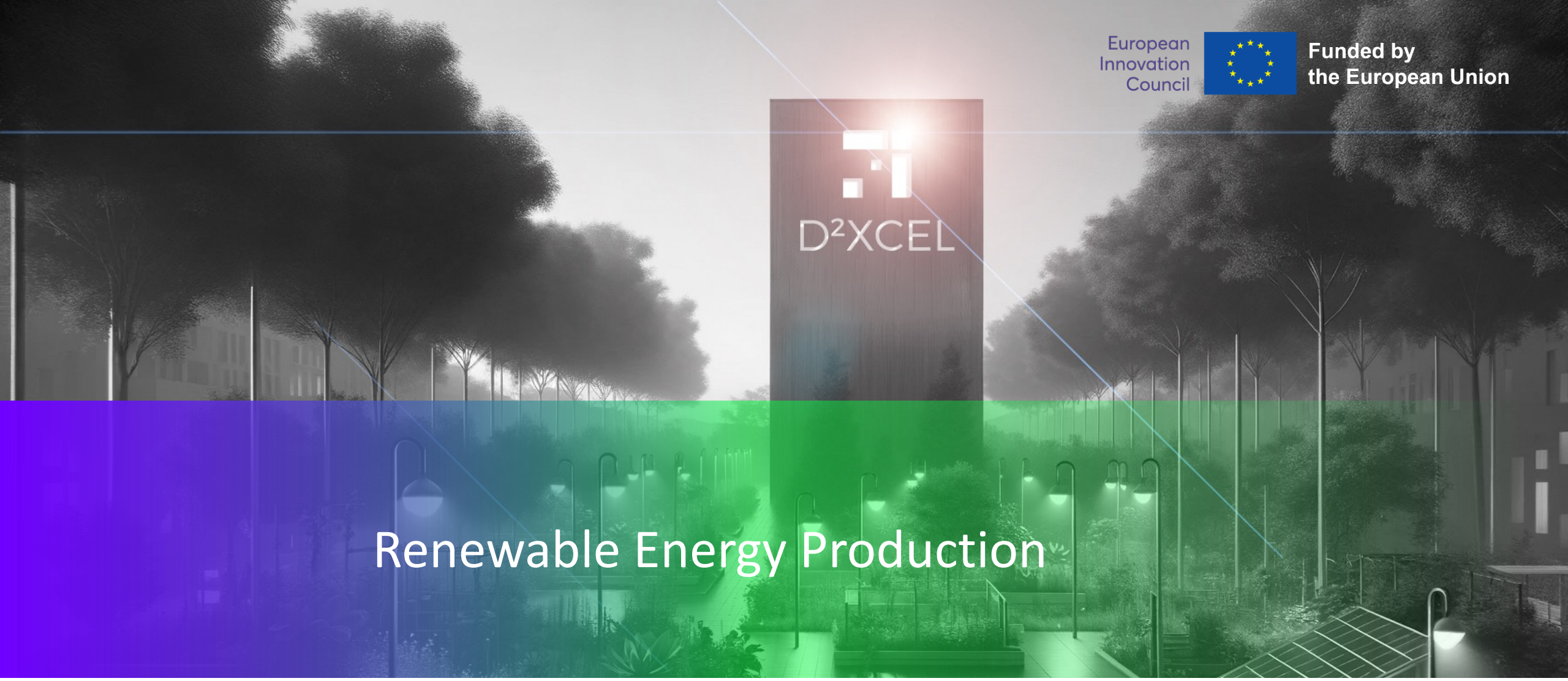

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Renewable Energy Production

TechTour · BRYSK · maritime street · NÜRNBERG MESSE · UNIMOS alliance · Corporate Ventures Advisory

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Summary

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Introduction

Introduction and objectives of the Roadmap report

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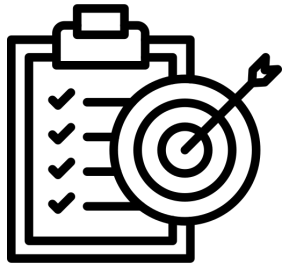
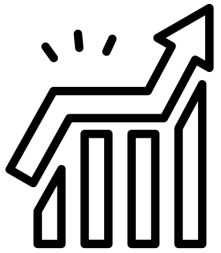
This report was developed as part of a broader initiative to identify and capitalize on market opportunities within the **Renewable Energy Production** sector. The report serves as a guide that maps out the market potential, challenges, and strategic actions necessary for the successful scaling of businesses in this sector.



The primary goal of the Renewable Energy Production Roadmap Report is to equip companies and stakeholders within the sector with the knowledge and tools needed to navigate the transition **towards more efficient, sustainable, and competitive market positions**.



Main function of the report is to highlight opportunities that the participating start-ups may have not recognised. It provides a structured approach to understanding market dynamics, customer needs, and emerging trends, thereby helping businesses position themselves effectively in the evolving marketplace.

Overview of the Participants

Ventures

Following the evaluations by the selection panel, 11 of the most promising European ventures in Renewable Energy Production were chosen through a competitive process. Companies were selected based on leadership potential, product/technology strength, market opportunity, go-to-market strategy, and business clarity.

Benerg

Building-scale biogas machines converting food waste into electricity with off-grid, high-efficiency, zero-waste technology

BIOJET

A sustainable and renewable alternative to liquid fossil fuels

Boson Energy

BOSON ENERGY develops technology for producing responsible hydrogen and green molecules.

carbonclean

Decarbonizing Industrial Process Heat with Thermal Energy Storage

IPS

The ultimate technology for grid balancing and energy generation

KITE//KRAFT

Kitekraft builds flying wind turbines. The systems is a tethered vertical take-off and landing aircraft that can operate like a kite to produce energy.

QHEAT™

Clean geothermal energy solutions for sustainable built environments

ReCatalyst

Optimizing the use of precious metals for decarbonisation of the energy and transport sectors

reLi

Integrating a software with stationary batteries to extend lifespan, optimize performance, and reduce energy costs and environmental impact

SCALE ENERGY

Scale Energy is implementing Europe's largest decentralized battery storage network to establish an energy system based on 100% renewables.

TIDETEC
Optimising two-way hydropower

Tidetec's concept is the most logical way to harness two-way hydropower, such as tidal, in a cost-effective manner.

Market opportunity Stakeholders

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Investors

Butterfly Ventures	Clear Corporate Finance BV	DeepTech & Climate Fonds	eCAPITAL	Urban Impact Ventures	Vinci Venture Capital
First Imagine Capital Ltd	Future Energy Ventures GmbH	Industrya	Invesdor ltd	Voima Ventures	Vsquared Ventures
Kiilto Ventures	kineo finance AG	Lhyfe	SKYCORP Technologies	Vireo Ventures Management GmbH	Viridis Capital

Market opportunity Stakeholders

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Network partners

ALW Finance & Innovation

ATRA Innovations Ltd

Gate2Growth

Invention Marketing

Papula-Nevinpat

Sunnic Lighthouse GmbH

Lead Customers

A2A S.p.A.

Port of Antwerp-Bruges

Market opportunity Mentors

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Vice President of Corenvest

Tobias Grün
Member of the Executive Board at BRYCK

Anne Lebreton-Wolf
ALW Finance & Innovation

Davide Garufi
CRH

Willem-Jeroen Stevens
Founder, Managing Partner, Clear Corporate Finance

Maximilian Kühn
Advisor, Hydrogen Europe

Klaas de Boer
NED, Chair and (occasional) investor

Methodology

Starting point

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We state here some of the underlying assumptions and 'facts' about the energy sector, and related to Renewable Energy Production in particular, that serve as the basis and context of this analysis.

- **Global Energy Consumption Trends:** Energy demand has been steadily increasing due to population growth and economic development, particularly in emerging economies. Fossil fuels (oil, coal, and natural gas) have historically dominated the energy mix, but there is a shift towards cleaner and renewable sources.

- **Climate Change and Environmental Concerns:** There is scientific consensus that greenhouse gas emissions from fossil fuels significantly contribute to climate change. International agreements, like the Paris Agreement, aim to limit global warming by reducing emissions, thus driving the transition to renewable energy.

- **Technological Advances:** Technology improvements have reduced the cost of renewable energy sources such as solar panels and wind turbines. Energy storage technologies, such as batteries, are crucial for addressing the intermittency of renewable sources and are rapidly advancing.

Starting point

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We state here some of the underlying assumptions and 'facts' about the energy sector, and related to Renewable Energy Production in particular, that serve as the basis and context of this analysis.

- **Economic Factors**: The cost of renewable energy has dropped significantly, with solar and wind becoming some of the cheapest sources of electricity in many parts of the world. Investment in renewable energy infrastructure is growing, with significant capital flows from both public and private sectors.

- **Policy and Regulatory Frameworks**: Government incentives, subsidies, and mandates for renewable energy have been pivotal in promoting the sector. Policies such as feed-in tariffs, tax credits, and renewable portfolio standards drive adoption and development.

Methodology

- 5 in-depth interviews were conducted with industry stakeholders using an AI tool to extract expert opinions across the following categories:

1. *Market trends and opportunities*
2. *Challenges and needs in sector*
3. *Key technologies and technology infrastructure*
4. *Competitive structure of sector*
5. *Risks for start-ups*
6. *Customer segments and distribution channels*
7. *Scaling and growth*
8. *Roadmap, i.e. evolution of sector*

- Surveys: Collected 10 survey responses to gather initial insights. The survey included 11 structured questions.
- Challenge queries for start-ups: We collected challenge statements from applying start-ups, and organized them by Market Opportunities and category, and analysed the interviews for expert insights for these categories of challenges.
- The gathered data was analyzed by focusing on key categories, identifying strategic opportunities and potential barriers. The analysis provided a comprehensive view of the sector, enabling the development of targeted insights for growth and scalability.

5 Stakeholder interviews

10 Survey respondents

28 Stated challenges by applying start-ups analysed

Validation process

Total of 20+ Participants

Results, Insights, Roadmap

Opportunities and market trends: Rapid growth, sustainability, but also grid infrastructure limitations. (1)

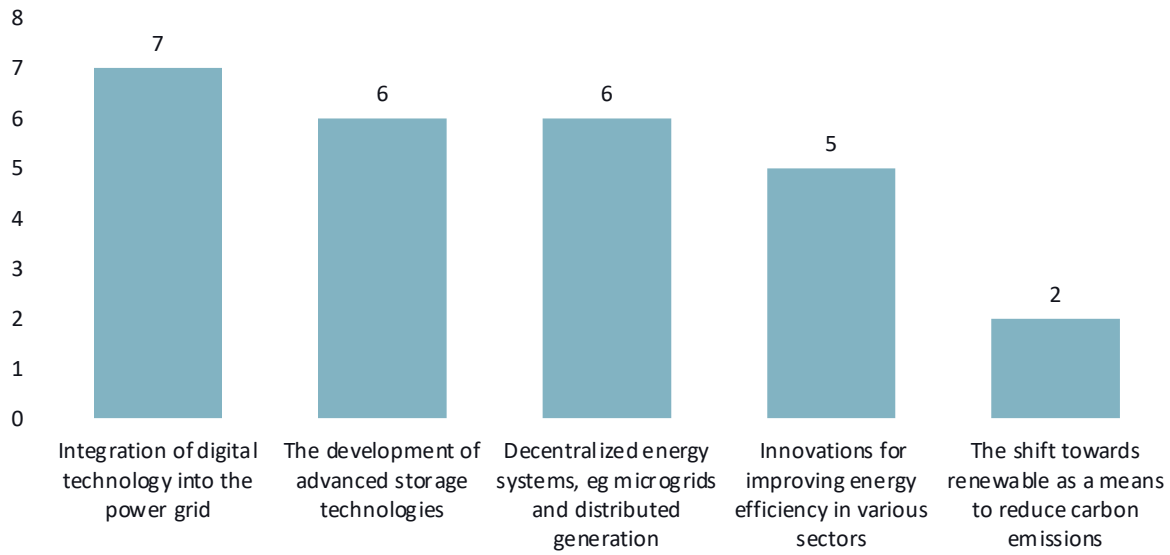
There are several current key trends and opportunities in the energy sector, particularly in renewable energy production. There is renewable energy's **rapid growth and increasing competitiveness**, with technologies like solar, wind, and tidal wave energy leading the way. The **trend** toward **decarbonization and electrification** of societies is another trend, driven by climate goals and efforts to reduce reliance on fossil fuels. **Challenges** such as **grid infrastructure limitations**, intermittency issues, and capital intensity are there as well, alongside opportunities for innovative solutions in energy storage, smart grids, material reuse, and software optimization. Specific technologies, including small nuclear reactors, green hydrogen, nano-coatings, and advanced solar orientations, are seen as promising avenues. **Collaboration between large companies and start-ups**, as well as diversification in production and suppliers to increase independence, are valuable strategies. The sector's evolution reflects both **technological advancements** and the importance of **sustainable practices**.

Anne Lebreton-Wolf

ALW Finance & Innovation

”Regarding unmet needs, well, it's very hard because you cannot imagine how far it can go. There are a lot of unmet needs and unexploited opportunities as well, for instance, tidal wave energy or other types of renewable energies. But for the time being, there is already a quite broad array of potential solutions to exploit and that could be deployed further."

*Which of the following **market trends** do you believe are most important for startups in the energy sector?*



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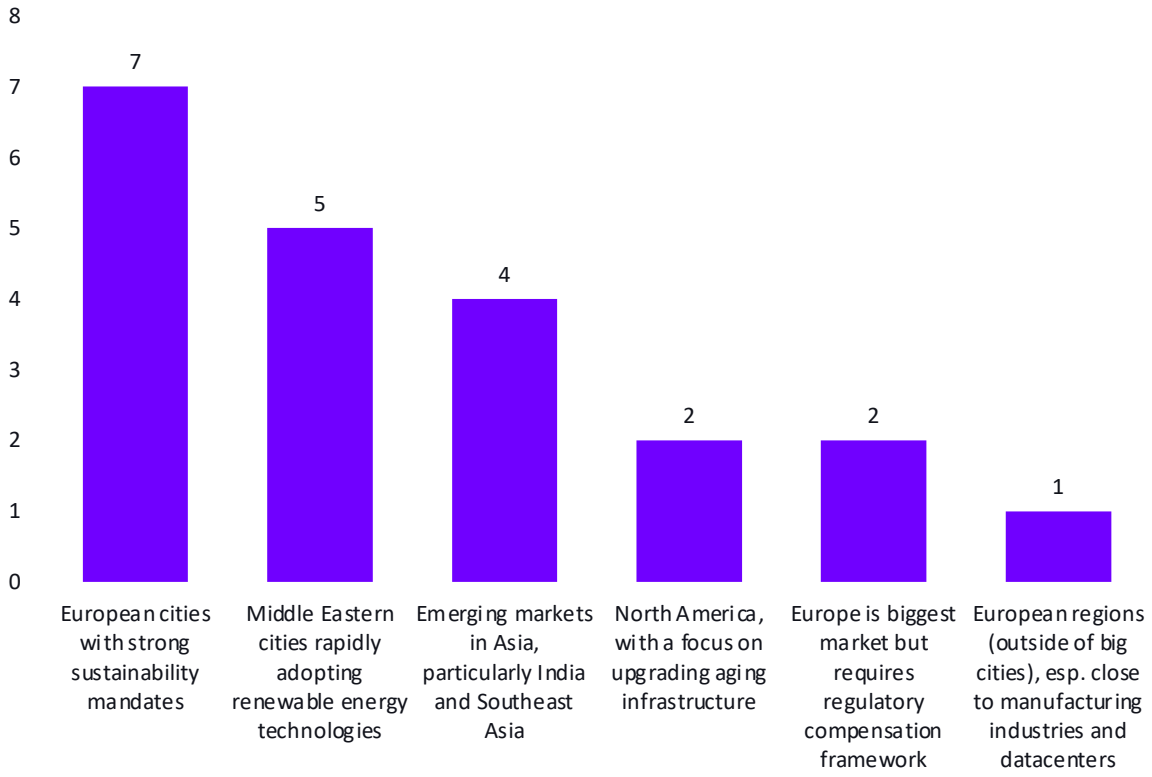
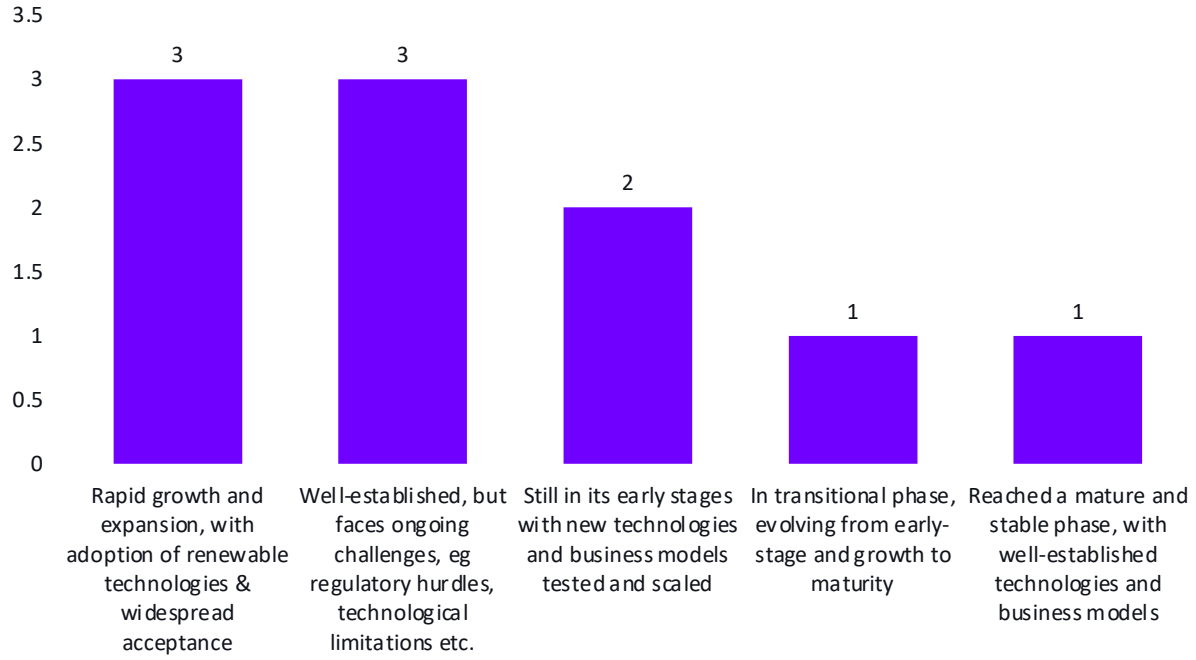
Opportunities and market trends: Rapid growth, sustainability, but also grid infrastructure limitations. (2)

*In terms of **geographic markets**, where do you see the greatest opportunities for growth in the renewable energy production sector?*



*What is the **state of the renewable energy production sector** currently in its long-term evolution, in the European context?*



Technology: Decarbonization driving shift towards more decentralised and flexible energy systems (1)

The energy sector is characterized by transformative shifts toward decarbonization, grid modernization, and the proliferation of renewable energy sources like solar, wind, and hydropower. Advances in energy storage technologies, smart grids, and greener alternatives such as green hydrogen are disrupting traditional systems, while innovations in infrastructure retrofitting and software solutions optimize efficiency and integration. Key trends include the growth of decentralized energy systems, the adoption of electric vehicles, and the increasing reliance on intermittent renewables that demand flexible storage and grid solutions.

Energy Storage Solutions	Batteries and long-duration storage technologies are evolving rapidly to manage renewable intermittency and enhance grid stability.
Smart Grids	Improved energy distribution systems enable decentralised generation and support ‘prosumers’ facilitating resilient and efficient energy management.
Green Hydrogen	Developing hydrogen from renewables offers a pathway to decarbonise heavy industries and transport while acting as an energy storage medium.
Small Modular Reactors (SMRs)	Advanced nuclear technology aims to provide scalable, low-carbon energy options with enhanced safety and cost-efficiency.
Software-based Optimization	Digital platforms are optimizing energy production and consumption to address fluctuations and improve demand response across renewables.
Direct Air Capture (DAC)	Emerging technologies for capturing carbon directly from the atmosphere contribute to net-zero goals and decarbonise hard-to-electrify sectors.

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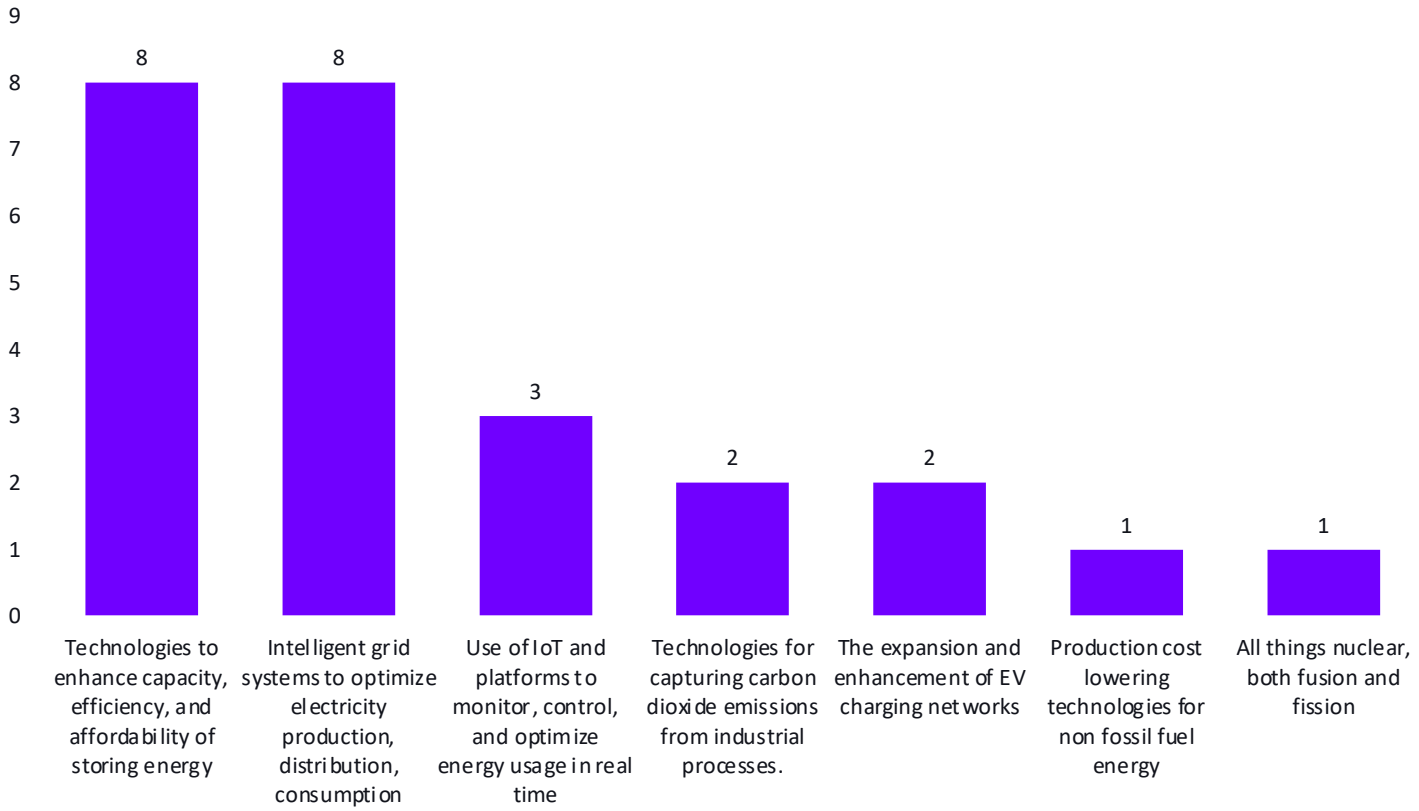
Technology: Decarbonization driving shift towards more decentralised and flexible energy systems (2)

*Which of the following **technology needs** do you think are critical for the future of the energy sector?*



Pontus Strahlman

Partner, Voima Ventures

"There certainly is much legacy technology that is being phased out. On the demand side, inventions such as electric cars, are driving up the demand for cheap renewable energy ... On the supply side we are e.g. phasing out coal plants. Grid stability is a key issue. Ensuring that we have a stable grid, that doesn't fall from capacity issues, is essential."

Scaling: Legacy systems require compatible solutions, but rising energy demand supports growth efforts. (1)

There is immense potential for growth in renewable energy production driven by electrification, innovation, and collaboration across industries. However, there are also significant challenges, including infrastructure updates, regulatory inconsistency, and capital demands. The ability to innovate while aligning with existing systems and addressing market needs is seen as critical for scaling successfully.

Balancing Electrification and Timing Production:
Synchronizing renewable energy production with broader electrification needs, predicting significant growth in electricity demand over the coming decades.

Infrastructure and System Integration:
Growth depends on upgrading legacy energy infrastructure and ensuring compatibility with existing systems. This includes innovations in energy storage, grid stability, and incorporating new technologies like biogas and hydrogen.

The Role of Innovation and Collaboration:
Technological advancements in optimization, monitoring, and alternative energy solutions (e.g., software, materials) are seen as vital. Collaboration between established players and agile start-ups is encouraged to maximize integration across the value chain.

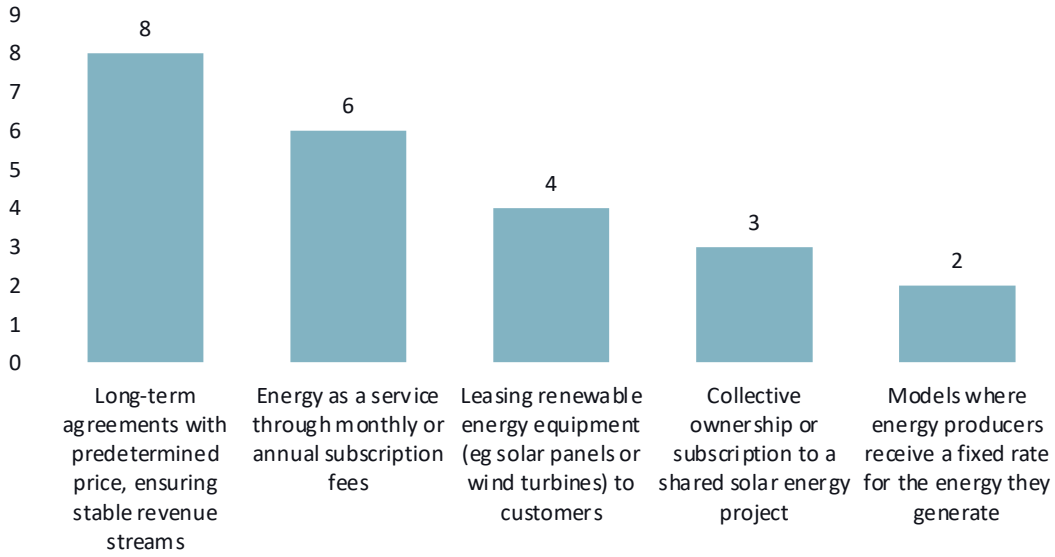
Challenges of Investment and Regulation:
Scaling up requires navigating capital intensity, regulatory unpredictability, and long project timelines. Start-ups must deliver commercially viable solutions independent of subsidies to be competitive.

Anne Lebreton-Wolf

ALW Finance & Innovation

" There is, of course, growth potential in this sector, in the renewable energy sector, but you have to have a long cash runway, you have to have a good yield on your technology and you have to have a good interconnection with all the partners, not just develop your technology as a standalone one, but already think of the whole value chain …."

*Which types of **revenue models** do you find most sustainable or appealing, given the current market conditions in the renewable energy production sector?*



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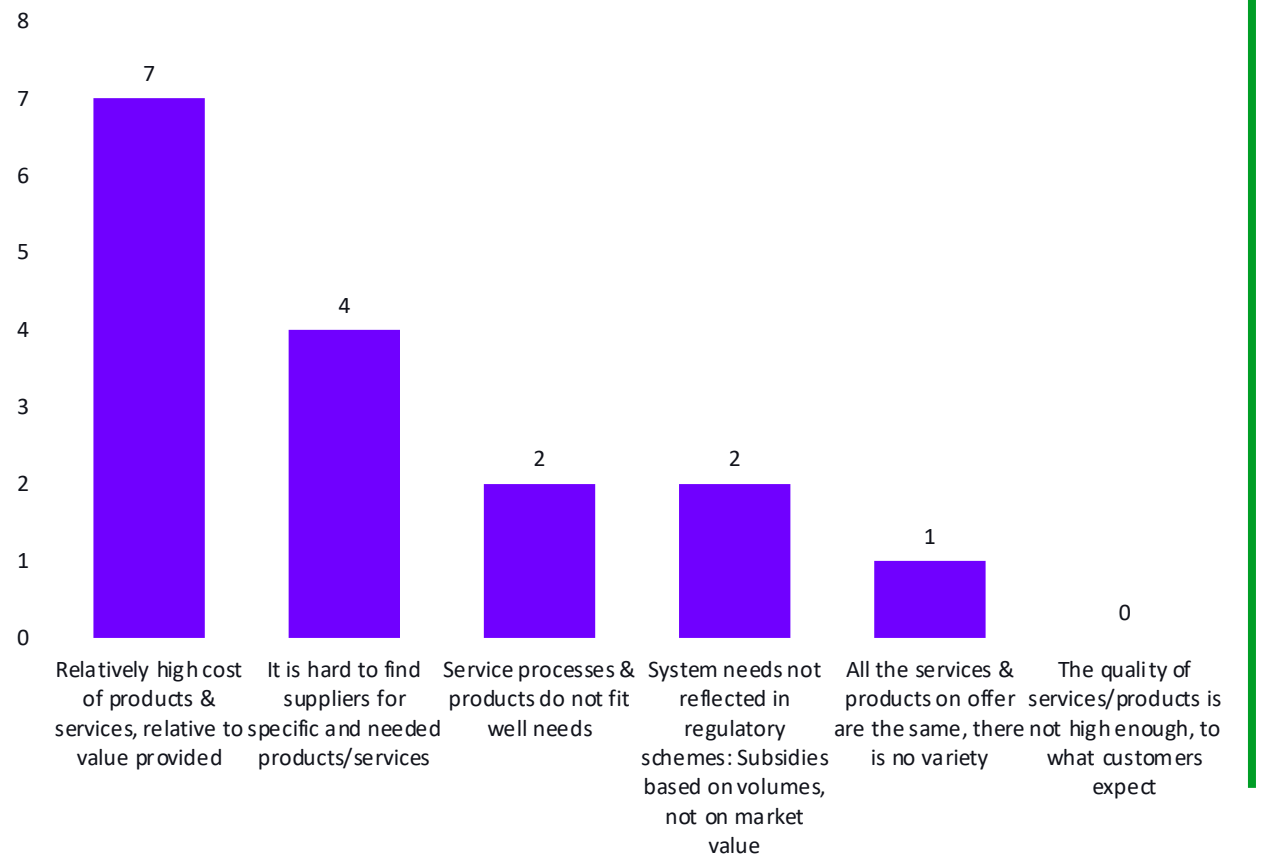
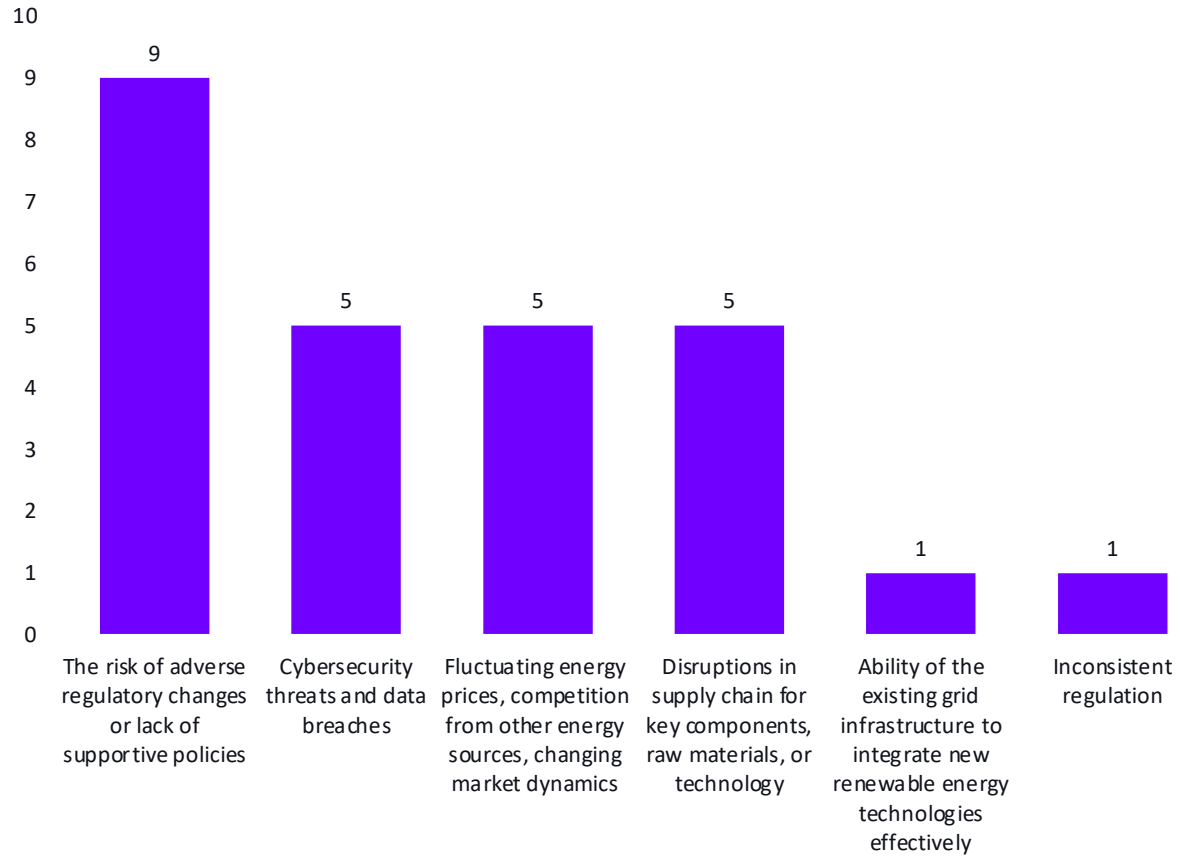
Scaling: Legacy systems require compatible solutions, but rising energy demand supports growth efforts. (2)

*What **areas** in the renewable energy sector **there are still needs and/or challenges** that are not adequately solved or provided for?*



*What do you consider to be the **key risks** that could impact the renewable energy production sector in the next 3–5 years?*



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Competition: Large infrastructure and niche projects, business for a diverse set of companies

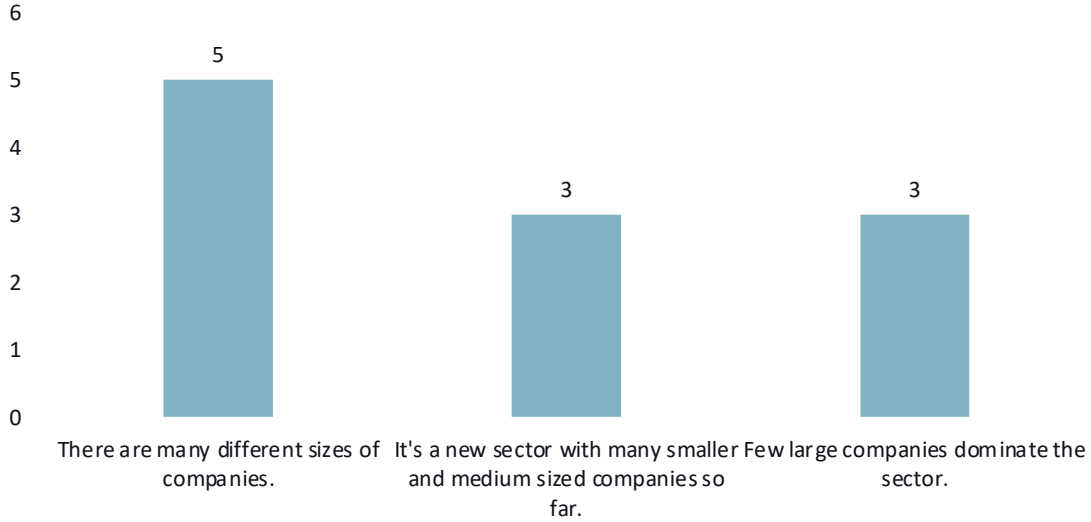
Competition in the renewable energy production sector is characterized by a **mix of large and small players**. Larger companies, often transitioning from fossil fuels, dominate on a national scale and leverage their resources to lead big infrastructure projects, while smaller, agile companies explore niche areas such as tidal energy and hydrogen. **At a local level**, competition is more diverse, with **microgrids and innovative solutions gaining traction**. **Strategic collaborations** between large organizations with established distribution channels and smaller entities with cutting-edge technologies are seen as **essential for fostering innovation and navigating market challenges**.

Pontus Strahlman

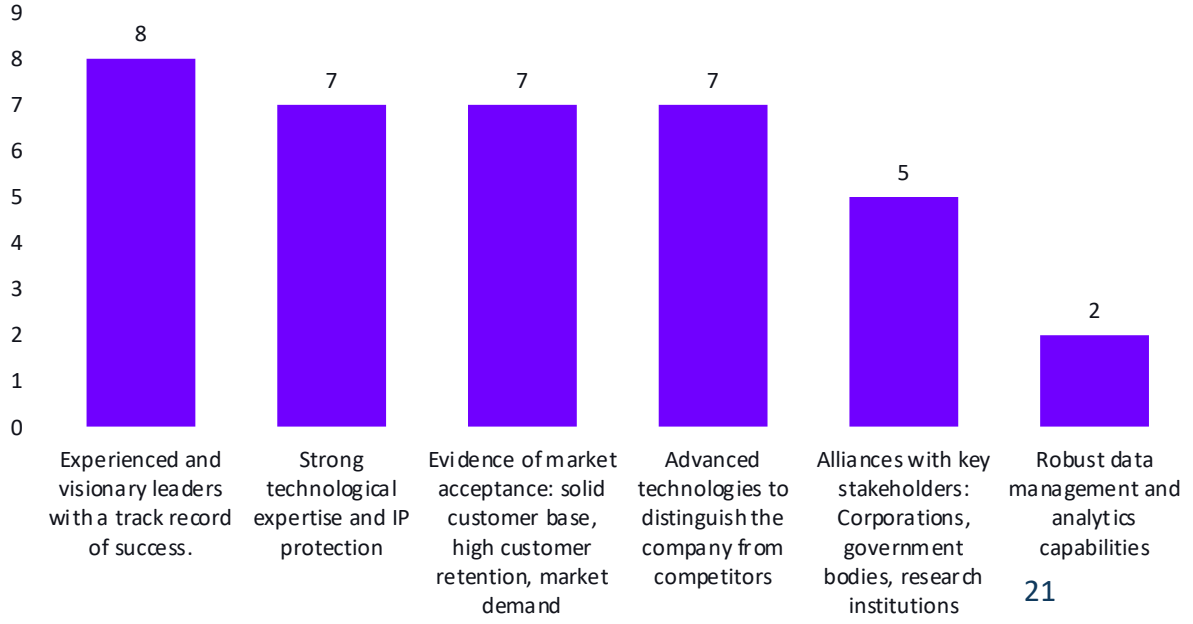
Partner, Voima Ventures

"Yes, lots of competition. Utilities companies have invested massive amounts into R&D to future proofing their technology. At the same time, incumbent companies like Tesla are offering both solar power solutions as well as energy storage solutions through their solar panels and power walls respectively... Successful cases have an innovation that gives them a clear and protected moat."

*What is the **competitive structure of the renewable energy sector**, i.e. who dominates the sector?*



*What specific **attributes or capabilities** do you look for to indicate a competitive advantage in the renewable energy sector?*



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Challenges and risks: Energy is typically capital intensive and requires long term commitment (1)

Start-ups face significant challenges in navigating high financial demands, regulatory unpredictability, legacy infrastructure issues, and the dominance of large players. Coupled with market volatility and technology risks, these barriers require strategic approaches to overcome and thrive in renewable energy production.

Capital Intensity and Funding Barriers:

Renewable energy projects often require substantial investments at industrial scale, making it difficult for start-ups to secure funding. Accessing both dilutive and non-dilutive financing presents major hurdles.

Regulatory Uncertainty:

The unpredictability of government policies, subsidies, and regulations poses long-term planning challenges for start-ups. Stability in these areas is crucial but currently lacking.

Infrastructure Compatibility and Retrofitting Needs:

Integrating renewable energy technologies into legacy infrastructure demands significant updates and financial resources. Ensuring compatibility while focusing on innovation adds complexity.

Dependence on Large Players:

Start-ups often struggle to penetrate value chains dominated by large, established companies. Delivering sufficient volumes, quality, and meeting standards are essential to gain access to these networks.

Market Volatility and Energy Storage Issues:

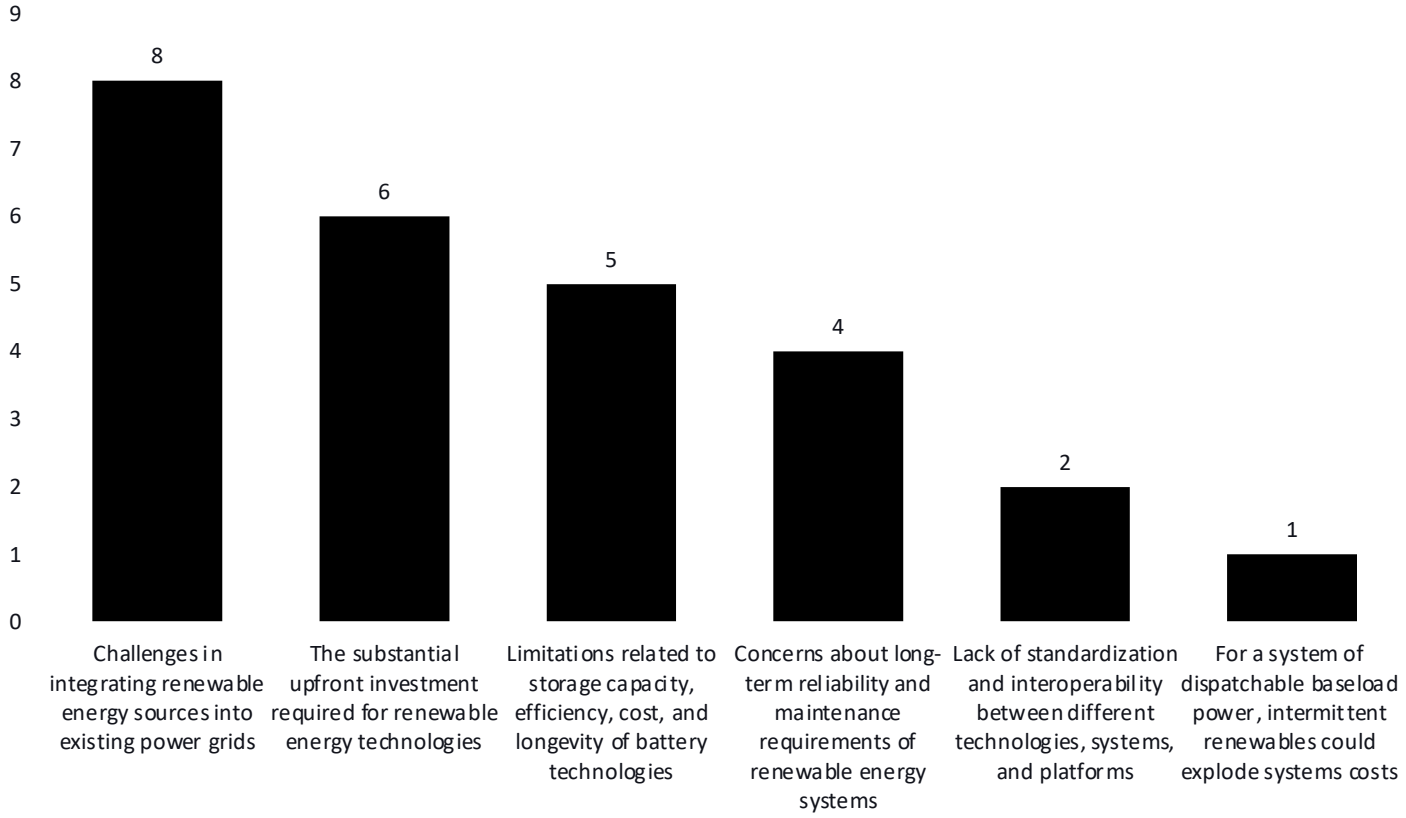
Renewable energy production methods like solar and wind generate volatility in the markets due to intermittent supply. Start-ups face challenges in addressing storage and grid stability to manage this discrepancy.

Technology Risks and Time-to-Market:

Innovations in the renewable energy sector are high-risk due to uncertainties in performance and extended timelines for product development, particularly for complex areas like nuclear energy or novel materials.

Challenges and risks: Energy is typically capital intensive and requires long term commitment (2)

*What are the main **technological or operational challenges** that could hinder the adoption in the renewable energy production sector?*



Anne Lebreton-Wolf

ALW Finance & Innovation

"The main risks are financial risks. The risks that the technology does not deliver sufficiently and that the technology needs more time, more financial resources to bring this new type of energy to the market in sufficient volumes to really be able to integrate the whole chain and be interesting for end customers. There is also another risk that the technology does not work as it is foreseen."

Customers and distribution: Energy sector is closely tied to public sector, yet need for flexibility and decentralization may open private sector opportunities (1)

Customer segments range from individuals to industries, each with unique needs and challenges, while distribution channels involve partnerships and infrastructure that support the integration of renewable systems.

Customer segments

1.Large-scale Industry Buyers
Major industrial and utility players dominate procurement due to their need for high energy volumes, advanced regulation compliance, and proven technologies.

2.Local and Niche Consumers
Smaller entities, such as municipalities and niche market players, are emerging, leveraging localized solutions like microgrids and community-based actors to adapt renewable systems.

3.End Consumers/Prosumers
Residential users and EV owners increasingly engage as active participants in renewable energy consumption, integrating smart solutions that align energy utilization with pricing dynamics.

Distribution channels

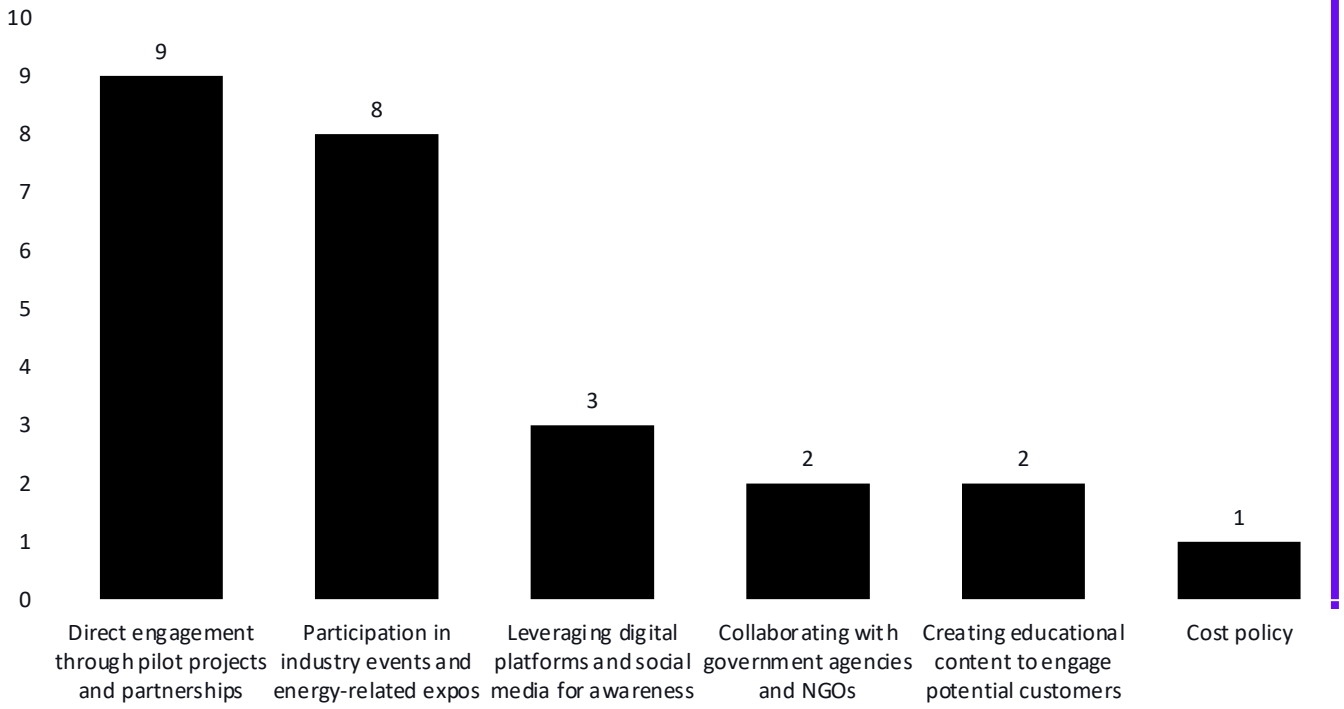
1.Public-Private Collaborations
Strategic partnerships between government entities and private companies are vital for funding, scaling projects, and incorporating new technologies while navigating regulatory challenges.

2.Established Channels
Large corporations with existing infrastructure maintain dominance yet may acquire smaller innovative firms for agility and new solutions integration.

3.Decentralized Solutions
Emerging models such as community grids, peer-to-peer networks, and localized production/distribution are enabling broader access while fostering renewable adoption at the grassroots level.

Customers and distribution: Energy sector is closely tied to public sector, yet need for flexibility and decentralization may open private sector opportunities (2)

*Which of the following **channels** do you believe are **most effective** for reaching and engaging customers in the renewable energy production sector?*



Pontus Strahlman

Partner, Voima Ventures

"More and more consumers are switching over to spot priced electricity. This trend should continue. Then consumers need to attach many of their utilities to some smart wallbox and a service that utilizes cheap pricing. If all the millions of EV's could be set to charge when electricity prices are cheapest that would do a lot of good for everyone."

Roadmap: The evolution of energy and renewable energy production

Past

Fossil Fuel Dependency

- The energy sector relied heavily on coal, oil, and natural gas, with limited alternatives.
- Traditional energy sources like biomass were prominent before industrial advancements.
- Oil dominated transportation, while coal powered electricity in early industrial grids.
- Renewables were in infancy, gaining modest attention during energy crisis periods like the 1970s.

Present

Renewable Expansion

- Renewables like solar and wind have significantly grown, driven by dropping costs and climate targets.
- Fossil fuels still dominate globally, with natural gas and coal playing key roles in many regions.
- Challenges such as renewable intermittency and outdated infrastructure hinder optimal integration.
- Investment shifts and increasing electrification (e.g., EVs) showcase evolving demand and priorities.

Short-term Future

Accelerated Transition

- Intense focus on decarbonization with policies targeting net-zero emissions by 2050 or sooner.
- Rapid growth of energy storage solutions to stabilize grids with decentralized energy systems.
- Expanding technologies like green hydrogen and advanced batteries to complement renewables.
- Developing nations may leapfrog traditional systems, embracing solar and wind innovations.

Long-term Future

Clean and Decentralized Systems

- Advanced technologies like nuclear fusion and decentralized smart grids will redefine energy landscapes.
- Customers will increasingly act as prosumers, producing and trading renewable energy locally.
- Renewable energy is expected to surpass fossil fuels significantly, driven by global electrification trends.
- Continued innovation and international collaboration will help solve persistent challenges, ensuring resilience and equity.

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Challenge-to-Action Framework

Challenge Description	Category	Start-ups with the challenge	Mentor & Stakeholder insight	Start-up action plan
Funding an extensive market outreach	Funding	12	It's a capital-intensive sector, thus hybrid financial instruments, and dilutive and non-dilutive financing become important	A long cash runway, proactive investor engagement, and leveraging partnerships (e.g. with municipalities)
Ensuring product-market fit and technology validation	Technology	7	Balancing intrinsic market value and innovation is crucial in ensuring product-market fit and technology validation	Focus on continuous service validation and flexibility in product development while actively building partnerships
Internal growth as a company, packaging of the services provided and search for strategic partners	Partnerships	3	Strong value proposition, with continuous dialogue with strategic partners, to strengthen the value chain	Proactively seek partnerships through networking, funded pilot projects, and strategic alignment
Long decision-making timelines of B2B clients	Sales	3	Continuous dialogue with incumbents and pilot project engagement can address lengthy B2B decision-making timelines	Maintain open communication to validate services, leverage indexed pricing models to streamline client processes.
Recruiting more people to get product finished for market launch, but we do not generate enough cash flow for hiring	Resources	2	Start-ups should focus on validating services through pilot partnerships and build strategic alliances to share costs and attract talent	Explore co-financing opportunities with potential collaborators. Develop flexible offerings to adapt to market uncertainties
Navigating regulatory complexities across multiple European markets	Regulatory	2	Avoid technologies and business models that are heavily dependent on government policies or subsidies.	Build networks with investors early and leverage partnerships with established entities to navigate regulatory hurdles
To encourage customers to shift electricity usage to times when supply exceeds demand	Operations	1	Create awareness about energy prices, link to renewable energy production, and offer energy flexibility with services of dynamic pricing	Develop smart consumption services and tech solutions that educate customers and automate shifting usage to optimal times.

Other Market Opportunity Roadmaps

Circular Models for Cities and Regions roadmap

Supply Chain Management & Trade Finance roadmap

Sustainable Mobility roadmap

AI-Powered Utility Management for Sustainable and Smart Cities roadmap

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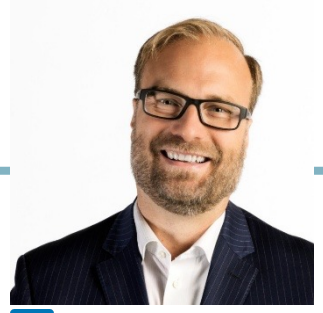
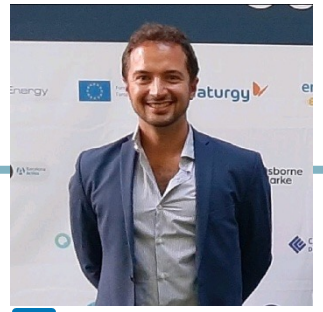


Pontus Strahlman
Partner, Voima Ventures



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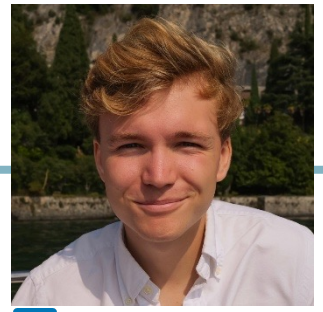

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Klaas de Boer
NED, Chair and (occasional) investor

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THANK YOU!

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