUDY

The feasibility study is the initial and critical step that involves a comprehensive evaluation to determine the actual viability of the nuclear power plant project. It encompasses the analysis of factors such as energy demand, potential site suitability, economic projections (costs and benefits), environmental impact assessments, and preliminary risk analysis. As the name suggests, the outcome of this step is crucial in order to ascertain the viability and feasibility of a project's future development.

There are four main areas of feasibility to consider:

Technical Feasibility
Technical Feasibility would involve evaluating reactor technologies suitable for Swedish conditions and regulations. This study would involve not just the technologies themselves but also include assessment of potential sites considering factors like geology, proximity to cooling water and grid connections.

Economic Feasibility
This study would analyse capital costs, operating expenses (including fuel and waste management), and projected electricity prices in the Swedish market. The long-term costs of decommissioning and the management of spent nuclear fuel would be critical components.

Environmental Feasibility
The study would need to thoroughly assess the potential environmental impacts, including thermal discharge to water bodies, land use, effects on local ecosystems, and the management of radioactive waste. An Environmental Impact Assessment (EIA) is mandatory for the construction of new nuclear installations under the Swedish Environmental Code.

Social and Political Feasibility
The feasibility study would likely consider public opinion, engagement with local communities, and alignment with national energy policy goals, which have seen shifts towards recognising nuclear's role in a fossil-free energy system.

REACTOR DESIGN

The second stage in the development phase is Reactor Design, focusing on selecting a proven and inherently safe reactor technology. This would likely involve a detailed evaluation of advanced BWRs or PWRs, given their established operational history and safety characteristics. The potential of Small Modular Reactors (SMRs) might also be explored, considering their advantages in scalability and deployment feasibility.

A foundational principle of Reactor Design is the mandatory and adherence to the safety standards set forth by the Swedish Radiation Safety Authority (SSM). Moreover, the design must ensure seamless integration with the Swedish national grid and the broader Nordic power market to enable efficient electricity transmission and distribution. The Reactor Design phase culminates in the creation of comprehensive engineering plans that detail the plant's physical architecture, integrated systems, and individual components.

The reactor design phase is primarily led by Original Equipment Manufacturers (OEMs), often starting years before a utility formally commits to a project, as it is intrinsically linked to the OEM's intellectual property. This stage involves the selection of a standard design or technology platform. While OEMs drive this process, utility involvement can vary, from simply observing and co-funding research and development to actively influencing specific design features like passive safety systems or modularisation.

PROJECT DESIGN

The Project Design builds upon the finalised Reactor Design and concentrates on demonstrating its practical feasibility, inherent safety features, and full regulatory compliance. All of these are crucial to the success of subsequent phases. A cornerstone of this phase is the construction of a comprehensive safety case. This extensive documentation will provide a meticulous demonstration of how the proposed plant design will meet Swedish safety regulations and effectively address all identified potential hazards. The safety case includes in-depth analyses of a wide range of operational scenarios and potential accident conditions, clearly outlining the incorporated safety features and established operational procedures designed to both prevent and effectively mitigate any associated risks. Furthermore, the development phase would also strategically incorporate considerations for the implementation of efficient radioactive waste management strategies, ensuring alignment with established national policies for the safe handling, secure storage, and responsible disposal of nuclear waste.

Key steps in Project Design:

- OEM finalises design, completes testing, prepares for licensing
- Delivery model is defined (that is, the approach to how the project will be executed e.g., design-only, full EPC, or strategic partnership)
- Utility becomes increasingly involved: influences customisations, interfaces with regulator

Once the reactor technology and vendor product have been selected and developed, the Project Design phase focuses on transforming the standard design into a complete, site-specific, licensable nuclear power plant layout. This phase bridges the gap between technology development and real-world implementation, ensuring that the chosen reactor can be safely and efficiently constructed, operated, and maintained at the selected site.

Activities include:

- Site-Specific Adaptation
- System Integration
- Engineering Design Documentation
- Procurement Preparation
- Execution Planning

To produce a licensable, constructable, and fully engineered plant design that integrates the selected reactor technology into the site and project context, ensuring readiness for regulatory approval, procurement, and construction.

LICENSING

Building new nuclear power plants in Sweden, including large reactors and Small Modular Reactors (SMRs), follows a dual-track licensing system under the Act on Nuclear Activities (1984:3) and the Environmental Code (1998:808). This requires approvals from multiple governmental bodies, local authorities, and crucially, the Swedish Radiation Safety Authority (Strålsäkerhetsmyndigheten, SSM), the central nuclear safety regulator. The system prioritises operational safety, protection from radiation, and comprehensive environmental consideration. In 2025, the Swedish government initiated a review to streamline and modernise the licensing process. The terms of reference for the inquiry (utredningsdirektivet) were decided in November 2023. The resulting interim report which has been circulated for consultation SOU 2025:7 report, Ny kärnkraft i Sverige – effektivare tillståndsprövning och ändamålsenliga avgifter (New Nuclear Power in Sweden – More Efficient Licensing and Appropriate Fees), outlines proposals to improve regulatory efficiency and better facilitate future nuclear development.

A cornerstone of the proposed framework in the SOU is achieving initial Governmental Permissibility (Tillåtlighet). This key approval from the Swedish Government would depend on positive assessments from SSM (on nuclear safety under the Act on Nuclear Activities) and the Land and Environment Court (on environmental impacts under the Environmental Code), alongside the vital consent of the local municipal council. A detailed Environmental Impact Assessment (EIA) is mandatory. Following governmental permissibility, SSM conducts a detailed licensing process, including in-depth reviews of the Safety Analysis Report (SAR), and employs a stepwise licensing approach for construction, trial operation, and routine operation, demanding safety demonstrations at each stage and providing lifelong oversight.

Key authorisations include a license under the Act on Nuclear Activities, granted by the Government after SSM's positive review. This license is fundamental for nuclear safety, security, and radiation protection, and is particularly critical for the primary circuit (reactor core, pressure vessel, coolant systems). The SAR must demonstrate compliance with stringent requirements, including those in SSM's detailed regulations like SSMFS 2008:17 (Regulations concerning the Design and Construction of Nuclear Power Reactors), which mandate principles such as defense-in-depth. Additionally, a permit under the Environmental Code, also Government-issued based on the Court's assessment and municipal approval, addresses the project's overall environmental acceptability. Compliance with the Radiation Protection Act (2018:396) is also overseen by SSM.

BREAKDOWN OF THE LICENSING PROCESS

The Swedish nuclear licensing process unfolds through several distinct phases:

- **Phase 1: Pre-Application & Preparation**
  Developers conduct feasibility studies, preliminary design, and site characterisation. The Environmental Impact Assessment (EIA) process begins, involving early consultations with authorities and stakeholders. Informal dialogue with SSM, the Land and Environment Court, and potential host municipalities is encouraged. For SMRs, this may involve a formal pre-licensing review with SSM.

- **Phase 2: Formal Application Submission**
  The applicant submits two comprehensive, parallel applications: one to the Government (under the Act on Nuclear Activities, referred to SSM) and one to the Land and Environment Court (under the Environmental Code, including the EIA).

- **Phase 3: Parallel Review and Assessment**
  SSM conducts an in-depth safety review of the nuclear license application, scrutinizing the SAR, plant design (especially the primary circuit and safety systems), security, radiation protection, waste management, decommissioning plans, and organisational competence. Simultaneously,

the Land and Environment Court reviews the Environmental Code application and EIA, manages public consultations, and assesses environmental impacts. The host municipality also formally reviews the proposal and decides on its consent.

- **Phase 4: Pronouncements and Government Decision on Permissibility (Tillåtlighet)**
  SSM and the Land and Environment Court submit their formal pronouncements and proposed conditions to the Government. Considering these inputs, the municipal decision, the EIA, and national interests, the Government decides on the project's overall Tillåtlighet (permissibility), potentially with overarching conditions.

- **Phase 5: Detailed Licensing, Construction, and Commissioning (Stepwise by SSM)**
  If permissibility is granted, the Land and Environment Court issues the formal environmental permit. The Government is expected to delegate further detailed licensing to SSM. The applicant then applies to SSM for a license to construct, followed by licenses for trial operation (commissioning) and finally routine operation. Each step requires detailed submissions and satisfactory safety reviews by SSM, which also conducts ongoing oversight during construction and commissioning.

- **Phase 6: Operation and Ongoing Oversight**
  Throughout the plant's operational life, SSM maintains continuous regulatory supervision, including regular inspections, audits, and periodic safety reviews (typically every 10 years). Significant modifications require SSM approval. This oversight extends until full decommissioning.

LICENSING SMALL MODULAR REACTORS (SMRS)

While the existing legal framework largely applies to SMRs, Sweden is actively adapting its regulations to accommodate these newer technologies. SSM's requirements are mainly performance-based. The Tidö Agreement (the coalition government platform) agreed upon by the Sweden Democrats, Moderates, Christian Democrats, and Liberals, supports SMRs and aims to streamline permitting. SSM have approved measures like removing reactor limits, allowing more siting flexibility, and introducing pre-licensing reviews for new SMR designs. International collaboration, particularly through the OECD NEA, is also pursued to harmonise SMR licensing. The government's goal is to facilitate nuclear expansion for energy and climate targets by making licensing more efficient while upholding strict safety standards.

2.2.2 CONSTRUCTION

The construction phase focuses on some of the most palpable elements of the new build process including planning and scheduling, site preparation, excavation, general construction and the installation of initial infrastructure, including basic utilities, roadways within the site, preliminary support systems and other necessary early-stage constructions. This will set the stage for the installation of reactor systems (primary circuit), turbine systems (secondary circuit), Balance of Plant (BoP), and switchyard components.

The construction phase involves the physical realisation and assembly of the nuclear power plant infrastructure including civil engineering, structural assembly, mechanical installations, and comprehensive site logistics.

Due to their smaller footprints, the scale of excavation and general construction for SMRs might be reduced compared to large-scale reactors. However, the types of activities remain the same. If multiple SMR units are planned for a single site (e.g. an "SMR park"), the overall construction effort could still be substantial. Modular construction of SMRs aims to shift more of the fabrication to factory settings, thereby diminishing the amount of on-site general construction work that may need to be completed.

PLANNING AND SCHEDULING

Effective planning and scheduling are critical for the successful construction of a nuclear power plant. This initial phase involves meticulously defining the sequence of all activities, considering the complex regulatory requirements and stringent safety protocols unique to nuclear projects. It includes allocating specialised resources and establishing realistic timescales that factor in rigorous quality assurance procedures and potential licensing milestones. These detailed schedules act as a vital roadmap, guiding the intricate construction process and enabling proactive management of potential hold-ups or challenges, such as the delivery of large, custom-fabricated components or the need for extensive non-destructive testing. Thorough planning ensures an efficient workflow and minimises disruptions across all subsequent stages, ultimately impacting the project's safety, cost, and timeline.

PREPARATION AND EXCAVATION

The second stage of the construction phase concentrate on site preparation. This includes clearing the land of any existing structures or vegetation, levelling the terrain to create a stable foundation, establishing access roads for heavy machinery and personnel, setting up temporary facilities like offices and storage areas, and implementing initial security measures. Thorough geotechnical investigations are also conducted at this stage to understand the soil conditions and ensure the ground can support the massive structures to come.

Following site preparation, the project moves into excavation. This is a significant undertaking, involving the large-scale removal of earth and rock to create the foundations for the reactor buildings, turbine hall, and other essential structures. Deep excavations are often required for the reactor containment and basements. This phase demands careful planning and execution, utilising heavy earth-moving equipment and ensuring the stability of the excavated areas. Proper management of excavated materials and adherence to environmental regulations are also critical aspects of this stage.

CONSTRUCTION

The subsequent phase encompasses general construction, which involves the physical realisation of the nuclear power plant infrastructure, excluding the specialised reactor and turbine systems. This includes extensive civil engineering work, such as pouring concrete for foundations and constructing the main buildings and auxiliary structures. It also involves structural assembly, erecting the steel frameworks and other load-bearing components.

INSTALLATION

Furthermore, general mechanical installations like basic piping and ventilation systems, as well as comprehensive site logistics for managing the flow of materials and personnel, fall under this category. This stage transforms the prepared and excavated site into the tangible buildings and structures of the future power plant.

BUILDING MATERIALS

The materials aspect of the nuclear value chain encompasses a range of critical components. This includes bulk construction materials such as cement, concrete and structural steel, which are essential for the civil works and foundational structures of nuclear power plants. In addition to this, specific alloys like zirconium alloys (essential for fuel cladding due to their low neutron absorption and corrosion resistance), high-grade steels (crucial for reactor pressure vessels and structural integrity), and specialised metals such as titanium and nickel alloys (used in various high-performance applications within the plant). The sourcing and quality control of these materials are paramount due to the stringent safety and operational requirements of nuclear facilities. Efficient management ensures their timely availability and adherence to rigorous industry standards.

2.2.3 PRIMARY CIRCUIT – NUCLEAR ISLAND

The primary circuit is the heart of the nuclear reactor system and is directly involved in the heat generation process.

The Primary Circuit typically includes the following:

REACTOR PRESSURE VESSEL (RPV)

This robust steel vessel forms the core of the nuclear island, housing the nuclear fuel and serving as the location where the controlled fission reaction generates immense heat. The structural integrity and reliability of the RPV are essential for safe reactor operation, as it serves as the primary barrier preventing the release of radioactive materials into the environment. Due to its pivotal role in reactor safety and functionality, the design, fabrication, and maintenance of the reactor pressure vessel are subject to stringent international standards and regulatory oversight.

REACTOR INTERNALS

Situated within the RPV, the reactor internals encompass the fuel assemblies containing fissile material, control rods that regulate the nuclear reaction, the moderator that slows down neutrons, and other structural components. This carefully engineered configuration facilitates a sustained and controlled chain reaction, producing the thermal energy that drives the power generation process.

STEAM GENERATORS

These crucial heat exchangers are used in PWRs and act as the interface between the primary and secondary circuits. They transfer the high-temperature, high-pressure heat from the primary coolant (circulating through the reactor core) to a separate secondary loop, producing the steam that will ultimately drive the turbines and generate electricity.

PRESSURIZER

In PWRs, the pressurizer maintains the required pressure within the primary coolant loop. By controlling the temperature of water and steam within this vessel, it prevents the primary coolant from boiling, even at the high operating temperatures necessary for efficient heat transfer.

REACTOR COOLANT PUMPS

These powerful pumps are responsible for circulating the primary coolant (typically water) through the reactor core and the steam generators. This continuous flow ensures efficient heat removal from the reactor and its transfer to the secondary circuit, maintaining stable operating temperatures.

CONTAINMENT STRUCTURE

This usually highly sizeable, reinforced concrete and steel structure encloses the reactor pressure vessel and other critical components of the primary circuit. Its primary function is to provide a robust barrier, preventing the release of radioactive materials into the environment in the event of a severe accident within the nuclear island.

FUEL SUPPLY SYSTEM

This system encompasses all the operations involved in the handling, storage, and loading of nuclear fuel into the reactor core. It includes the delivery of fresh fuel assemblies, their secure on-site storage, and the carefully orchestrated process of inserting them into the reactor according to a specific arrangement optimised for efficient and safe nuclear reaction.

This is a highly specialised and critical stage. This involves carefully positioning and assembling the core components of the nuclear reactor, including the reactor vessel, steam generators, pressuriser, and the complex network of high-pressure piping that circulates in the primary coolant. This work demands precision engineering, strict adherence to quality control and safety protocols, and often involves specialised heavy lifting equipment and highly skilled personnel.

PRIMARY CIRCUIT FOR SMRS

SMR designs often emphasise simplification and compactness. The primary circuit components might be smaller, more integrated, or utilise different technologies (e.g. some SMRs might use natural circulation instead of large pumps) compared to LSRs. The modular nature of some SMRs could mean that larger pre-assembled modules containing primary circuit components are installed, potentially streamlining the on-site assembly process.

2.2.4 SECONDARY CIRCUIT – TURBINE ISLAND

The secondary circuit can also be split into four distinct sub-categories. Here, the secondary circuit takes the heat generated in the primary circuit (or directly from the reactor core in some designs like Boiling Water Reactors - BWRs) and converts it into mechanical energy to drive the turbine.

It typically includes:

STEAM TURBINES

These large, multi-stage turbines convert the thermal energy of the high-pressure steam generated in the primary circuit into mechanical rotational energy. As steam expands through the turbine blades, it causes the rotor to spin, which in turn drives the electrical generator. The rotor of the turbine is directly connected to the generator, which converts the mechanical energy into electrical energy through electromagnetic induction. This is the final step in transforming nuclear heat into usable electricity for the grid.

CONDENSERS

Located downstream of the steam turbines, the condenser cools and condenses the exhaust steam back into water (feedwater). This phase change creates a vacuum at the turbine outlet, significantly increasing the efficiency of the steam cycle. The heat removed is typically transferred to cooling water.

MOISTURE SEPARATOR REHEATERS

Often found in larger nuclear power plants, these components are positioned between the high-pressure and low-pressure stages of the steam turbine. They remove moisture that forms as the steam expands and cools and then reheat the steam to improve turbine efficiency and prevent damage to the low-pressure turbine blades.

FEEDWATER SYSTEM

This system is responsible for taking the condensed water (feedwater) from the condenser and pumping it back to the steam generators in the primary circuit. The feedwater is often preheated using heat recovered from various stages of the turbine cycle to enhance the overall thermal efficiency of the plant.

INSTRUMENTATION AND CONTROL (I&C)

Sensors and control systems that monitor and regulate the operation of the turbines, generators, and associated systems. These systems ensure optimal performance of the turbines, condenser, and feedwater system, responding to changes in power demand and maintaining stable and efficient energy conversion.

2.2.5 BALANCE OF PLANT (BOP)

Beyond the primary and secondary circuits, a nuclear power plant relies on a range of essential systems known collectively as the Balance of Plant (BoP). These systems support the core power generation processes and ensure the plant's safe and efficient operation.

Key BoP components include:

CONDENSER

The condenser is a crucial heat exchanger in the secondary circuit. After steam drives the turbine, it must be cooled and condensed back into water to be pumped back to the steam generators, completing the cycle. This condensation process typically involves circulating a large volume of cooling water through tubes within the condenser. The heat from the exhaust steam is transferred to this cooling water, which is then either discharged (in a once-through cooling system) or sent to cooling towers or other heat exchangers for heat dissipation. The efficiency of the condenser directly impacts the overall efficiency of the power plant.

COOLING TOWERS/HEAT EXCHANGERS

Cooling towers or other heat exchangers are vital for dissipating the waste heat from the condenser cooling water. In systems with cooling towers, the warm water from the condenser is sprayed downwards, and evaporation cools the remaining water, which is then recirculated. Different types of cooling towers exist, including natural draft and mechanical draft designs. Alternatively, other types of heat exchangers, such as air-cooled condensers or surface condensers using a large body of water, may be employed to reject heat to the environment. The choice of cooling technology depends on factors like environmental regulations, water availability, and site conditions.

PUMPS

Pumps are essential throughout the Balance of Plant for the reliable and continuous movement of various fluids. Large pumps are required to circulate the cooling water through the condenser and to pump the condensed water back to the steam generators (feedwater pumps). Numerous other pumps are used for auxiliary cooling systems, service water systems, and various other plant processes, ensuring the correct flow rates and pressures are maintained for efficient and safe operation.

HVAC SYSTEMS

HVAC (Heating, Ventilation, and Air Conditioning) systems are critical for maintaining controlled environments within various buildings and areas of the nuclear power plant. These systems ensure the comfort and safety of personnel, protect sensitive equipment from temperature and humidity extremes, and play a vital role in preventing the spread of airborne contamination in radiologically controlled areas. Nuclear-grade HVAC systems often incorporate high-efficiency particulate air (HEPA) filters and pressure control mechanisms to maintain air quality and prevent the release of radioactive particles.

INSTRUMENTATION AND CONTROL

Instrumentation and Control (I&C) systems form the "nervous system" of the Balance of Plant, providing the sensors, controllers, and interfaces necessary to monitor and regulate the operation of all these auxiliary systems. This includes a wide array of instruments measuring parameters such as temperature, pressure, flow rate, and fluid levels. Sophisticated control systems, often computer-based, automatically adjust valves, pumps, and other equipment to maintain desired operating conditions and respond to changing plant demands. Reliable and accurate I&C systems are crucial for the safe, stable, and efficient performance of the BoP.

2.2.6 SWITCHYARD

This stage marks the crucial connection point between the power plant and the electrical grid. It involves the installation of key equipment that enables the safe and efficient transfer of generated electricity to the transmission network.

TRANSFORMERS

Transformers play a vital role in the switchyard by stepping up the voltage of the electricity generated by the plant to the high voltage levels required for efficient long-distance transmission across the grid. These are typically large, high-capacity transformers designed to handle the significant power output of a nuclear power plant. They ensure that the electricity can be transmitted with minimal energy loss over long distances to reach consumers.

SWITCHGEAR

Switchgear encompasses a range of electrical devices, including high-voltage circuit breakers, disconnectors (isolators), and current transformers. These components are essential for controlling, protecting, and isolating various sections of the electrical system within the switchyard and the connection to the grid. Circuit breakers are critical for interrupting fault currents and protecting equipment from damage, while disconnectors provide a visible isolation point for maintenance. Control systems associated with the switchgear allow for the safe and reliable management of power flow to the grid.

TRANSMISSION LINES

Transmission lines are the high-voltage power lines that carry the electricity stepped up by the transformers from the switchyard to the wider electrical grid. These lines are typically supported by large pylons or towers and are designed to transmit large amounts of power efficiently over significant distances. The design and construction of these lines adhere to stringent engineering and safety standards to ensure reliable delivery of electricity to the distribution network and ultimately to end-users.

2.3 KEY GLOBAL PLAYERS

Understanding the landscape of global technology suppliers is crucial for assessing the potential for new build projects within the civil nuclear space. This section examines the primary international companies involved in supplying core reactor technologies and critical components. It seeks to outline which essential parts of the reactor value chain are not currently produced within the Nordics and therefore necessitate imports and identifies the dominant global entities in these areas.

This section focuses on Tier 0 OEMs (original equipment manufacturers) that are the highest level of the supply chain for nuclear power plants. These are typically large, multinational engineering and technology corporations with the expertise and resources to design, engineer, and supply major companies and projects.
The OEMs are the system integrators – the large, multinational engineering and technology corporations that possess the comprehensive expertise and substantial resources to:

- **Design the entire nuclear power plant** including the core reactor technology, safety systems, and integration with other plant components.
- **Engineer the complex systems** including handling of detailed engineering specifications, ensuring all components work together safely and efficiently.
- **Supply the major, integrated components and systems.** While they may not manufacture every single nut and bolt, Tier 0 OEMs are responsible for providing the most critical and technologically advanced parts of the plant, often managing a network of Tier 1 and Tier 2 (as defined in Section 3.2) suppliers.
- **Manage the overall project** and taking on significant responsibility for the project's execution, including overseeing construction and ensuring quality standards are met.

EXAMPLES OF INTERNATIONAL OEMS AND TECHNOLOGIES

International nuclear technology development is spearheaded by a diverse range of Original Equipment Manufacturers (OEMs), offering a spectrum of nuclear technologies. Together, these OEMs highlight the global distribution of expertise shaping the future of nuclear power:

WESTINGHOUSE (USA)

A Tier 0 OEM offering its AP1000 technology (a complete plant design) and supplying critical components like reactor vessels. They provide an end-to-end solution for large-scale nuclear power plants.

EDF (FRANCE)

As a major utility and technology holder of EPR technology, EDF acts as a Tier 0 OEM, designing and often leading the development of large nuclear power plants. They also have the capability to supply major components like reactor vessels.

ROLLS-ROYCE (UK)

While traditionally known for nuclear propulsion, Rolls-Royce is now positioning itself as a Tier 0 OEM for Small Modular Reactors (SMRs), offering a complete "reactor island solution." This encompasses the design, engineering, and supply of the core nuclear part of an SMR power plant.

ROSATOM (RUSSIA)

A state-owned nuclear energy corporation with a full spectrum of capabilities, acting as a Tier 0 OEM. They design, build, operate, and even fuel nuclear power plants, offering comprehensive "reactor island manufacturing" and overall plant solutions.

DOOSAN ENERBILITY (SOUTH KOREA)

While specializing in the critical manufacturing of reactor vessels and primary circuit components, Doosan often acts as a key Tier 1 supplier to Tier 0 OEMs like Westinghouse, EDF, and KHNP. However, their manufacturing expertise is essential and places them as a crucial player within the core reactor value chain.

GE HITACHI (USA/JAPAN)

Similar to Westinghouse and EDF, GE Hitachi is a Tier 0 OEM offering its BWRX-300 SMR technology as a complete reactor system. They leverage their history in large BWRs to provide a comprehensive SMR solution.

CHINA NATIONAL NUCLEAR CORPORATION (CNNC)

A major state-owned Tier 0 OEM in China, responsible for developing and deploying China's indigenous nuclear reactor technologies and building nuclear power plants both domestically and internationally.

3. INTRODUCTION TO THE GAP ANALYSIS

The successful deployment of new nuclear power in Sweden depends on a complex interplay of technical, institutional, and societal factors. Several key prerequisites shape the feasibility and execution of nuclear new builds, ranging from the readiness of private and public actors to broader market conditions and regulatory frameworks.

These include:

- Private actors and resources (including tech, human capital and workforce readiness
- Public actors and resources
- Supply chain readiness and localisation potential
- Political consensus
- Market and system conditions
- Legislation, local and international
- Financing and investment environment
- Public acceptance

This gap analysis focuses primarily on the first three areas: **private actors and resources (including technology, human capital, and workforce readiness), public actors, and supply chain readiness and localisation potential**. The remaining factors are considered indirectly and are not covered in full depth. The ambition is to provide an in-depth assessment of the first three areas for Sweden and the Nordic region, while also identifying critical international dependencies that may emerge through observed capability gaps.

3.1 TIER STRUCTURE

In the nuclear value chain, a tiered structure is used to clarify who fulfils each role, and how critical their role is. Some actors lead the project and provide the actual reactor technology. Others contribute key systems, engineering, or construction expertise. And some support with components or services that, while not nuclear-specific, are still essential. This breakdown helps understand where Swedish capabilities are strong, and where there are dependencies.

TIER 0: OWNERS, OPERATORS AND OEMS (CORE TECHNOLOGY AND PROJECT OWNERSHIP)

Key actors:

- Nuclear utilities and plant owners (Tier 0 – Utilities)
- Reactor OEMs – companies that design, license, and deliver the nuclear island (Tier 0 – OEMS)

What they do:

- Drive the overall project concept and reactor technology selection
- Take legal and regulatory responsibility for nuclear safety
- Tier 0 owns the business case and puts up equity
- Provide core systems design (Reactor Pressure Vessel, internals, primary loop, fuel, etc.)
- Often lead EPC or EPCM work in turnkey models

Examples of Tier 0s:

- EDF, GE Hitachi, Westinghouse, Vattenfall (owner/operator)

TIER 2: SUPPORTING VENDORS

Key actors:

- Often companies often without a nuclear legacy but with transferable capabilities from adjacent sectors (oil & gas, infrastructure, renewables)
- Include subcontractors, electrical installers, material suppliers, and industrial service providers

What they do:

- Support with standard components, industrial construction, instrumentation, or fabrication
- Typically work under Tier 1 companies in a subcontracting or delivery role
- May evolve into Tier 1 players over time with sufficient nuclear project exposure and qualification

Examples of Tier 2s:

- Elajo (electrical installation), Amokabel (cables), Roxtec (sealing systems), Tensor AB (fasteners)

TIER 1: ENGINEERING, SYSTEM INTEGRATION, AND KEY COMPONENT SUPPLIERS

Key actors:

- EPC(M) firms, advanced engineering consultants
- Specialised system providers
- Experienced construction firms and component manufacturers

What they do:

- Deliver detailed engineering, licensing support, civil works, and integration
- Provide major subsystems, such as turbine islands, I&C systems, HVAC, and safety systems
- Coordinate with Tier 0 OEMs to adapt core designs to local site and regulatory conditions

Examples of Tier 1s:

- AFRY (system integration), ABB (I&C), Studsvik (fuel analytics), Bouygues (civil works), Danfoss (HVAC controls)

For the gap analysis, the focus will be on Tier 0 and Tier 1 suppliers, aiming for an exhaustive identification within Sweden. This will also involve identifying gaps and relevant international Tier 0 and Tier 1 suppliers that could support nuclear new build in Sweden. Only those Tier 2 suppliers in Sweden deemed critical for the value chain will be covered, meaning the list of Tier 2s will not be exhaustive.

3.2 MODELS FOR NUCLEAR NEW BUILD

There are two major models that are important to consider, depending on which type of nuclear new build project to be undertaken, and which technology that is selected. Although ownership and responsibility sit in Tier 0, the exact lead role can follow two main archetypes, turnkey or utility led. These are not rigid boxes but points on a spectrum; in every case the utility remains the contracting client even if an OEM drives day-to-day execution and operations.

OPTION 1: TIER 0 OEM LEADS THE PROJECT OPERATIONS – TURNKEY OR CONSORTIUM MODEL

(COMMON FOR FIRST-IN-A-KIND OR FIRST-IN-A-WHILE BUILD)

In this model, the Tier 0 OEM (Original Equipment Manufacturer) which owns and supplies the nuclear reactor technology acts as the lead developer of the entire nuclear project. The OEM typically assumes responsibility not only for the nuclear systems but also for managing the overall project delivery.

Typical use cases:
This approach is commonly used for first-of-a-kind or "first-in-a-while" builds, especially in countries without recent nuclear construction experience or where the utility lacks in-house capacity to manage large-scale nuclear projects.

Examples:
- EDF/Framatome at Flamanville (France) and Hinkley Point C (UK)
- KHNP at Barakah (United Arab Emirates)
- Areva-Siemens at Olkiluoto 3 (Finland)

Key responsibilities of the OEM:
- Engineering and design of the reactor and nuclear systems
- Full project and interface management across all contractors
- EPCM, either directly or through a consortium
- Subcontracting of civil works, balance-of-plant systems, and other supporting infrastructure

This model simplifies execution for the Utility, as the OEM carries most of the technical and delivery risk. However, it may reduce the Utility's influence over design, supplier selection, and localisation. The extent of local industry involvement is largely dependent on the OEM's global supply chain strategy and willingness to engage local partners.

OPTION 2: UTILITY LEADS WITH INDEPENDENT EPCM AND LICENSES OEM-TECHNOLOGY

(MORE COMMON IN MATURE NUCLEAR MARKETS)

In this approach, the Utility or project sponsor takes on a central role in project delivery. It contracts an independent EPCM (Engineering, Procurement and Construction Management) firm to oversee the engineering and delivery of the plant, while sourcing the core reactor technology from a Tier 0 OEM under a licensing or supply agreement.

Typical use cases:
This model is more common in countries with existing nuclear experience, capable utilities, and robust project management capacity. It allows for greater strategic control and flexibility.

Examples:
- Bruce Power in Canada, which uses independent EPCM firms for large refurbishments
- Future projects like Sizewell C (UK), where more local management may be layered onto an EDF technology base

Key responsibilities of the Utility:
- Selects and manages the EPCM firm
- Licenses reactor technology from OEMs (e.g. Framatome, Westinghouse, GE Hitachi)
- Oversees integration, localisation, and risk management throughout the project lifecycle

This model requires more internal capability from the utility but enables greater influence over supplier selection, localisation strategy, and project phasing. The OEM plays a more limited role, focused on delivering the nuclear island and supporting licensing.

3.3 NUCLEAR NEW BUILD IN SWEDEN, AN ASSESSMENT OF MOST LIKELY OPTION

Sweden's last nuclear reactor, Forsmark 3, began commercial operation in August 1985. Given that no new reactors have been built since then, the country lacks recent experience in nuclear power plant construction. Therefore, any forthcoming nuclear projects should be regarded as "first-in-a-while". In such projects, the tier 0 OEM, the primary technology provider, typically assumes a leading role. One of the crucial aspects is not only having in-depth nuclear knowledge but also understanding how projects are tied together throughout various stages and processes, including supervision and integration.

Such an actor would be part of a wider ecosystem that enables it to integrate experienced international firms with national suppliers for civil delivery. It is therefore important for a global EPC integrator to specify and procure all systems. The extent of involvement from local Swedish or Nordic companies will largely depend on the localisation requirements set by the utility companies commissioning the reactors. These requirements can vary significantly, ranging from minimal local participation to substantial engagement across various phases, including design, engineering, component manufacturing, and construction. One large Tier 0 OEM pointed to their capability to design their systems "to integrate well". Moreover, they pointed out the importance of community support through transparent communication, while engagement with European peers ensure alignment on shared technology and regulatory practices.

Therefore, early and proactive engagement with potential OEMs and Engineering, Procurement, and Construction (EPC) partners is crucial to maximize opportunities for domestic industry involvement in Sweden's nuclear energy expansion.

STRATEGIC IMPLICATIONS: IMPORTANCE OF EARLY ENGAGEMENT WITH OEMS AND EPCS

- If Swedish utilities proceed with Option 1, the selected OEM and global EPC partner will play a central role in shaping the project, not only in terms of design and delivery, but also in identifying and contracting suppliers throughout the value chain

- In practice, this means that these international partners will have significant influence over which companies are brought into the project, including in areas such as component supply, civil works, engineering services, and systems integration

- For Sweden, and to some extent the broader Nordic region, this represents both a challenge and an opportunity. If the strategic goal is to maximize Swedish (and Nordic) industrial participation in future nuclear projects, it is essential to engage early and proactively with the shortlisted OEMs and EPCs.

3.4 CAPACITY CONSTRAINTS

It has been highlighted by several interviewees that the significant global pipeline of nuclear new build projects may lead to capacity constraints among the few Tier 0 OEMs capable of delivering full-scale nuclear reactor solutions. These constraints could potentially create bottlenecks, especially as multiple countries compete for the same limited pool of proven vendors and expertise.

As a result, Tier 0 OEMs may actively seek broad-based local support, particularly in areas outside the core nuclear scope, such as civil construction, infrastructure and conventional systems. The extent of this local engagement will depend on both the technical selection and the selected reactor as well as the strategic approach of the OEM, including how integrated or modular their solution is. For example the level of modularity in a SMR reactor is higher. A large Nordic trade association within the civil nuclear space noted the cruciality of integrating Nordic firms under structured EPC models to ensure meaningful contribution to Swedish or broader Nordic nuclear projects. Moreover, a prominent developer of small modular reactors has emphasised that the inherent modularity of SMRs facilitates seamless integration by enabling a highly standardised and incremental approach to project development.

Interviewees also emphasised that, aside from the nuclear-specific, namely, the primary circuit and reactor core, the remainder of a nuclear power plant closely resembles a large-scale industrial energy infrastructure project. In essence, the key differentiator is the source of energy generation (i.e. nuclear fission), but most of the supporting systems, construction processes, and project management structures are comparable to those found in conventional power generation or process industry facilities.

Indeed, one large construction firm pointed to Sweden's skills in these areas. This was validated through the performed interviews where a large Swedish engineering company highlighted the need for "soft infrastructure" meaning a repeatable knowledge base, centralised documentation platforms and experienced oversight teams. Several companies interviewed illustrate their strong civil engineering and infrastructure credentials. These extend beyond technical skills but also toward the existence of high-quality stakeholder engagement processes, particularly among municipalities, site operators and project planners.

3.5 PROGRAMMATIC/ SERIAL APPROACH VS ONE-OFF PROJECT

If Sweden adopts a programmatic approach to nuclear energy expansion, constructing a series of reactors rather than a single standalone unit, it will have significant implications for local supplier integration, cost efficiency, and industrial planning. This is because it provides essential long-term visibility to market players, which is especially important considering the current global vendor capacity situation. Failing to clearly signpost long-term plans could result in vendors prioritizing other countries with more predictable and substantial pipelines.

A multi-reactor program creates stronger justification for local supplier development and greater incentives for both OEMs and EPCs to invest in local supplier relationships and build long-term capabilities within Sweden or the Nordic region.

This is because:

- Economies of repetition make it worthwhile to qualify and train local firms once, then engage them across multiple projects
- The risk-reward balance shifts: local companies are more willing to invest in certifications, tooling, and knowledge if future business volumes are more predictable
- A repeatable pipeline enables local suppliers to scale up gradually, reducing the risk of overextension and enabling productivity improvements

The principle of economies of repetition extends powerfully to the strategic development of a highly skilled local workforce. This involves adopting a staggered approach to talent cultivation, where skills are built incrementally and continuously over time. Effective signposting, clearly mapping out career pathways and training opportunities, is crucial to attract and guide new talent into the industry, maximising the efficiency of initial recruitment and foundational training efforts. By consistently investing in and repeatedly engaging with local human capital through structured programmes (much like Dutch initiatives to boost the Netherlands' nuclear workforce or platforms such as Destination Nuclear), organisations can leverage these economies to not only qualify individuals for specific roles but also to scale up local competence in a broader, more sustainable sense, ensuring a robust and adaptable workforce for successive projects.

Serial construction of the same or similar reactor designs can significantly reduce overall project costs. Key cost-reduction mechanisms include:

- Standardized designs that reduce engineering time and procurement complexity
- Learning curve effects, where both OEMs and local suppliers become more efficient with each subsequent build
- Reuse of supply chain infrastructure, such as logistics hubs, qualified subcontractors, and digital tools for construction planning
- Improved project governance, with lessons learned from early reactors applied to later ones

Empirical evidence from countries such United Arab Emirates shows that the unit cost of nuclear power can drop significantly, by up to 40% (4th reactor vs 1st), when reactors are built in series using a consistent model and delivery approach.

A serial approach would allow Sweden to anchor a more sustainable domestic nuclear supply chain, rather than relying entirely on international subcontracting. It could also create export opportunities for Swedish suppliers who develop competitive expertise during the national build-out. The following sections will cover the value chain in detail, with each sub-part addressed in its own chapter. Swedish and Nordic capabilities will be examined.

3.6 METHODOLOGY FOR GAP ANALYSIS

When conducting the gap analysis, Business Sweden has utilised a ranking system to identify and evaluate strengths and weaknesses within the Swedish nuclear value chain.

- Based on the conducted mapping, Business Sweden has ranked both the main components as well as the individual sub-components to understand the strengths and weaknesses of the Swedish nuclear value chain
- The evaluation is based on the primary focus of the study, i.e. the Swedish capabilities in this sector, but also includes a high level assessment of the Nordic capabilities and the international dependencies. The Nordic capabilities also include Swedish capabilities, thus this aspect is aiming to understand what Sweden and our partners in our neighboring countries could deliver jointly. The international dependencies evaluation works as a residual, i.e. if Sweden and/or the Nordics come out low/weak in a certain component, the dependency will be high or very high, and vice versa
- Below is a description of the conducted ranking alternatives, intended to function as a reader's guide for the following pages

Swedish capabilities		Nordic capabilities (incl.Sweden)		International dependencies (vs Sweden & Nordics)	
Ranking	**Description**	**Ranking**	**Description**	**Ranking**	**Description**
Absent	No domestic capability. Fully dependent on international OEMs. No Tier 1 or 2 active	Absent	No relevant Nordic capability or participation	Absent	Sweden including Nordics are fully dependent on international actors (Tier 0 OEMs, EPCs, IP holders); delivery impossible without them
Limited	Limited local actors, minor roles only. Needs international leadership and tech integration	Limited	Nordic actors exist but only offer marginal value or more of indirect relevance	Limited	Sweden including Nordics lacks key capabilities and would not manage alone without international partnerships
Moderate	Partial local capability. Tier 1/2 active but need Tier 0 OEMs. Dependent on partnerships	Moderate	Nordic partners offer useful support, e.g., past project experience or complementary skills	Moderate	International support useful for acceleration or risk-sharing, but Sweden including Nordics could still deliver on its own
Strong	Strong local Tier 1 capability. Can lead within Sweden/Nordic with limited OEM dependency	Strong	Nordic firms can meaningfully strengthen Sweden's delivery capability	Strong	Minor international input helpful, but not critical
Very Strong	Full domestic capability. Can design, integrate, and deliver independently at scale	Very Strong	Nordic firms have leading capabilities and could co-deliver with Sweden or independently	Very Strong	No international dependency – Sweden (and/or Nordics) fully self-sufficient

Figure 7. Description of ranking alternatives (Swedish, Nordic and International Capabilities)

4. GAP ANALYSIS AND SUPPLIER MAPPING

Sweden possesses robust competencies in construction, balance of plant (BOP), and switchyard infrastructure, supported by major companies like ABB, Alfa Laval, Atlas Copco and Hitachi Energy. However, significant gaps remain, particularly in development, design and nuclear island, necessitating substantial reliance on international Tier 0 OEMs for reactor vessel manufacturing and primary nuclear technology.

International collaboration remains crucial, particularly for highly specialised nuclear island components and advanced technology. Tier 0 international suppliers such as Westinghouse, EDF, Rolls-Royce, GE Hitachi could be vital partners, providing proprietary reactor designs and critical nuclear-specific technology. This calls for strategic decisions on international partnerships, capability building, and investment in domestic supply chains, especially if Sweden aims to scale nuclear new builds.

	DEVELOPMENT	CONSTRUCTION	PRIMARY CIRCUIT *Nuclear Island*	SECONDARY CIRCUIT *Turbine Island*	BALANCE OF PLANT	SWITCHYARD *Grid connection*
	~10% of costs*	~40% of costs	~15% of costs	~15% of costs	~15% of costs	~5% of costs
Swedish capabilities	Moderate capabilities	Moderate capabilities	Limited capabilities	Limited capabilities	Moderate capabilities	Strong capabilities
Nordic offering (incl. Sweden)	Moderate capabilities	Strong capabilities	Limited capabilities	Moderate capabilities	Strong capabilities	Very strong capabilities
International dependency	High dependency (reactor core design)	Moderate capabilities (management experience for nuclear projects)	Full dependency	High dependency (turbine)	Moderate capabilities (nuclear graded products)	Low dependency

Figure 8. Assessment of the capabilities of Swedish, Nordic and International Actors across the civil nuclear value chain
*These figures are indicative estimates based on international benchmarks and conducted interviews of typical nuclear new build projects; actual cost distribution can vary significantly depending on reactor type, delivery model, local capabilities, regulatory environment, and site-specific conditions.

The picture below presents selection of the key-players in the Swedish ecosystem relevant to nuclear new builds, spanning the entire project lifecycle from early development through to grid connection. It highlights a wide range of domestic and regional actors with varying degrees of nuclear relevance and readiness. An identification of a total of 173 Swedish companies that could take part in a new nuclear new build project was made during the study. But in this chapter, a selection of the most eligible and relevant are presented.

Overall, the mapping reveals a Swedish ecosystem that is well-positioned to support non-nuclear components of a new build but still exhibits critical capability gaps in nuclear-specific systems, particularly in reactor design, primary circuit manufacturing, and certified installation. These gaps define the contours of Sweden's international dependencies and indicate where targeted investment or strategic partnerships will be required to close them.

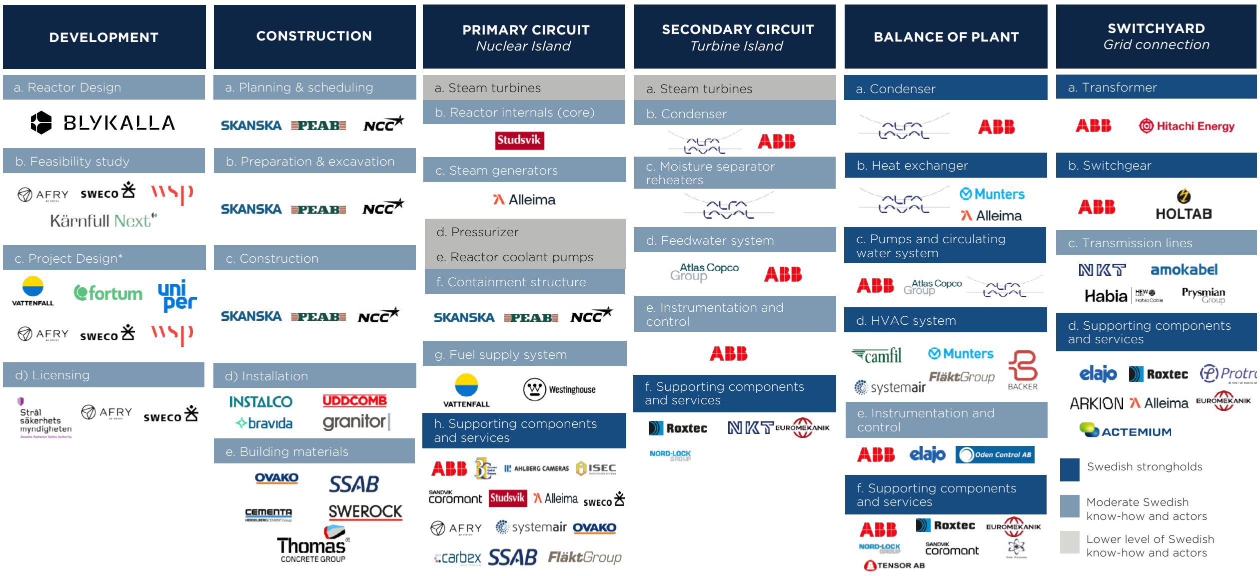


Figure 9. Mapping of the Swedish civil nuclear value chain

4.1 DEVELOPMENT

Sweden has strong operational experience and capable firms for feasibility and licensing (e.g., AFRY, Sweco, Studsvik, WSP), but lacks the core capabilities to design and deliver a new nuclear reactor on its own. No domestic entity holds the intellectual property or has the recent large-scale new build execution experience required to lead a project in its entirety. As Sweden hasn't built a new reactor since the 1980s any upcoming project would be categorized as "first-in-a-while."

This requires Swedish industry to:

- Partner internationally for core reactor design and technology (e.g., EDF, GE Hitachi, Westinghouse).
- Leverage Nordic strengths, particularly Finnish (Fortum, TVO) and Norwegian (DNV) partners, to complement gaps in project execution, licensing strategies, and system integration.

Swedish companies can lead parts of a nuclear new build, but only through strategic partnerships with international OEMs and Nordic collaborators can it close the design and delivery gap, de-risk execution, and meet modern regulatory standards.

DEVELOPMENT			-10% of costs
	SWEDISH CAPABILITIES	NORDIC CAPABILITIES	INTERNATIONAL DEPENDENCIES
Total	Limited	Moderate	High
Feasibility Study	Strong	Strong	Low
Reactor Design	Limited	Limited	Very high
Project Design	Moderate	Moderate	High
Licensing	Moderate	Strong	Low

Figure 10. Illustration of Sweden's capabilities within the development segment of the civil nuclear value chain

4.1.1 LIST OF KEY COMPANIES

SWEDEN

Project Design
Vattenfall: Project leadership and operations
Uniper (Sweden): Operations and maintenance
Blykalla: SMR reactor design
Sweco: Engineering
WSP Sweden: Engineering
AFRY Sweden: Engineering

Feasibility study and licensing
Kärnfull Next: SMR project developer (feasibility study)
Sweco: Feasibility study, civil and environmental design, grid and infrastructure studies
WSP Sweden: Feasibility study, licensing support, safety cases, and site infrastructure
AFRY Sweden: Feasibility study, system engineering, integration, and regulatory
Studsvik: Nuclear analytics, fuel modelling
SKB: Licensing and waste strategy input
KSU (Nuclear Training and Safety Centre): Competence assurance support
SSM (Swedish Radiation Authority): Licensing and regulatory review

NORDIC REGION

Finland
Fortum: Licensing, feasibility studies, full nuclear operations
TVO: Owner and project manager of OL3 (EPR), with deep design management experience
AFRY Finland: System engineering, integration, and regulatory documentation
Valmet: Automation and early control system integration

Norway
Norsk Kjernekraft (Norway): SMR feasibility and concept development
DNV: Technical assurance, licensing support

INTERNATIONAL (FOCUSED ON REACTOR AND PROJECT DESIGN):

EDF/Framatome (France): EPR reactor technology
Westinghouse (USA): AP1000 reactor technology
China General Nuclear / CNNC (China): Hualong One and ACPR series
Mitsubishi / Hitachi (Japan): APWR and ABWR variants
KEPCO/KHNP/Doosan Enerbility (Korea): APR-1400 and core systems
Rosatom (Russia): VVER and turnkey design package
Candu Energy (Canada): PHWR and detailed conceptual design
Rolls-Royce SMR (UK): SMR conceptual design and delivery
GE Hitachi (USA/Japan): BWRX-300 reactor technology (SMR)
NuScale / Holtec / TerraPower / X-energy (US): Advanced and SMR design startups

4.1.2 SWEDISH CAPABILITIES

Sweden hosts multiple Tier 0 utilities and nuclear actors, such as Vattenfall, Fortum (FI), and Uniper, which operate the country's six existing nuclear reactors across the Forsmark, Ringhals, and Oskarshamn plants. For alternative technological pathways, such as lead-cooled reactors, the domestic company Blykalla offers strong expertise in reactor design. However, from a full project lifecycle perspective, they remain dependent on international partnerships. It can be classified as a "first-in-a-while project".

While Swedish Tier 0 utility entities currently operate plants and have experienced project leadership no new plant has been built in Sweden since the early 80's (Forsmark Unit 3). New built experience including detailed reactor core design, primary nuclear technology development, and certain critical system integrations necessitates collaboration with specialised international reactor Tier 0 OEMs and partners that are up to date with current technology.

Sweden has a foundation of actors across feasibility and licensing activities for nuclear new builds. However, while key players exist, the country shows clear gaps in end-to-end reactor technology ownership and recent large-scale construction execution. Sweden's industrial and regulatory experience remains strong, but achieving a complete nuclear new build will require international partnerships. Especially in the design phase, where the technology is selected, and core reactor knowledge is crucial. These limited capabilities in the design phase are reflected by one Tier 0 interviewee who pointed to vendors possessing knowledge and intellectual property concerning reactor design. Aside from Blykalla Swedish entities with deep expertise in this phase appears somewhat limited.

In the Project Design phase of a nuclear new build, Swedish engineering firms like Sweco, WSP Sweden, and AFRY play a critical role in turning the selected reactor technology into a fully integrated, site specific, and licensable plant design. Sweco contributes extensive expertise in civil, structural, and environmental engineering, supporting site layout, permitting, and Balance of Plant (BoP) system integration. WSP brings deep competence in structural design, infrastructure development, and safety classified civil works, helping ensure that plant components meet both regulatory and environmental standards. AFRY, with decades of nuclear experience, acts as a key partner in system integration, detailed engineering, instrumentation and control (I&C), and grid interface design.

Sweden thus possesses substantial expertise and a robust engineering ecosystem through established companies focused on project integration and multidisciplinary coordination but would in this case complement a Tier 0 OEM in certain parts of the design and EPCM duties. Studsvik offers critical capabilities in nuclear analytics, thermal hydraulics, and fuel behaviour simulations.

Numerous interviewees point toward the importance of creating a robust delivery model that can bring together Swedish capabilities. One Tier 0 OEM posited that it is crucial for Swedish suppliers to "engage early and meet strict qualification standards" adding that "risk-averse clients will not accept unproven vendors". Moreover, a Swedish trade body pointed to the establishment of a robust process from the onset of a new project noting that "if the project pipeline isn't real, training won't happen". This is complemented by another interviewee who stated that "what we (Sweden) lack is a program structure that allows us to learn and retain knowledge".

Swedish industry has capabilities in:

- Feasibility study for site and environment
- Licensing preparation and regulatory compliance
- Fuel performance analytics and safety modelling
- Engineering and project design capabilities

Swedish industry lacks/has limited capabilities in:

- Domestic reactor design, apart from Blykalla
- Recent experience executing a nuclear new build under modern regulatory standards, new project will be a "first-in-a-while" scenario for Sweden

Swedish firms can successfully lead feasibility studies, licensing work, project design, but must partner with an international Tier 0 OEM to deliver the core technology and execution management for a new nuclear plant.

4.1.3 NORDIC CAPABILITIES

The broader Nordic region provides valuable complementary capabilities that strengthen Sweden's nuclear design expertise. Fortum (Finland) maintains strong nuclear engineering and operational capabilities, having substantial experience in nuclear plant operations, lifecycle management, and plant upgrades. AFRY enhances regional integration and interface management capacity. Norwegian expertise, notably from DNV, provides essential third-party assurance, risk management, and compliance verification services critical in the rigorous regulatory environment of nuclear new builds.

While Sweden has strong capabilities in feasibility studies, licensing support, and system integration, it lacks certain competencies critical for a full-scale nuclear new build, particularly in nuclear project execution and system-level design management. Nordic partners from Finland and Norway offer highly relevant complementary expertise.

Companies like Fortum and TVO bring recent, direct experience in operating, licensing, and even constructing large-scale nuclear reactors (e.g., Olkiluoto 3). Engineering consultancies like AFRY Finland and Valmet provide further depth in system integration and control systems, while organizations like DNV and Norsk Kjernekraft contribute technical assurance and early SMR project development skills.

These Nordic players could strengthen Swedish led nuclear projects by:

- Sharing best practices from recent new builds
- Offering licensing pathway strategies
- Assisting with integration of OEM technologies
- Supporting system engineering, automation, and risk assurance

4.1.4 INTERNATIONAL DEPENDENCIES

Given the complexity associated with advanced large scale reactor technologies, including Small Modular Reactors (SMRs), Sweden inherently relies on international expertise. Primary reactor OEMs such as EDF, Westinghouse, Rolls-Royce, and GE Hitachi are critical partners, providing proprietary reactor technology, core system designs, and specialised integration knowledge. Specifically, reactor design, core physics optimisation, advanced digital control systems, and certain critical safety system elements typically originate from these Tier 0 international suppliers.

The international players bring:

- Proven, up-to-date reactor designs or advanced SMR concepts
- Experience with international regulatory frameworks (e.g., UK ONR, US NRC and ASN France)
- Established supply chains for critical primary circuit components
- Firsthand experience with complex EPCM projects globally and project management expertise that covers the full new build scope

Forming the right partnerships with these OEMs is essential to align Sweden's infrastructure capabilities with technology delivery and licensing success.

4.2 CONSTRUCTION

Sweden has strong players in civil construction and infrastructure, Skanska and NCC have relevant experience from both domestic and Nordic nuclear-related projects.

However, Sweden lacks deep experience in nuclear grade construction and have restrictions in capacity, especially manpower, for a large-scale reactor project. Estimates suggest a need for 7,000–10,000 workers, equal to the workforce of Sweden's two largest construction firms combined. This raises strategic questions about how to attract and train a temporary, highly specialised workforce without long-term employment guarantees, or whether to source them from abroad.

Moreover, Sweden cannot deliver full EPCM for a nuclear plant on its own. It must rely on international partners like the Tier 0 OEM or Tier 1's such as Bouygues, Bechtel , and Hyundai E&C for:

- General EPCM
- Nuclear-specific construction procedures and material requirements
- Specialised installation and quality assurance/quality control (QA/QC) processes

Sweden has the local infrastructure, firms, and coordination capacity to manage and execute general construction. But for nuclear-specific works and delivery at scale, it needs to form partnerships with global Tier 0/1 EPCM specialists. Nordic partners (e.g., Fortum, TVO, Veidekke) offer added strength in managing complex builds and could help bridge the manpower and logistics gaps. Success depends on building the right consortium, not just relying on domestic capacity.

DEVELOPMENT ~40% of costs

	SWEDISH CAPABILITIES	NORDIC CAPABILITIES	INTERNATIONAL DEPENDENCIES
Total	Moderate	Strong	Moderate
Planning & Scheduling	Moderate	Strong	Moderate
Preparation & Excavation	Moderate	Strong	Moderate
Construction	Moderate	Strong	Moderate
Installation	Moderate	Moderate	Moderate
Building Materials	Strong	Strong	Moderate

Figure 11. Illustration of Sweden's capabilities within the construction segment of the civil nuclear value chain

4.2.1 LIST OF KEY COMPANIES

SWEDEN

Planning & scheduling, preparation & excavation, construction
NCC: Civil and infrastructure construction
Skanska: Major infrastructure and complex project execution
Peab: Construction and civil engineering services
Bilfinger Sweden: Mechanical installations, precision engineering
Sweco, WSP, AFRY: Project management and engineering integration
Vattenfall, Fortum, Uniper: Project leadership and operational oversight

Installation
Instalco: Swedish based installation and service supplier
Bravida: Provider of end-to-end solutions for service and installation of electricity, plumbing and ventilation

Materials
Ovako: Manufacturer of engineering steel
SSAB: Global steel producer
Heidelberg Cement: Sweden's main supplier of cement and concrete solutions

NORDIC REGION

Fortum (Finland)/TVO: Project execution, regulatory compliance, operational insights

Veidekke (Norway): Civil construction, site logistics

INTERNATIONAL
Bouygues Construction (France): Nuclear civil works and containment
Bechtel (USA): EPCM, construction management
Hyundai Engineering & Construction (South Korea): Specialised nuclear construction
Westinghouse (USA): Specialised nuclear installations
Samsung E&C (South Korea): Civil engineering and large-scale infrastructure for nuclear projects
Jacobs (USA/UK): Engineering, project delivery, and licensing support for nuclear new builds

4.2.2 SWEDISH CAPABILITIES

Sweden's nuclear construction capabilities are robust, with extensive expertise in civil engineering, complex project management, and specialised installation services. Companies such as NCC and Skanska offer proven experience in large-scale infrastructure projects such as "E4 Stockholm Bypass" and "Slussen" but also has experience of working with nuclear facilities. Skanska has experience in nuclear related infrastructure, including the expansion of the SFR final repository in Forsmark and the construction of an encapsulation plant for spent nuclear fuel in Olkiluoto, Finland. NCC is currently constructing a test facility for advanced nuclear technology in Oskarshamn, supporting the development of Blykalla's lead cooled SMR concept.

It is important to recognise that Sweden has strong credentials within the wider construction sector. One large construction company interviewed pointed to their credentials beyond nuclear energy noting that they "know how to build tunnels, roads and concrete foundations" however they noted that they "need to be involved from day one, not halfway through the process".

Swedish Tier 0 utility actors, notably Vattenfall and Uniper, offer significant strengths in overseeing construction processes based on their extensive operational experience from Sweden's existing nuclear plants.

However, the construction of a large-scale reactor requires not only substantial financial resources but also a significant investment of human capital. One actor in the civil construction space emphasised the size of this undertaking suggesting that to build a large-scale-reactor Sweden "will need to use the equivalent of the entire workforce of the two biggest construction firms in Sweden equating to between 7000 and 10 000 people". The typical time period for construction usually last between 7-15 years depending on design maturity, regulatory environment, and supply chain readiness.

While the availability of human capital is undoubtedly crucial for the successful deployment of new nuclear power in Sweden, the long-term sustainability and alternative utilisation of this workforce beyond the construction phase must also be considered carefully. This is particularly pertinent when examining the potential need for a large temporary workforce. One interviewee employed by a large Tier 0 actor questioned the incentives that exist for a young adult to become a welder unless a clear vision for a proliferation of construction projects is planned. This view was echoed by a Swedish construction partner who pointed to the significant construction demands of new nuclear projects as well as the necessity of specifically skilled human capital. This illustrates the challenge of attracting and training a significant number of specialised workers for a finite construction period without a clear vision for their continued employment in other sectors or future nuclear projects. A strategic approach must therefore not only address the immediate need for skilled labour but also the long-term implications for the workforce and the broader economy.

A comparison was made between the prospective Ringhals 5 and 6 reactors and other mega-infrastructure efforts, such as Sizewell C in the UK, emphasising the importance of having the right soft infrastructure in place. Notably, interviewees illustrated that large operators have not insisted on a highly localised (Swedish-only) supply chain. Instead, they have pointed to the prioritisation of reliability and competence over nationality however simultaneously note that reliance on international suppliers could leave projects vulnerable to geopolitical disruptions amid growing instability in global trade. Moreover, the research revealed an anticipation of broader cooperation across borders once a specific reactor technology is selected. If SMRs are pursued, there may be opportunities to share workforce training and project expertise with countries like the United Kingdom, Poland and Czechia.

Swedish industry has capabilities in:

- General civil construction
- Mechanical installations for non-primary systems
- Site logistics and project management
- Installation capability

Swedish industry lacks/has limited capabilities in:

- Specialised nuclear-grade construction experience
- Full EPCM delivery capability for nuclear islands
- Manpower for large-scale projects

4.2.3 NORDIC CAPABILITIES

Nordic capabilities further enhance Sweden's construction competencies. Finnish entities, especially TVO and Fortum, bring extensive experience from recent nuclear construction projects like Olkiluoto 3, adding valuable insights into complex project execution, management of multinational consortia, and regulatory navigation . Additionally, Norwegian company Veidekke provides comprehensive civil engineering and construction logistics expertise beneficial for large infrastructure projects in demanding environments.

Nordic companies provide additional resources and expertise in civil construction and logistics management. While lacking extensive direct nuclear construction experience, Nordic firms can strengthen Swedish projects in non-nuclear classified areas and construction execution logistics.

The Nordic offshore oil and gas sector, particularly in Norway, possesses a highly skilled workforce with decades of experience in delivering complex, safety-critical infrastructure in harsh environments. Companies such as Aker Solutions, Kværner, and Bladt Industries have established capabilities in modular construction, precision welding, heavy lifting, marine logistics, and large-scale project integration. These competencies closely align with the needs of nuclear new build projects, especially those involving Small Modular Reactors (SMRs), which rely heavily on off-site prefabrication, stringent QA, and logistical precision. The offshore workforce is already accustomed to rigorous safety protocols, regulatory compliance, and multidisciplinary coordination, making them well-positioned to transition into roles supporting nuclear module assembly, civil works, and component integration. Leveraging this workforce can help accelerate nuclear delivery timelines while ensuring the high standards required for the sector.

4.2.4 INTERNATIONAL DEPENDENCIES

International dependencies are notable, especially in specialised nuclear construction tasks. Sweden relies on international Tier 0 and Tier 1 contractors for the most specialised nuclear island construction activities. Companies such as Bouygues Construction (France), Bechtel (USA), and Hyundai Engineering & Construction (South Korea) provide essential expertise in nuclear-grade civil construction and integrated project management practices that meet global nuclear standards. Collaboration with these international firms is typically indispensable for any new nuclear plant construction, particularly involving advanced reactor types and SMR technologies.

International firms (Bouygues, Bechtel, Hyundai E&C, Westinghouse) are essential for:

- Nuclear-specific EPCM and overall project management, specifically for core technology
- Specialised installation of primary circuit systems
- Nuclear project EPC and QA/QC management

4.3 NUCLEAR ISLAND

Sweden has partial capabilities to support this phase. Studsvik contributes to core simulations and fuel modelling, Alleima manufactures precision tubes for steam generators, and civil construction firms like Skanska and NCC can deliver the containment structure. However, Sweden lacks the ability to manufacture or assemble the primary systems of the nuclear island. It has no domestic OEM with design authority or experience in delivering a full nuclear island system.

Swedish companies cannot deliver the nuclear island without international support. While it has the technical know-how to contribute to supporting functions like analysis, safety, and construction, the country is missing key capabilities in reactor design, component manufacturing, and system-level integration. No project can move forward without access to certified reactor pressure vessels, internals, steam generators, and pumps, all of which must come from abroad. This puts technology selection and international partnerships at the centre of Sweden's nuclear strategy.

- Swedish industry has a strong foundation in nuclear analytics, civil construction, and project oversight, but it cannot independently deliver the core systems required for a nuclear island
- Companies will need to partner with international OEMs to access certified technologies and meet regulatory demands
- Securing the right global partner early will be critical to project success

PRIMARY CIRCUIT (NUCLEAR ISLAND) ~15% of costs

	SWEDISH CAPABILITIES	NORDIC CAPABILITIES	INTERNATIONAL DEPENDENCIES
Total	Limited	Limited	Very high
Reactor pressure vessel	Absent	Absent	Very high
Reactor internals (core)	Limited	Limited	Very high
Steam generators	Limited	Limited	Very high
Pressurizer	Absent	Absent	Very high
Reactor coolant pumps	Absent	Absent	Very high
Containment structure	Moderate	Moderate	Moderate
Fuel supply system	Moderate	Moderate	Moderate

Figure 12. Illustration of Sweden's capabilities within the primary circuit segment of the civil nuclear value chain

4.3.1 LIST OF KEY COMPANIES

SWEDEN

Reactor internals (core): Studsvik (core simulation & analysis – not OEM)
Steam generators: Alleima (tube manufacturing only)
Reactor coolant pumps: Oden Control AB (actuators/valves); no full pump systems
Containment structure: Skanska, NCC, PEAB (civil construction)
Fuel supply system: Vattenfall (procurement interface), Västerås Westinghouse

NORDIC REGION

Containment structure: YIT, SRV (civil construction support – Finland)
Fuel supply system: Fortum (fuel cycle operations as utility, not supplier)

INTERNATIONAL

Reactor pressure vessel (RPV): Japan Steel Works (Japan), Doosan Enerbility (Korea), Framatome (France), MHI (Japan); Rolls Royce SMR (UK)
Reactor internals (core): Westinghouse, Framatome, Rosatom, GE Hitachi, KHNP, CNNC, Royce SMR (UK)
Steam generators: Framatome, Doosan, Rosatom, Westinghouse, Royce SMR (UK)
Pressurizer: Doosan, Rosatom, Westinghouse, Royce SMR (UK)
Reactor coolant pumps: Curtiss-Wright (USA), Framatome, Rosatom, Royce SMR (UK), KSB (Germany)
Containment structure: Bouygues, VINCI (France); Bechtel (USA); Hyundai E&C (Korea), Royce SMR (UK)
Fuel supply system: Westinghouse, Framatome, Rosatom (TVEL), GEH, KHNP, Candu Energy

4.3.2 SWEDISH CAPABILITIES

Sweden currently exhibits limited capabilities to support the nuclear island, specifically in manufacturing reactor pressure vessels, primary coolant systems, and core components. While local engineering firms and utilities (Vattenfall, Fortum, Uniper AFRY, Sweco) excel in integration, regulatory compliance, and safety management, they lack the capacity to deliver comprehensive primary nuclear technology independently. Studsvik complements these capabilities through advanced nuclear analytics, thermal hydraulic modeling, fuel behaviour simulations, and specialised testing services, although not directly involved in manufacturing reactor components.

Swedish industry has historically maintained strong nuclear operational expertise but has limited domestic capabilities to manufacture full nuclear island systems today. Nordic firms offer some civil support services, but Sweden will rely heavily on international Tier 0 OEMs for the delivery of key primary systems and reactor components.

Swedish industry has capabilities in:

- Core simulation and modelling (Studsvik)
- Precision tube manufacturing for steam generators (Alleima)
- Containment structure through construction capabilities (NCC, Skanska, Peab)

Swedish industry lacks/has limited capabilities in:

- Reactor pressure vessel construction
- Reactor internals (core)
- Nuclear-grade reactor coolant pumps, steam generators, and pressurizers

Swedish firms can contribute to support functions but cannot deliver the nuclear island independently.

4.3.3 NORDIC CAPABILITIES

Nordic capabilities offer partial support to Sweden's nuclear island requirements, particularly through Finnish nuclear experience. Fortum's involvement in the Olkiluoto projects provides valuable expertise in primary circuit management, regulatory compliance, and nuclear safety oversight. Nonetheless, comprehensive nuclear island fabrication, including reactor vessels and reactor internals remains outside Nordic regional competencies.

Nordic contributions are limited to:

- Conventional civil construction support for containment structure (YIT, SRV)
- Fuel cycle operational expertise (Fortum)

They cannot replace the need for international OEMs in critical system manufacturing or nuclear island assembly.

4.3.4 INTERNATIONAL DEPENDENCIES

Given these capability gaps, Sweden must rely significantly on international Tier 0 OEMs for nuclear island solutions. Companies such as Westinghouse (USA), EDF (France), Rolls-Royce (UK), and Doosan Enerbility (South Korea) are indispensable due to their unique capabilities in reactor vessel manufacturing, primary coolant systems, and integrated reactor designs. GE Hitachi (USA/Japan) also offers proprietary technology such as the BWRX-300, suitable for SMR development. Collaboration with these global leaders is essential for Sweden's nuclear new build ambitions, particularly in advanced reactor development and SMR technologies.

International companies provide:

- Reactor pressure vessels (Japan Steel Works, Doosan, Framatome, MHI)
- Reactor internals and steam generators (Westinghouse, Rosatom, GE Hitachi)
- Nuclear-grade reactor coolant pumps (Curtiss-Wright, Framatome)
- Construction of containment structures (Bouygues, Bechtel, Hyundai E&C)
- Full nuclear fuel supply chain (Westinghouse, Framatome, Rosatom, KHNP, Candu)

These partners are crucial for delivering a fully compliant and operational nuclear island.

4.4 SECONDARY CIRCUIT/ TURBINE ISLAND

Swedish industry has strong capabilities in industrial automation, electrical systems, and auxiliary components. Companies like ABB, Alfa Laval, and Atlas Copco can deliver critical support systems such as control platforms, heat exchangers, and pumps. However, Sweden does not manufacture the core rotating equipment, turbines, generators, and reheaters, which are central to the secondary circuit.

Swedish companies cannot deliver the turbine island on its own. While they bring valuable supporting capabilities, the core components must be imported from global OEMs. This adds integration and coordination complexity, particularly under nuclear-grade requirements. Without early partnerships, there is a risk of delays, supply chain bottlenecks, or misalignment between local systems and imported hardware.

- Core turbine systems must come from international suppliers like GE, Siemens Energy, or Mitsubishi
- Integration risks increase when local auxiliary systems are paired with imported rotating equipment
- Lack of domestic nuclear-grade experience in this area may constrain flexibility during project execution
- Strong industrial base gives Sweden a role, but not control, in this phase

Sweden can deliver automation, electrical integration, and supporting infrastructure for the turbine island, but not the turbines or generators themselves. The success of this phase depends on early alignment with global OEMs and careful integration of Swedish systems to meet nuclear standards and timelines.

SECONDARY CIRCUIT (TURBINE ISLAND) ~15% of costs

	SWEDISH CAPABILITIES	NORDIC CAPABILITIES	INTERNATIONAL DEPENDENCIES
Total	Limited	Moderate	High
Steam turbines	Absent	Absent	Very high
Condenser	Moderate	Strong	Low
Moisture sep. reheaters	Limited	Moderate	High
Feedwater system	Moderate	Moderate	Moderate
Instrumentation & Control	Strong	Very strong	Low

Figure 13. Illustration of Sweden's capabilities within the secondary circuit segment of the civil nuclear value chain

4.4.1 LIST OF KEY COMPANIES

SWEDEN

Condenser: Alfa Laval: Supplies heat exchangers that support condenser cooling loops. ABB Sweden: Provides electrical integration and automation systems that monitor and control condenser performance.
Feedwater System: Atlas Copco: Industrial pumps and compressed air systems (partial capability)
Pumps: ABB
Instrumentation & Control: ABB Sweden: Control systems and automation; supports turbine control

NORDIC REGION

Steam turbines: Wärtsilä (Finland): Engines and power systems
Instrumentation & Control: Valmet (Finland): Energy systems integration and control

INTERNATIONAL

Steam turbines: General Electric (USA): Advanced turbine tech; used in multiple Gen III plants, Mitsubishi Power (Japan): High-efficiency turbine island solutions, Siemens Energy Global (Germany): Full steam turbine systems, Alstom (France): Legacy and specialised turbine and generator systems
Condenser: GE, Alstom, Mitsubishi
Moisture Separator Reheaters: GE, Siemens Energy, Alstom, Mitsubishi
Feedwater System: Included in EPC from OEMs (GE, Alstom, Siemens Energy); Curtiss-Wright may supply pumps
Instrumentation & Control: OEM-supplied or integrated with I&C vendors like Siemens Energy and Valmet

4.4.2 SWEDISH CAPABILITIES

Swedish industry has capabilities in the turbine island, especially through well-established industrial and engineering expertise. Sweden's contribution to the turbine island in a nuclear new build context is concentrated in auxiliary system components and automation, not in core rotating equipment. Auxiliary system components are the smaller, supporting parts that help the main systems (like the steam turbine) work properly. This includes pumps that move water around (feed water) and heat exchangers that help cool things down and air compressors used for control systems. They don't produce power themselves, but without them, the main systems would not run safely or efficiently. Here, companies like Alfa Laval and Atlas Copco could supply.

I&C and automation refers to the control systems that monitor and regulate how the turbine works, where Sweden also has a strong base with companies like ABB. Automation in this case refers to control valves and pressure, monitoring temperatures and performance and automatically respond if something goes wrong.

Sweden lacks domestic production of nuclear grade steam turbines, generators, and moisture separator reheaters, which must be sourced from international OEMs. However, Swedish industrial firms offer valuable support in instrumentation, auxiliary cooling, and pumping systems, which are essential to the performance and integration of the turbine island.

Swedish industry has capabilities in:

- Electrical integration, monitoring, and turbine island automation (ABB Sweden)
- Auxiliary cooling and heat exchanger solutions supporting condenser operations (Alfa Laval)
- Industrial air and auxiliary feedwater pumping systems (Atlas Copco)

Swedish industry lacks/has limited capabilities in:

- Manufacturing of nuclear-grade steam turbines and generators
- Supply of nuclear-grade primary feedwater pumps

Thus, Swedish companies can integrate and support secondary circuit auxiliary systems effectively, but must procure all core rotating equipment and steam cycle-specific hardware from international suppliers.

4.4.3 NORDIC CAPABILITIES

Nordic countries, particularly Finland, complement Sweden's turbine island capabilities significantly. Wärtsilä and Valmet (Finland) provide expertise in turbine equipment, generators, and complex systems integration, benefiting from extensive experience in energy projects across the region. These companies enhance the regional capability for designing and delivering comprehensive secondary circuit solutions.

Firms like Wärtsilä and Valmet bring substantial experience in energy systems integration, control systems, and auxiliary plant operations, especially from conventional and industrial power sectors.

The Nordics can complement with:

- Energy systems integration and automation for turbine island operations (Valmet)
- Auxiliary systems support and energy management (Wärtsilä)
- Offering operational best practices and project execution insights from recent large-scale builds in Finland

4.4.4 INTERNATIONAL DEPENDENCIES

Sweden does not have a domestic turbine or generator manufacturer, making it fully dependent on international OEMs for the delivery of the core rotating equipment within the turbine island. While Swedish industry can support auxiliary systems such as automation, cooling, and pumping, the main turbine generator set must come from global players.

Major OEMs such as General Electric (GE), Siemens Energy, Mitsubishi Power, and Alstom provide the high-efficiency turbine technologies used in modern nuclear plants. These companies also typically supply integrated packages including moisture separator reheaters, feedwater systems, and turbine control platforms. Their involvement is critical not only for equipment delivery but also for ensuring compliance with nuclear-specific quality and regulatory requirements. Many of them are already a part of the supplier base of the Tier 0 OEMs.

According to one large International Tier 1-supplier, a notable gap in Sweden's new build ambitions appears to lie in the established manufacturing and supply chain capabilities for key components within both the Primary and Secondary Circuits. Indeed, while components for the turbine Island might seem like standard industrial equipment, their integration into a nuclear power plant demands adherence to stringent, nuclear-specific quality standards and regulations. The lack of readily available Swedish suppliers with this specific nuclear experience across both circuits could result in increased reliance on international vendors and pose risks of bottlenecks in project timelines and costs. If Sweden wants to facilitate and incentivize supply chain readiness for large nuclear components in Sweden additional government support such as state aid is likely needed.

4.5 BALANCE OF PLANT

Sweden has a strong industrial base across the BoP value chain. Companies like ABB, Alfa Laval, Atlas Copco, Munters , and Camfil deliver high-quality HVAC, automation, and auxiliary systems used in energy and industrial projects globally. In many areas, Swedish firms can provide complete component delivery and integration. However, most companies operate in conventional or industrial domains and do not possess extensive nuclear experience.

Sweden can cover most of the BoP scope through domestic and Nordic suppliers, but gaps remain in nuclear-grade components and full-system integration.

- Lack of EPCM experience for nuclear-specific BoP may complicate integration and interface management
- Gaps in nuclear-grade pumps, control systems, and condensers require international sourcing
- Some Nordic and Swedish firms do not hold nuclear QA certifications

Sweden is well positioned to lead and deliver much of the BoP scope in a nuclear new build, especially across HVAC, automation, and support systems. Nordic partners add strength in pumps and process integration. Still, successful execution will require international suppliers for nuclear-class equipment and integration of safety-critical systems. Early coordination and interface planning will be key to ensuring regulatory compliance and timeline certainty.

BALANCE OF PLANT			~15% of costs
	SWEDISH CAPABILITIES	NORDIC CAPABILITIES	INTERNATIONAL DEPENDENCIES
Total	Moderate	Strong	Moderate
Condenser	Moderate	Moderate	Moderate
Cool. towers / Heat exchangers	Moderate	Moderate	Moderate
Pumps	Moderate	Moderate	Moderate
HVAC	Strong	Very strong	Low
Instrumentation & Control	Very strong	Very strong	Low

Figure 14. Illustration of Sweden's capabilities within the balance of plant segment of the civil nuclear value chain

4.5.1 LIST OF KEY COMPANIES

SWEDEN

Condenser: ABB Sweden: Electrical and automation scope
Heat Exchanger: Alfa Laval, Munters
Pumps & Circulating Water System: Atlas Copco: Compressed air and pump solutions
HVAC System: Camfil, Munters, Systemair, FläktGroup, Backer : Full HVAC offering
Instrumentation & Control: ABB Sweden, Elajo, Oden Control AB

NORDIC REGION

Pumps & Circulating Water System: Grundfos (Denmark): Pump and water handling systems
HVAC System: Danfoss (Denmark): HVAC control
Instrumentation & Control: Valmet (Finland): Automation and auxiliary integration

INTERNATIONAL

Condenser: GE Power (USA): Condensers as part of turbine island packages, BHEL (India) – Supplies nuclear-grade condensers in turnkey EPCs
Heat Exchanger: Alfa Laval (Global/SE HQ): Though Swedish, it is a global leader, SPX Flow (USA): Specialised in heat exchanger and thermal systems
Pumps & Circulating Water System: Flowserve (USA): Nuclear-qualified pumps for cooling water systems, KSB (Germany): Pumps for nuclear BoP applications
HVAC System: Carrier (USA): Advanced HVAC systems including for control rooms, Johnson Controls (USA): Nuclear facility HVAC design and control
Instrumentation & Control: Schneider Electric (France): Power automation, SCADA (Supervisory Control and Data Acqusition), and I&C Honeywell (USA): Safety and DCS (Distributed Control System) systems for plant, I&C Emerson (USA): Instrumentation, control valves, process automation

4.5.2 SWEDISH CAPABILITIES

Sweden possesses extensive capabilities in the Balance of Plant through well-established companies with broad infrastructure experience. Firms such as ABB Sweden, Alfa Laval, Atlas Copco, Munters and HVAC-specific companies like Camfil and Systemair, can deliver comprehensive solutions across electrical distribution, automation, cooling and ventilation systems, instrumentation, and control engineering. Swedish companies such as Alfa Laval and Atlas Copco provide advanced equipment and systems for cooling, heat exchange, compressed air solutions, and fluid handling.

Furthermore, Sweden possesses a deep and mature industrial base across BoP systems, particularly in HVAC, instrumentation, control, pumps, heat exchangers, and support infrastructure. These capabilities position Sweden strongly to deliver or integrate most BoP components in a nuclear new build context.

Swedish industry has capabilities in:

- **HVAC:** Deep ecosystem with multiple global suppliers (Camfil, FläktGroup, Munters, Systemair, Backer)
- **Instrumentation and control:** ABB's Symphony Plus platform + integrators like Elajo and Oden Control
- **Heat exchangers and air handling:** Munters, Alfa Laval (for related applications)
- **Industrial support systems:** Pumps (Atlas Copco), fasteners (Nord-Lock), and cable systems (Roxtec)

Swedish industry lacks/has limited capabilities in:

- Integration of all BoP systems into a nuclear-specific EPCM package
- Nuclear-grade safety-class experience

4.5.3 NORDIC CAPABILITIES

The Nordic region further strengthens Sweden's BOP capabilities through specialised expertise from companies such as Danfoss (Denmark), Grundfos (Denmark), and Valmet (Finland). These companies contribute with essential technology and solutions for pumps, control systems, and energy-efficient auxiliary system integration.

While Sweden has a strong foundation in industrial components for the Balance of Plant (BoP), the broader Nordic region offers key complementary technologies, especially in pumps, HVAC control, and automation systems. Nordic suppliers such as Grundfos, Danfoss, and Valmet are recognised for high-quality equipment and systems integration, with proven track records in both energy and process industries. These companies bring significant added value through specialised auxiliary systems and automation, even though they do not supply nuclear-safety-class hardware directly.

The Nordic region is strong in:

- Industrial- and utility-scale pumps and fluid handling
- HVAC automation and control solutions
- Process control systems and automation for auxiliary infrastructure

The Nordic region is lacking in:

- Delivery of nuclear-grade components (e.g., qualified pumps, I&C for safety systems)

As such, Nordic suppliers are ideally suited to support Swedish efforts in BoP system integration and component delivery, particularly in auxiliary systems, fluid handling, and process automation, while critical nuclear-class components must still be sourced globally.

4.5.4 INTERNATIONAL DEPENDENCIES

International suppliers play a critical role in delivering nuclear-qualified components for Balance of Plant systems that go beyond the capabilities of Nordic industry. These include nuclear-grade pumps, condensers, heat exchangers, HVAC systems for control rooms, and safety-class instrumentation and control platforms. While many Swedish and Nordic companies can supply auxiliary systems, these global actors offer the deep nuclear EPC experience and system-specific qualifications required for compliance in regulated nuclear environments. Many of them are already part of the supplier base of the Tier 0 OEMs.

Sweden's BoP capabilities are robust but can benefit from international support, especially for specialised nuclear applications and certain advanced technologies. Global companies like Schneider Electric (France), Honeywell (USA), and Emerson (USA) offer leading solutions in advanced control systems, automation, and instrumentation technology tailored to nuclear-specific standards. International collaboration typically involves technology transfer and joint ventures to ensure the optimal performance and compliance of auxiliary systems with stringent nuclear industry requirements.

Together, these companies complement domestic and regional players, especially for procurement, licensing, and safety-case-aligned design in a Swedish nuclear new build.

4.6 SWITCHYARD

Sweden has a well developed electrical engineering base. Companies like ABB Sweden and Hitachi Energy are global leaders in transformers and switchgear, supported by strong cable manufacturers such as Amokabel, NKT and Habia Cable . Engineering firms like AFRY, Sweco, and WSP bring top-tier design and permitting expertise. Utilities such as Vattenfall and Uniper offer valuable experience in grid interface and long-term operations.

Swedish companies can deliver most switchyard components and services domestically, but certain specialised systems, particularly gas-insulated switchgear with proven nuclear grade design, and ultra-high-voltage equipment, may still require international collaboration.

- Most of the switchyard can be sourced and delivered locally
- Gaps exist in ultra-high voltage even if 400kV transformer manufacturing exits in Sweden
- EPCM experience for nuclear-specific switchyards may require global partners
- International vendors bring proven compliance with nuclear grid codes and advanced control system

Swedish companies have strong capabilities across switchyard design, equipment supply, and grid integration. Swedish and Nordic firms can meet most needs, but most complex installations may require partnerships with global players.

SWITCHYARD (GRID CONNECTION)			~5% of costs
	SWEDISH CAPABILITIES	NORDIC CAPABILITIES	INTERNATIONAL DEPENDENCIES
Total	Strong	Very strong	Low
Transformer	Strong	Very strong	Low
Switchgear	Strong	Very strong	Low
Transmission lines	Strong	Very strong	Low

Figure 15. Illustration of Sweden's capabilities within the switchyard segment of the civil nuclear value chain

4.6.1 LIST OF KEY COMPANIES

SWEDEN

Transformers: Hitachi Energy Sweden, ABB Sweden
Switchgear: ABB Sweden (Modular AIS and GIS systems), Holtab (Prefabricated switchgear units)
Transmission Lines/Cables: NKT, Amokabel, Habia Cable

NORDIC REGION

Switchgear: Ensto (Finland): Medium-voltage switchgear
Transmission Lines: Draka Norsk Kabel (Norway), Reka Cables (Finland)

INTERNATIONAL

Transformers: GE Grid Solutions (USA/France), Mitsubishi Electric (Japan), Schneider Electric (France), Siemens Energy (Germany)
Switchgear: GE Grid Solutions (USA/France), Schneider Electric (France), Mitsubishi Electric (Japan), Siemens Energy (Germany)
Transmission Lines: Prysmian Group (Italy), Nexans (France), LS Cable & System (South Korea)

4.6.2 SWEDISH CAPABILITIES

Companies like ABB Sweden and Hitachi Energy form the backbone of the transformer and switchgear offering, while Habia Cable, and Amokabel support high-voltage cable production. Complementing these OEMs, Swedish firms like AFRY, Sweco, and WSP offer leading design and engineering services. Utilities like Vattenfall, Fortum, and Uniper bring deep experience in grid connection and operational interface.

Swedish industry has capabilities in:

- High-voltage transformers and substation design (ABB, Hitachi Energy, Siemens Energy)
- Medium and high-voltage switchgear (ABB, Holtab)
- Grid cabling and cable component manufacturing (NKT Sweden, Amokabel, Habia)

Swedish industry lacks/has limited capabilities in:

- Full-scale turnkey EPC of high-voltage substations for nuclear applications

4.6.3 NORDIC CONTRIBUTIONS

While Sweden leads Nordic capabilities in switchyard systems, neighbouring countries contribute selectively through component manufacturing and industrial solutions relevant for nuclear switchyard applications. The Nordic region does not host full-scale OEMs for high-voltage transformers but offers valuable complementary strengths in medium-voltage switchgear, rugged transmission cables, and supporting infrastructure such as protective enclosures, moulded components, and industrial electronics. Companies from Finland, Norway, and Denmark bring specialised materials expertise and niche technologies that are particularly well adapted to harsh climates and long operational lifespans, both essential in nuclear power environments.

4.6.4 INTERNATIONAL DEPENDENCIES

Global suppliers could be instrumental in delivering specialised high-voltage equipment and advanced grid control systems that go beyond Sweden's or the Nordics capabilities, especially in ultra-high-voltage transformers, gas-insulated switchgear, and complex substation control platforms. Companies like GE Grid Solutions, Mitsubishi Electric, Schneider Electric, Nexans, and LS Cable & System offer proven nuclear-compatible infrastructure and international experience in grid compliance across Europe, Asia, and North America.

Sweden's switchyard capabilities are robust, yet international suppliers add valuable complementary technologies, particularly in advanced high-voltage equipment and grid management solutions. Major international players such as GE Grid Solutions (USA/France), Schneider Electric (France), and Mitsubishi Electric (Japan) provide specialised high-voltage components, and advanced substation automation technologies. Collaborations with these companies typically involve technological exchange and joint project execution.

Assessment of International Capabilities:

- Extensive EPC and nuclear integration experience
- Grid code compatibility with EU and international nuclear regulations
- Providers of turnkey high-voltage substation systems for nuclear new builds

These international players would typically be engaged through EPC contractors or utility procurement teams and can work in parallel with Swedish integrators.

5. IMPACT ASSESSMENT

This section provides a concise analysis of the economic and employment impact of constructing nuclear power plants in Sweden, comparing scenarios for a large-scale 1 200 MW Light Water Reactor (LWR) and a Small Modular Reactor (SMR, 300 MW). The assessment is based on capital expenditure (CAPEX) modelling, domestic content scenarios, and employment/value-added coefficients from Swedish input-output data.

For each plant type, three domestic content scenarios were modelled: Low, Base, and High, reflecting varying degrees of Swedish and Nordic supplier participation. The Low to High scenarios are dependent on technology selection, nuclear pipeline in Europe and domestic orderbook (one-off vs program build-out). Moving from Low to High requires targeted efforts such as supplier qualification, long-term fleet deployment, supportive procurement policy, and early visibility into project timelines, several of which are outlined in the recommendations.

The calculations apply sector-specific economic multipliers to each CAPEX category, linking them to Swedish industries (by NACE code). These multipliers estimate the value-added (GDP impact) and full-time equivalent jobs (FTEs) generated both directly and indirectly through the supply chain. All CAPEX values are discounted at 2.5% Weighted Average Cost of Capital (WACC) to reflect their real economic value over time.

While the model provides a structured and transparent view of potential economic outcomes, results are subject to several uncertainties, including the accuracy of CAPEX allocation to industries, the applicability of historical coefficients, assumptions around localization levels, and potential schedule delays. Notably, the SMR scenario is based on a single 300 MW unit without applying any cost reductions from serial deployment. In reality, a rollout of multiple SMRs (e.g. a fleet of 6–8 units) would likely result in economies of scale, lowering unit costs and improving the economic case over time.

The **Base** scenario assumes realistic localization based on current capabilities:

Reactor Type	Total CAPEX (SEK)	Domestic CAPEX (SE)	Domestic CAPEX (SE + Nordic)	Direct GDP Impact (SE)	Indirect GDP Impact (SE)	Total GDP Impact (SE)	Total FTEs (SE)
SMR (300 MW)	27,2 bn	11,5 bn (44,8%)	14,6 bn (56,9%)	4,8 bn	4 bn	8,8 bn	7 602 (4151 Direct + 3 451 Indirect)
LSR (1200 MW)	90,2 bn	48,8 bn (54,1%)	58,8 bn (65,1%)	21,2 bn	18,8 bn	40 bn	33 454 (17 727 Direct + 15 727 Indirect)

Figure 16. Comparative table showing the economic and financial impacts of SMRs and LSRs

Note: Direct GDP Impact = VA (Value Added) from firms directly involved in delivering goods/services for the project, Indirect GDP Impact = VA (Value Added) generated through upstream supply chains such as Tier 2 (sub-suppliers) and Tier 3 (suppliers to sub-suppliers), including industries providing materials, components, or services not directly contracted for the project. All CAPEX and value-added figures presented are expressed in discounted (real) terms using a 2,5% Weighted Average Cost of Capital (WACC). This reflects the time value of money and aligns with investment-grade economic modelling practices. This aligns with national accounting principles and reflects standard input-output economic modelling

Approximate impact ranges across Low–High scenarios:

LSR 1 200 MW:

- GDP Impact (Direct + Indirect GDP Impact): **SEK 28.5 bn (low) – 45.7 bn (high)**
- Jobs (Total FTEs = Direct + Indirect FTEs): **23 800 FTEs (low) – 38 000 FTEs (high)**

SMR 300 MW:

- GDP Impact (Direct + Indirect GDP Impact): **SEK 6,1 bn (low) – 11,2 bn (high)**
- Jobs (Total FTEs = Direct + Indirect FTEs): **5 500 FTEs (low) – 10 200 FTEs (high)**

LSR Scenarios	CAPEX (real value)*	Impact on GDP (real value)	#FTE's
LOW	• Swe: **34,8 bn SEK** • Swe + Nordic: 39,9 bn SEK	• Direct: 15,1 bn SEK • Indirect: 13,4 bn SEK • Total: **28,5 bn SEK**	• Direct: 12 631 • Indirect: 11 207 • Total: **23 838**
BASE	• Swe: **48,8 bn SEK** • Swe + Nordic: 58,8 bn SEK	• Direct: 21,2 bn SEK • Indirect: 18,8 bn SEK • Total: **40 bn SEK**	• Direct: 17 727 • Indirect: 15 727 • Total: **33 454**
HIGH	• Swe: **55,7 bn SEK** • Swe + Nordic: 70,2 bn SEK	• Direct: 24,2 bn SEK • Indirect: 21,5 bn SEK • Total: **45,7 bn SEK**	• Direct: 20 229 • Indirect: 17 947 • Total: **38 176**

Note: Total CAPEX (real value) for LSR = SEK 90,2 bn

SMR Scenarios	CAPEX (real value)*	Impact on GDP (real value)	#FTE's
LOW	• Swe: **8,0 bn SEK** • Swe + Nordic: 9,5 bn SEK	• Direct: 4,8 bn SEK • Indirect: 2,8 bn SEK • Total: **6,1 bn SEK**	• Direct: 2 890 • Indirect: 2 403 • Total: **5 292**
BASE	• Swe: **11,5 bn SEK** • Swe + Nordic: 14,6 bn SEK	• Direct: 4,8 bn SEK • Indirect: 4,0 bn SEK • Total: **8,8 bn SEK**	• Direct: 4 151 • Indirect: 3 451 • Total: **7 602**
HIGH	• Swe: **14,7 bn SEK** • Swe + Nordic: 19,8 bn SEK	• Direct: 6,1 bn SEK • Indirect: 5,1 bn SEK • Total: **11,2 bn SEK**	• Direct: 5 312 • Indirect: 4 416 • Total: **9 728**

Note: Total CAPEX (real value) for SMR = SEK 25,7 bn
*All CAPEX (real value) figures shown are discounted using a 2,5% Weighted Average Cost of Capital (WACC). This means they reflect the present value of future investment expenditures, adjusted for the time value of money.

Figure 17. Comparative table showing the economic and financial impacts of SMRs and LSRs

5.1 DOMESTIC CONTENT

To estimate the Swedish and Nordic share of nuclear construction, three scenarios were developed: **Low, Base**, and **High**. Each reflects different levels of supplier readiness, localization policy, and industry mobilization.

- **Low** assumes low domestic orderbook (<5GW), limited Swedish sourcing, especially in reactor components and EPC.
- **Base** reflects realistic localization, high Swedish orderbook (~5GW), using existing strengths in construction, machinery, engineering, and electrical systems
- **High** assumes extensive domestic orderbook (>5GW), proactive localization efforts, supplier qualification, and scale-up through a fleet-based rollout

Scenario	SMR (SE)	LSR (SE)	Nordic (add-on)
Low	31%	39%	6%
Base	45%	54%	11–12%
High	57%	62%	16–20%

In the Base case, Swedish suppliers capture **~SEK 11,5 billion** (SMR) and **~SEK 48,8 billion** (1 200 MW). Nordic suppliers add ~11–12% on top, mainly in electrical and engineered systems.

Higher degree of domestic content means greater retention of value within the national economy—more jobs, higher tax revenue, stronger industrial base. A shift from Low to High scenario can boost value added by up to 60% (~SEK 18 bn) and generate 10 000+ additional FTEs per 1 200 MW unit.

Other influencing factors and their impact on domestic content:

- **Supplier readiness** – Nuclear-grade quality, certification and delivery capacity
- **Fleet effect** – Repetition enables learning, cost reduction and scaling
- **Policy and procurement strategy** – Early qualification, local content criteria, support tools
- **Project timing and visibility** – Long lead times allow suppliers to invest and ramp up
- **Financial environment (WACC)** – Affects present value of procurement and risk appetite

In short, localization is not fixed, although it is a strategic variable. With the right framework, Sweden could retain most of the nuclear CAPEX domestically, strengthening long-term economic and industrial resilience.

5.2 WORKFORCE

Nuclear construction generates significant employment across the Swedish economy—both directly (through companies delivering to the project) and indirectly (via supply chains and supporting services).

Reactor Type	Direct FTEs	Indirect FTEs	Total FTEs
SMR (300 MW)	~4 100	~3 400	7 600
1 200 MW	~17 700	~15 700	33 454

Note: Direct FTE = employment in Swedish companies that supply to the project. Indirect FTE = employment in supporting industries activated through demand (supply chain effect)

Nordic suppliers are estimated to add **1 000–5 000 FTEs**, depending on plant type and scenario.

The two charts below illustrate how Full-Time Equivalent jobs (FTEs) are distributed across industries for both reactor types. Each bar shows the total employment impact in a given industry, with black representing direct jobs and blue indicating indirect jobs generated through the value chain.

Figure 18. Total FTEs by Industries, LSR

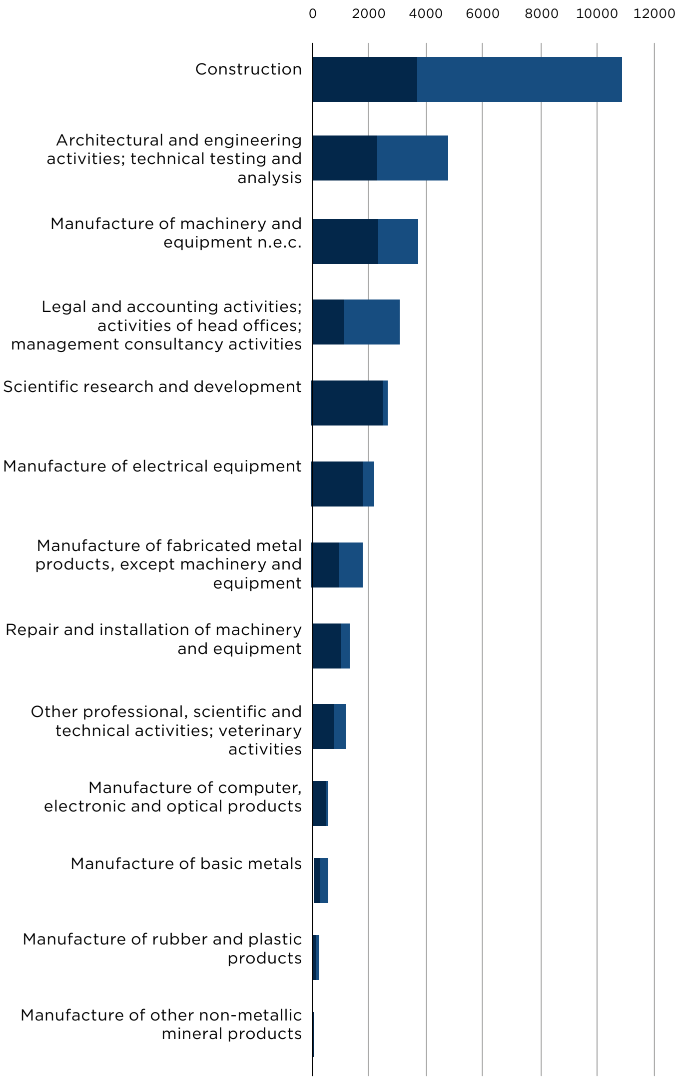
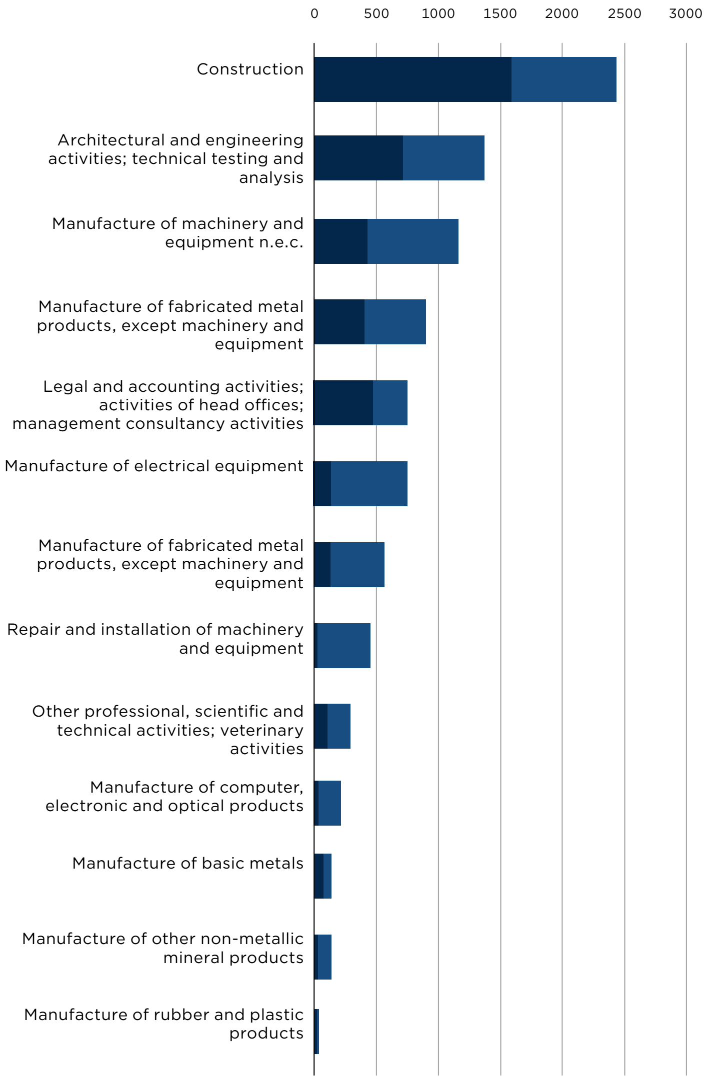


Figure 19. Total FTEs by Industries, SMR



These jobs span high-skill engineering and R&D roles as well as large-scale employment in construction, manufacturing, and technical services.

TOP CONTRIBUTING SECTORS (FTES, BASE CASE)

The table below shows the five sectors with the highest total employment impact (direct + indirect FTEs) in Sweden for each reactor type. The NACE codes represent standardized industry classifications used across the EU for economic analysis.

Sector (NACE)	Description	SMR FTEs	1 200 MW FTEs
Construction (F)	Building and civil engineering works	2 005	10 900
Engineering & Testing (M71)	Architectural and engineering services; technical testing	1 124	4 859
Machinery & Equipment (C28)	Manufacture of general-purpose and special-purpose machinery	962	3 789
Management & Consulting (M69–70)	Legal, accounting, and management consultancy activities	623	3 143
Electrical Equipment (C27)	Manufacture of electrical distribution and control equipment	621	2 216

LABOUR QUALITY AND STRATEGIC RELEVANCE

- High-skill roles (M71, M69, M72) contribute disproportionately to value added per FTE.
- Manufacturing and construction provide scalable employment and regional distribution benefits
- Localization helps anchor long-term competencies in clean energy, precision engineering, and project delivery

5.3 STRATEGIC LEVERS FOR ECONOMIC AND EMPLOYMENT IMPACT

In the value chain, the Swedish domestic content is lowest in the primary circuit, followed by the secondary circuit and balance of plant. These areas therefore hold the greatest potential for increasing captured business and value added. To understand where investments have the largest impact, each invested krona has been benchmarked against two complementary lenses:

Lens	What it captures	Why it matters
GDP impact (Gross value-added per) SEK	Wages, profits and production taxes created directly inside Sweden's borders for every SEK of output (think "incremental GDP").	Maximises the programme's contribution to Sweden's economic growth and fiscal base.
Full-time equivalents (FTEs) per billion SEK	Direct + first-tier supplier employment generated for every billion SEK invested.	Targets job creation, skills development and regional labour-market impact.

GDP impact (Gross value-added) per SEK - Highest direct value-added per SEK invested:

Rank	NACE code	Industry description	Direct VA per 1 SEK
1	M72	Scientific research & development	0.63
2	M71	Architectural & engineering; technical testing	0.53
3	M69-70	Legal, accounting, HQ, consultancy	0.52
4	M74-75	Other professional, scientific & technical	0.46
5	C33	Repair & installation of machinery/equipment	0.39

Full-time equivalents (FTEs) per billion SEK - Highest employment (FTEs) per billion SEK invested:

Rank	NACE code	Industry description	Total FTEs / 1 bn SEK
1	F	Construction	≈ 1 313
2	M69-70	Legal, accounting, HQ, consultancy	≈ 1 207
3	M74-75	Other professional, scientific & technical	≈ 1 224
4	M71	Architectural & engineering; technical testing	≈ 1 027
5	C33	Repair & installation of machinery/equipment	≈ 1 000

HOW TO INTERPRET THE MULTIPLIERS

- Value-added (GDP contribution) lens – captures wages, profits and taxes generated inside Sweden's borders; a 0.63 multiplier means every SEK spent on R&D directly produces 63 öre of GDP in that sector before any spill-overs.
- Employment (FTE) lens – measures both on-site and first-tier supplier jobs; Construction dominates because of its labour intensity and low import share, whereas knowledge sectors punch above their weight in wages rather than headcount.

This dual-lens analysis reveals which sectors generate the highest economic return and job creation per unit of investment. Scientific R&D and engineering services stand out as the most value-generating activities, while civil construction offers the strongest employment multiplier. Professional services—such as consultancy, legal, and technical advisory—rank highly across both metrics, making them particularly effective levers for national value creation.

KEY TAKEAWAYS:

- Scientific R&D and engineering (M72, M71) deliver the highest direct GDP impact per invested SEK, making them strategic targets for early-phase investment.
- Civil construction (F) provides the strongest employment effect, with over 1,300 FTEs per billion SEK invested.
- Professional services (M69–75) offer a dual benefit—ranking in the top five for both GDP and employment impact.
- These insights apply across both SMR and LSR scenarios and remain relevant even at lower orderbook volumes, with increasing importance as Sweden moves toward a fleet-based rollout.

5.4 SENSITIVITY ANALYSIS

Several factors have a material impact on the economic and employment outcomes of a nuclear build. Key sensitivities include:

DELAY AND DISCOUNTING

Discounting at 2,5% WACC significantly reduces project value:

Reactor	NPV Loss (SEK)	FTE Loss (Sweden)
SMR	~0,7 billion	~430
1 200 MW	~2,9 billion	~1 900

Note: NPV (Net Present Value) – The NPV Loss captures the difference between the nominal (undiscounted) CAPEX and the discounted (real) CAPEX. It reflects the economic reality that a SEK invested today is worth more than the same SEK spent in the future.

Delays lower the present value of localized procurement and reduce workforce needs during peak construction years.

SCENARIO SPREAD

Shifting from **Low →High localization (1 200 MW)** can increase:

- GDP impact by ~60%
- Job creation by ~ (5 000–10 000) FTEs per plant
- Nordic supplier involvement, especially in turbine island, BoP, and EPC support

OTHER CRITICAL DRIVERS

- Rolling out a fleet of reactors (rather than a single unit) creates opportunities for learning-by-doing, cost reductions, and scaling up. This helps Swedish and Nordic suppliers move up the capability curve, becoming more competitive and experienced with each project
- Procurement strategy (e.g. local content clauses, pre-qualification) is essential for activating domestic value chains
- Industry readiness varies by segment: construction and machinery manufacturing (NACE C28) are mature, primary circuit and I&C still have capability gaps

5.5 RESULTS

The impact assessment confirms that domestic sourcing of nuclear power plant CAPEX, whether for a 1 200 MW LWR or a 300 MW SMR—can generate significant economic returns for Sweden. In the base scenario, Swedish industry captures ~44% of CAPEX as GDP through direct and indirect value added, with over 33 000 full-time jobs (FTEs) generated for the 1 200 MW reactor and 7 600 FTEs for the SMR.

The 1 200 MW reactor yields ~40 billion SEK in total value added (GDP contribution) for Sweden, while the 300 MW SMR contributes ~8,8 billion SEK, showing strong scalability across project sizes.

Higher localization further amplifies the benefits: from the low to high scenario, value added increases by ~60% (from 28,5 to 45,7 billion SEK) and job creation rises by over 14 000 FTEs (from ~23 800 to ~38 200). Regional sourcing from Nordic neighbours adds additional industrial spillover, raising total domestic content to nearly 78% in the high case.

The analysis shows that nuclear investment offers substantial economic and employment returns, especially when localisation is prioritized.

Reactor	Total GDP Impact (SEK)	Share of CAPEX (%)
SMR	~8,8 billion	~34%
1 200 MW	~40 billion	~44%

KEY TAKEAWAYS

- Base scenario for 1 200 MW has potential to yield high economic returns (~40–45% of CAPEX as GDP, thousands of jobs).
- Moving to high localization adds significant value—both strategically and economically.
- With a proactive approach, nuclear builds can serve as a national industrial policy lever, boosting clean energy, jobs, and competitiveness across the Swedish economy.

6. BUSINESS CASE

The new nuclear capacity (MW) needs to be committed in Sweden and neighbouring countries to make it attractive for reactor vendors to locate LSR/SMR module manufacturing in Sweden. It draws on interviews, public plans announced up to May 2025, as well as desktop research. It focuses on the Nordics and Baltics and does not include central Europe since already established hubs in UK, France and rising in Poland.

6.1 THRESHOLD NUCLEAR CAPACITY FOR ATTRACTING PRODUCTION TO SWEDEN

FOR LSR

A Swedish-located supply-chain for large reactors becomes commercially attractive once the combined Nordic-Baltic orderbook reaches ≈ 4–7 GW (4-7 units). At this scale a Swedish Type 2/3 module plant, meaning fabricating steel containment and equipment modules can be amortized and could cover a significant share of civil-structural, turbine island and balance-of-plant scope.

Moving further up the value chain (full equipment supply) requires ≥ 7 GW ideally over 12GW and can also keep a heavy-forging press and further equipment production locally covering all segments of the value chain.

FOR SMR

A dedicated factory for small-modular-reactor (SMR) module production is economically viable only if it can count on a sizeable, multi-year orderbook. Interviews with Tier 0 SMR OEMS suggest a minimum commitment of 7 GW in one geographical cluster before investing in a new manufacturing line. This would amount to roughly 50 TWh per year, covering about one-sixth of the 300 TWh of annual electricity demand that Sweden is targeting for 2045 and thus making a significant contribution toward the country's electrification goals.

Aggregated announced and planned nuclear projects in Sweden and its Nordic-Baltic neighbors' amount to 7–10 GW of new capacity to 2045, exceeding the threshold and making Sweden a strong candidate for regional module production. It is important to note that the financial framework approved by the Swedish parliament covers 5000 MW, but the Swedish road map for new nuclear targets a total additional capacity of roughly 10 000 MW by 2045.

6.2 AGGREGATED PIPELINE (INDICATIVE)

The picture below shows an aggregated future pipeline of 7-10 GW in the Nordic and Baltics.

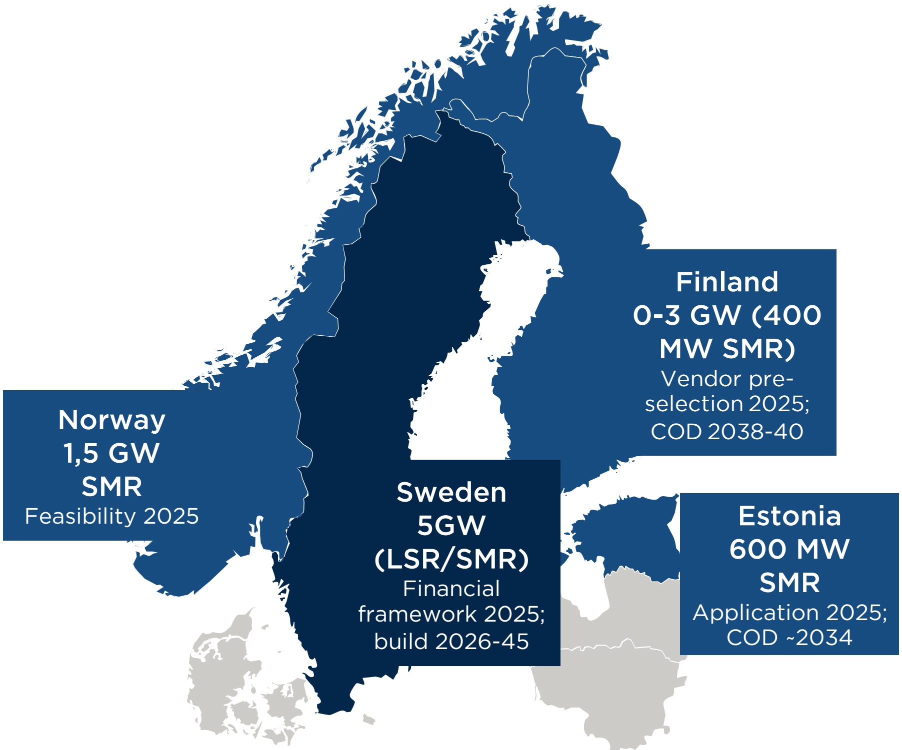


Figure 20. Aggregated future pipeline of 7-10 GW in the Nordics and Baltics

Country	Planned Additional Capacity (MW)	Status / Horizon
Sweden	5 000 MW	Financial framework 2025; build 2026-45 (Half before 2035)
Finland	0-3000 MW	Vendor pre-selection; scale-up 2030-40
Estonia	600 MW	Application 2025; COD ~2034
Norway	1 500 MW	Feasibility 2025; COD 2035-40

REGIONAL MARKET DEMAND FOR NEW NUCLEAR

Regional market demand for new nuclear power is outlined below for each country

SWEDEN

The Swedish government has proposed a funding mechanism for four large-scale reactors - with installed capacity of around 5,000 MW - or the equivalent in small modular reactors (SMRs) and in its nuclear road map targets a total of 10 000 MW additional nuclear by 2045. Half of those should be on-stream by 2035.

Vattenfall has decided to shortlist British Rolls-Royce SMR and American GE Hitachi Nuclear Energy for ongoing evaluation.

Fortum is also exploring the possibility of 1-2 LSR and 1 SMR in Finland or Sweden.

FINLAND

Finnish utility Fortum has selected two large reactor vendors plus one small modular reactor vendor to continue discussions with after concluding a two-year feasibility study examining the prerequisites for nuclear new build in Finland and Sweden. This capacity could therefore not be exclusive to Finland

The Steady Energy LDR-50 pilot (thermal 50 MW) is a precursor; market studies envisage up to roughly one gigawatt of new SMRs by 2040.

ESTONIA

Fermi Energia has applied to build 2 × 300 MW BWRX-300 units (≈600 MW) with first power in the early-2030s.

NORWAY

Norsk Kjernekraft proposes up to 1.5 GW of SMR capacity at Tjeldbergodden, producing 12.5 TWh/yr. Policy work is ongoing, the project is seen as an industrial decarbonisation driver.

6.3 MODULARIZATION AND THRESHOLD CAPACITY FOR LOCAL MODULE MANUFACTURING

Modularisation splits the plant into three factory-built building blocks or types: **1) Concrete, 2) Steel frames,** and **3) Equipment pods**, this is applicable for both LSRs and SMRs. Each block can be viewed as a dedicated production line.

- **At the first wave of orders** the simplest, highest-throughput items—Type 1 concrete cages—are the obvious candidates for local production
- **As the orderbook fills up** (e.g. additional reactor units are confirmed) the steady flow of tonnage justifies investing in heavy-steel workshops for Type 2 frames
- **When volume grows further** and schedules overlap, it becomes viable to set up a clean, test-ready hall for Type 3 equipment, capturing more value-added work—piping, cabling, FAT testing—inside the country

In short, every new reactor contract widens the economic window for moving another module class on-shore, gradually turning Sweden from a buyer of foreign modules into a full-spectrum supplier.

Module type	
Type 1 – Concrete	Steel re-bar cages, embedded plates, sometimes steel-plate composite walls with no equipment fitted **Pure civil steel/concrete** – nothing "live" inside
Type 2 – Big steel frames	Large open-frame steel modules (e.g., containment shell rings, pipe racks, floor modules, turbine-hall box columns). No major rotating equipment but may carry pre-installed hangers and bracketry. **Big empty steel frames** – structural skeletons only
Type 3 – Equipment modules	Skids that arrive with pumps, heat-exchangers, tanks, piping, cabling and instrumentation already installed and tested. Example: AP1000 "EP" equipment pods; turbine skid "box" for Hinkley C. **Plug-and-play equipment pods** – pumps, heat exchange, wiring factory-installed and tested

	LSR - Modularisation schedule based on capacity (1200 MW – 90% capacity)	SMR - Modularisation schedule based on capacity (300 MW – 90% capacity)
Orderbook (SWE)	Likely localisation outcome	Likely localisation outcome
≤1.5 GW (1 LSR or 1–5 SMR)	Civil works, and construction mainly	Civil works and concrete modules cast locally
≈2–4 GW (2–3 LSR or 6–14 SMR)	Dedicated Swedish concrete facility + growing Tier-2/BOP workshare (valves, switchgear, I&C)	Dedicated Swedish concrete facility + growing Tier-2/BOP workshare (valves, switchgear, I&C)
≈4–7 GW (4–7 LSR or 15–23 SMR)	Economic case for a Swedish Type 2/3 module factory (steel pipe racks, skids, turbine hall modules)	Economic case for a Swedish Type 2/3 module factory (steel pipe racks, skids, turbine hall modules)
≈7–12 GW (≥7–12 LSR or 24–40 SMR)	Full module factory plus high chance of relocating (or JV-building) forging (heavy manufacturing of power plants moved to Sweden)	Full module factory, high chance of forging/pressure-vessel line relocation or joint venture
≥12 GW (>12 LSR or ≥40 SMR)	Sweden becomes the Nordic LSR manufacturing hub – multiple module lines, heavy-component exports	Sweden becomes Nordic manufacturing hub — multiple lines, with exports

Figure 21. Modularisation schedule for nuclear reactors for LSRs and SMRs in Sweden

Whether an LSR or SMR is built some degree of localization of the supply chain is likely - lowest hanging fruit would be production or assembly of concrete and steel structures. Due to the difference in physical size and area required, LSR would likely generate a larger local need for such elements.

The LSR vendors have a long legacy of nuclear new build and are likely to have a well-developed supply chain and sourcing model already established. Potential new build solely in Sweden (regardless if it's 2500 MW or 5000 MW etc) could likely be an insufficient project pipeline size to incentivize large mature actors to establish new production facilities for key components or products in the Primary - Tertiary Circuit in Sweden. Although a scenario where new such production facilities are established in Sweden is highly attractive and should be encouraged - it is likely not a very probable development. The likelihood of localization in Sweden could increase if neighboring Nordic or Baltic countries place orders from the same vendors, as Sweden is well placed to supply the region.

The situation for SMR vendors (such as RR SMR and GEH) likely differs from the more commercially established LSR vendors as the technology is novel and not yet rolled out in any meaningful scale and first-of-a-kinds are still being constructed. Although these actors have substantial experience in the nuclear field the supply chain structure is likely not fully set and countries that choose such technologies at an early stage likely have a higher probability of capturing more of the supply chain (although this opportunity also comes with more inherent project risk). Key components such as the primary circuit are unlikely to be localized in Sweden due to a lack of specialized know-how. However, components like the containment structure and civil works could theoretically be sourced locally, even at lower production volumes. It will only become feasible to expand substantial parts of the production to Sweden at volumes exceeding roughly 7 GW. At higher volumes beyond this threshold, there is a stronger case to expand all production to Sweden or the Nordic region.

In order for any LSR or SMR vendor to consider localization of products or services in Sweden the most important parameter will be domestic and regional project pipeline. Following that the usual parameters such as state aid, access to sufficient competence and competitive labor costs are likely key parameters.

For SMRs: The business model relies on highly standardized factory production. In the interview with a Tier 0 SMR that in order for them to be considering replicating their current manufacturing plant they capacity needs to be larger than 16 SMRs, 450 MW each (7 GW) which would account for one third of the 150 TWh needed to fulfill the expanded energy need of Sweden (from 150 TWh to 300 TWh by 2040).)

Given the aggregated Nordic-Baltic pipeline of ≈7-10 GW, Sweden can credibly offer such volume, especially if regional orders are coordinated and attractive prerequisites for establishments are provided.

7. RECOMMENDATIONS

Based on the value chain mapping, gaps identified and the economic impact/business case assessments in the preceding chapters, the recommendations below set out a strategic roadmap including proposed next steps for establishing and promoting a Swedish nuclear value chain for Swedish new built and global business.

7.1 OBJECTIVE OF THE RECOMMENDA-TIONS GIVEN IN THE REPORT

The recommendations across the nuclear value chain are designed to position Sweden as an active contributor, not just a customer, in future nuclear new builds. While Sweden brings strong industrial, regulatory, and project experience, it lacks recent nuclear build execution and full ownership of key technologies.

The overarching goal for the recommendations is to:

- Build strategic national capabilities in areas where Sweden can lead
- Secure knowledge transfer and reduce dependency through early international partnerships in core reactor technology and nuclear-grade construction
- Enable long-term participation across multiple projects
- Develop a competent, scalable workforce and delivery ecosystem to support a sustained nuclear program

For the various parts of the value chain the objective and potential are the following:

DEVELOPMENT

The objectives of the recommendations is to help Swedish industry transition from being a capable contributor to becoming a credible initiator and orchestrator of nuclear new builds. It is about gaining know-how, reducing future dependency, and positioning Swedish companies to shape, not just host, the next generation of nuclear power.

CONSTRUCTION

The goal of these recommendations is to close Sweden's execution gap in nuclear-grade construction. While Swedish companies have strong civil firms and infrastructure capabilities, it needs to gain experience and specialised skills needed for nuclear new builds. The recommendations aim to capture as much of the construction volume but also to acquire know-how for future nuclear new build.

PRIMARY CIRCUIT

The goal here is know-how and industrial foothold. Swedish companies cannot deliver the nuclear island on its own, but it can and should embed itself deeply in the value chain. The objective is to gain critical knowledge, reducing future dependency, and carving out a focused Swedish role in the heart of the reactor to the extent possible.

SECONDARY CIRCUIT

The objective here is to maximise Swedish companies' role in turbine island integration by leveraging its industrial strengths. The goal is to embed Swedish industry into the turbine island, expand its export potential, and make it a trusted partner in nuclear systems.

BALANCE OF PLANT

The goal is to turn Sweden's industrial strength into nuclear-qualified capability, not by reinventing technology, but by lifting existing suppliers to meet nuclear standards and lead in system integration. There is already know-how in Sweden but it needs to be adapted to a nuclear context.

SWITCHYARD

The goal is to consolidate Sweden's existing strengths into a complete, exportable switchyard offering, and ensure smooth grid connection for future nuclear plants.

7.2 PRIVATE SECTOR-LED INITIATIVES

Recommendations to private actors in the nuclear value chain to contribute, grow market share, build technology leadership, and enhance competitiveness.

DEVELOPMENT

Engage in international design partnerships early. Collaborate with Tier 0 reactor OEMs during the pre-licensing phase to align on design choices, intellectual property access, and certification pathways for the selected reactor technology. Early, structured engagement will give Swedish companies influence over key decisions, deepen domestic expertise, and streamline later licensing steps. (Proposed lead: Swedish Tier 0 - Utilities and Tier 1 Engineering firms)

CONSTRUCTION

Establish long-term partnerships with international EPC(M) contractors. Rather than relying on one-off subcontracting, Swedish companies should establish multi-project frameworks or joint ventures with experienced global EPC players (e.g., Bechtel, Bouygues, Hyundai E&C). Long-term partnerships enable continuous knowledge transfer across projects, distribute risk more fairly, and support the gradual development of local capacity. (Proposed lead: Swedish Tier 0 utilities and Tier 1 Construction companies, for example: Vattenfall, Afry, Skanska)

Expand domestic capacity for large-scale nuclear construction. Enable major Swedish construction firms (e.g., Skanska, NCC) to re-enter nuclear-grade execution through pilot projects, strategic partnerships, or training with experienced international EPC contractors. Re-engaging Sweden's civil engineering majors will secure domestic jobs and build a workforce that understands nuclear quality requirements from the outset. (Proposed lead: Swedish Tier Construction companies, for example NCC, Skanska, Peab)

PRIMARY CIRCUIT

Secure strategic partnerships with international OEMs. Establish long-term industrial and technology agreements with leading OEMs (e.g., GE Hitachi, Westinghouse, EDF) to gain access to core reactor technologies. Strategic partnerships that go beyond simple procurement can enable technology transfer and give Swedish industry a voice in future product development. (Proposed lead: Tier 0 – Utilities, Vattenfall, Uniper)

Build deep understanding of core reactor technology through active participation. Swedish utilities and suppliers should work closely with the selected OEM to gain hands-on experience with core systems, design principles, and integration requirements. Ongoing joint engineering efforts and staff exchanges will ensure Swedish teams can operate, maintain, and adapt the technology confidently. (Proposed lead: Swedish Tier 0 - Utilities and Tier 1 Engineering companies, for example, Vattenfall, Afry, Sweco, WSP)

Specialize in selected nuclear island components. Instead of aiming to own the entire core scope, Swedish companies could focus on mastering and co-delivering specific subcomponents—such as fuel modelling, safety case development, or auxiliary core systems. Targeted ownership of niche areas allows domestic firms to build on existing strengths and integrate more effectively into global supply chains. (Proposed lead: Swedish Tier 1 product and primary circuit suppliers, for example Studsvik, Alleima NCC, Skanska)

SECONDARY CIRCUIT

Develop reference projects in non-nuclear sectors. Use industrial projects to build nuclear-relevant credentials before entering regulated nuclear contexts. Demonstrating high-quality execution on conventional plants creates a compelling track record for future nuclear bids. (Proposed lead: Swedish Tier 1 suppliers, for example ABB, Alfa Laval, Atlas Copco)

Collaborate with OEMs for turbine integration. Establish formal agreements with turbine OEMs (e.g., GE, Siemens Energy, Mitsubishi) to align Swedish auxiliary systems with global turbine packages. Early interface coordination ensures compatibility, reduces design conflicts, and helps Swedish suppliers qualify as preferred partners internationally. (Proposed lead: Swedish Tier 1 Secondary Circuit Suppliers, for example ABB, Alfa Laval, Atlas Copco)

7.3 PUBLIC SECTOR-LED INITIATIVES

Recommendation to the public nuclear actors follows below:

OVERALL

Promote a program-based approach. A program-driven model secures a predictable order book that incentivizes private-sector investments, enables government-led talent and certification initiatives, and transforms Sweden's nuclear ambitions into a long-term industrial strategy rather than a short-term project. This approach would significantly increase domestic content and facilitate the transfer of nuclear-specific expertise. (Proposed lead: Ministry of Climate & Enterprise)

DEVELOPMENT

Build long-term, large-scale project management capabilities. This is a strategic imperative if Sweden is to roll out a full-scale nuclear program over the coming decades.

A first step could be to expand the role of the Kärnkraftsamordnare into a small cross-ministerial steering group that gradually evolves into a permanent program office. This team could compile lessons from megaprojects such as Förbifart Stockholm and the North Bothnia Line, and conduct joint risk reviews on active infrastructure projects. Over time, the office could become the central coordination hub for all nuclear builds, facilitating dialogue between ministries, agencies, and industry. (Proposed lead: Ministry of Climate & Enterprise)

Invest in programmatic readiness. Establish a structured national program for nuclear new builds with dedicated coordination between government, regulator, and utilities to accelerate feasibility studies, siting, and licensing. The government could adopt a comprehensive "New Nuclear Plan" that clarifies roles, decision gates, and funding flows. A standing working group could resolve permitting and land use issues, while agencies such as SSM and Svenska kraftnät jointly pilot parallel (rather than sequential) reviews. Publishing lessons learned openly would help future projects progress faster. (Proposed lead: Ministry of Climate & Enterprise / SSM)

Secure and retain critical engineering talent. Launch a national nuclear talent initiative targeting early-career engineers, regulatory professionals, and safety specialists. Consider expanding master's level places at KTH, Chalmers and LTH, introducing flexible conversion courses for mid career engineers, and launching a targeted scholarship model co funded by industry and academia. Consider expanding master's-level capacity at KTH, Chalmers, and LTH; introducing flexible conversion courses for mid-career engineers; and launching a targeted scholarship model co-funded by industry and academia. A complementary track could establish a fast-track work permit channel for experienced nuclear specialists already within the EU who lack Swedish credentials. (Proposed lead: Ministry of Education & Research; Ministry of Employment)

CONSTRUCTION

Create a long-term workforce strategy. Create a national workforce plan encompassing apprenticeships, technical training, and retraining programs to ensure a steady pipeline of welders, installers, and project supervisors—not just for one project, but for a sustained build-out. A pragmatic approach could involve industry and authorities co-developing a "skills scenario tool" to model alternative build rates and identify bottlenecks. Vocational college curricula (Yrkeshögskola) could then be adjusted, and mobile training centers—already trialed abroad—could be deployed near initial construction sites. Lessons from the UK's Sizewell C academy may offer useful templates. (Proposed lead: Ministry of Education & Research , Ministry of Employment support by SSM, Tier 0 OEMs/Utilities, Tier 1 Construction companies and Business Sweden)

SECONDARY CIRCUIT

Certify Swedish secondary circuit suppliers to nuclear standards. Launch a national qualification program. An example of a simple starter initiative could be to cover the cost of each supplier's first quality audit, distribute easy-to-use template manuals, and publish a list of approved firms on a public website to help customers find them. (Proposed lead: SSM)

BALANCE OF PLANT

Certify Swedish BoP suppliers to nuclear standards. Launch a national qualification program to elevate HVAC, I&C, pump, and electrical suppliers to nuclear safety-class compliance through documentation, training, and audits. Initiate a national qualification program to elevate HVAC, I&C, pump, and electrical suppliers to nuclear safety-class compliance through documentation, training, and audits. The program could be rolled out in stages—starting with the most time-critical component types and later expanding to the full BoP scope. Sector-wide gap workshops could pair experienced nuclear vendors with newcomers for mentoring. (Proposed lead: SSM)

SWITCHYARD

Streamline permitting and grid interface management. Coordinate between utilities and regulators to ensure predictable timelines and grid connection strategies for new nuclear plants. For example, regulators and the grid operator could jointly define clear nuclear connection rules with industry, then launch a single online portal where developers submit all documents once and the system forwards them to relevant authorities. (Proposed lead: Swedish Energy Markets Inspectorate; Svenska Kraftnät)

7.4 CROSS-SECTOR COLLABORATION OPPORTUNITIES

Recommendations for cross-sector collaborations (public-private):

OVERALL PROMOTION

Mobilize the industry through an industry association.
Sweden currently lacks a formal interest organization for nuclear, but one is now emerging in the form of Nuclear Sweden (formerly SAFO). Business Sweden understands that this organization will focus on developing a supplier network, while policy advocacy will largely remain under Energiföretagen. Nuclear Sweden should serve as a hub for both Swedish and

foreign-owned suppliers who are part of—or wish to join—the Swedish nuclear ecosystem. It should also regularly organize relevant activities (e.g., workshops, seminars), involving other Team Sweden actors such as the Swedish Energy Agency and Business Sweden where appropriate.

In addition, Nuclear Sweden should build on the insights and materials in this report and its supporting documents to further highlight and promote key Swedish actors and capabilities—both domestically and internationally. Sweden should also strengthen its investment and export promotion efforts by attracting strategic, job-creating investments across the nuclear value chain and expanding nuclear-related exports, as global demand for these solutions is expected to grow over the coming decades. (Proposed lead: Ministry of Climate & Enterprise, Business Sweden, Swedish Energy Agency, relevant private companies, Tier 0 & Tier1)

DEVELOPMENT

Strengthen regulatory interface capacity. Build up public-sector and utility-side expertise (Tier 0 Utilities) in navigating licensing for new reactor types (e.g., Build expertise within the public sector and Tier 0 utilities to navigate licensing for new reactor types (e.g., SMRs), including cooperation with regulators in countries like Finland, the UK, and Canada. SMRs), including collaboration with regulators in countries such as Finland, the UK, and Canada. Joint task forces and systematic knowledge exchange can shorten review cycles and reduce duplication.

Practical next steps could include establishing a "Licensing Academy" where Swedish, Finnish, and Canadian reviewers rotate staff for three-month exchanges, and launching a shared digital knowledge base to log common questions and precedents for future applicants. Over time, these exchanges should accelerate reviews and help harmonize safety expectations across borders. (Proposed lead: Tier 0 utilities & Swedish Radiation Safety Authority; Support: Energiforsk & Ministry of Climate & Enterprise).

SECONDARY CIRCUIT

Position Sweden as a hub for auxiliary systems. Leverage the industrial strengths of companies like ABB, Atlas Copco, and Alfa Laval to position Sweden as a preferred partner for turbine island automation, pumps, heat exchangers, and control systems. A coordinated export campaign, supported by domestic reference projects, can establish a strong Swedish brand in the global supply chain.

Swedish Tier 1 suppliers, with support from Business Sweden, could host a joint "Swedish Auxiliaries Pavilion" at major trade fairs and develop an online catalogue of qualified auxiliary packages to make sourcing easier for international stakeholders. (Proposed lead: Swedish Tier 1 Secondary Circuit Suppliers, for example ABB, Alfa Laval, Atlas Copco; Business Sweden, Energimyndigheten)

Attract turbine manufacturing to Sweden. A national nuclear new build program could facilitate the establishment of local turbine production. Local manufacturing would create high-value jobs and shorten logistics chains for future builds. (Proposed lead: Ministry of Climate & Enterprise)

BALANCE OF PLANT

Develop a coordinated Swedish BoP offering. Create joint BoP packages involving multiple Swedish suppliers (e.g., condensers, pumps, HVAC, I&C). Coordinated proposals make it easier for utilities to contract Swedish firms and present a unified quality strategy to regulators.

A Swedish BoP Council could define common interface standards, allow suppliers to pre-qualify once for all projects, and jointly pitch turnkey packages to international stakeholders. (Proposed lead: ABB, Alfa Laval, Business Sweden, Energimyndigheten)

SWITCHYARD

Promote full-scope switchyard capabilities for nuclear projects. Together with ABB and Hitachi Energy, Sweden should consolidate and promote a comprehensive switchyard offering—including engineering, equipment, and integration. A turnkey switchyard solution signals self-sufficiency to investors and simplifies grid interface negotiations.

(Proposed lead: Hitachi Energy, ABB, Svenska kraftnät, Energimyndigheten, Business Sweden)

7.5 RECOMMENDATIONS FROM THE IMPACT ASSESSMENT AND BUSINESS CASE

The impact assessment and business case analysis highlight clear strategic levers for maximising Sweden's economic and employment returns from nuclear new builds. These priorities align with Sweden's industrial strengths and can be activated even at lower orderbook volumes, with increasing relevance as the national programme scales.

OBJECTIVE

To steer capital toward sectors that deliver the highest national return—measured in GDP contribution and job creation—and to embed Swedish capabilities across the nuclear value chain in a way that supports long-term industrial growth.

RECOMMENDATIONS

Front-load knowledge-intensive activities. Scientific research and engineering services offer the highest value-added per invested SEK. Early investment in these areas de-risks licensing, accelerates project timelines, and embeds Swedish intellectual property into the reactor ecosystem. This includes collaborative R&D programmes, tailored engineering hubs, and early-stage design partnerships with OEMs.

Leverage professional services as a dual engine for value and employment. Legal, consultancy, and technical advisory services rank among the top contributors to both GDP and FTEs. Bundling these into integrated project management and regulatory support packages strengthens Sweden's role across the full lifecycle and builds exportable expertise.

Use construction as a domestic job accelerator. Civil works generate the highest employment per SEK invested. Maximising domestic participation – through long-term partnerships, local content thresholds, and targeted workforce development – can anchor thousands of jobs and build lasting project delivery capacity.

Secure long-term service contracts for equipment and operations. Installation and maintenance services offer sustained value beyond the build phase. Locking in domestic suppliers for turbine and balance-of-plant systems ensures continuity, incentivises local investment, and builds a durable service ecosystem that can serve future projects.

These four priorities are not static—they scale with the size and structure of the nuclear programme. Looking at the threshold and modularisation breakdown from the business case, priorities 1–3 are applicable even at lower orderbook volumes (<4 GW), particularly for Type 1 and Type 2 modules. Priority 4 becomes increasingly relevant as volumes exceed 7 GW, where equipment localisation (Type 3) becomes commercially viable and strategically impactful.

Embedding these priorities into procurement strategies, programme design, and industrial policy would enable Sweden to capture the full economic potential of its nuclear ambitions.

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