

Emerald Horizon

Pitch Deck

March 2024

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Current Market Environment

Current macroeconomic shifts will accelerate the transition to greener & more sustainable energy

Energy Markets

- The combination of high and volatile energy prices is inflicting economic strain on households and businesses alike.
- These fluctuating costs not only pose financial challenges but also hinder sustainable progress towards achieving universal access to energy.
- The resulting economic price is prompting a shift in the choice of energy sources but also an acceleration of renewable deployment.



Energy Policy

- In response to immediate supply concerns and to safeguard consumers, governments in the US, EU, and other regions have implemented short-term measures and long-term goals.
- Short-term measures shift towards proactive policies aimed at bolstering investments in clean energy and efficiency.
- Long-term goals have been set to secure a resilient, clean and independent energy supply.



Energy Trade



- European sanctions on coal and oil imports, coupled with Gazprom's decisions to curtail gas supply, have collectively sparked a significant reshuffling of trade flows around the world.
- Furthermore, mounting pressure from the electorate in the US results in a postponement of export permits for natural gas.

Economic Impact



- The persistent surge in fossil fuel prices has exerted upward pressure on inflation and interest rates introducing tight financial conditions.
- Simultaneously, the confluence of diminishing real incomes and escalating prices not only accentuates financial strain for individuals but also raises the spectre of a looming global recession.

Source: IEA World Energy Outlook, PwC/Strategy& Analysis

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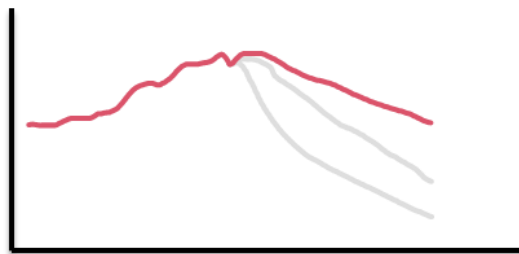
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Technologies are required – and available – to meet climate goals

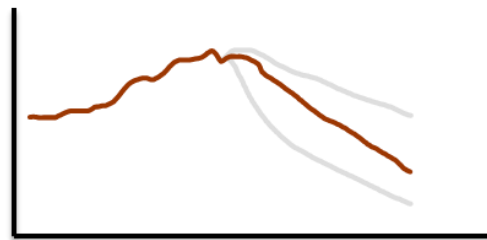
Current Trajectory



The temperature rise will reach **2.5°C** by 2100

Based on climate policies and measures that are actually in place or under development

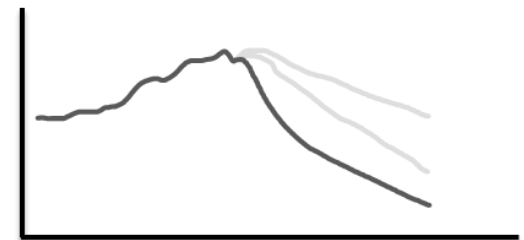
Fulfilled commitments



The temperature rise will reach **1.7°C** by 2100

Assuming governments fully and promptly meet all their climate-related commitments, including long-term net-zero emission pledges and NDC (Nationally Determined Contribution) targets

Net Zero by 2050



The temperature rise will stabilize at around **1.6°C** by 2100

Additional policy and regulatory push on fuel carbon intensity leading to swift adoption of decarbonization technologies in all sectors

Actions are needed from all stakeholders, primarily in the Energy sector, contributing the highest share of GHG emissions globally

Growth opportunities as a result of the energy transition are vast



Challenges

- **The Generation Gap:** Governments and utilities aim to reduce reliance on imported energy sources and accelerate the adoption of domestic renewable energy.
- **The Storage Gap:** Increased focus on energy storage solutions like batteries to balance the intermittent nature of renewable energy.
- **The Grid Gap:** The energy crisis highlighted the importance of grid modernization efforts to ensure a robust and flexible power grid capable of handling disruptions and fluctuations in energy supply.
- **The Conversion Gap:** The process of converting heat into electricity and vice versa is associated with relatively low efficiency, typically around 30%.
- **The Critical Minerals Gap:** To reduce reliance on international supply chains, mining companies need to source materials locally and develop strategic partnerships with domestic suppliers.
- **The Funding Gap:** Current targets agreed to by the world's major economies under the Paris Agreement would require at least tripling of global energy transition investment (including all decarbonization) to more than \$5 trillion each year between 2023 and 2050.

Opportunity

- **New Business Models:** The energy transition creates new business models, such as distributed energy systems, community-owned renewable projects and energy-as-a-service models.
- **Climate Mitigation:** Transitioning to low-carbon and renewable energy sources contributes to global efforts to mitigate climate change by reducing greenhouse gas emissions.
- **Resilience:** Investing in local and renewable energy sources enhances energy security and reduces dependency on fossil fuel imports.
- **Job Creation:** The energy transition generates a large number of jobs, ranging from manufacturing and installation to operation and maintenance of renewable energy facilities.
- **Technological Innovation:** The energy transition necessitates substantial investments in cutting-edge technologies, catalysing innovation and concurrently generating promising opportunities.
- **Economic Growth:** Investing in clean energy technologies not only transforms the energy sector but also accelerates sustainable solutions, fostering a dynamic ecosystem of growth and development.

Source: PwC/Strategy& Analysis, IEA World Energy Outlook

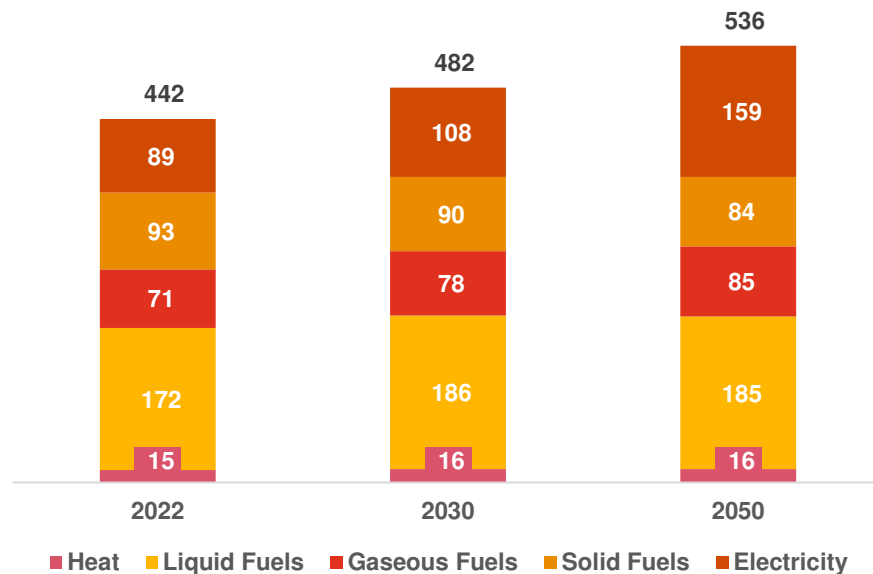
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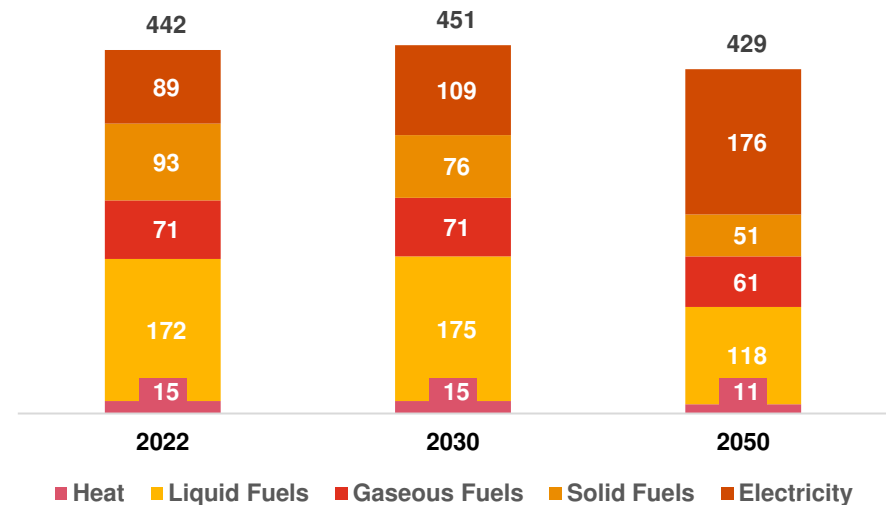
The global demand for electricity and its share in overall energy consumption will rise in the next decades

World Final Energy Consumption – provides an outlook based on the latest policy settings (STEPS); *in EJ*



- Under the existing policy framework, the world is poised for a continual growth in both energy and electricity demand.

World Final Energy Consumption - assumes all national energy and climate targets are met in full/on time (APS); *in EJ*



- Government targets aim to lower overall energy demand, yet increased electrification is set to boost electricity demand.

In both scenarios, electricity demand will reach levels which can hardly be met by current supply

Source: IEA World Energy Outlook, PwC/Strategy& Analysis

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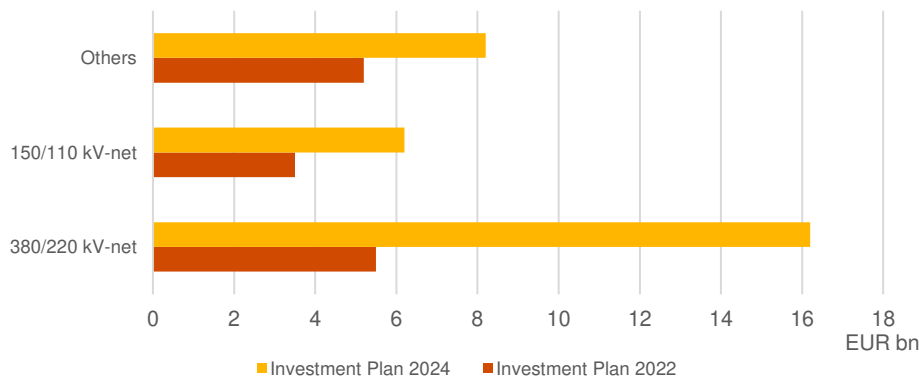
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The volatility of renewable energy sources necessitates substantial investments in grid infrastructure

Volatile electricity sources overload the grid

- During peak times, the volatile nature of renewable electricity supply often surpasses the capacity of the current infrastructure to efficiently distribute power to intended locations, leading to grid congestion.
- Grid congestion can compromise the reliability of the electrical grid, leading to potential voltage fluctuations, equipment overloads, and, in extreme cases, blackouts or brownouts.
- While congestion could marginally reduce as the operator's capex plans are realized through 2029, it is expected to impact PV project realization (as systems cannot be connected to the grid).
- To address acute grid congestion the grid operator implements costly measures such as redispatching.

Grid Investment Plan – Netherlands (exemplary)



Source: PwC/Strategy& Analysis, TenneT Investment Plan 2024, Netbeheer Nederland

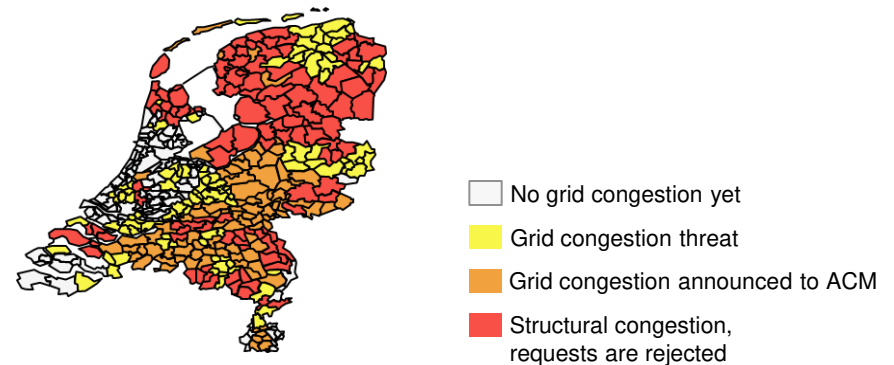
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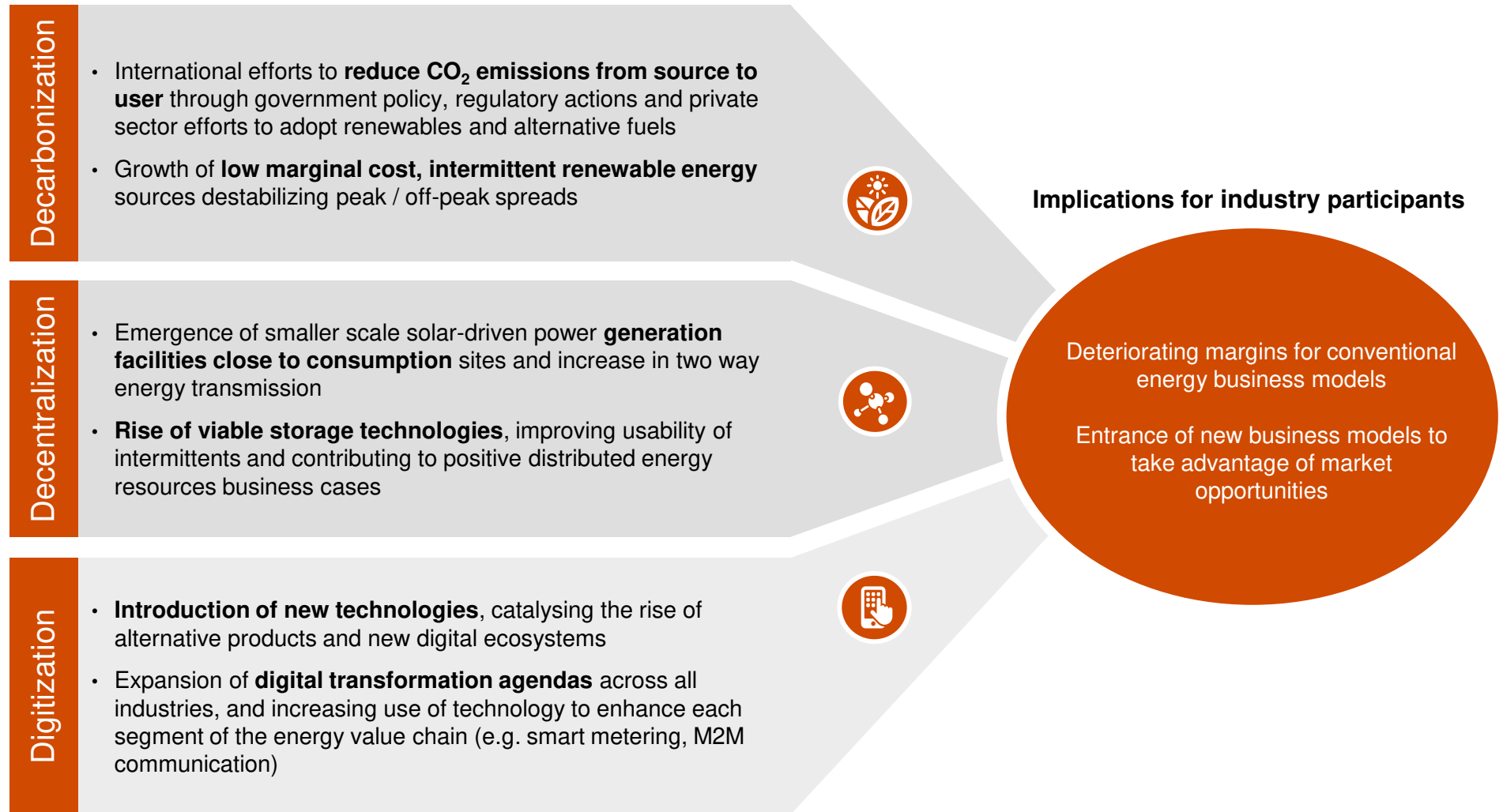
Issues with Grid Expansion

- **Resource Constraint:** Grid expansion falters with scarce skilled labor and material shortages, coupled with limitations in the construction sector's capacity.
- **Legal and Regulatory Complexity:** Legal intricacies and stringent regulations add complexity to expanding the grid, requiring careful compliance.
- **Sustainability Challenges:** Sustainable infrastructure faces hurdles as the construction sector struggles with limited capacity to meet the demand for eco-friendly development.
- **High Public Expectations:** Intensified public scrutiny for timely, high-quality outcomes.
- **Approval Delays and Technical Complexity**

Grid Congestion Map – Netherlands (exemplary)



Decarbonization, decentralization and digitisation are disrupting conventional energy business models



Source: PwC/Strategy& Analysis

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Unstable energy markets profoundly impact the environment, economies and ultimately society





Emerald Horizon

Emerald Horizon offers decentralised, carbon free and non-volatile energy



Industry – Energy as a Service

Energy Production via advanced nuclear Power



Location

Graz, Austria



Foundation

2019



Core Technologies



Energy and heat generation



Heat storage
Heat to power storage



Achieved milestones

- ✓ Concept & Design
- ✓ Digital twin models
- ✓ Several small scale models/prototypes developed & tested
- ✓ Scale up of team, partners and facilities
- ✓ Patent application and prototype for a NES battery
- ✓ Proven PV contracting model

Emerald Horizon – The beginnings

- Investors and co-founders of Qbasis Invest, Florian Wagner and Philipp Pölzl, sought an investment opportunity in green energy.
- Due to a lack of promising green energy investment possibilities, **Florian Wagner and Philipp Pölzl** founded their own energy company – Emerald Horizon. They soon garnered significant experience in the energy market through **investments in solar energy** but lacked the scientific background required for developing new technologies.
- Upon encountering and **onboarding former CERN scientist and dedicated environmentalist Dr. Mario J. Müller**, Emerald Horizon then had **both the economic and technical expertise** to realize innovative technical solutions.

Emerald Horizon - Overview

- Emerald Horizon's **main focus is to develop an advanced nuclear power system using thorium as input material that can fit into a commercial shipping container**, producing 25 MW of thermal heat (ADES). Further, the company develops a heat storage (**CALStore**).
- Emerald Horizon plans to install its ADES units in close proximity to its customers, such as cities, production plants, hospitals, and on ships, and sell the **energy produced as a service**.
- The company is looking for **€25m in funding round 2A** to cover R&D expenses and a further **€225m in round 2B** to finish the demonstrator for the advanced nuclear power system (ADES) and transfer it to serial production.

Key investment highlights



Passionate Team – The team consists of 38 (internal & external) dedicated team members and is expanded continuously



Green Innovation Leader – Pioneering advanced clean energy solutions secures the company a technological edge



Risk Optimization – Two independent solutions (ADES, CALStore) effectively diversify investor risk



Strategic Alliances – Leading firms and research institutions back the company in crucial tech and regulatory domains



Learning Curve – Each unit is cost-effective and comparatively small (learning with each unit produced)



Scalability – All products are designed in such way that they are easily scalable



Optimized Capital Use – Emerald Horizon has achieved outstanding R&D results with little financial resources

Emerald Horizon's experienced and dedicated management team



Florian Wagner

CEO

Florian Wagner is Co-Founder & CEO at Emerald Horizon

Curriculum Vitae

2019 to present

- Co-Founder & CEO at Emerald Horizon

2007 to 2013

- Authorised officer at licenced investment firm

2005 to present

- Co-Founder at Qbasis Invest

Education

Medical University Graz

Officer in the Austrian army (Lieutenant in the signals corps)



MMag. Philipp Pölzl

CFO

MMag. Philipp Pölzl is Co-Founder & CFO at Emerald Horizon

Curriculum Vitae

2019 to present

- Co-Founder & CFO at Emerald Horizon

2007 to 2013

- Director Institutional Clients at licensed investment firm

2005 to present

- Co-Founder at Qbasis Invest

Education

Karl Franzens University Graz

Texas Tech University

University of St. Gallen (HSG)

Certified expert for securities, funds and derivative financial instruments



DI Dr. Mario J. Müller

CTO

DI Dr. Mario J. Müller is CTO at Emerald Horizon

Curriculum Vitae

2021 to present

- Head of R&D at Emerald Horizon
- CTO since 2023

2005 to 2017

- CSTO in industry

2006 to 2015

- Director at private research center

2002 to 2005

- Associate member of staff at CERN

Education

Graz University of Technology

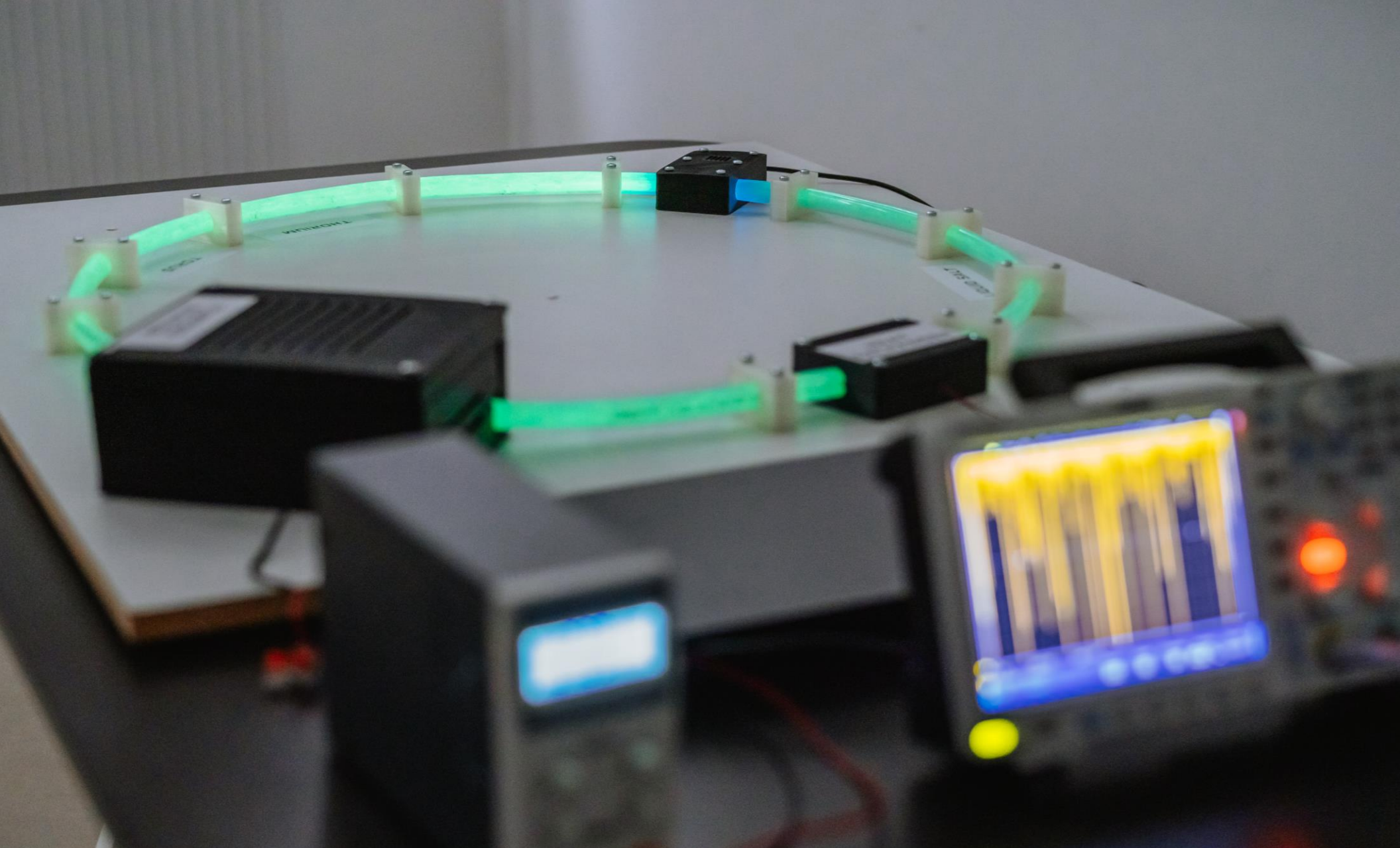
Source: Company information

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ADES

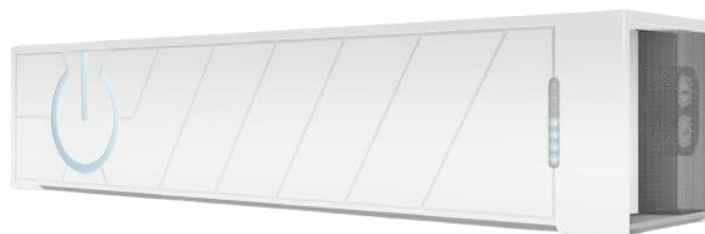
ADES is a unique combination of molten salt reactor and accelerator driven system technology

Molten Salt Reactor

- A molten salt reactor uses fluoride salt as primary coolant, at low pressure.
- The concept can use less dangerous radionuclide, like thorium, or spent light-water reactor fuel as energy source.
- The concept is a radical shift from conventional nuclear power plants but early adoptions date back to the 1960s.
- However, many designs require small amounts of uranium to initiate nuclear reactions.

Accelerator driven system

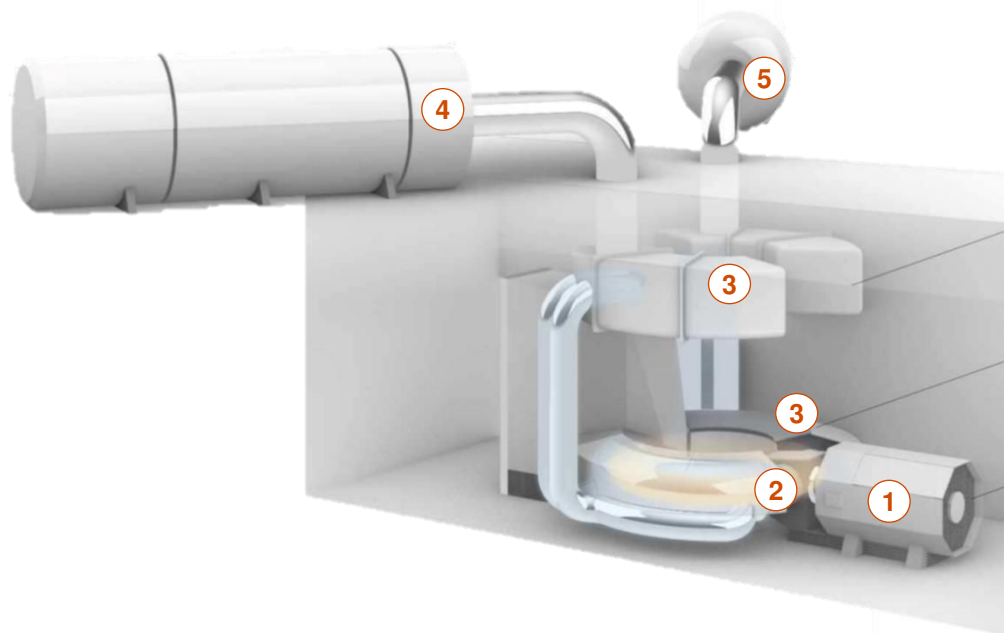
- An accelerator driven system (ADS) is a particle accelerator that transmutes long-lived nuclear- fuel or waste into shorter-lived fission products.
- ADS can use thorium as an energy source, which is estimated to be five times more abundant than uranium.
- Nobel laureate Carlo Rubbia (CERN) proposed an ADS design using a fuel cycle in order to negate the need to use uranium as driver fuel.



Accelerator Driven Energy System (ADES)

- ✓ ADES combines a water-free thorium-based fuel cycle with molten salt for cooling & heat distribution, excluding vapor pressure.
- ✓ The compact design fits in a standard shipping container, providing convenient mobility to various locations.
- ✓ Additionally, the technology uses a disrupting particle accelerator based injector system instead of an uranium based chain reaction limiting radiation to a minimum.

The heat produced within the system can be converted to electricity, hydrogen or any other form of energy



1

Particle injection:

The injector, operating as a particle accelerator, stimulates Thorium-232, inducing its transmutation into Uranium-233.

2

Amplification:

The Uranium-233 fission in the molten salt loop releases energy and generates temperatures of up to 900 °C.

3

Heat exchanger:

First and second level heat exchangers transfer energy to either (4) electricity generation or (5) hydrogen generation.

4

Electricity:

A tertiary loop drives a turbine for electricity generation.

5

Hydrogen:

750 to 900°C heat allows the generation of hydrogen.

Source: Company Reports, PwC Analysis, Nuclear Energy Institute, World Nuclear Association

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ADES has a multitude of applications across various industries

Applications



Energy Generation

Augmentation and stabilization of energy yields from wind and solar farms



E-mobility

Facilitate the **rising electricity needs** of expanding electric mobility initiatives



Power Grids

Seamless integration into power grids supporting its stability



Digitalisation

Emission-free energy for energy-intensive infrastructure such as data centres

Industries



Transportation

Zero-emission propulsion technology as a **substitute for heavy oil** in the maritime sector



Urban Areas

Implementation of **additional layer of redundancy** supporting the conversion to carbon free real estate



Health Care

Autonomous power solution for hospitals and healthcare facilities



Industrials

Sustainable substitute for fossil fuels to promote a more eco-conscious industrial sector

ADES offers clean and safe technology



- ADES has a **passive-safe ON/OFF control unit**.

ON/OFF switch



- ADES **leverages AI** to **adjust its power output** based on the installation location.
- ADES thereby ensures **optimal performance** in **diverse environments**.

AI-powered optimization



- **80%** of thorium is **converted** into energy. Even the remainder contains raw materials that **can be reused**. No final repository for nuclear waste is hence necessary.
- ADES **produces 0% transuranic waste** of Plutonium, Neptunium, Americium and Curium, ... known as “nuclear waste”.

No traditional nuclear waste



- **ADES runs subcritically.**
- When the injector impulses the thorium, it causes a reaction - **but not a chain reaction** - making ADES much safer than conventional nuclear power plants.

No chain reaction



- The final ADES module **will not need to be serviced** continuously.
- A **Safety Security Environment Software** will ensure safe control.

Minimum maintenance

Overall, the new technology is a small, scalable and risk-optimized solution to energy generation



Container size: Compact modular design allows for quick and cost-effective production, transport and installation.



Formidable energy output: Each unit can produce up to 25MW of thermal heat which is enough to supply 10,000 households with electricity and heat.



Cost efficient: The system with a unit cost ~€ 25m has a short payback time (under 4 years).



Decentralised & self-sufficient: Once the system is installed and the secondary loop is loaded each unit is entirely self-sufficient guaranteeing decentralised and stable power supply.



Risk-optimized: Reduced nuclear risks and the generation of less long-lived radioactive waste compared to conventional reactors.

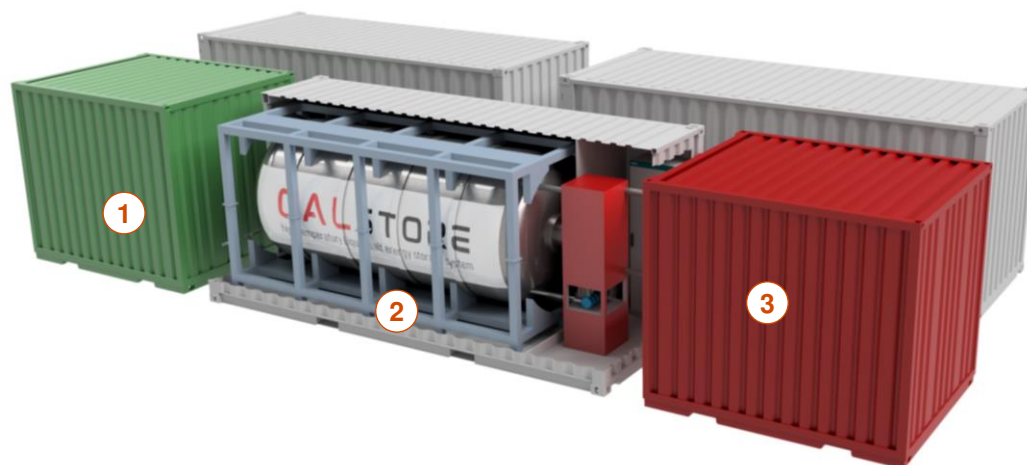


Attractive financing conditions: Long-term power purchase agreements facilitate highly leveraged financing.



CALstore

The flexible molten salt storage offers versatile solutions for advanced energy management



1

Input:

Sources such as wind or solar energy generate substantial amounts of volatile energy.

2

Storage:

CALstore efficiently stores surplus energy in a well-isolated tank using a salt mixture. Upon energy input, the salt's temperature surpasses the melting point.

3

Output:

When electricity is needed, heat exchangers extract stored thermal energy from the molten salt, transferring it to a working gas like helium driving a gas turbine.

USPs of CALstore

- CALstore stores large amounts of energy (**5 MWh**) which can be released when needed.
- The system is **entirely water-free**, eliminating the risk of vapor pressure or detonation gas reactions.
- **Abundant, cheap, and well available salts** like potassium nitrate and sodium nitrate are used.
- **Adaptable configuration** (salt mixture, storage capacity and temperature range) depending on the specific energy input and output requirements.
- Product costs are estimated to be **significantly lower** than comparable storage solutions (<EUR 1 million EUR per CALstore).

CALstore bridges the time gap between volatile energy supply and peak energy demand

Electricity Storage



Renewable sources often generate electricity during periods of low energy demand, while at peak demand times, the supplied electricity from renewables is typically insufficient.

Thermal Energy Storage



Thermal energy derived from heavy industries like steel production or other energy sources, such as ADES, can be stored and utilized at later points in time.

Applications



Utilities

Augmentation and stabilization of energy yields from wind and solar farms.



Urban Areas

Storing electricity or heat generated by a rising number of residential solar systems.



Transportation

Energy storage system for transportation (i.e. ships).



Industrials

Storing non-usable process heat from heavy industries.



Timeline and Partnerships

Emerald Horizon has completed significant milestones to date

	Expertise to contract energy modules (established PV project business and invoicing)	✓
	Technological and economic concept developed (ADES, CALStore)	✓
	Venture funding received (cash plus in-kind contributions)	✓
	Subsidies received (i.e. FFG subsidy of € 2.7m)	✓
	Network of team, partners and facilities established	✓
	Patent application and completion of prototype (NES)	✓
	Completion of prototypes (ADES, CALStore)	✗
	Completion of demonstrators (ADES, CALStore)	✗
	Start of serial production (ADES, CALStore)	✗
	Expertise to mine thorium together with a partner	✗

✓ Completed ✗ Ongoing

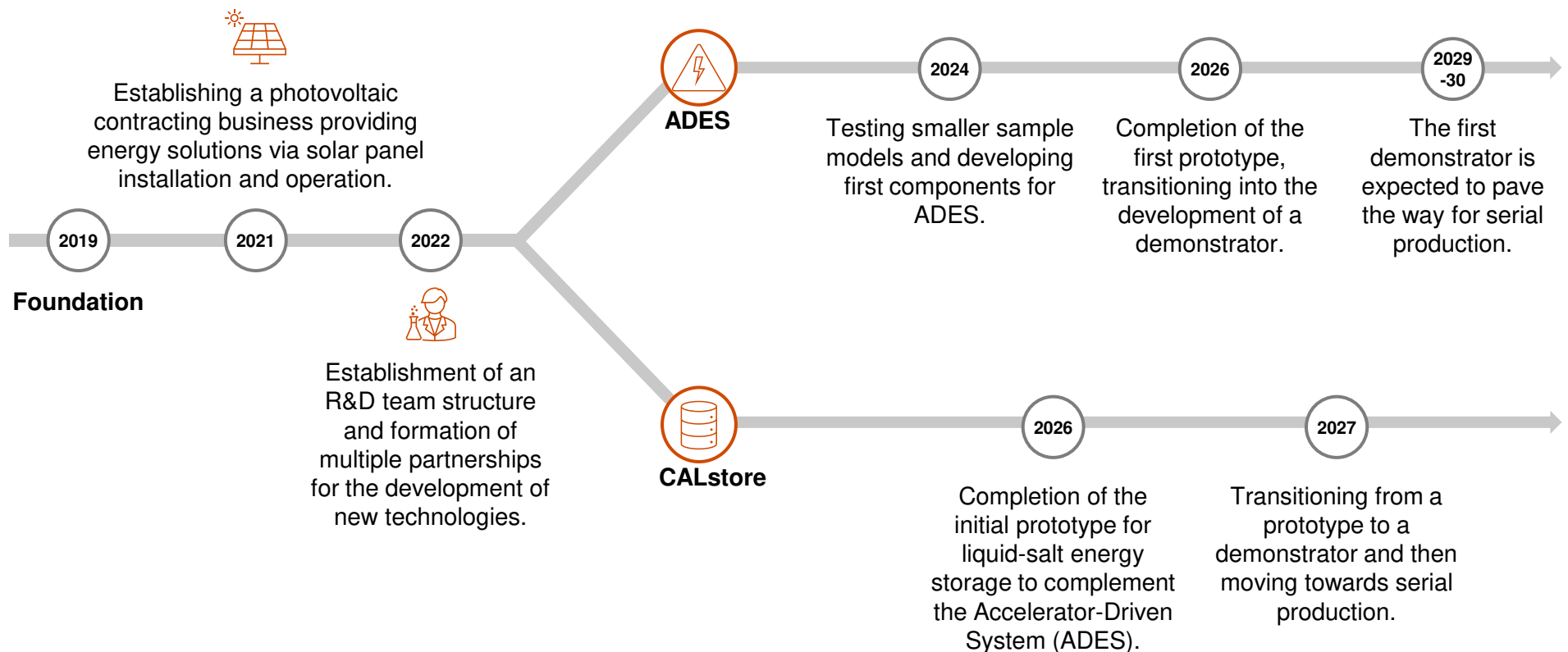
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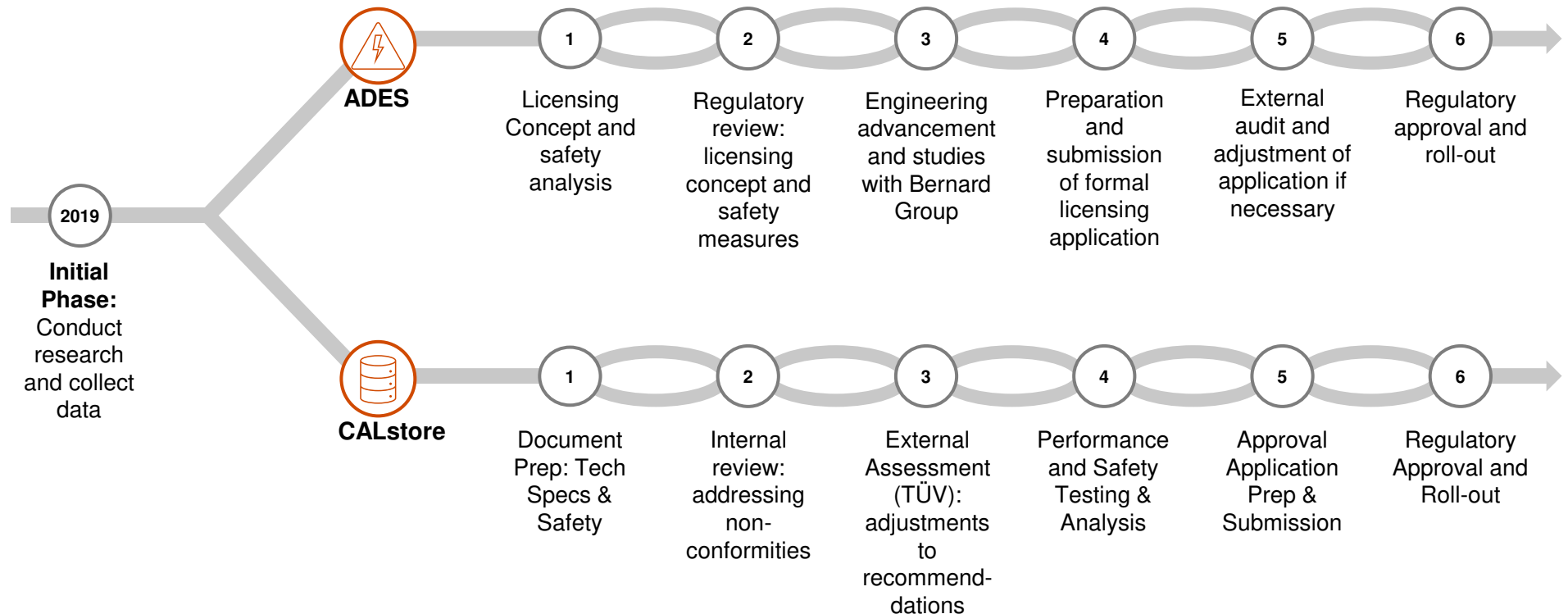
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Serial production for CALstore could start after 2027, while serial production for ADES could start after 2030



Regulatory approvals are considered at an early stage and intensified as the technology progresses



Feedback loops

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A strong partner network enhances the company's capabilities

Emerald Horizon is committed to collaboration and building strategic partnerships in all areas

Technology Partners



- Expertise in planning & engineering, measurement technology and hydrogen production

Advantage: Experience in the industry and a large team of 450 employees

R&D Partners



- Austria's best technical university with access to all scientific disciplines

Advantage: Development of new disciplines, cooperation at R&D projects, international network

Financial/Business Exp. Partners



- Licensed and international investment firm with over one billion euros in trading volume per week

Advantage: Capital support at product level



- Expertise in developing molten salt technologies

Advantage: Knowledge in producing & handling of molten salt, extend production



- Leading centre for nuclear technology with access to a large number of nuclear research results

Advantage: Cooperation in simulation, research and technical validation



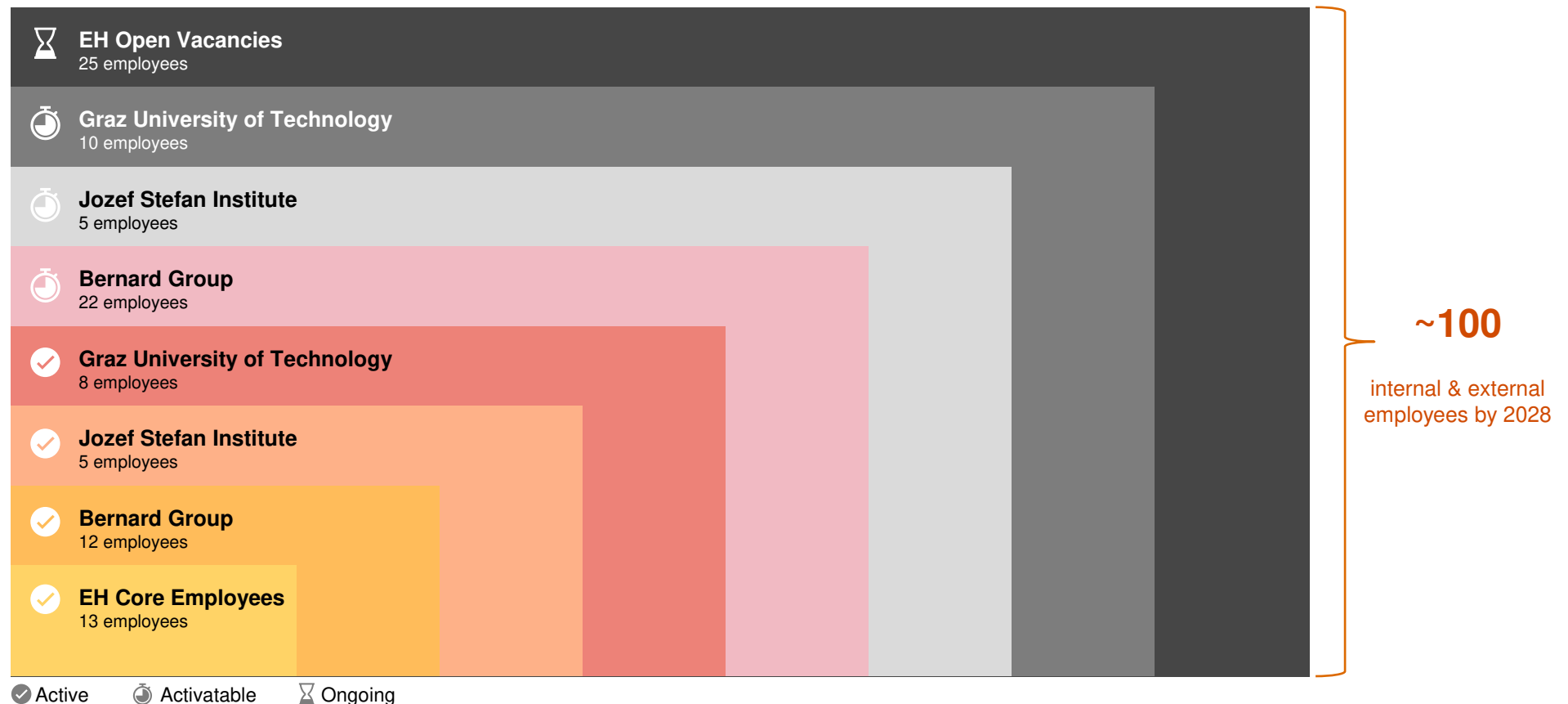
- Access to more than 200 green tech companies

Advantage: Expertise with regard to start-ups

Emerald can quickly scale its workforce due to its extensive partner network

Current staff and further scale-up

- Emerald Horizon currently employs **13 staff** and leverages the expertise of **25 external employees** through strategic partnerships with Bernard Group, Jozef Stefan Institute and Graz University of Technology
- The workforce can be scaled to about 100 staff within a relatively short period of time.



☒ Active
 ☐ Activatable
 ☐ Ongoing

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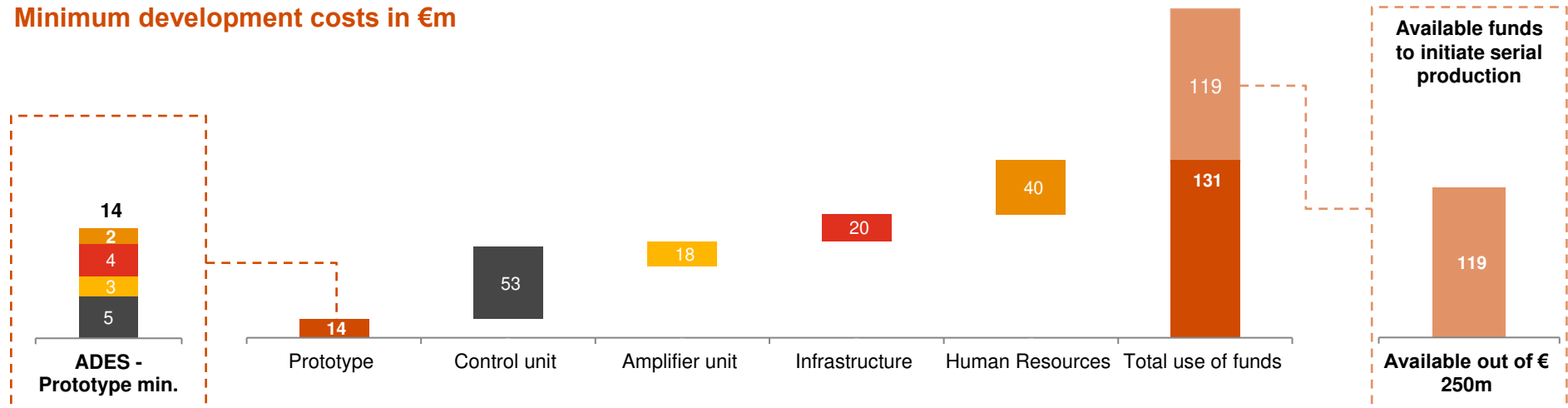
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Funding Need & Unit Economics

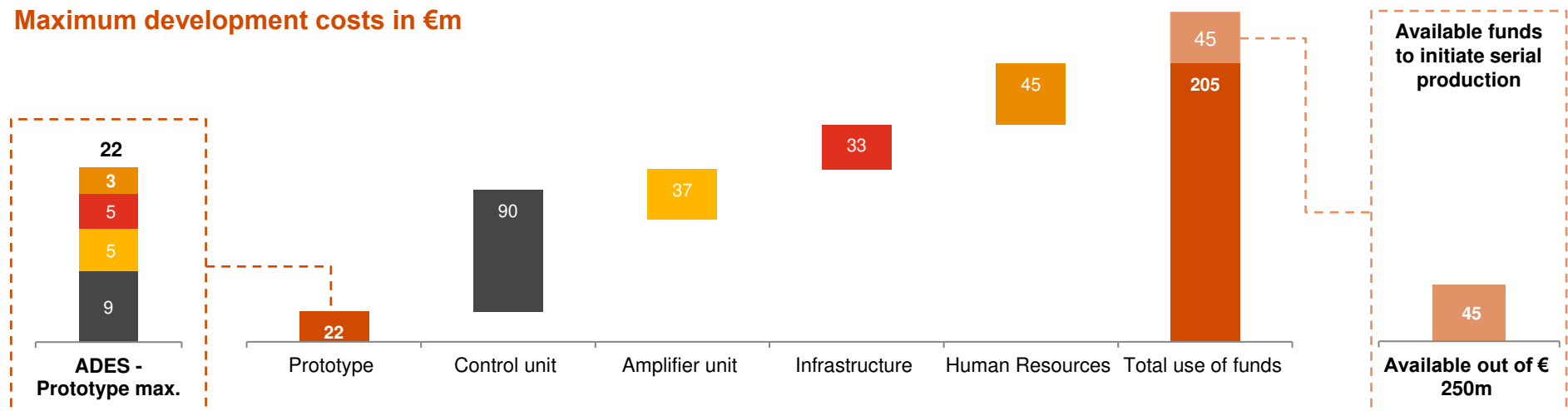


€250m investment over the next 5 years for ADES prototype and demonstrator development

Minimum development costs in €m



Maximum development costs in €m



Due to low operating costs, each ADES generates attractive returns

Year	2031	2032	2033	2034	2035
1 Generated Electricity [MWh]	87 600	87 600	87 600	87 600	87 600
Electricity Price (EUR/MWh)	90	90	90	90	90
2 Revenue	7 884 000	7 884 000	7 884 000	7 884 000	7 884 000
3 Thorium costs	(50 000)	(50 000)	(50 000)	(50 000)	(50 000)
Personnel expenses	(250 000)	(250 000)	(250 000)	(250 000)	(250 000)
Other Operating costs	(250 000)	(250 000)	(250 000)	(250 000)	(250 000)
EBITDA	7 334 000	7 334 000	7 334 000	7 334 000	7 334 000
4 D&A	(1 250 000)	(1 250 000)	(1 250 000)	(1 250 000)	(1 250 000)
EBIT	6 084 000	6 084 000	6 084 000	6 084 000	6 084 000
5 Interest on debt	(800 000)	(800 000)	(800 000)	(800 000)	(800 000)
EBT	5 284 000	5 284 000	5 284 000	5 284 000	5 284 000

ADES – P&L (abbreviated)

A useful life of 20 years is assumed for each ADES, whereby the sample calculation on the life presents the first five years.

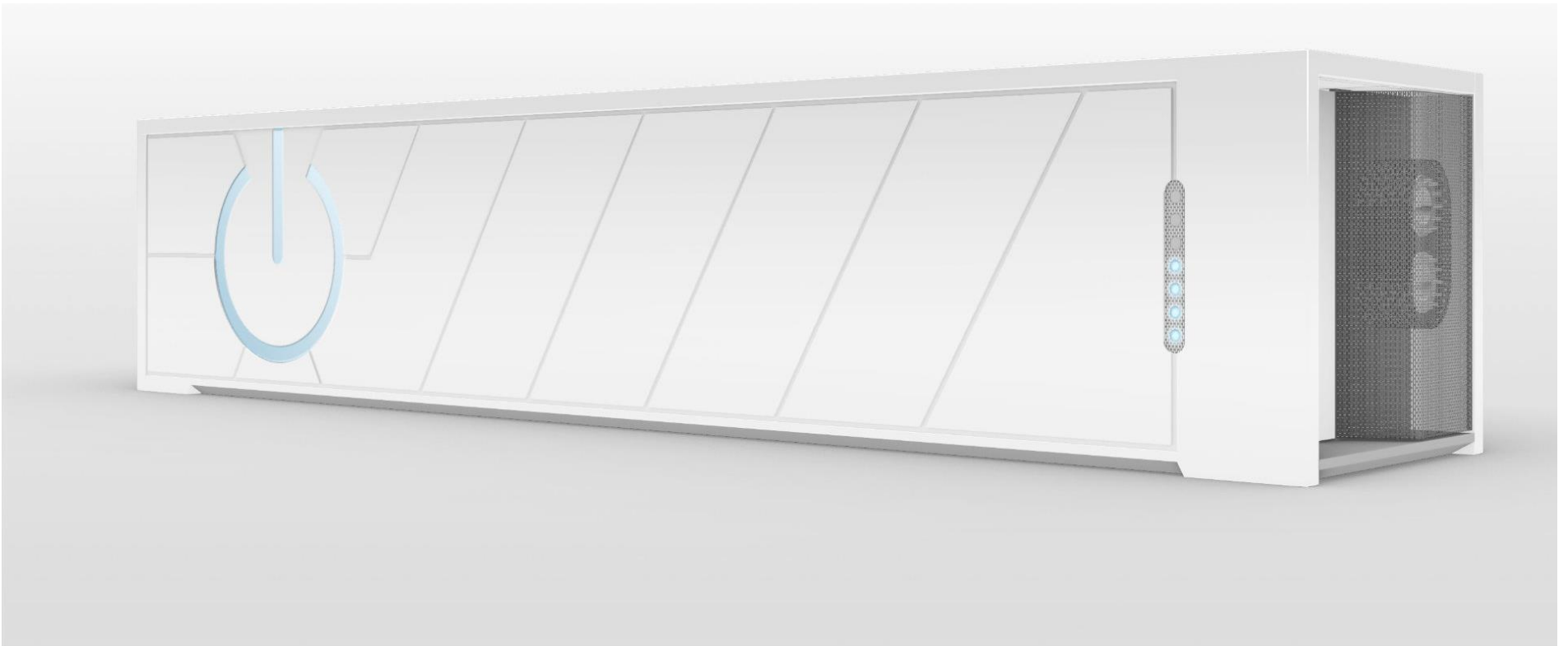
Initially, the costs of ADES are estimated at EUR 25m, whereby it is assumed that 80% (EUR 20m) can be financed with debt.

- 1 Electricity generation per year is influenced by an 80% utilization rate and a 50% heat-to-power conversion factor.
- 2 Thorium cost is anticipated at EUR 2500/kg.
- 3 Personnel and operating costs are expected to be low, with remote maintenance capability.
- 4 Depreciation and amortization (D&A) are calculated over a 20-year useful life.
- 5 Stable and predictable revenues from long-term power purchase agreements justify a 8% interest rate assumption (15 year financing period).

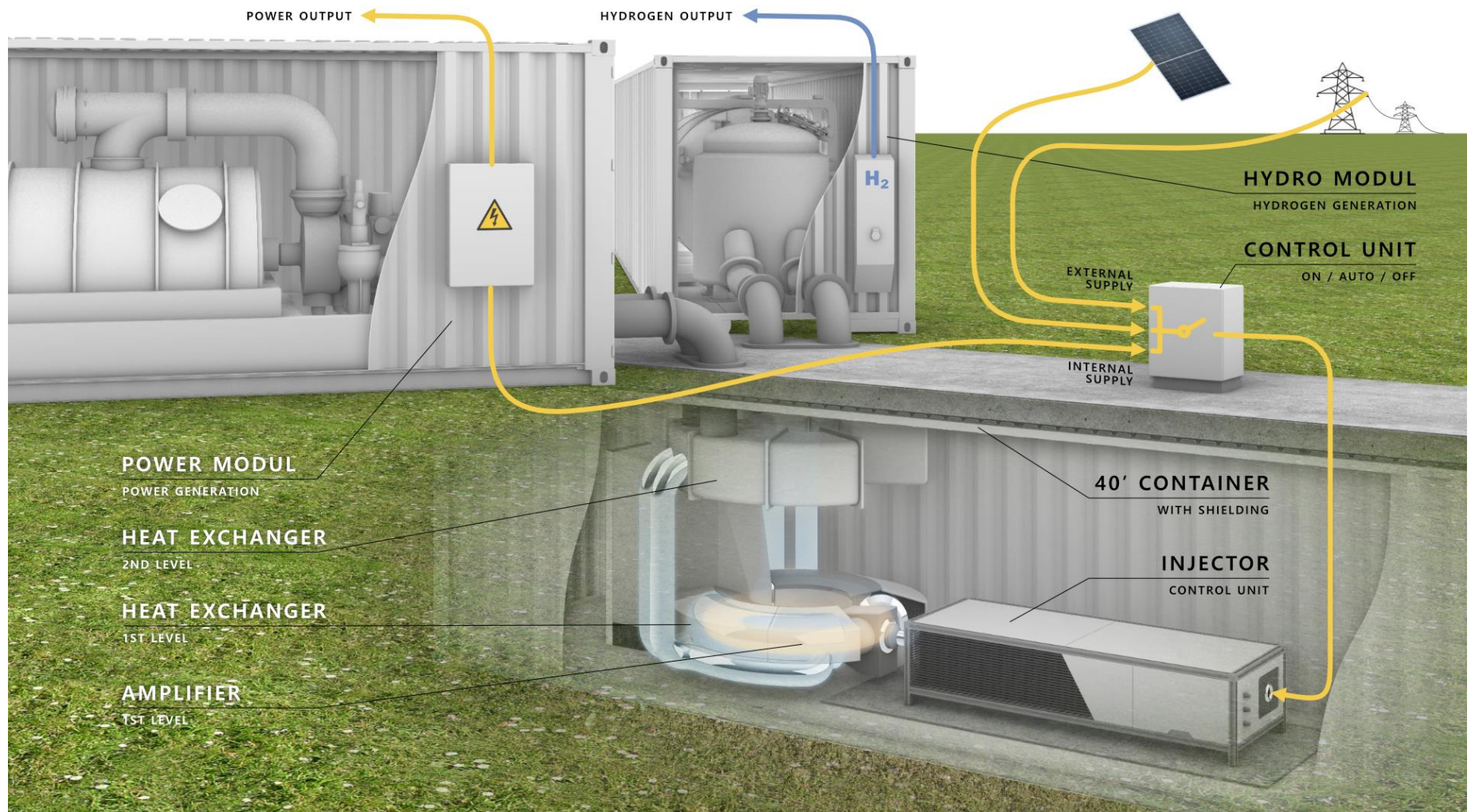
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ADES (design)

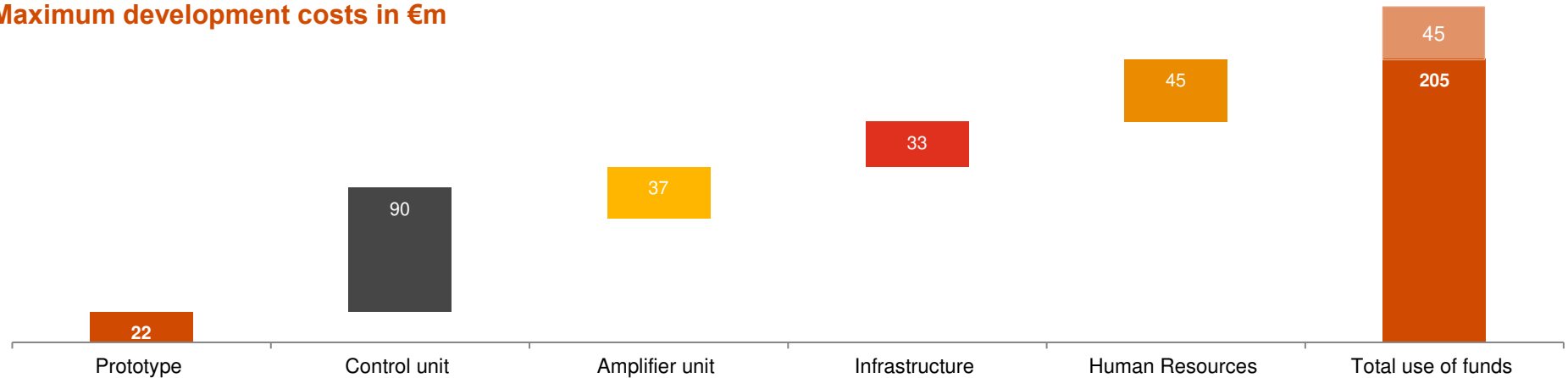


ADES (detail)



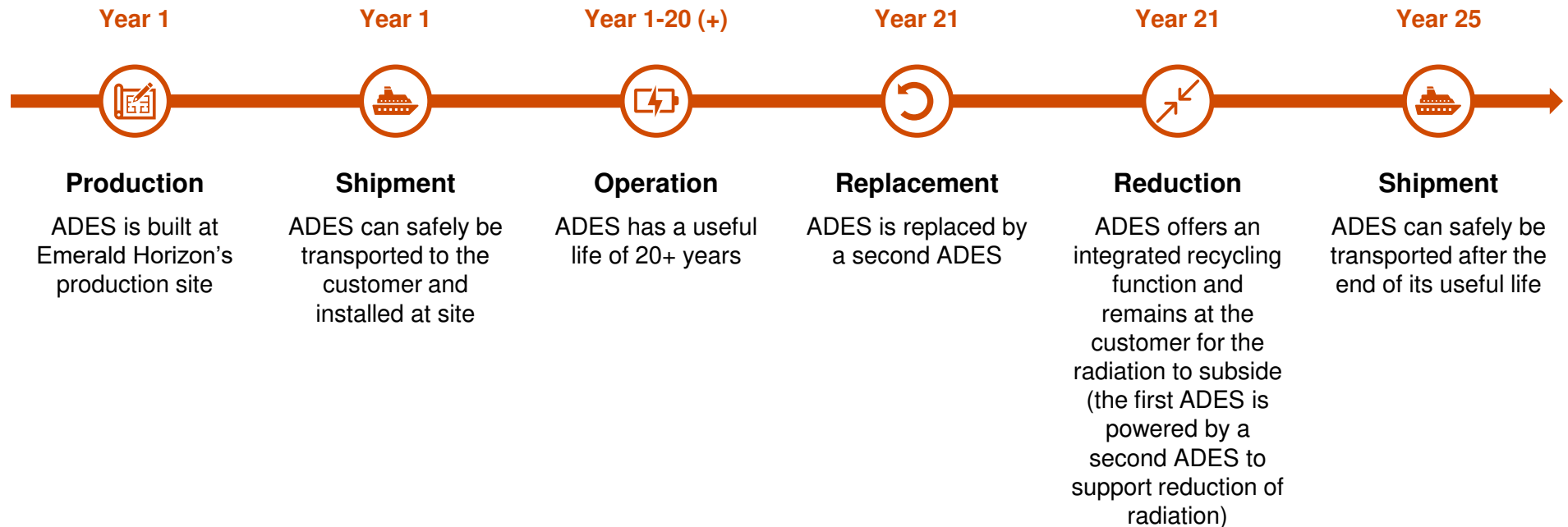
Development Costs (detail)

Maximum development costs in €m



Control unit	Amplifier Unit	Infrastructure	Human Resources
• Particle-Generator • Mechanical support • Electrical support • Targets • Collimators • Measurement & controlling	• Vessel • Salt • Thorium • Gases	• ADES space • Cooperation space • Vehicles • IT hardware • IT software	• Physicist • Chemist • E-technician • Mechanics • Civil engineer • IT expert • Medical doctor • Biologist • Legal counsel • Financial controller

Product Lifecycle of ADES (simplified)



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