Tesi | 30 years

Industrial Scale Projects in Finland

October 2025

Introduction

There is currently a lively debate about industrial-scale investment in Finland. This report brings the perspective of Finnish Industry Investment Limited (Tesi): we describe the market situation for industrial projects, open our own analytical framework and present the role of Tesi as a co-investor.

With the expanded investment mandate, Tesi is also investing in new industrial projects, and this strategy is already being implemented. A diversified investment base strengthens Finland's economy. In the allocation of public funding, we focus on long-term added value, export and profit potential, and security of supply. Tesi's strategy supports this whole by diversifying investments across value chains, attracting private capital and by targeting market-driven funding towards projects with the strongest potential for return and impact.

Recently, the debate has focused in particular on data centres and their electricity consumption. The issue is a subject of strong opinions, but it is important to remember that Finland is part of the common Nordic-Baltic electricity market - decisions are not made in isolation from regional constraints. If investment projects in the various value chains (such as data centres, green metallurgy and Power-to-X (P2X) solutions) proceed as planned, electricity demand will grow significantly and securing base load will become a decisive factor. Although Nordic electricity production is currently in surplus, new capacity will not be built without demand - the potential on paper will only be realised as investments are made.

The strong growth of wind power will support energy sufficiency, but system balance also requires adequate controllable capacity and more consumption flexibility. These can smooth out price fluctuations and reduce the impact on industry and households. This requires close cooperation between public authorities, network and production companies and investors, and a common up-to-date view of the situation.

Our aim is for this report to provide a clear overview of the opportunities and constraints of the investment wave and to make Tesi's role in this development visible and understandable.

Helsinki, 25 September 2025

Henri Hakamo

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Background - Verticals behind new industrial-scale projects

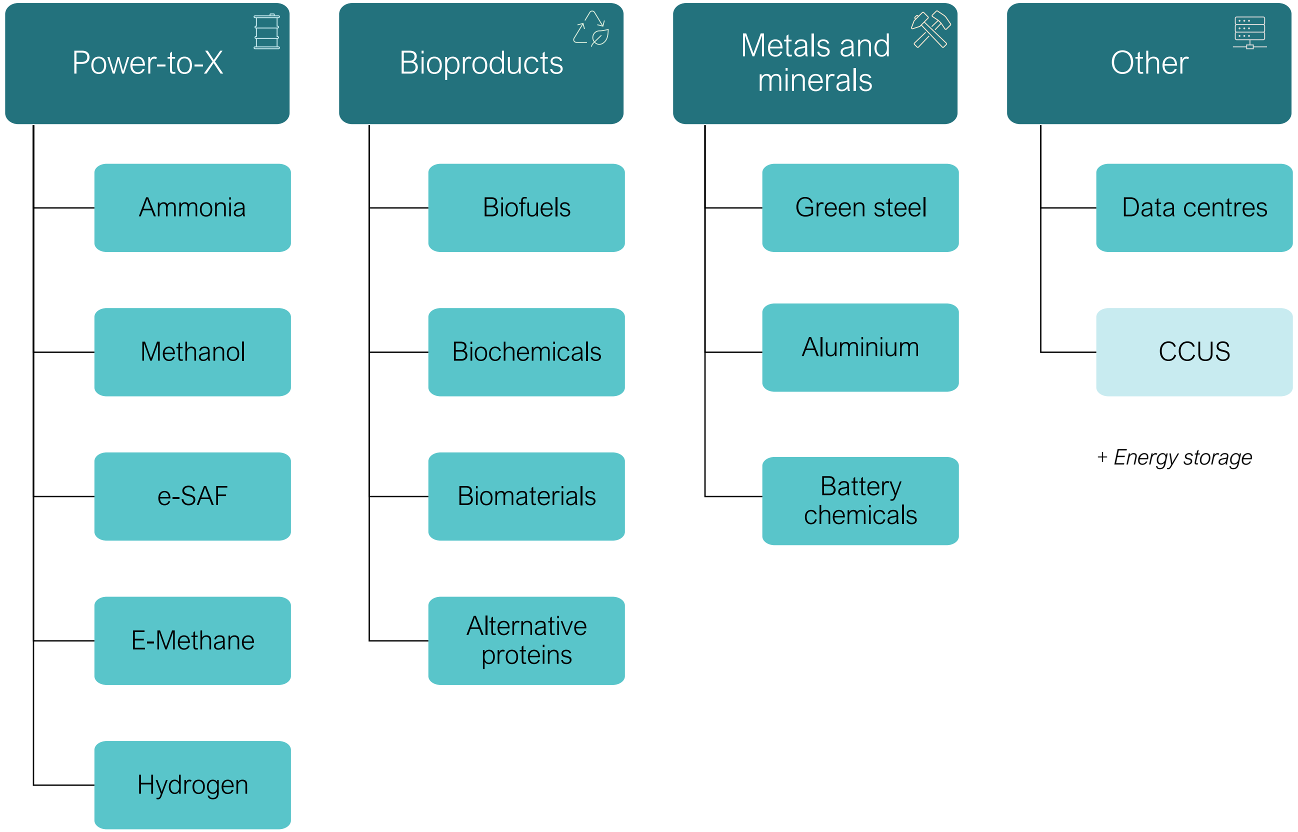
This report has been prepared to describe the development of the priority areas defined in the new industrial policy strategy and Tesi's role in this ecosystem.

The report focuses on the following verticals:

- P2X i.e. hydrogen and hydrogen-related derivatives
- Bioproducts
- Metals and minerals
- Others - data centres and Carbon capture, utilisation, and storage (CCUS)

These verticals are based on the industrial policy strategy and on regions where industrial-scale energy-intensive investments, in particular, are planned for the coming years.

The report is primarily intended for professional use and not all terms are separately explained.



- Power-to-X
  - Ammonia
  - Methanol
  - e-SAF
  - E-Methane
  - Hydrogen
- Bioproducts
  - Biofuels
  - Biochemicals
  - Biomaterials
  - Alternative proteins
- Metals and minerals
  - Green steel
  - Aluminium
  - Battery chemicals
- Other
  - Data centres
  - CCUS

+ Energy storage

Summary - main findings on industrial-scale projects in Finland

Subject	Summary
Significant opportunities for growth	○ Finland has the opportunity to build growth through new industry. These investments, if implemented, will be significant and have the potential to create industries and knowledge clusters around them. ○ The industrial projects are largely based on Finland's clean and cheap energy production and strong infrastructure and they constitute a genuine competitive advantage. ○ Interesting growth opportunities include hydrogen and its derivatives, bioproducts, metals and minerals, and data centres.
Key comments	○ Energy availability is a connecting factor across value chains, but each value chain has significantly different opportunities and challenges. Looking at the whole picture and predicting future developments is very complex and requires extensive cooperation. Thus, a comprehensive and shared picture of the situation, which can also be updated as the outlook changes, would be important for decision-making. ○ At present, the focus should be on getting projects to the construction phase in order to translate investment intentions into investment.
Tesi's role as an investor in industrial-scale projects	○ Tesi's renewed strategy gives it an extended mandate to support the creation of new industry. ○ Tesi invests in major industrial-scale projects that promote clean transition, new industrial technologies and increase industrial demand for renewable energy in Finland. Tesi's operation is entirely market-based and investments should be made on the same terms as private investors. ○ In line with its strategy, Tesi invests in projects at different stages, from project development to investment decision.
Investment opportunities	○ Demand drivers for industrial-scale projects are strongly linked to the growth of energy transition. Regardless of the geopolitical situation, renewable energy is the quickest, cheapest and most scalable option for meeting the growing demand for electricity. ○ The biggest opportunities for investors on the Finnish market are in the emerging value chains of green hydrogen, hydrogen derivatives and low-carbon metals production, as well as new chains in the bioeconomy. In the current market situation, there is an undersupply of capital for these projects, which allows for an attractive risk-return ratio. For data centres, there are fewer direct options for investors and, correspondingly, there is enough capital available for projects. ○ The report describes the key aspects, risks and expected returns associated with the development of industrial-scale projects.

> "For new industrial projects, the time horizon is beyond start-up and growth company funding: now is the time to build the foundation for stronger scaling opportunities in the 2030s."

Henri Hakamo
Chief Strategy and Research Officer

Summary - value chains

Summaries of industrial-scale value chains

Tesi's vision

Sector	Market opportunity	Challenges	Conclusion
Power-to-X	Finland has excellent preconditions for hydrogen production thanks to competitive wind power, an electricity grid and industrial biogenic CO2. Many P2X projects are planned in Finland in different parts of the value chain	The P2X value chain is associated with high regulatory risk and high production costs. Scaling up requires significant infrastructure.	If regulation develops in a favourable direction, Finland will be able to compete internationally and at a large scale. It is the only value chain in which it will be possible to fully exploit the variable generation profile of wind power.
Metals & minerals	Finland has cheap energy, know-how and many minerals, all which underpin its natural competitiveness As it develops, it has the potential to build value chains and sectors in Finland and increase the EU's independence in critical minerals.	The emergence of a value chain requires a common understanding at the EU level of the development of the sector in Finland and the related support mechanisms.	A very interesting value chain but, especially on the metals side, a favourable outcome depends on the success of individual projects.
Bioproducts	Finland has very strong expertise and experience in biomaterials and fuels and, wit the latter, the potential to innovate on a large scale. Traditional applications (e.g. pulp & paper) are mature and in stable demand.	Most bioeconomy innovations are still expensive compared to fossil and are without sufficient regulatory support. Forest-based feedstock is already widely used, but there are also scalable opportunit(e.g. forest residues, lignin)ies other than combustion as markets develop	So far, the opportunities are dispersed among individual innovations and extensive industrial scaling up of the new wave is yet to rise.
Data centres	Finland has a particularly favourable environment for data centres because of the price of electricity and its infrastructure, district heating networks and cool climate. Strong market demand right now.	Jobs and tax revenue are created in Finland, especially during the construction phase, but the long-term benefits are limited. Most of the added value flows abroad.	Market fundamentals strongly support value chain development, but the opportunity may include system-level challenges

Summary – analysis of effectiveness of the value chain

■ High (positive)
■ Intermediate
■ Low (negative)

				Other	
Sector	P2X	Bioproducts	Metals and minerals	Data centres	Carbon sequestration
Summary of benefits and challenges	+ Flexible energy consumption profile - the only scalable vertical for the full utilisation of wind power − High dependence on regulation and high decarbonisation costs	+ Stable demand and proven technology − Biomass availability and processability varies − No regulation to support demand (except for biofuels)	+ Fundamental market demand + Social impacts − Inflexible energy consumption profile − A challenging playing field	+ High willingness to pay and immediate demand + Mature technology − Inflexible energy consumption profile − Limited social benefits	+ Medium CO_2 reduction costs − Needs state regulation − Limited demand
Size of opportunity (one-off Capex/Value added, € billion 2030–2040)	<5 · 5–10 · **+ 10 billion**	**<5** · 5–10 · + 10 billion	<5 · 5–10 · **+ 10 billion**	<5 · 5–10 · **+ 10 billion**	**<5** · 5–10 · + 10 billion
Recurrent economic impact (Opex/Capex, man-years/Capex; Opex = Operating expenditure)	Potential for sector development if critical scale and derivative production is achieved	Low in animal and imported biomass; utilising medium to high forest biomass	High employment intensity; opportunity to develop a downwardly-integrated business operation	Low degree of domesticity; low employment impact (hyperscalers' Capex mainly on servers)	Low Opex and employment; costs mainly in transport and final disposal (not in Finland)
Demand base (natural/economic/regulated)	Regulated; high production cost	Economic; pulp and paper industry is profitable; regulated demand for biofuels	Inherent demand; supply-demand deficit (e.g. aluminium in the EU); battery material requirement	Inherent; high willingness to pay	Regulated Low Opex and employment; costs mainly in transport and final disposal (not in Finland)
CO_2 reduction cost, €/tCO_2	300+ (~1,000 at highest, e.g. e-SAF)	0 (pulp & paper), 200–350 (HVO) or more depending on the product targets	Below the EU Emissions Trading Scheme (ETS) price level or 150-300 (green steel)	Does not reduce CO_2	150–300
Finland's competitiveness	Low electricity costs; good availability of onshore wind power and biogenic CO_2	Established capabilities and supply chains; limited raw material availability at present	Strong mineral reserves in certain segments; low electricity price; constrained by stable base load	Very competitive access to land and electricity; distance not a problem	Additional costs for transport and storage; if using e-fuels, no problem
Energy requirement and flexibility	High (+20 TWh/y); flexibility	Low	High (+20 TWh/y); low flexibility	High (+20 TWh/y); low flexibility	Small (<1 TWh/y)
Scaling timeline (viability) (first investments possibly earlier)	2030–2040 Hydrogen/e-methane/e-methanol possibly 2027–2032	2030+ (if regulation is developed)	Now(mainly in the pre-project study); green steel ~2035+	Now and in the future	2035–2040 (if regulation is developed)

HVO = Hydrotreated Vegetable Oil (renewable diesel)

Growth opportunities

Finland is competitive in new industrial projects in which the business operation is based on energy intensity and fossil-free energy

Finland's competitive advantages in clean transition projects

Renewable electricity

Affordable and sufficient renewable electricity

95% fossil-free electricity generation in 2024

Last year, Finland's electricity production was almost entirely fossil-free and 56% renewable.

Affordable renewable electricity is an important competitive advantage for industrial projects because electricity represents a large part of production costs.

Electricity grid

Stable and comprehensive grid

45.6€/MWh average electricity price in 2024

Last year, electricity in Finland was the third cheapest in Europe.

The electricity network operated by Fingrid is one of the most efficient in Europe. Its capacity is critical for large industrial projects in order to secure the supply of electricity.

Bio-based (biogenic) CO2

Bio-based (biogenic) carbon dioxide availability

30 million tonnes of bio-based (biogenic) CO^2 in 2024

One of Finland's important resources is bio-based (biogenic) CO2, which is generated by the forest industry.

Bio-based (biogenic) CO2 will enable the production of synthetic fuels, which could make Finland a major producer of these fuels.

Water

Supply of clean water

10% of Finland's surface is water

Finland has an excellent water supply. Water is needed, for example, for making hydrogen.

Minerals

Availability of critical minerals

10+ different minerals used in industry

Several minerals, such as nickel, cobalt and chromium, used in batteries and battery technology, are found in the Finnish ground.

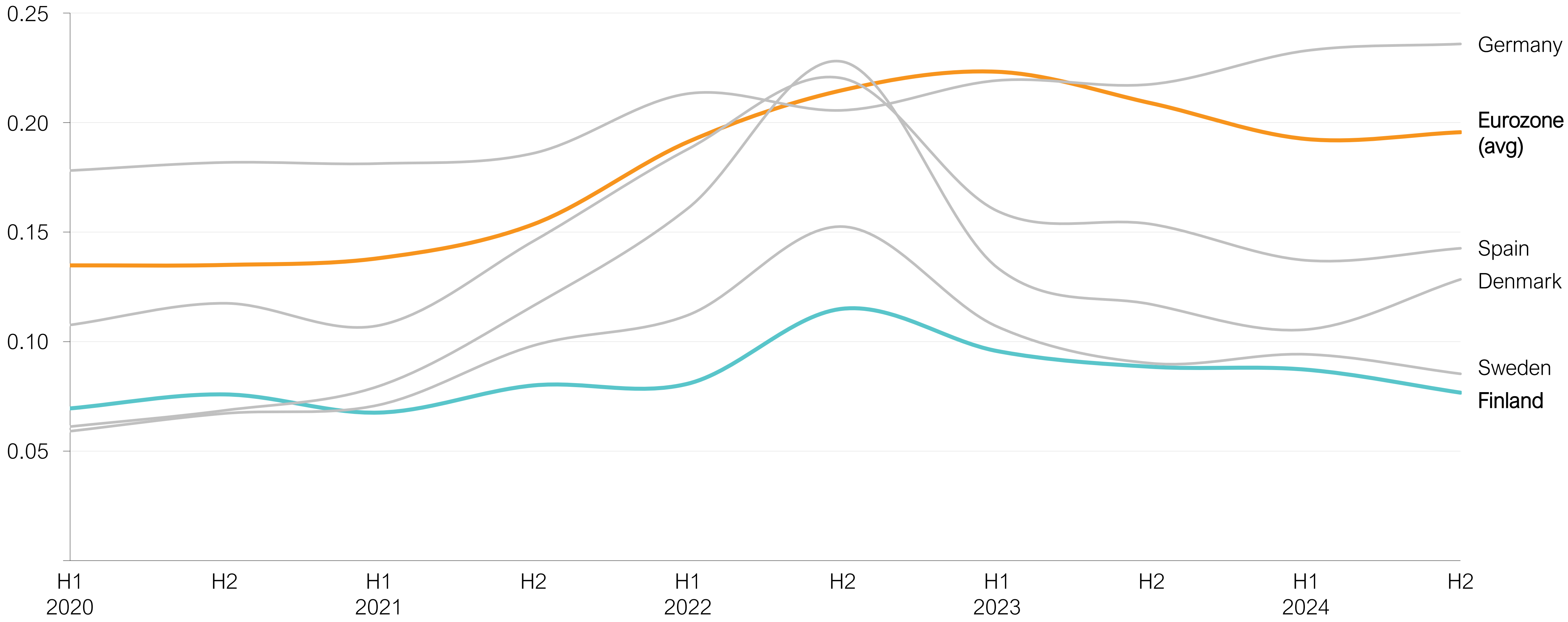
Finnish production accounts for 90%+ of the total European production of the above minerals.

Sources: Finnish Energy (Energiateollisuus ry)

Finland has cheap electricity, a strong energy infrastructure and significantly, cost-effective onshore wind power potential

Electricity prices for non-household customers[1]

Half-yearly average, €/kWh



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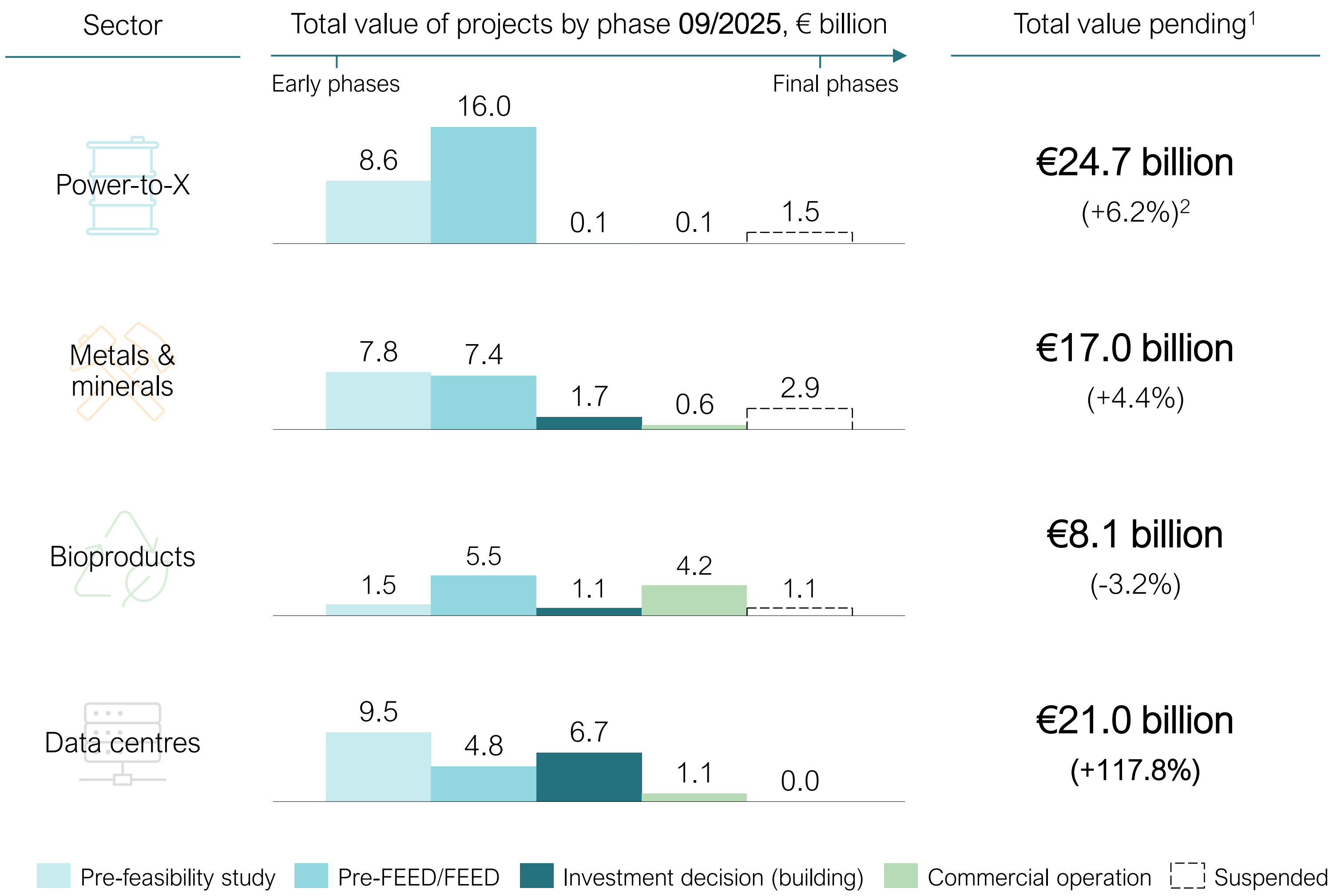
1) Industry, services, offices and agriculture

Source: Eurostat

A strong competitive advantage has generated an exceptionally robust investment pipeline across a wide range of sectors

- Through the data dashboard maintained by the Confederation of Finnish Industries (EK), you can find projects worth more than 300 billion euros, which, if implemented, will create significant opportunities for Finland.
- Tesi's own monitoring focuses on investments concentrated in value chains that are in line with industrial policy, to which Tesi also targets its own investment activities. The monitoring is largely based on data on the EK’s data dashboard , but has also been the subject of our own research.
- Despite the general economic situation, investment intentions have also developed positively in recent years and many projects are maturing towards an investment decision.
- The projects are moving at different paces and it is a long journey from the pre-feasibility study phase to the actual investment decision. Not all the blanks in the pre-feasibility study will progress to an investment decision.
- It is also worth noting that the total value of an investment is not the same as the added value that remains in Finland. This depends on the wider value chains, the degree of domesticity of the plants and the end product.



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1) Covers all projects from the pre-feasibility study phase to the investment decision phase
2) Change from the first quarter of 2025 (03/2025)

From the perspective of investors and other financiers, all value chains offer different return opportunities and risk profiles

For the progression of strong flow of projects to investment, funding needs to be in place from project development to construction. Each value chain has a different risk and return profile and funding logic. They are vulnerable to geopolitics and changes in the regulatory environment: matters which investors need to take into account in their planning. This can mean, for example, splitting investments into different phases, increasing the flexibility of contracts, and multilateral cooperation for sharing risks, for example through consortia.

Key withdrawals

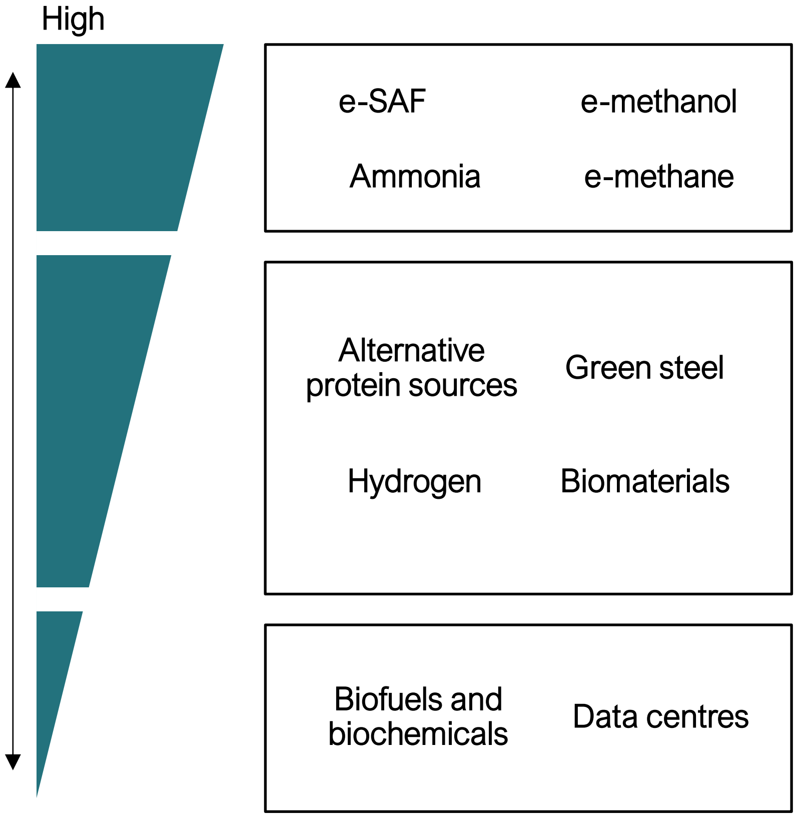
- Electricity prices and availability are key factors, especially for metals and P2X projects.
- Carbon tariffs, such as the EU’s Carbon Border Adjustment Mechanism (CBAM), and the EU’s Emissions Trading Scheme (ETS) create visibility for low-carbon industry margins.
- The interest rate tests the profitability of projects, but long-term PPAs and offtake contracts hedge cash flows.
- The state is able to support projects, particularly through guarantees, minority ownership and by speeding up the permit process, thus reducing capital costs in critical projects.

Investor's perspective

- Success requires regulatory stability and binding offtake agreements.
- The level of risk varies for different verticals.

Sector	Risk level	Product potential	Funding logic
Metals & Minerals (steel, aluminium, battery metals)	Medium (capital & licence risk)	~ 20-25% IRR (development stage; IRR = Internal rate of return)	Billion-dollar class project finance, industrial anchors + state guarantees
P2X	High (market & regulatory risk)	~ 25–30% IRR (development stage)	Strategic investors + EU Hydrogen Bank/IPCEI support, contract models (IPCEI = Important Project of Common European Interest)
Data centres	Low (technology proven)	~ 13-18% IRR (development stage)	Real estate investors/corporate balance sheets, long leases and Power purchase agreements (PPAs)
Bioproducts	Low-medium level (raw material price)	~ 15–20% IRR (development stage)	CAPEX for forest and energy companies; public pilot aid; infrastructure funds allow exit

Technological risk in industrial scaling



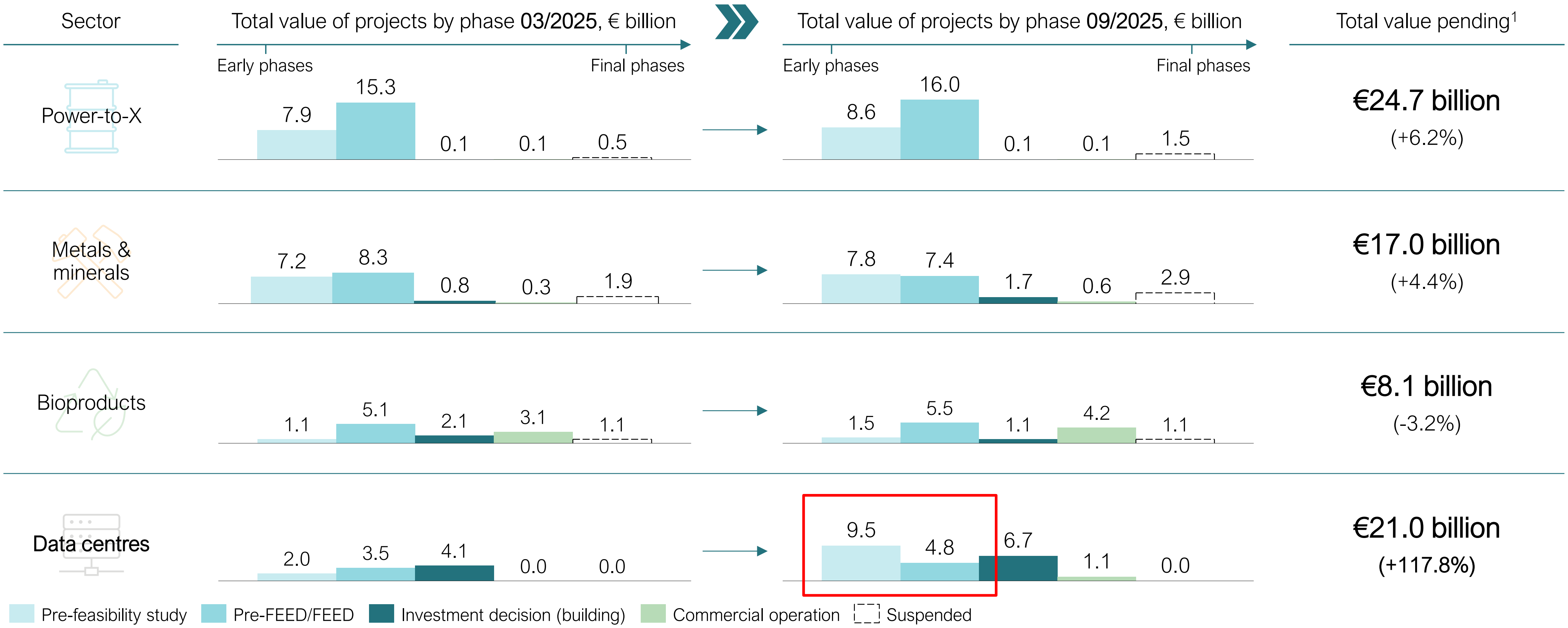
[1] Tesi research rounds 4 (3/2021),5 (12/2021), and 7 (11/2022), encompassing 574 medium-sized companies

Investment intentions have also increased despite the economic downturn and there has been significant growth in Q2–Q3/25

Development of the total value of industrial-scale projects by phase

Total project values by phase per sector 03/2025 and 09/2025, € billion

NOTE: The development of the total value is based on the figures reported by the EK, and published on a project-by-project basis. The changes do not necessarily always reflect the start of new projects, but also the fact that projects in the EK data panel have had their values updatedat the time of publication.



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1) Covers all projects from the pre-feasibility study phase to the investment decision phase

Source: *Data dashboard by EK: Green investments in Finland (09/2025)*

There have been differences in project progress by sector – data centres making extensive progress, manufacturing projects more uncertain

Major developments in the industrial-scale project field, Q2–Q3/2025

Suspended

CNGR and Finnish Minerals Group’s battery plant project in Hamina suspended

(two projects with a combined value of around €1 billion)

yle Etusivu Venäjän hyökkäys Sanapyramidi

Teollisuus

Kiinalaisyhtiö vetäytyy Haminan akkumateriaalitehtaan rakentamisesta

CNGR Advanced Material on suunnitellut akkumateriaalitehdasta Suomen malmijalostuksen kanssa.

Suspended

Hydrogen plant at e-factory in Simo to be shut down

(value about €1 billion)

yle Etusivu Venäjän hyökkäys Sanapyramidi

Energia

Iso vihreän polttoaineen tuotantolaitos jääkin rakentamatta Simoon

E-tehdas suunnitteli vihreän sähkön jalostuslaitosta, jossa oli tarkoitus tuottaa vetyä ja edelleen erilaisia polttoaineita. Hanke kaatui muun muassa biopohjaisen hiilidioksidin heikkoon saatavuuteen.

Investment decision made

A project that is larger than some has entered the construction phase:

Beijing Easpring's Kotka battery materials plant (value approx. €800 million); target for completion 2027

Microsoft's three data centres (Kirkkonummi, Vihti and Espoo); completion target for all three, 2027

HyperCoKouvola data centre (value approx. €1 billion; completion target 2026

Completed

Bilt Tek's Kemi data centre is completed and operational

(worth approx. €700 million)

yle Etusivu Venäjän hyökkäys Sanapyramidi

Talous

Kemin Veitsiluodon tehdasalueelle avataan iso datakeskus, joka työllistää 22 henkilöä

70 megawatin suuruisessa datakeskuksessa tehdään töitä keskeytyksettä ja vuoroissa.

Source: *Data dashboard by EK: Green investments in Finland (09/2025)*, *https://yle.fi/a/74-20153949*, *https://yle.fi/a/74-20164160*, *https://yle.fi/a/74-20123112*

Several steps have been taken in Finland to support and accelerate the flow of investments from initial ideas to investment decisions

Finland's actions to speed up clean transition industrial investment

Political measures

A predictable business environment is crucial for investment. Many projects are not yet commercially viable without regulation.

Regulatory uncertainty and change is one of the biggest risks for project developers and financiers alike.

- ✓ Finland's climate policy aims for carbon neutrality by 2035
- ✓ The Finnish government has tasked Gasgrid Finland with promoting the national hydrogen network.
- ✓ Finland's distribution obligation is more ambitious than the EU's RED III Directive.

Financial incentives

Competition for projects between the EU and the US is fierce. The Inflation Reduction Act (IRA) package has in part caused projects planned for Europe to move to the US.

In Finland, several projects have been interrupted in recent years. Grants from BF, the Ministry of Economic Affairs and Employment (TEM) and the Investment Bank (EIB) affect investment decisions significantly.

- ✓ The support programme of Business Finland (BF) for clean industrial investment started this year.
- ✓ BF's tax credit for large concerns is at least €50M for clean investment.
- ✓ Other measures, such as a lower electricity tax for industry, emissions trading and aid.

Permitting and zoning

Target land permitting is a key part of the investment decision. In Finland, the slow permitting process has delayed investment.

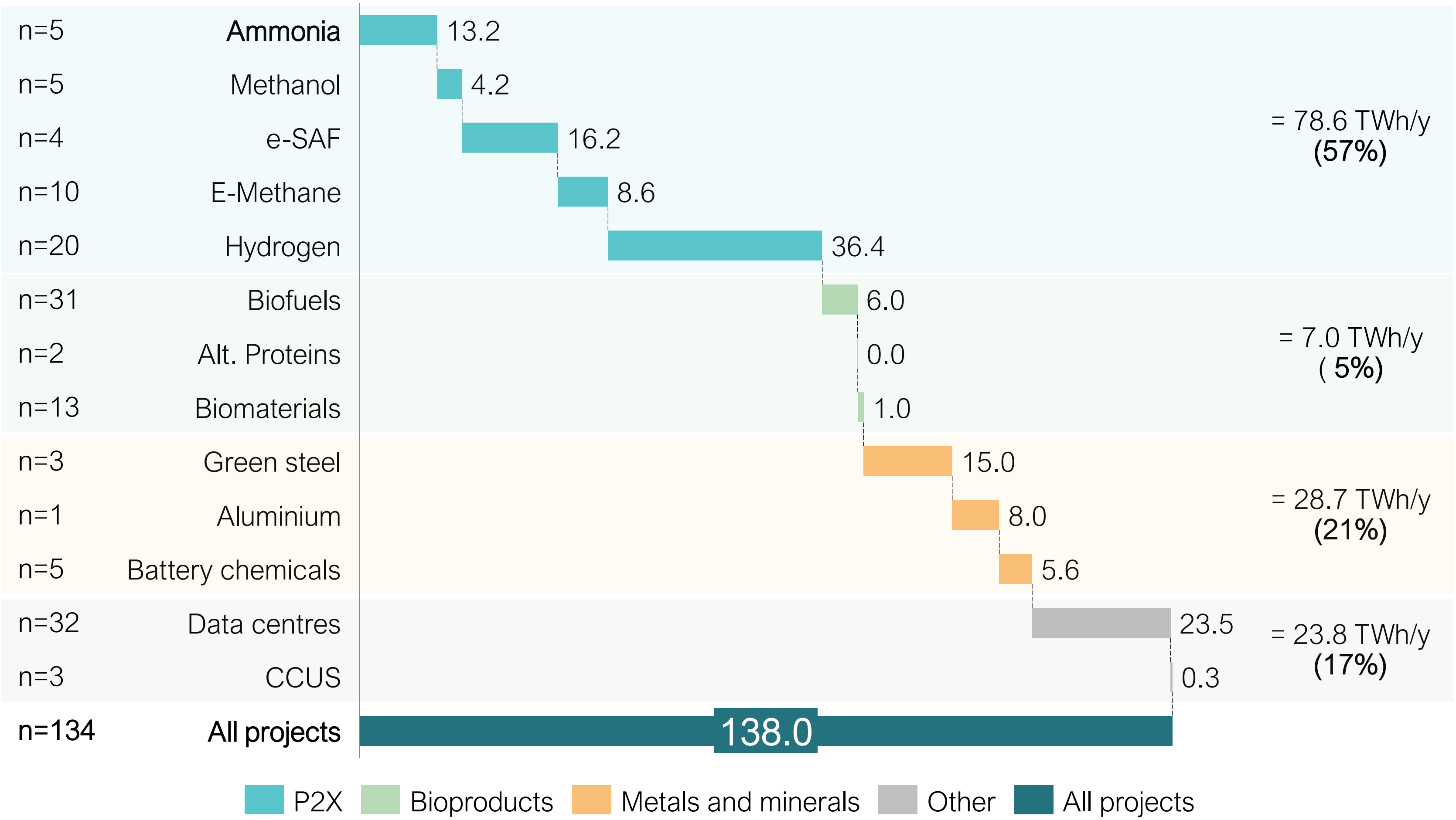
Permitting may be delayed by appeals process because of stakeholder groups who have no direct connection to the projects.

- ✓ From next year, environmental permitting will be centralised ("one-stop shop model")
- ⏳ There is government proposal for the issue of building permits for battery and hydrogen plants without zoning.

Overall, the challenge is one of industrial-scale electricity demand and supply – without projects, no new capacity will be built

Energy requirements by value chains[1]

Terawatt hours per year



- Although hydrogen projects have a particularly high energy requirement, they can be flexible in their consumption and thus introduce flexibility.
- Bioproduct plants cover their energy needs largely with process byproducts. They are even energy self-sufficient and can generate electricity for the grid - unlike most other heavy industries.
- Metal and mineral projects are very energy intensive and need a steady supply of electricity
- Data centres place a greater burden on the energy system than other projects

Note!

The following energy demand estimates are indicative and are based on published project-specific target capacities or production volumes. Energy demand estimates may change as projects progress, and some projects may not be completed at all. The energy requirement estimates presented also do not reflect the full future energy requirement of the value chains presented – only those pending projects for which production estimates are available are included in the image.

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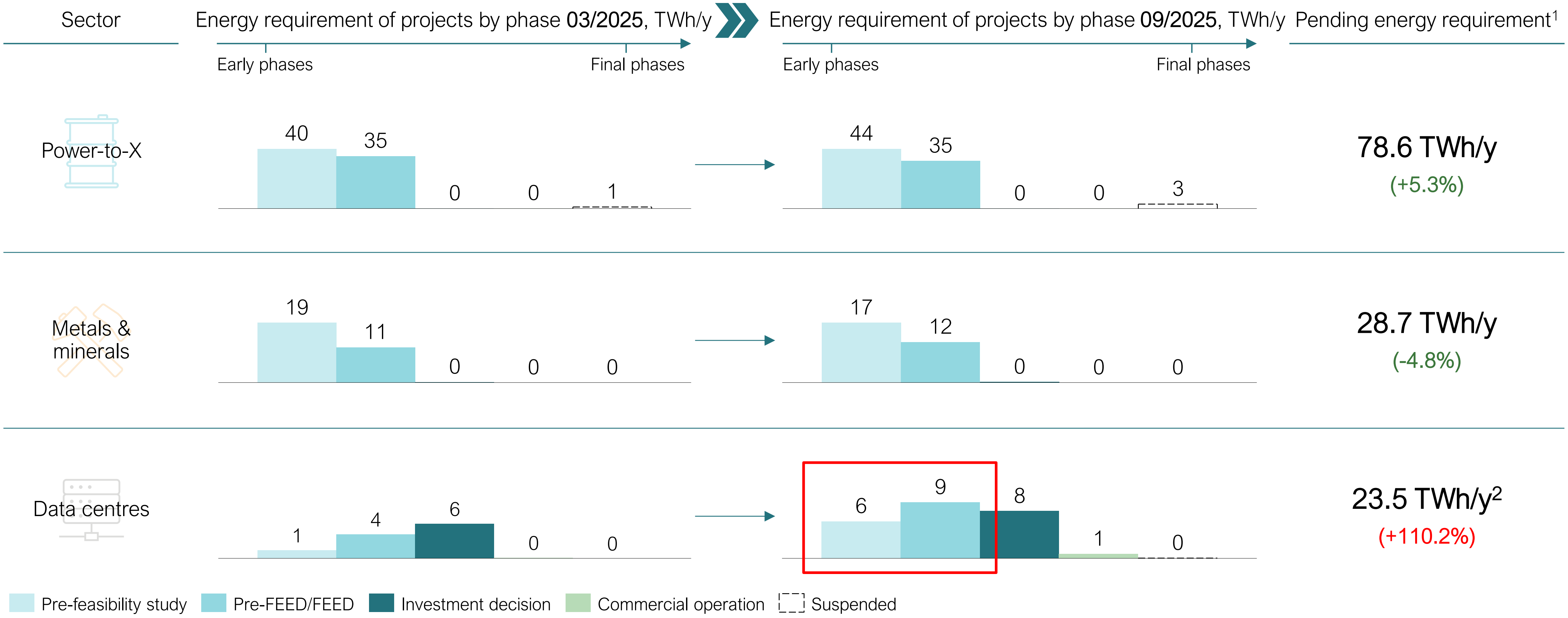
1) Note! Some projects will cover their own energy consumption with purpose-built energy production so that the pressure will not be fully on the Finnish energy system.

Source: EK's *Green Investments in Finland* data dashboard (September 2025); Tesi Asset Heavy report (Spring 2025)

A particular challenge is base load generation – metals and minerals, in particular, as well as data centres depend on a steady supply of electricity and "compete" for the same limited and more slowly scalable resource

Phase-by-phase development of energy requirement for industrial-scale projects

Terawatt hours per year



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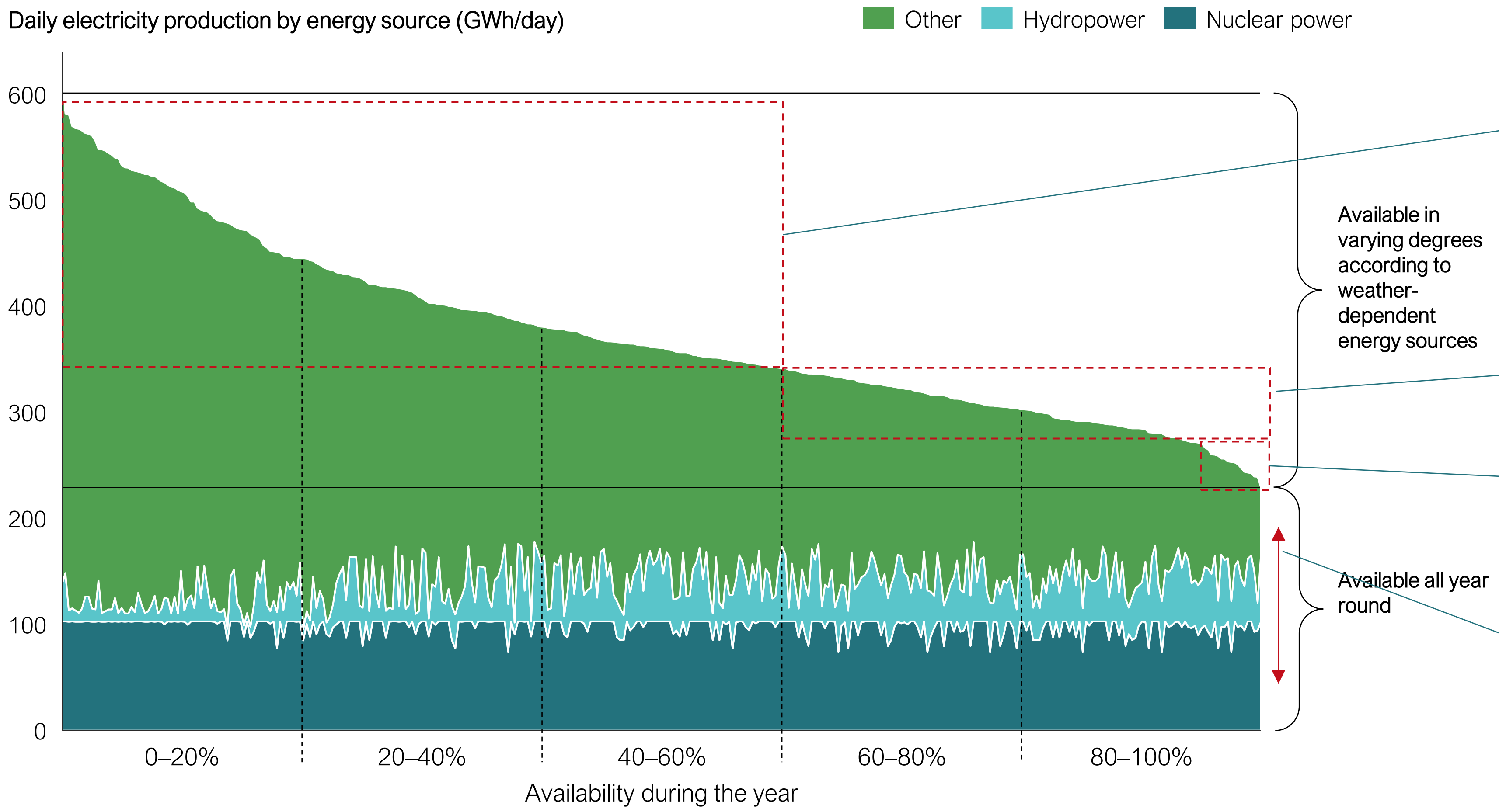
1) Covers all projects from the pre-feasibility study phase to the investment decision phase

2) Note! An estimate of the energy consumption of all data centres is not available – an overall estimate of energy consumption: 25-30 TWh/y

Source: *Data dashboard by EK: Green investments in Finland (09/2025), Tesi Asset Heavy survey, Spring 2025*

An insufficient base load could pose significant challenges in the future without active and coordinated measures

Daily electricity production profile for 2040 (largest to smallest energy production day)



Observations

- Finland's energy system provides industry with electricity that is both cheap and reliable electricity, but the availability of this **base load** is limited.
- **The potential of wind and solar energy:** Of electricity generated in Finland, the share of wind power has grown to around 20%, and the aim is to reach 50% by 2030.
- Most new investments, such as metal smelters, and hydrogen processing and data centres require a **year-round, reliable electricity supply**, i.e. sufficient base load capacity.
- The advantage of **hydrogen production in** the Finnish electricity system is that electrolysis plants can be designed to be *flexible* – hydrogen is almost the only industrial-scale process that can be shut down for hours or run at partial power, depending on wind conditions.
- **Storage and flexibility – challenges and opportunities:**
  - Solutions for large-scale energy storage are still being developed in Finland.
  - **Hydrogen** and other Power-to-X products can act as *chemical storage*: hydrogen produced from excess electricity can be stored and used later for energy production or industrial needs.
  - To secure **peak capacity**, it has been considered necessary to develop *flexible generation*, such as fast-starting gas turbines or biofuel power plants that can make up for production shortfalls during cold and quite periods. The necessary investments are significant. These hours result in “expensive” price spikes.
  - **Demand response** plays an important role: large electricity users are encouraged to adjust their consumption based on hourly and daily price signals. Together, consumption flexibility and storage help smooth price spikes and maintain market stability when there are variations in renewable production.

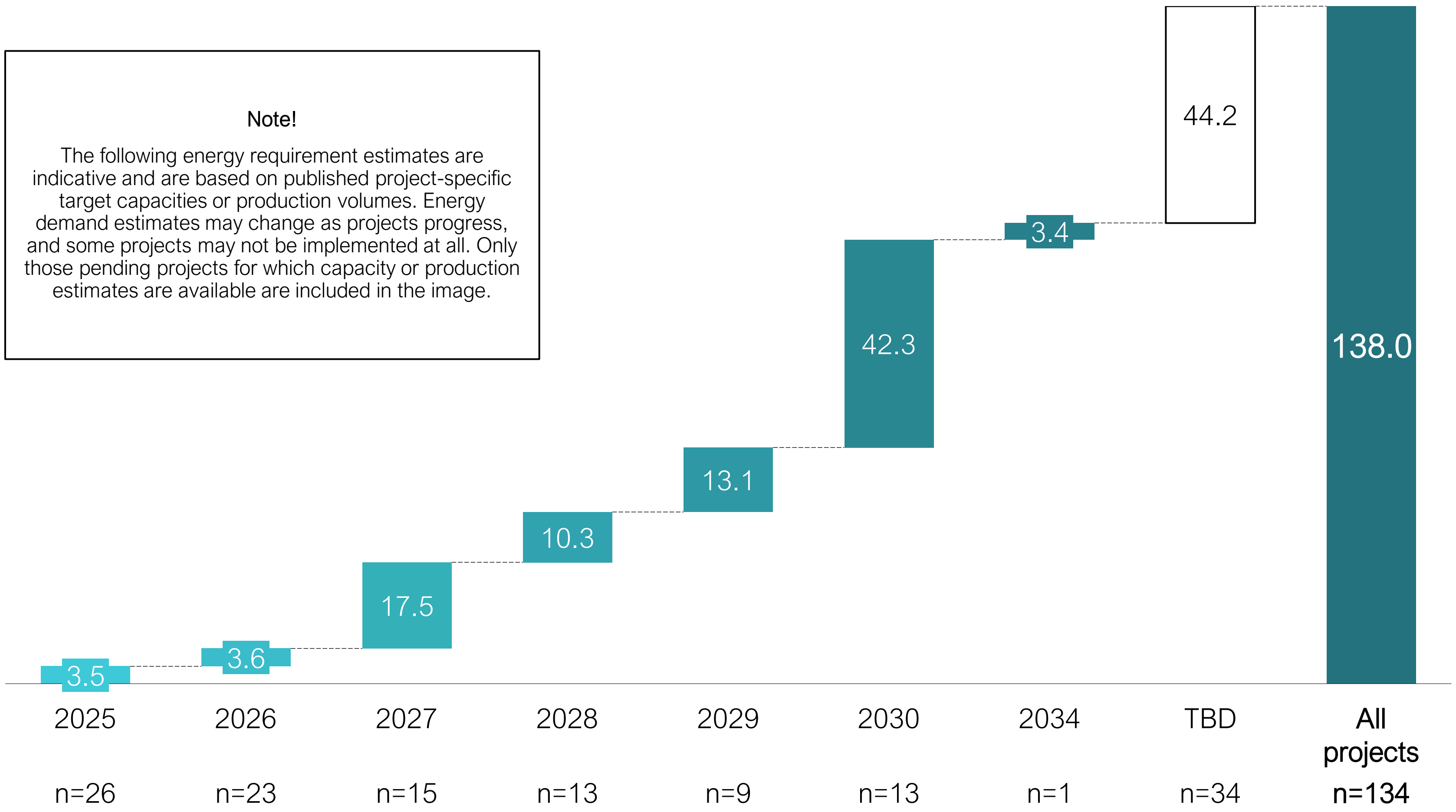
The total energy requirement of the projects is projected to be realised steadily over the coming years

The estimated energy requirement pe year

Terawatt hours per year

Note!

The following energy requirement estimates are indicative and are based on published project-specific target capacities or production volumes. Energy demand estimates may change as projects progress, and some projects may not be implemented at all. Only those pending projects for which capacity or production estimates are available are included in the image.



Conclusion

- Looking at new industry alone, the projected increase in electricity demand will be significant. In order to obtain a complete overall picture, an assessment of the needs of existing industry should be included.
- Several different estimates of electricity adequacy have been made – overall forecasting is very difficult and the picture changes regularly. However, it is unlikely that all projects will be completed within the planned timeframe
- In our view, the main priority is to be able to strategically increase peak capacity in order to avoid sharp price spikes. This will allow better exploitation of wind energy potential and, correspondingly, reduce negative external effects (externalities).

Source: The EK's *Green Investments in Finland* data dashboard (September 2025); Tesi Asset Heavy report (Spring 2025)

Tesi’s role

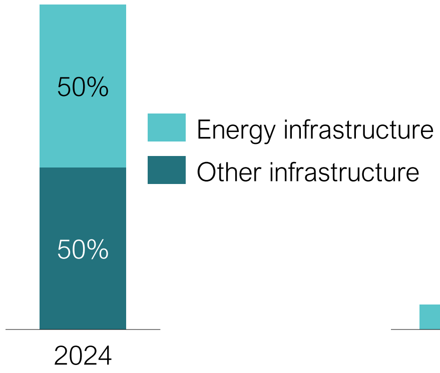
Demand drivers for industrial-scale projects are linked to growth in energy transition

From an investor's perspective, the energy transition has strong global demand drivers:

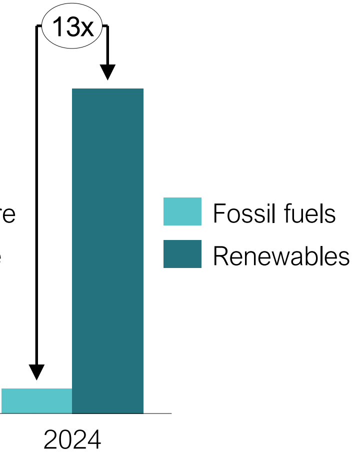
- Growing demand for electricity (electric cars and heating) and digital infrastructure (data centres and artificial intelligence).
- Geopolitics drives countries towards energy security and industrial competitiveness.
- Renewable energy (wind and solar power) is the cheapest form of energy. Electricity from onshore wind and solar power is around 50% cheaper than fossil energy.
- Renewable energy is the fastest way to scale up energy production. Development of wind and solar power takes 1–2 years and is about 3x faster than fossil energy production.
- There are many untapped areas in different countries to scale up renewable energy production

Strong demand drivers through energy transition

Global infrastructure investment energy vs. others



Global investment in the energy sector



Regulation is progressing, but is developing slowly

EU demand drivers are based on future fines; on other continents demand is based on investment tax aid

National application of the Renewable Energy Directive (RED) III causes delays in implementation

Source: Copenhagen Infrastructure Partners, Tesi's analysis, ChatGPT

Industrial-scale projects offer many investment opportunities, and there is a little capital available

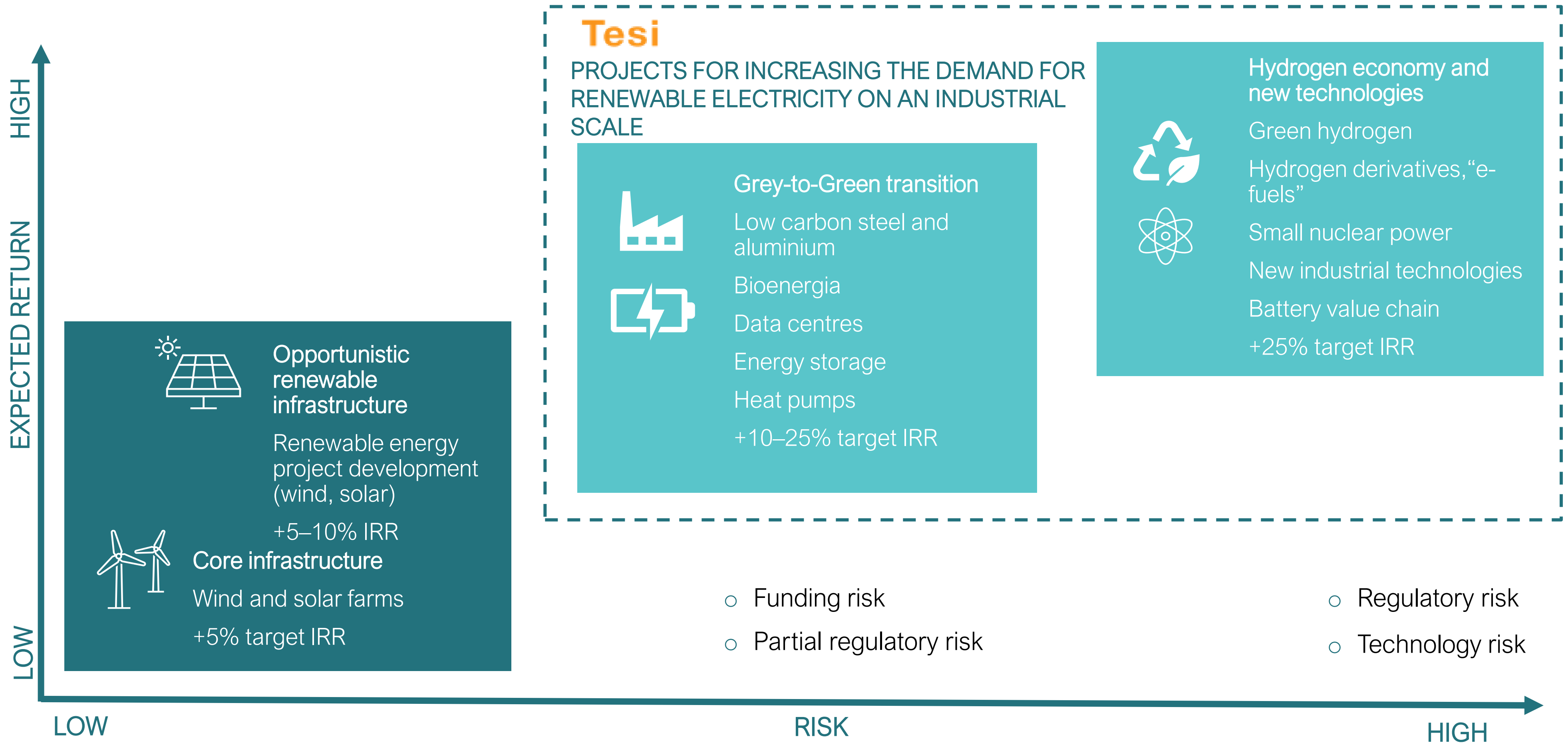
Investment opportunities for industrial-scale projects

Tesi's vision

Sector	Total value of pending projects	Market opportunity	Capital demand vs. supply	Conclusion
Power-to-X	€24.7 billion	Several projects; focus on project development; first Final Investment Decision (FID) phase opportunities	Undersupply of capital	Good access to projects; attractive risk/return due to lack of capital
Metals & minerals	€16.6 billion	Highly concentrated, single large projects; future opportunities will focus on the FID phase	Large-scale capital undersupply is a challenge	Good access to projects, attractive risk/return due to capital requirements
Bioproducts	€7.9 billion	Decentralised, smaller group of projects	Capital available for energy projects: undersupplied to growth companies	Good access to projects, attractive risk/reward in the bioenergy segment
Data centres	€19.5 billion	Several large projects; wide range of developers and operators	Oversupply of capital	Investors have access mainly to smaller projects or development companies while large operators finance data centres themselves

Tesi's investments in industrial-scale projects are in high value-added projects that increase the demand for renewable energy

Expected risk and return between projects



PROJECTS FOR INCREASING THE DEMAND FOR RENEWABLE ELECTRICITY ON AN INDUSTRIAL SCALE

Opportunistic renewable infrastructure

Renewable energy project development (wind, solar)

+5–10% IRR

Core infrastructure

Wind and solar farms

+5% target IRR

Grey-to-Green transition

Low carbon steel and aluminium

Bioenergia

Data centres

Energy storage

Heat pumps

+10–25% target IRR

Hydrogen economy and new technologies

Green hydrogen

Hydrogen derivatives,"e-fuels"

Small nuclear power

New industrial technologies

Battery value chain

+25% target IRR

- Funding risk
- Partial regulatory risk

- Regulatory risk
- Technology risk

Tesi seeks continuity across funding rounds and a role of minority investor

Investment criteria and the role of Tesi

Investment criteria

- Capital-intensive investment projects on which there are a clear emission reductions and an increased demand for renewable energy
- Long-term commercial agreements (offtake, PPA) that guarantee predictable cash flow
- Industrial or financial lead investor; continuity across funding rounds
- The technology is often not scaled up to the commercial category, but it must be proven

Tesi's role

- Tesi is a minority investor in the development and construction phase of projects
- Investing in Finnish or foreign companies developing industrial-scale projects in Finland
- Investments can be made in a TopCo or a project company (special-purpose vehicle, SPV)
- Tesi's investments in individual projects will increase as project development succeeds

Minority investor	Lead investor(s) 80-90%	10–20%
Tesi's role	Share of lead investors	Tesi's share of the round
€5–50M	Expected portfolio return, IRR ~15–20%, 2.5x	50–1,000+ M€
Size of Tesi's funds	Expected return	Investment in projects
Projects that increase the demand for renewable energy	Scaling up of proven technologies	Industries with a high emission reduction potential
Impact	Technology risk	Industries

Why Tesi invests in industrial-scale projects

Challenge	Description	The role and objectives of Tesi
The chicken and the egg problem in the value chain	○ Clean transition investment opportunities are focused on renewable energy (wind and solar power) generation, which will not proceed without industrial-scale electricity demand projects	○ Tesi invests in major renewable energy projects that increase the industrial demand for electricity
Lack of capital, especially in the early stages	○ The timeline for industrial-scale project development can be several years. Project development involves significant risks with economic forecasts and permitting. There is a bottleneck in the funding of a first-of-a-kind facility.	○ Tesi takes risks at the project development stage and at the investment decision stage. Investment size increases as project risks decrease.
Attracting foreign investment to Finland	○ Project credibility and local acceptability may suffer without domestic anchor investors.	○ Tesi acts as a domestic anchor investor and as a beneficial owner in industrial-scale projects.
Building new value chains	○ In Finland, clean transition projects focus on future technologies, such as green hydrogen, whose value chains are developing. ○ Cooperation between market players and special government funding bodies (Business Finland, Finnvera).	○ Tesi builds a situation snapshot of industrial-scale projects. ○ Creating new industrial value chains in Finland (hydrogen, low-carbon metals).
Attractive risk/return ratio	○ Attractive returns due to capital undersupply ○ There is a possibility to structure the risk profile according to the project phase. ○ Risks are concentrated on capital needs and implementation, less on technology.	○ Creating a decentralised portfolio of industrial-scale projects 2025–2030. ○ Portfolio-level return target 15-20% IRR.

Project development

Progress of industrial-scale project development

■ Phase ■ Gate

Project report (Feasibility study)

Pre-feasibility study

- Determining the locations
- Project planning at high-level
- Investment estimates are rarely available at this stage

Pre-feasibility study (Pre-FEED)

Early stage project study

- Pre-feasibility studies on access and availability of raw materials
- Concept-level technical assessments
- Preliminary assessment of financial eligibility

Project report (FEED)

Actual project planning

- Precise technical design or planning
- Preparing partnerships and funding
- Permitting

Investment decision (FID)

Investment decision

- Decision stage: whether or not to proceed ("go/no-go")
- Comprehensive assessment of the technical and economic feasibility of the project
- Funding finalised and commitments confirmed
- Permits and agreements (e.g. offtake, connections) are sufficiently certain or ready
- Partners responsible for implementation selected

Construction

After completion (Commercial Operations Date, COD), the plant is transferred to commercial operation

Project development typically takes 1–5 years

	Project report (Feasibility study)	Pre-feasibility study (Pre-FEED)	Project report (FEED)	Investment decision (FID)	Construction
Share of total project funding	~1–3%	~2–5%	~4–10%		~100%
Example budget:	*< €5M*	*~ €10–25M*	*~ €25-75M*		*~ €1,000+M*

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1) FEED = Front-end Engineering Design, 2) FID = Final Investment Decision, 3) COD = Commercial Operation Date

Key aspects of project funding for industrial-scale projects

Project development phases	Things to note	Value creation	Potential risk
Location and grid connection	• Site selection, brownfield vs. greenfield • Ensuring grid capacity	Securing a plot of land in the initial phase Availability of connection	Land ownership Delays with grid connection
Permitting	• Zoning • Environmental permits • Building permit	Completion of the zoning and permitting process as part of FEED	Political risk Complaint periods Binary risk, authorisation comes or not
Buying electricity	• Power Purchase Agreement • Base load vs. production flexibility	Largest single Opex driver Possible demand response	Bankability of the value chain Timetable delays
Raw materials	• Scalability and pricing • Long supply chains	Ensuring the supply of raw materials	Project by project risks New Technologies (Carbon capture and utilisation, CCU)
Planning and procurement	• Capex reliability • Planning and plant integration • EPC vs. EPCM	Capex control Risk sharing, plant performance Technology guarantees	Project delays Capex overruns Responsibility sharing
Offtake agreements	• Pricing and commitment • Duration in relation to capital structure liabilities	Key bankability driver	Offtaker bankability CPs related to the contract
Investment subsidies	• Possible investment aid on a local and EU level	Revenue-raising effect	Deadlines for investment subsidies Model performance without aid
Funding	• A financial or industrial lead investor with the ability to supply finance over various rounds	Project development premium	Financial viability and bankability
Team	• Team track record • Scaling up and engaging	Moving from initial fundraising to project implementation	Over-dependency on a key person

The locations of industrial-scale projects are concentrated on renewable electricity generation, industrial parks and ports

Industrial investment project development

Key issues for location

Choice of location

- **Site reservation, grid connection and permitting will be initiated during the project study phase.**
- A zoned industrial plot will speed up the project, as no zoning change is needed and the infrastructure is in place (brownfield vs. greenfield).

Grid connection

- **The capacity of the electricity grid varies from region to region**, which affects the implementation of investments. For example, in Southern Finland, connections exceeding 10 MW are currently subject to temporary restrictions.
- Electricity production is concentrated on the west coast, while most consumption is in southern Finland. This causes bottlenecks in transmission capacity.

Other connections

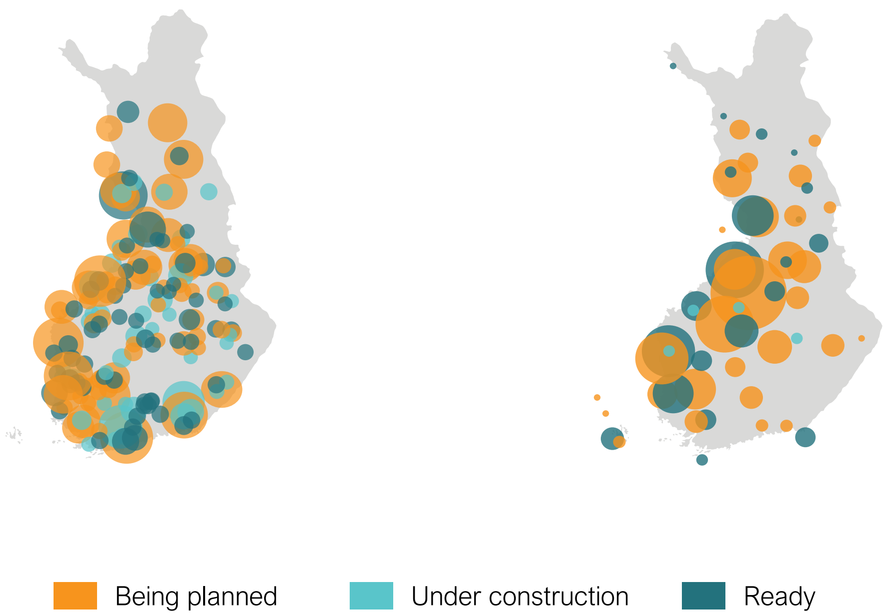
- **The project developer is responsible for covering the costs associated with the grid connection**
- The procurement of other connections, such as water and gas networks, depends on the project.
- Waste heat from hydrogen plants and data centres can be used in a district heating network.

Electricity demand – clean transition plant investments

EK data dashboard, 2025

Electricity supply – wind power investments

Renewables Finland, 2025



Source: Fingrid (5/2025), Data dashboard by EK: *Green investments in Finland (06/2025)*

Long-term power purchase agreements (PPAs) are used to hedge against fluctuations in electricity prices

Industrial investment project development

Key issues for the PPA

Pricing and delivery volumes

- **A PPA is a power purchase agreement in which a large electricity user commits to buy power at a price agreed with the generator**. The price of electricity can be fixed, indexed or set at a minimum and maximum price. It is essential for the financier to understand how the electricity price defined in the PPAs compares to the market price outlook.
- PPAs allocate imbalance risk between the parties in different ways. In a baseload model, the seller commits to a fixed delivery profile and is responsible for deviations. In a pay-as-produced model, the buyer purchases the actual production and thus bears the risk of fluctuating production. The pay-as-nominated model is an intermediate model in which the seller bears the risk of deviations.
- A key challenge is the limited availability of baseload supply, which drives PPA prices higher as demand increases.

Dependency risk of projects

- **A PPA must be secured before FID.** This creates a dependency risk, as delays in the wind farm may postpone the investment in the associated installation.
- EU additionality requires that the renewable electricity used in green hydrogen comes from generation capacity that was commissioned up to three years before the hydrogen plant.

Counterparty risk

- **A PPA contract for a large single industrial project can be worth hundreds of millions of euros.**
- The PPA removes the electricity price risk, but introduces a counterparty creditworthiness risk plus the risks associated with long contract duration.
- In addition, there are the other risks of a wind energy project, such as development risks.

Example of PPAs for industrial projects

Electricity producer	Capacity	PPA volume	COD	Delivery volume
Wind power	243 MW	635 GWh	2025	Pay-as-produced
Wind power	51 MW	110 GWh	2025	Pay-as-produced
Solarpower	180 MW	165 GWh	2027	Pay-as-nominated
Wind power	450 MW	650 GWh	2025	Pay-as-nominated

1) PPA = Power Purchase Agreement, 2) COD = Commercial Operation Date

Key value creation and risks in the project development are related to permitting

Industrial investment project development

Key issues for permitting

Permitting risk

- **The permitting process represents a binary risk at the project development stage – without permits, the project will not proceed to an investment decision.** The bankability improves when there is no permitting risk.
- The involvement of local stakeholders often improves local acceptance of the project (“social operating permit”).
- In Finland, the challenge has been multi-stage permitting, which has slowed down investments. The Finnish government has proposed measures to speed up the permitting process. Starting in 2026, the “one-stop shop” principle, will be applied to environmental permitting.

Permitting stages

- **The time required for permitting varies from project to project. Some permits are treated as overlapping. Possible appeal processes will lengthen the timeframe.**
- The permitting process is initiated during the development phase. It typically starts with an Environmental Impact Assessment (EIA), which looks at the project's impact on biodiversity and the habitat of local residents.
- Zoning can often be initiated in parallel with the EIA. If the project is located on an existing industrial plot, a separate zoning change is usually not required, which speeds up the process. Chemical and building permits are applied for closer to the the investment decision.

Industrial project permitting

EIA and environmental permit	Zoning	Chemical permit	Building permit
~18–24 months	~12 months	~6–12 months	~6 months
right of appeal +6–12 months	right of appeal +6–12 months	right of appeal +6–12 months	right of appeal +6–12 months

Source: Finnish judiciary (2024), Confederation of Finnish Industries (Investment report, 2022)

Supply chain risks should be taken into account when sourcing raw materials

Industrial investment project development

Key issues for raw material sourcing

Key issues

- Ensuring profitability and contract structure
- Ensuring raw material availability and industrial scalability
- Long value chains and supply chain dependency
- Hedging against price risk, if possible
- The introduction of new technologies, e.g. carbon capture, may require new economic incentives

Green hydrogen and e-fuels

- **The electricity price, availability and grid connectivity need to be verified early on.**
- CO2 capture and the PPA pose a dependency risk - the success of the project depends on the progress of other projects.
- The biogenic CO2 must be clean. It is often captured from the flue gases of a third-party power plant.
- Electrolysis requires large quantities of water.
- Short transport distances are crucial when choosing the location of a plant.

Metals and minerals

- **Electricity is the largest expense. Without a competitive electricity price, the project is not viable.**
- A strong grid network is crucial for meeting the high demand for electricity.
- A port connection is essential for many projects.
- For critical minerals, the upstream part of the value chain (i.e. mining) is located in Finland, but the processing is mainly done elsewhere.
- In base metals (steel, aluminium), the early part of the value chain – such as ore production and primary processing – is concentrated outside Finland, which lengthens the value chain to the factory.

Bioproducts

- **Biomass availability and processability varies.**
- The developer need to assess whether other projects in the region are competing for the same resources.
- The broader adoption of biofuels is constrained by limited access to bio-waste feedstocks.
- Advanced biofuels are made from waste and residues. Traditional biofuels made from crops are more restricted as they may compete with food production.
- EU regulation makes it more important to verify the origin of raw materials (e.g. RED III).

Planning must include preparation for Capex overruns and schedule delays

Industrial investment project development

Key issues for planning

Delivery models

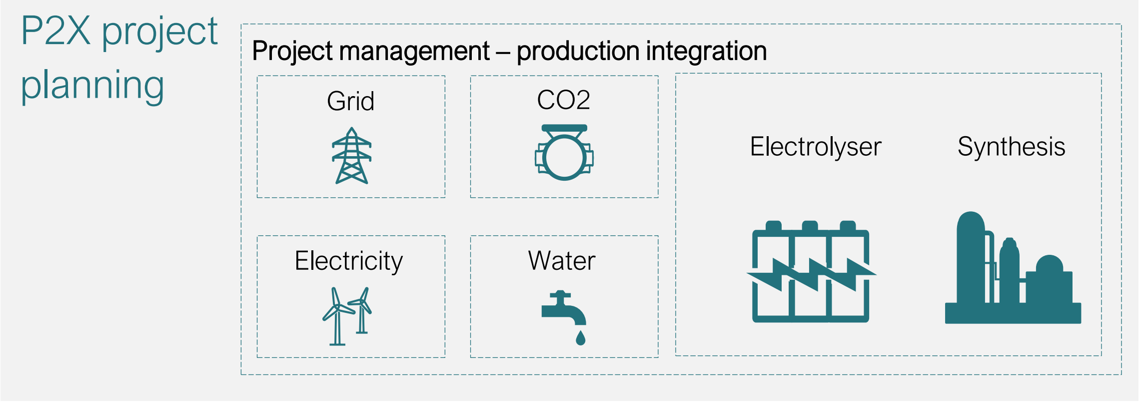
- **Industrial plant projects are typically realised using with the EPC or EPCM models, where the responsibility and risks are shared differently between the developer and the contractor.** It is important to choose a contractor who can deliver the project on time.
- Under an EPC (*Engineering, Procurement and Construction*) model, a single contractor is responsible for project design, procurement, and construction.
- Under an EPCM (*Engineering, Procurement and Construction Management*) model, the contractor is responsible for engineering and project management, while the project developer enters into direct contracts with equipment suppliers and construction contractors.

Capex overruns

- **The cost estimate of the project must be realistic and include a sufficient risk reserve to cover unexpected costs.** It is essential for the financier to understand how project delays and changes in Capex affect the expected return.
- It is more the norm than the exception for initial investment estimates to be exceeded, reflecting project scale, extended development timelines, and the first-of-a-kind nature of such projects.

Equipment contracts and guarantees

- **Bankability is enhanced by well-known equipment suppliers.**
- Debt financiers require performance guarantees to mitigate technical risks, especially if new technologies are used (such as electrolysers in P2X projects).
- The scope of guarantees may range from coverage limited to the technology licence to guarantees encompassing the full equipment supply.



P2X project planning

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1) FOAK = first of a kind project

In industrial projects, revenue is secured through long-term offtake agreements

Industrial investment project development

Key issues for offtake

Financier's or donor's perspective

- **Offtake agreements are negotiated before the FID, so that the producer can be sure of sufficient demand.** Without a long-term sales agreement the project will not be eligible for debt financing. From the perspective of financiers, key questions include;
  - Is the price point sufficient to provide the project with sufficient revenue for debt service and operational costs?
  - Do buyers pay the full amount agreed (take-or-pay) or the deliveries made (take-and-pay)?
  - Does the term of the offtake agreement cover the maturity of the debt?

Pricing and contract models

- **There are several pricing models:** a fixed price, an indexed price, and an open-book model where a fixed percentage of the producer's profit is set.
- In a **take-or-pay** model, the buyer pays the agreed amount regardless of whether it accepts delivery; the producer gets a strong guarantee of a revenue stream. In the **take-and-pay** model, you only pay for the amount received.

Risks

- A key risk is the absence of secured offtake agreements. Market conditions remain challenging, with a large number of projects competing at early stages of development.
- The risk of default is reduced by contracting with highly creditworthy parties.

Example ofan industrial project offtake agreement

Option 1: a single buyer acquires the total production of the plant

Buyer	Amount	Credit rating	Model contract
🚚 Road transport	200 kt/a	High	Take-or-pay

Option 2: offtake portfolio with multiple buyers

Buyer	Amount	Credit rating	Model contract
🚚 Road transport	80 kt/a	High	Take-and-pay
🚢 Maritime transport	60 kt/a	Mediocre	Take-and-pay
🚢 Maritime transport	60 kt/a	Low	Take-and-pay

Investment subsidies support the implementation of clean transition projects

Industrial investment project development

Key issues for investment aid

Financier's perspective

- **Investment subsidies are intended to supplement private financing.**
- Subsidies can speed up commercialisation and reduce risks for financiers. Key questions for financiers include:
- Is the project viable without subsidies?
- How do investment subsidies affect profitability and expected returns?
- Are there any conditions attached, for example in terms of the progress of the project?

Eligibility for subsidy

- Grants can have a validity period, i.e. they expire if the project does not progress within the set timeframe. This should be taken into account in the project schedule.
- The applicant submits a project plan and cost estimate. The application often demonstrates the emission reduction potential, technical feasibility, commercialisation and the impact on employment and regional development.

Examples of subsidies available for Finnish projects

Granting authority	Content of the subsidy
EU hydrogen bank	Supports the production of green hydrogen by paying a premium to producers. €2 billion has been earmarked for the hydrogen bank.
Innovation Fund	The Innovation Fund provides grants for projects with significant CO2 reduction potential.
Business Finland	Investment grants of more than €30M for clean transition projects.
Business Finland	Large clean transition investments of more than €50M can apply for a tax credit.
Ministry of Economic Affairs and Employment	RePowerEU is EU support for clean transition investments. TEM manages the aid in Finland.

A clear funding path creates continuity for the project across cycles

Industrial investment project development

Key issues for funding

Traditional funding challenges in Finnish projects

- **Typically, the ability of investors to finance the project has been inconsistent.** New lead investors are needed for large construction phase rounds.
- Finland has very little experience of large investment projects worth hundreds of millions of euros outside listed companies.

Financier's or donor's perspective

- **A lead investor adds credibility and expertise to the project.** Local anchors attract international capital. Offtakers and technology providers may also play a role in the first investment rounds.
- **The project must have a credible funding path and continuity across cycles.** The financiers of the project development phase are able to finance a significant part of the larger Capex round.
- **Risk-sharing models enable the gathering of large funding rounds**. Investors can share the risks of the project development and FID phase.

Examples of European investment programmes

Programme name	Programme content
TIBI – France	€6 billion investment programme for growth companies. By 2024, 35 investors and 92 funds were involved. Investors include public actors, large companies, VC funds and institutions.
WIN – Germany	Launched in 2024, the initiative will channel €12 billion to growth funding between 2025 and 2030. The project is being led by the KfW development bank (the German equivalent of Tesi) together with insurance companies, large companies, public bodies and banks.
Finland next?	There are many clean transition projects in Finland, but their implementation is slowed down by a lack of domestic funding. One solution could be a national investment programme.

Expected returns and key risks of industrial-scale project development

Project development phase (Pre-FEED & FEED)

Expected return and risks

Expected return

- The expected return on project development is based on the project development premium at the end of project development
- Key value chain milestones include grid connections, zoning and permitting, and completion of the FEED study
- Possible exit window for the FID funding round
- Expected return on industrial seed investments +25–30% IRR

Risks

- Delays in project development and the resulting need for further funding
- Long permitting processing times
- Availability of offtake agreements
- Investors' ability to finance the project beyond the Devex rounds
- Possible changes in regulation over time
- Devex overruns
- In the event of project failure and likely loss of capital, a liquidation preference structure can be used as a partial hedge

Investment decision phase (FID)

Expected return and risks

Expected return

- The expected return at the investment decision stage is based on the cash flows of the plant and the lower expected return of a de-risked plant
- Infrastructure-style risk/return ratio; turnover based on long-term contracts and key inputs
- Exit 2-3 plant years after construction if involved in the project development phase, or alternatively a longer dividend yield based holding period
- Expected return at FID ~12–25% IRR depending on the industry

Risks

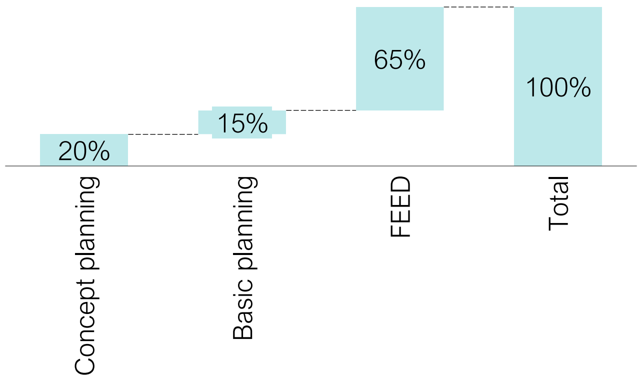
- Investor coherence
- Capex overruns
- Project management and responsibility sharing
- Performance risks, lower than expected utilisation or production disruptions
- Higher unit costs, changes in market prices of final products
- Breach of covenants related to debt financing

Distribution of the cost and revenue structure of a P2X project at different stages of its life cycle

Indicative example of P2X project cash flows

Project development (Devex)

Duration of the design phase: 1–5 years



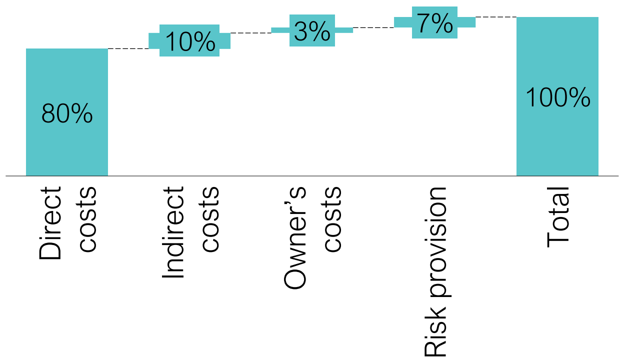
Devex often represents ~2–5% of the total project investment. A typical investor return is ~20–30% IRR.

Pre-feasibility study:
- Start of permitting and EIA
- Securing connections
- Economic planning
- Preliminary assessment of Capex

Project report:
- Technical planning
- Securing of funding
- Project agreements
- Offtake agreements

Construction phase (Capex)

Duration of the construction phase: 1–3 years



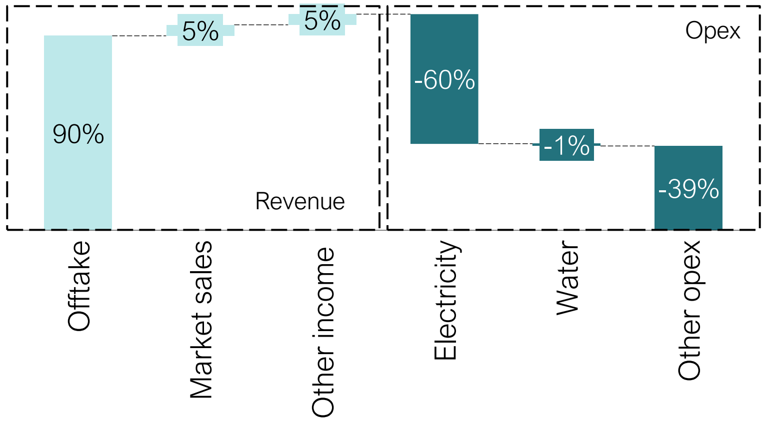
Capex ranges from hundreds of millions to billions. The investor's expected return is ~12-25% IRR.

Direct costs:
- Electrolyser
- Process equipment
- Pipework/pipelines and connections
- Buildings and infrastructure

Indirect costs:
- Project agreements
- Due diligence costs
- EPC or EPCM model
- Risk provision

Operational activities

Duration of the operational phase: 30+ years



A long-term offtake agreement creates a base for a predictable revenue stream. Electricity is clearly the largest single item of operational costs.

Return (yield) structure:
- Offtake sales
- Sales to the spot market
- Sale of secondary products

Cost structure:
- Electricity and other inputs
- Operation and maintenance
- Personnel costs

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