ectogrid™

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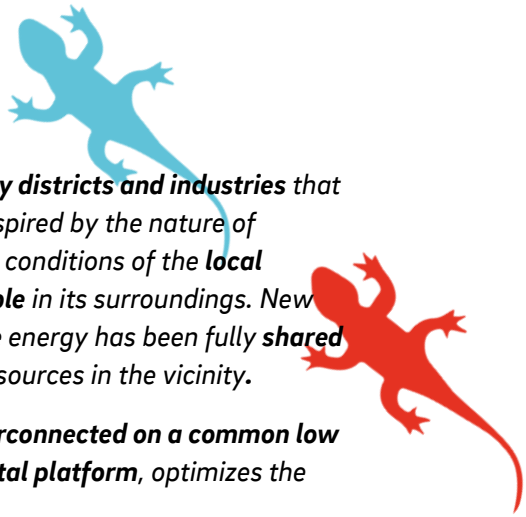
Elevator Pitch – E.ON ectogrid™ in brief

For a short introduction to the product:



Elevator pitch

*E.ON ectogrid™ is a **heating and cooling** solution for **city districts and industries** that reduces the **supplied energy** with up to **75[1] percent**. Inspired by the nature of **ectothermic** animals, the energy solution **adapts** to the conditions of the **local** environment and **makes the most of the energy available** in its surroundings. New energy is only added into the system when all available energy has been fully **shared** between buildings or **harnessed** from available energy sources in the vicinity.*

*This is accomplished by **decentralized heat pumps interconnected on a common low temperature grid** that, together with an **intelligent digital platform**, optimizes the efficiency of the energy solution.*

[1] Data from E.ON ectogrid™ at Medicon Village, Lund

Problem Statement – Why is the product in market?

To increase the perceived value of our solution we need to create awareness of the problem we solve.

Problem statement

Currently, half[2] of the Europe's total energy consumption is dedicated to heating and cooling. Alarmingly, 80%[3] of this energy is derived from non-renewable sources, often produced through usage of fossil fuel combustion. With the majority (70%)[4] of Europe's population residing in urban areas, the ongoing trend of urbanization is anticipated to further escalate the demand for both heating and cooling within and surrounding our cities.

The existing heating and cooling systems not only significantly contribute to air pollution within our cities but also releases greenhouse gases into the atmosphere, posing multiple environmental challenges for our planet.

The transition from this problematic situation must not only consider environmental sustainability, but also economic and social sustainability. It is imperative that we establish efficient and secure energy systems that can provide cities with reliable heating and cooling solutions that are future-proof, without impeding their growth and prosperity.

The above problem statement can be related to different layers of stakeholders within our cities:

Municipality & City Developers

The increasing demand for heating and cooling and reliance on non-renewable sources poses risks in terms of straining urban infrastructure, such as the electricity grid, and contributing to local environmental issues.

Industries

Industries may face escalating operational costs and potential regulatory pressures because of their contribution to air pollution and greenhouse gas emissions through the utilization of non-renewable energy sources while at the same time producing waste heat. Regulations in future for new industries, data centres etc. will require reuse of their waste heat

Real Estate Companies

Real estate companies may encounter challenges in sustainable property development and management, with the environmental and cost impact of energy supply influencing property values and market perception.

[2] https://ec.europa.eu/eurostat/web/products-eurostat-news/w/DDN-20230203-1
[3] https://ec.europa.eu/eurostat/web/products-eurostat-news/w/DDN-20230203-1
[4] https://ourworldindata.org/urbanization

Solution Description – How do we solve the problem?

The core principle of E.ON ectogrid™ is to provide heating and cooling by first utilizing existing energy sources locally available, minimizing the supplied energy. Our solution to the described problems is to take an integrated approach to heating and cooling with a decentralized and digitally intelligent system, enabling highly efficient and flexible energy usage and distribution:

1. **Share and balance excess energy between buildings**
   Opportunity: The process of cooling a building also means removal of heat and vice versa for heating. Traditionally, cities have been designed with separate infrastructures for heating and cooling, resulting in that this excess energy is being lost. By taking an integrated approach, excess energy from both heating and cooling can be shared between buildings, reducing the need of supplied energy.

2. **Harness local available energy sources**
   Opportunity: In Europe, there is as much waste heat energy as the total heating energy consumption of the same continent[5]. This waste heat typically originates from sources like industries, data centres and supermarkets within or surrounding our European cities. Furthermore, there are also other virtually free and endless energy sources in our cities coming from natural energy sources locally available such as air, water or ground.

3. **Data-driven energy optimization**
   Opportunity: Digitalization through Internet of Things (IoT) and machine learning technologies are key to intelligent energy management. With the transition to decentralized energy systems with increasingly intermittent energy availability and volatile cost patterns, connected and intelligent platforms are essential for a well-functioning and efficient energy system.

See Appendix 1 for schematic overview.

[5] https://heatleap-project.eu/wp-content/uploads/2023/06/HEATLEAP_Policy_Paper_7-June-2023.pdf?_sm_nck=1

Product Description – What is E.ON ectogrid™?

E.ON ectogrid™ is a well proven heating and cooling solution for city quarters, industrial areas, science parks that reuse and share of already available energy within a city area. This is accomplished by recovering and sharing excess energy between buildings and by harnessing ambient energy and/or waste heat in the near vicinity.

The decentralized architecture of E.ON ectogrid™ coupled with the digital intelligence of E.ON ectocloud™ enables the energy system to be highly flexible and adaptable to both local and external conditions. The system revolves around usage of heat pumps in each building, all connected on a common low temperature grid. The grid consists of two pipes, one warm and one cold, where the direction of energy flow is demand-driven, making it possible to share excess energy between neighbours with diverse needs and with low distribution losses.

Energy storage is used to increase the share of local energy used in the system as well as to provide energy flexibility over time. Due to E.ON's ectogrid™ inherent flexibility and ability to adapt to the surrounding conditions, local energy of many forms can be seamlessly integrated into the system. This includes waste heat of different temperatures as well as ambient sources for heating and cooling such as geothermal, aquifers or surface water or by air fan coolers.

Only when all available energy in the local surroundings has been recovered and utilized to its fullest extent, new external energy is added. This makes for a very energy-lean and efficient system that reduces supplied electricity up to 75%.

See Appendix 1 for schematic overview.

Technical specification ectogrid™

- **One low temperature thermal grid for distribution of heating and cooling** consisting of one warm and one cold pipe, capable of sharing low temperature excess energy.
- **Decentralized pumping** makes it possible to have bidirectional sharing excess energy between buildings (from the decentralized heat pumps) and balance the grid in a flexible way
- **Decentralized heat pumps that** cool down buildings by turning down the temperature from the cold pipe of the grid and heat up buildings by turning up the temperature from the warm pipe.
- **Thermal energy storage** solutions act as both hydraulic balance in the grid and thermal flexibility as demand varies between heating and cooling
- **Local energy sources and units** that adds or withdraws energy from the system, i.e. low temp waste heat source, a geothermal energy system, energy from air or water etc.
- **Intelligent cloud platform** E.ON ectocloud™ connects and controls all parts of the energy system, providing state-of-the-art digital and data-driven services. Through advanced machine learning algorithms, optimal control strategies for the distribution and usage of energy, including the use of electricity, are continuously computed and applied, unlocking the full potential of E.ON ectogrid™.

Product USP – What makes E.ON ectogrid™ unique?

There are other solutions for the same problem, but what's makes ectogrid™ unique?

The uniqueness of E.ON ectogrid™ is:

- **Two-In-One** – One energy system for both heating and cooling, enabling energy sharing while avoiding the construction of separate infrastructures - future-proofing cities for increased cooling needs.
- **Circular -** The low temperature grid unlocks the potential to integrate low-grade energy waste and to share surplus energy between buildings, reducing the climate footprint.
- **Decentralized** – Rather than relying on large scale generation plants, E.ON ectogrid™ relies on small-scale decentralized heat pumps and chillers in each building.
- **Electrified** – As E.ON ectogrid™ is powered by electricity (sector coupled) and flexible in its energy use, it can be run largely on renewable and local power enabling decarbonization.
- **Digitalized** – All distributed parts of E.ON ectogrid™ are digitally connected and intelligently controlled to optimize internal efficiency and flexibly adapt to external factors such as dynamic energy availability and prices.

Value Proposition – What values do we create?

E.ON ectogrid™ is a sustainable solution that enhances efficiency, reduces environmental impact, and fosters self-sufficiency while ensuring long-term prosperity of local communities and businesses. Our system generates value through the following key benefits:

- **Sustainability**: E.ON ectogrid™ reduces the reliance on non-renewable energy sources and increase the energy circularity, significantly reduces the carbon footprint for heating and cooling. Given the sector coupling of heating and cooling with the electricity system, an increased share of renewable electricity usage is made possible.

- **Cost Savings**: Stakeholders benefit from an energy-lean and cost-efficient solution, arising from the smart design and digital intelligence of E.ON ectogrid™ to maximize utilization of all available energy sources, including electricity cost optimization. By taking advantage of the energy flexibility in E.ON ectogrid™ while considering energy supply conditions, the usage of electricity can adapt based on availability and cost.

- **Energy Efficiency**: By decentralized approach, recovering and sharing excess energy between buildings and taking advantage of all local energy sources, our system ensures high energy efficiency with reduced supplied energy up to 75% as a result.

- **Future proof**: With increased self-sufficiency and reduced exposure to energy markets, E.ON ectogrid™ enhances urban resilience. Our decentralized, data-driven and scalable energy system is designed for future growth, providing reliable heating and cooling services even in dynamic energy supply and demand conditions.

- **Two in one**: The increasing relevance of maintaining a comfortable indoor temperature during summer months requires thought-through solutions. Because E.ON ectogrid™ is an infrastructure solution that answers to both heating and cooling demands, it is a way to also future proof increased cooling needs in cities.

- **Health & Well-being**: By improving air quality, reducing pollution, and mitigating health risks, E.ON ectogrid™ promotes the health and well-being of citizens. Our system creates cleaner, healthier living spaces, contributing to a higher quality of life for communities.

The above value proposition can vary between target audience. Below is adjusted value propositions for different audiences.

Value proposition for Municipality
E.ON ectogrid™ empowers municipalities and city developers with sustainable energy solutions, generating value through enhanced urban resilience and efficiency.

- Sustainable Development: Municipalities and city developers can be helped in achieving sustainable development goals (SDG) by moving away from non-renewable energy sources.
- Resilience & Efficiency: Enhanced urban resilience achieved by utilizing available energy sources within the city area, increasing the self-sufficiency.
- Future-Proof Solution: Through the distributed architecture of E.ON ectogrid™ with built-in scalability together with a data-driven approach, future long-term growth of city areas is enabled.
- Health & Well-being: Our system contributes to improved air quality in urban areas by reducing pollution and emissions associated with traditional combustion-based systems.

Value proposition for Industries
E.ON ectogrid™ offers industries the opportunity for increased energy efficiency and sustainability leadership, generating value through cost savings and regulatory compliance.

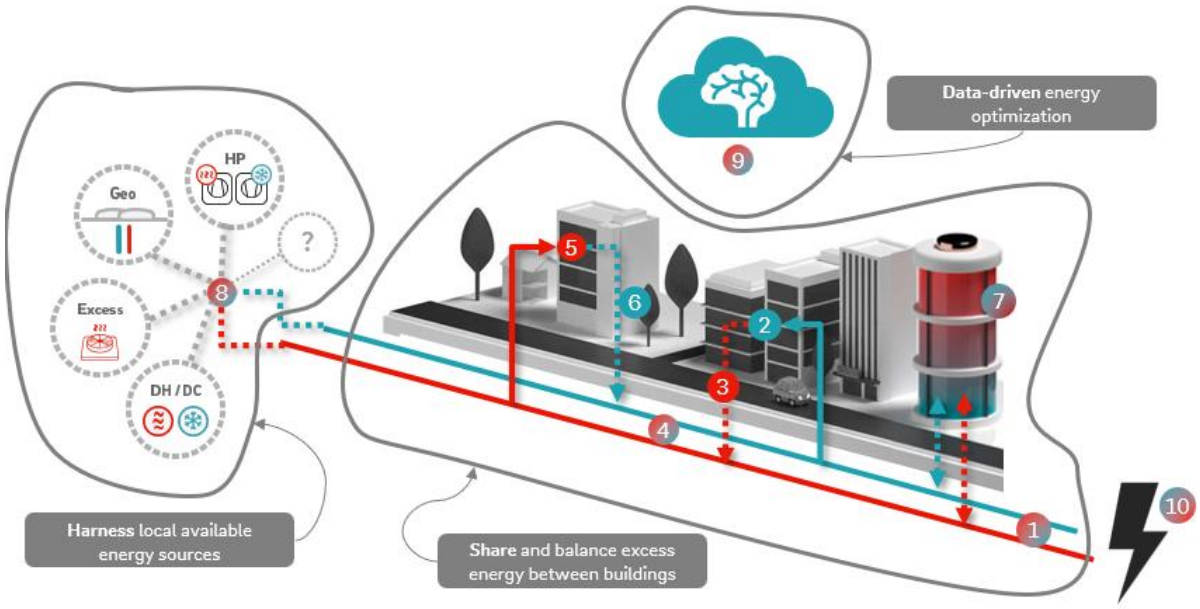
- Energy Efficiency: Our system helps industries optimize their business by utilizing waste heat recovery, lowering energy costs, and improving overall energy efficiency.
- Regulatory Compliance: E.ON ectogrid™ assists industries in complying with environmental regulations by reducing emissions and curtailing environmental impact.
- Sustainability Leadership: By embracing a circular energy philosophy, E.ON ectogrid™ empowers industries to enhance brand reputation and stakeholder trust.
- Flexible business models: Data driven approach through E.ON ectocloud™ makes it possible to set-up different business models depending on customer need

Value proposition for Real Estate Companies
E.ON ectogrid™ enhances property values and market differentiation for real estate companies, generating value through sustainability and long-term viability.

- Property Value Enhancement: Enhanced property values by offering lower operational expenses, minimize risk exposure/increased self-sufficiency and attracting environmental-conscious tenants and buyers.
- Market Differentiation: Real estate companies can differentiate their properties and brand in the market by promoting increased sustainability, appealing to environmentally conscious consumers.
- Reduced Operational Expenses (OPEX): Decrease in business expenses through reduction of energy costs to the benefit of both the property owners and their tenants.

Appendix 1 – Schematic overview of E.ON ectogrid ™

E.ON ectogrid™ explained schematic and step by step:



1. **One thermal grid** for heating and cooling with one warm and one cold pipe - distributing and sharing energy between buildings
2. **Decentralized chillers** cool down building by lowering the temperature from the cold pipe
3. **Warm excess energy** is put back in the warm pipe
4. **Energy sharing** is possible thanks to bidirectional low temperature pipes with minimum energy losses
5. **Decentralized heat pumps** heat up building by raising the temperature from the warm pipe
6. **Cooled excess energy** is put back into the cold pipe
7. **Storage** of heating and cooling to balance the entire grid
8. **Low graded energy sources** from i.e. industries or local energy sources (i.e. ground, air and water) can be harnessed thanks to the low temperature system.
9. **Intelligent cloud platform** E.ON ectocloud™ connects and controls all parts of the energy system and usage of energy, unlocking the full potential of E.ON ectogrid™.
10. **Primary energy** is only added when the locally shared and harnessed energy is not enough.