InEExS
ENERGY SERVICES ON THE BLOCKCHAIN

Upgrade of building heating systems for increased energy efficiency and flexibility

Αναβάθμιση Συστημάτων Θέρμανσης Κτιρίων για Αυξημένη Ενεργειακή Αποδοτικότητα και Ευελιξία

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22/2/2025 – Verde.tec Forum: Workshop 1

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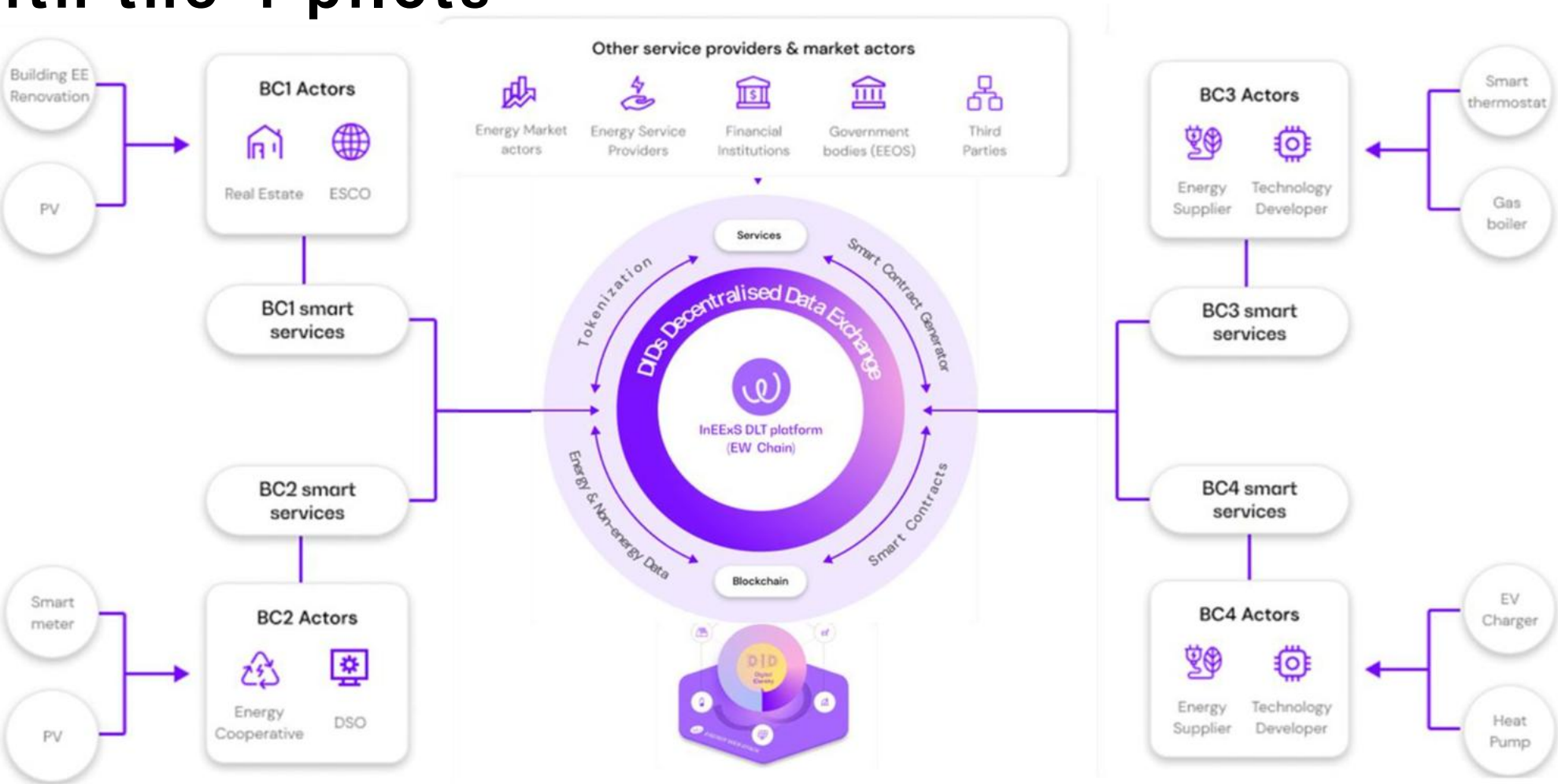
The InEExS Blockchain platform and integration with the 4 pilots



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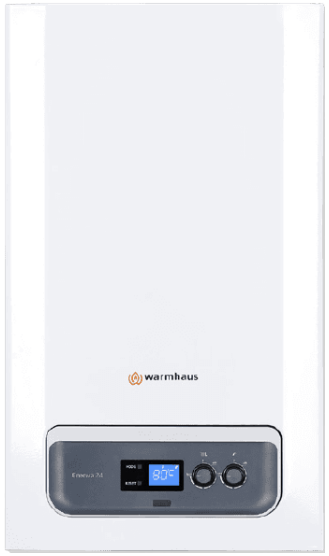
BC3 - Energy efficiency through Smart heating

Legacy Heating



Gas Boiler

Heatpump

End user

Room thermostat

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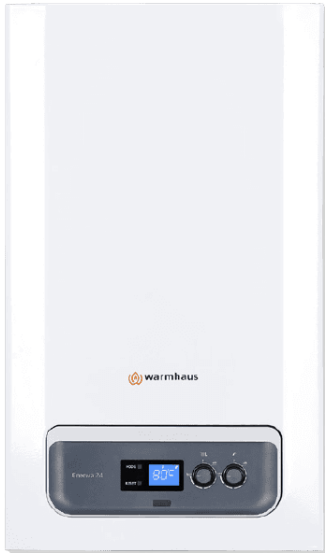
DOMX Smart Heating



Gas Boiler

Heatpump

Control

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Smart Heating Controller

Input

End user

Wireless Room thermostat

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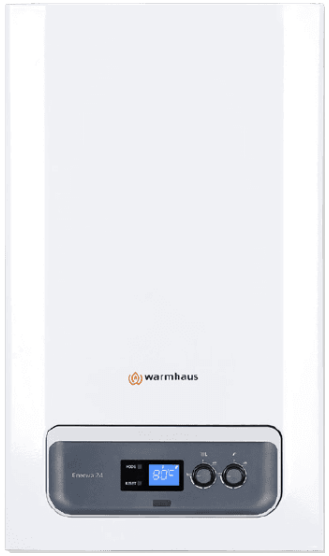
DOMX Smart Heating

domx smartphone app

End user



Gas Boiler

domx cloud services

Control

Input

Heatpump

domx Smart Heating Controller

Wireless Room thermostat

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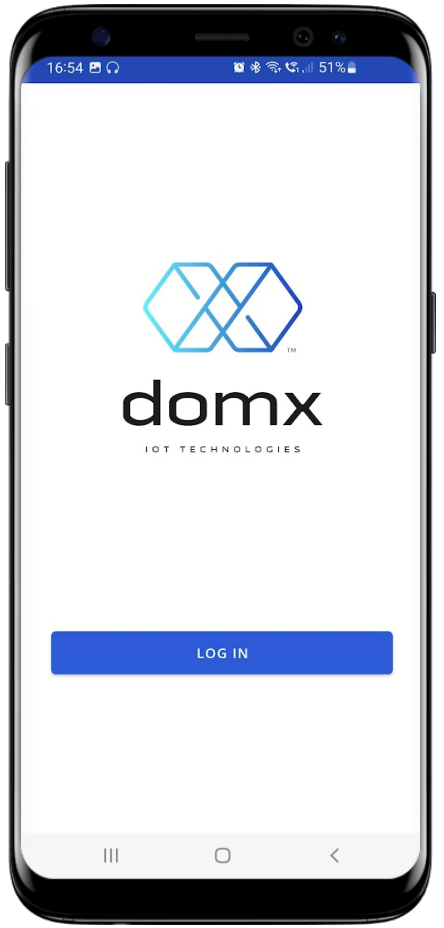
DOMX Smart Heating

- **Device Benefits**
  - User friendly smartphone application
  - Wide system compatibility (>70% of gas boilers, >60% of heatpumps)
  - Thermal comfort management (avoiding room temperature overshooting)
  - Energy efficient heating (tuning of outlet temperature)
  - Energy saving tips (alerts, push notifications)
  - Error reporting (push notifications)
- **System Benefits**
  - Metering and control through a single device
  - Analysis of consumption (day/week/month)
  - Quantification of achieved savings (kWh, €, CO2)
- **Portfolio Management benefits**
  - Access to real-time and historical data through secure web API
  - Portfolio Management services and dashboard:
    - Operation monitoring
    - Error reporting

Wireless Room Thermostat



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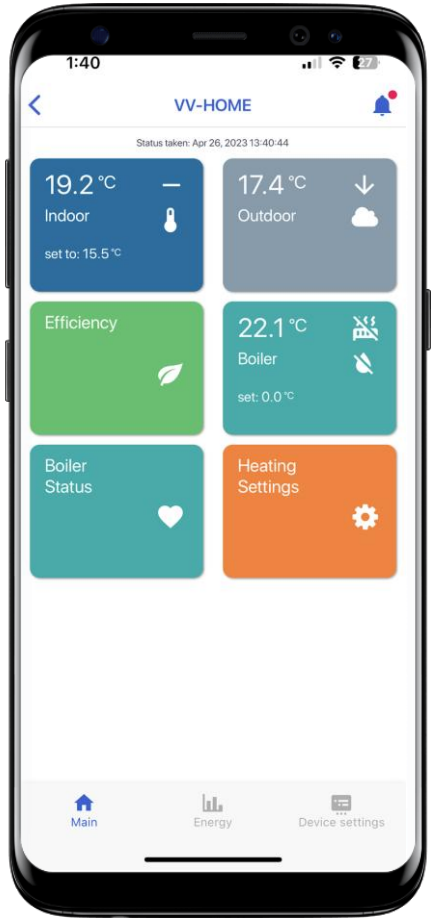

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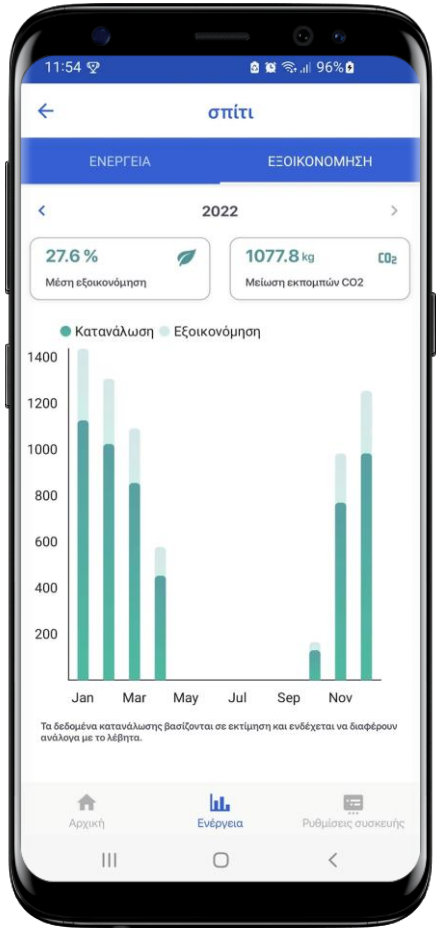

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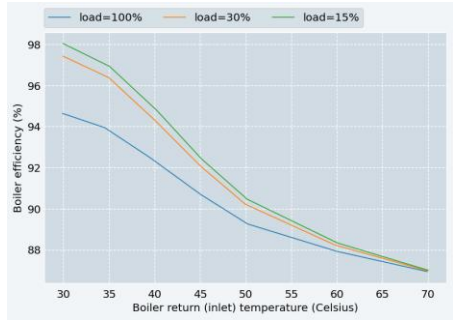
DOMX Energy Saving Mechanisms

- Employ an **accurate** room temperature sensor (0.1C)
  - Control temperature overshoots - undershoots
- Indoor Temperature Compensation
  - PID controlled adaptation of **outlet** temperature, based on ΔT (target - room)
  - Avoid temperature overshoots - undershoots
- Use of **lower modulation** for increased duration per heating event
  - Avoid repetitive boiler activations (ON/OFF penalty)
  - Exploit building thermal inertia
- Outdoor Temperature Compensation
  - Restrict the **maximum boiler target** temperature based on outdoor temperature
- Physics-based ML algorithms to model the system's performance
  - Building
  - Heating System
  - User



Baseline vs Energy Saving Modes

Room temp/ Target

Outdoor temp

Outlet temp/ Target

Power

BASELINE

Fixed outlet temperature of 65 °C

AVG boiler temperature 39.32 °C

Estimated consumption 40.31 kWh

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29.7 %

Energy consumption reduction

ENERGY SAVING

Adaptive outlet temperature

AVG outlet temperature 36.59 °C

Estimated consumption 28.19 kWh

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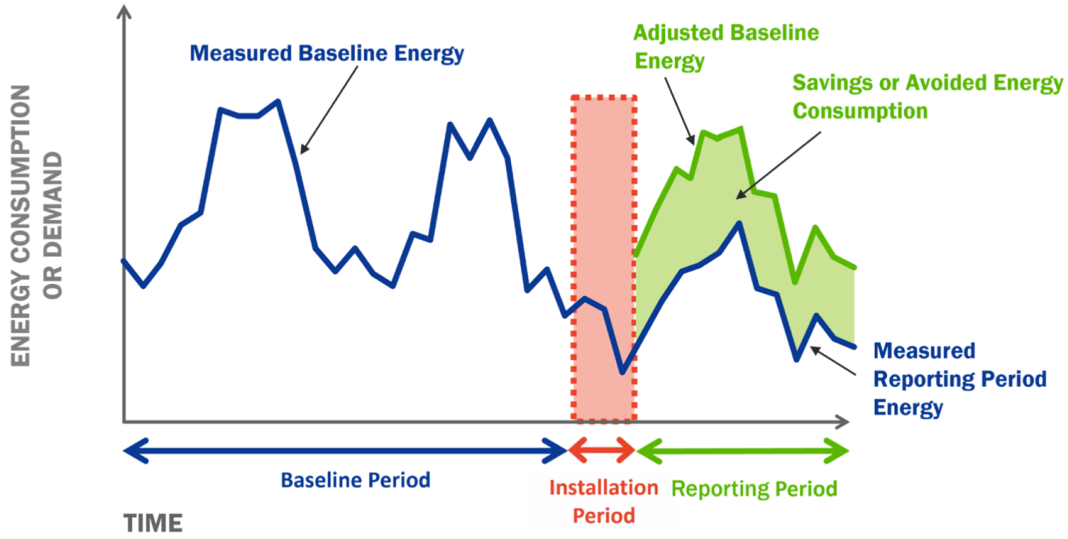
BC3: Measurement and Verification Approach

Energy Savings Calculation



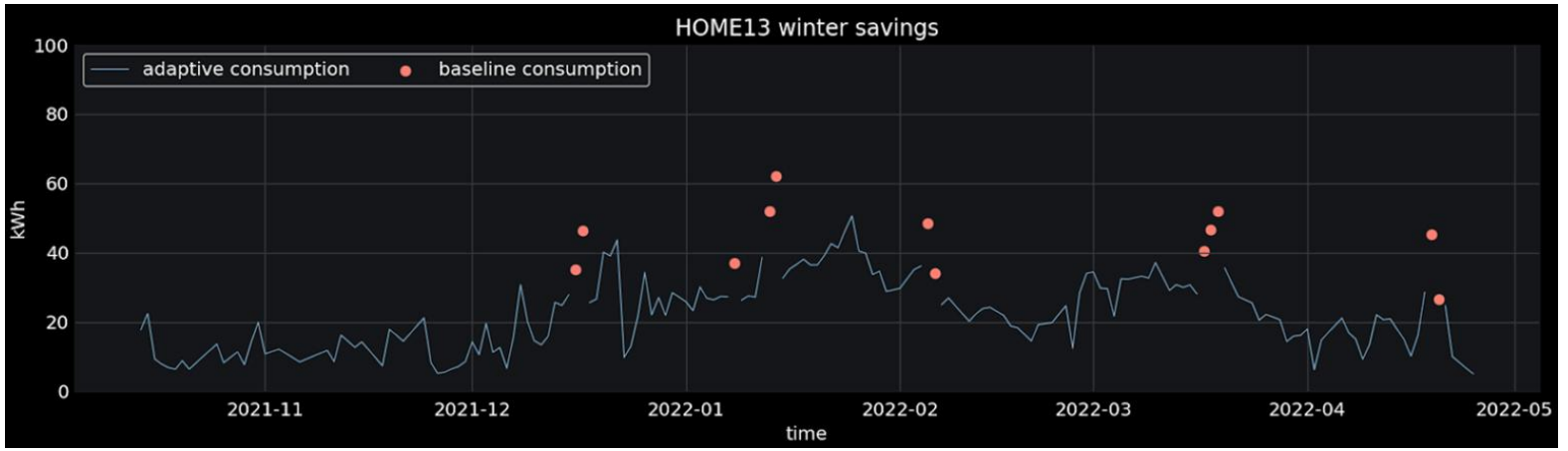
Energy Efficiency Measures and calculation of Savings

Energy savings cannot be directly measured, as they represent the absence of demand. Savings are determined by comparing measured energy consumption or demand **before** and **after** the implementation of an energy efficiency measure (EEM), making suitable adjustments for changes in conditions.

The **International Performance Measurement and Verification Protocol (IPMVP)** develops a consensus approach to measuring and verifying efficiency investments and requires the alignment with one or more of the four Options and impacts the granularity of the savings reported and the measurements required.

Option D: Calibrated Simulation
If the **Baseline** Period or **Reporting** Period data are unreliable or unavailable (e.g., new construction), energy data from a calibrated simulation model can be applied.

Baseline Performance Simulation



Energy Saving mode Consumption per day + 12 Baseline days over the entire heating season

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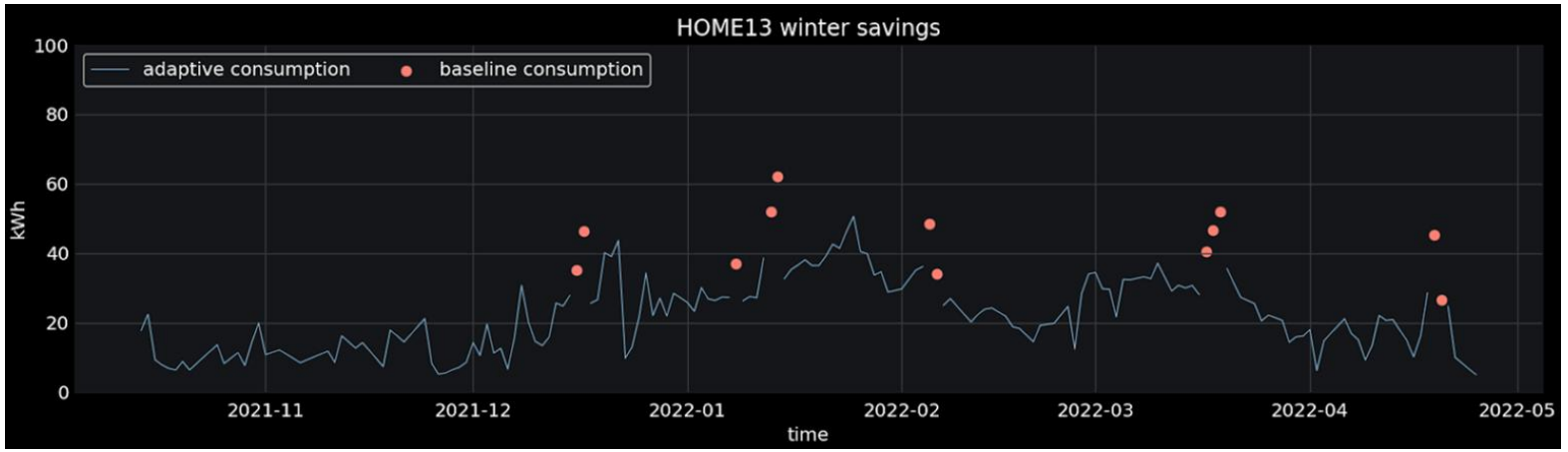
Baseline Performance Simulation



Energy Saving mode Consumption per day + 12 Baseline days
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Energy Saving mode + Simulated Baseline Consumption per day
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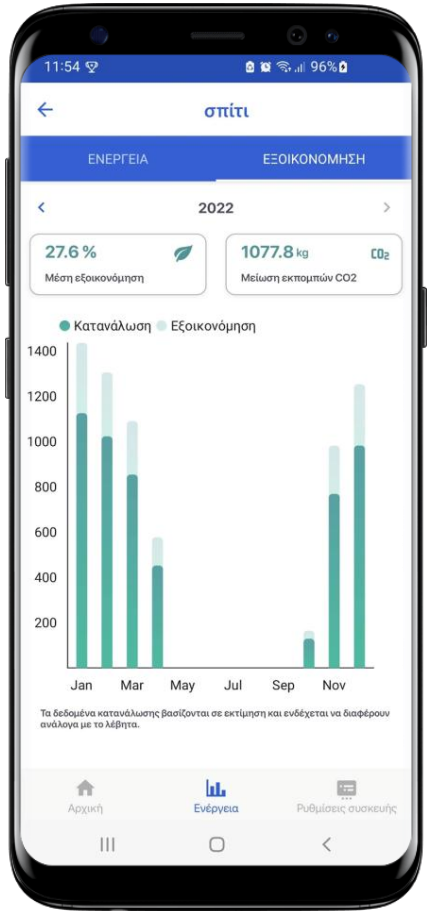

Consumer level savings reporting

Portfolio level savings reporting

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Decarbonisation: Natural Gas Efficiency

BAXI

IMMERGAS

RIELLO

FERROLI

SIME

System compatibility has been tested with several more gas boiler vendors including:
UNICAL, ITALTHERM, WARMHAUS, BALTUR, NAVIEN, WESTEN, DAIKIN, VIESSMANN, VAILLANT

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InEExS Business Validation and Replicability

Transformation of the Energy Sector

Transformation of the Energy Sector

- Lignite and Oil are phased out
- Natural Gas as transition fuel (despite?) decarbonisation being the focus of European (EU) policy
- Electrification at the foreground of green transition and EU policy
- Renewable Energy projects compete on equal grounds
- Prosumption, flexibility, collaborative movements: data-driven innovation
- Energy prices at historical high levels
- Energy Poverty a reality affecting alarming levels of the population alienates public from green transition
- Competing forces: nations and sectors offering different solutions and some “solutions”
- Old wounds surfacing up: the role of nuclear power, market interference, energy autarky vs interconnections

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InEExS Relevance and Replicability

Retail premium services: telecommunication v energy sectors

Telecommunications (telcos): a mature consolidated market following more that 20 yrs of competition in which bundled services (broadband, mobile, cable TV) are standard

Telcos offer premium services on top of price (€/min, €/MB) competition:

- Access to specific channels and platforms (reason to switch provider depending on sport package)
- Access to unique technology: internet speed
- Mobile services tailored on use habits (data vs minutes)
- Special prices on “niche” services: roaming access / costs

Energy Suppliers offer bundled products (electricity + natural gas) focusing on price reduction and one-off offers, ***but they do not add premium services***

Decarbonisation: Natural Gas Efficiency

Retail premium services for the energy sector: technology driven efficiency

A premium service for an energy retailer: cost reduction through energy savings that can be guaranteed ex ante, quantified and validated

- InEExS BC3: Efficiency and flexibility services for legacy natural gas boilers, *and heat pumps*, **without compromising effort**.
- Optimal tuning of based on smart heating controllers offering advantages to consumers and energy suppliers:
  - Improve energy efficiency (up to 35%)
  - Provide real-time flexibility services to suppliers
  - Deliver remote maintenance support of technicians
  - Contribute towards suppliers Energy Efficiency Obligation Scheme (EEOS) ~ for now

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Decarbonisation: Natural Gas Efficiency

Energy Efficiency Obligation Schemes (EU Energy Efficiency Directive)

- Mandatory Energy Savings for all EU countries: obligated parties (energy distributors and energy retailers) must reduce at least 1.5% of energy sold (excl. transport fuels) from 2024 to 2030.
- Obligated parties must support energy efficiency improvements for end-users (i.e. insulation, efficient appliances, smart energy management, electrification).
- Focus on technical improvements that can be quantified and validated.
- Member states must track progress and report to the European Commission ensuring transparency and compliance with energy-saving targets.
- Critical for contributing towards Fit for 55 and Green Dea targets by reducing overall energy consumption and greenhouse emissions.

In Greece EEOS are being regulated and monitored by CRES (ΚΑΠΕ).

2024 target of Greece @186 ktoe: 2,163 GWh ~ 500k Athens households for a year

HERON for 2024 @ 5.21 ktoe

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Decarbonisation: Natural Gas Efficiency

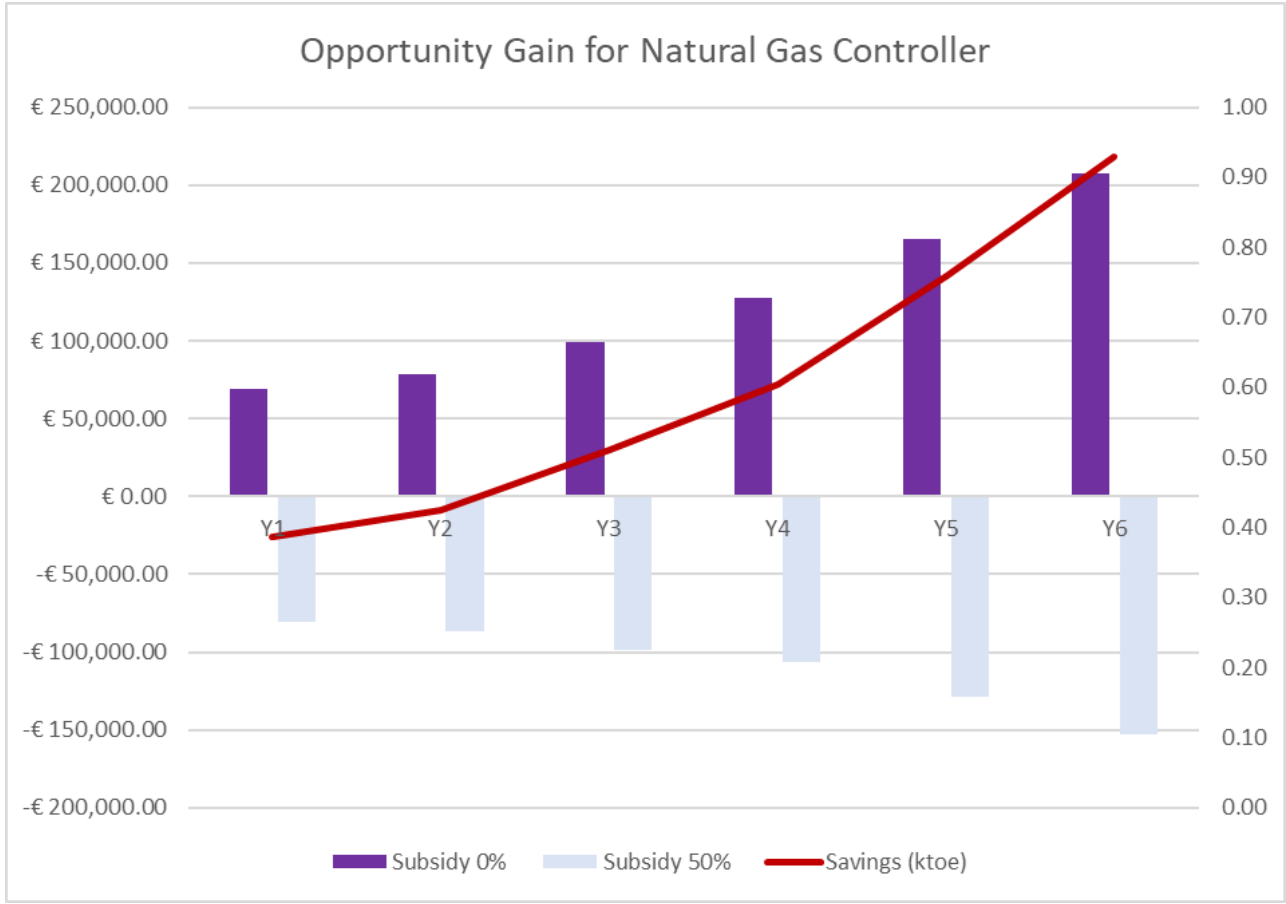
Business Model for DOMX Efficiency 20%

Market analysis

Market size: 5-10% of a Utility's market share representing the most eager early adopters. Conversion rate ramping up to 30% leading to 15% total adoption by Y6

Demographics: higher educated, 35+ years old, in urban centres.

Barriers: other utilities offering smart monitoring, scheduling and efficiency products, compatibility with boiler



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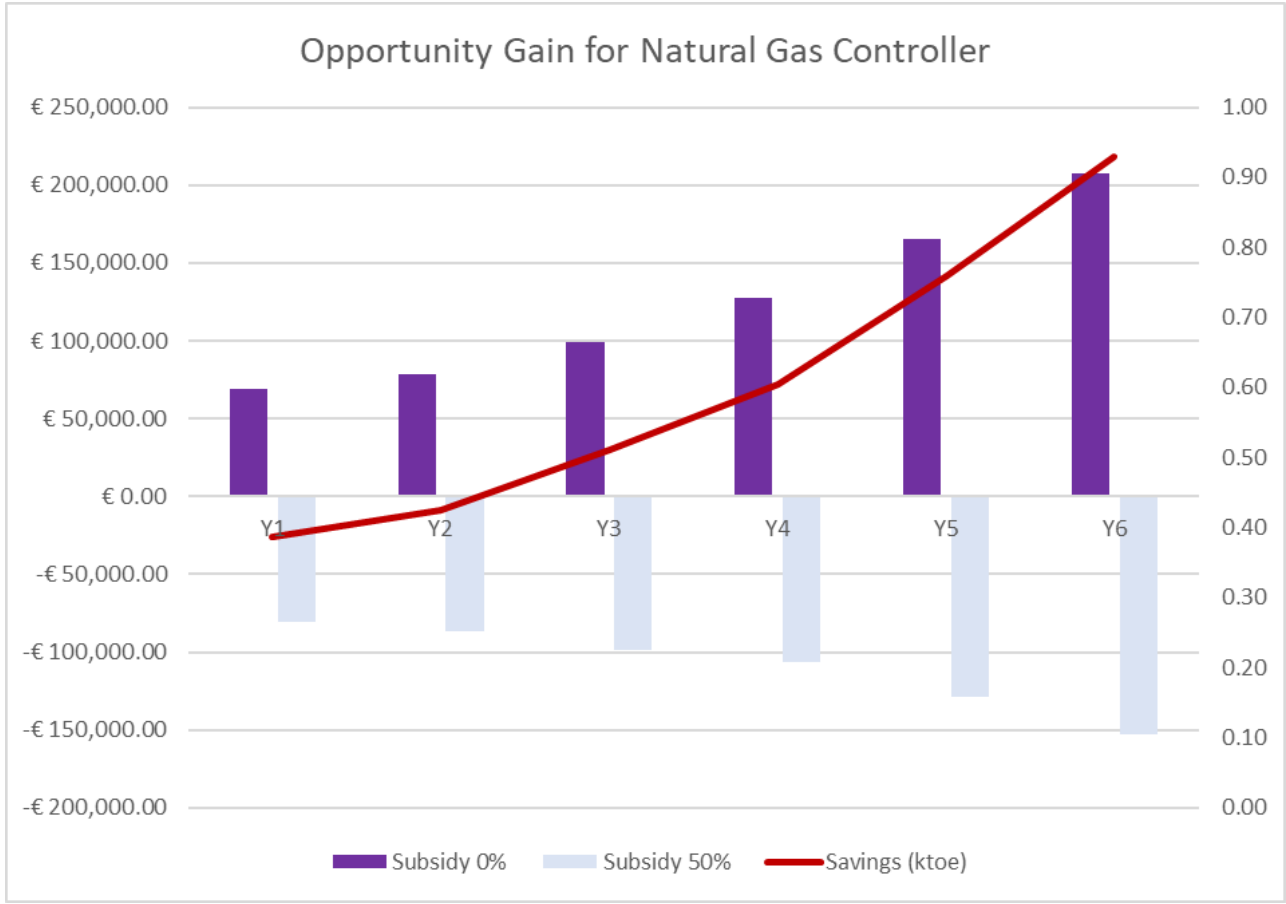
Even 0% subsidy viable under customer retention and acquisition scenarios + increase in market share



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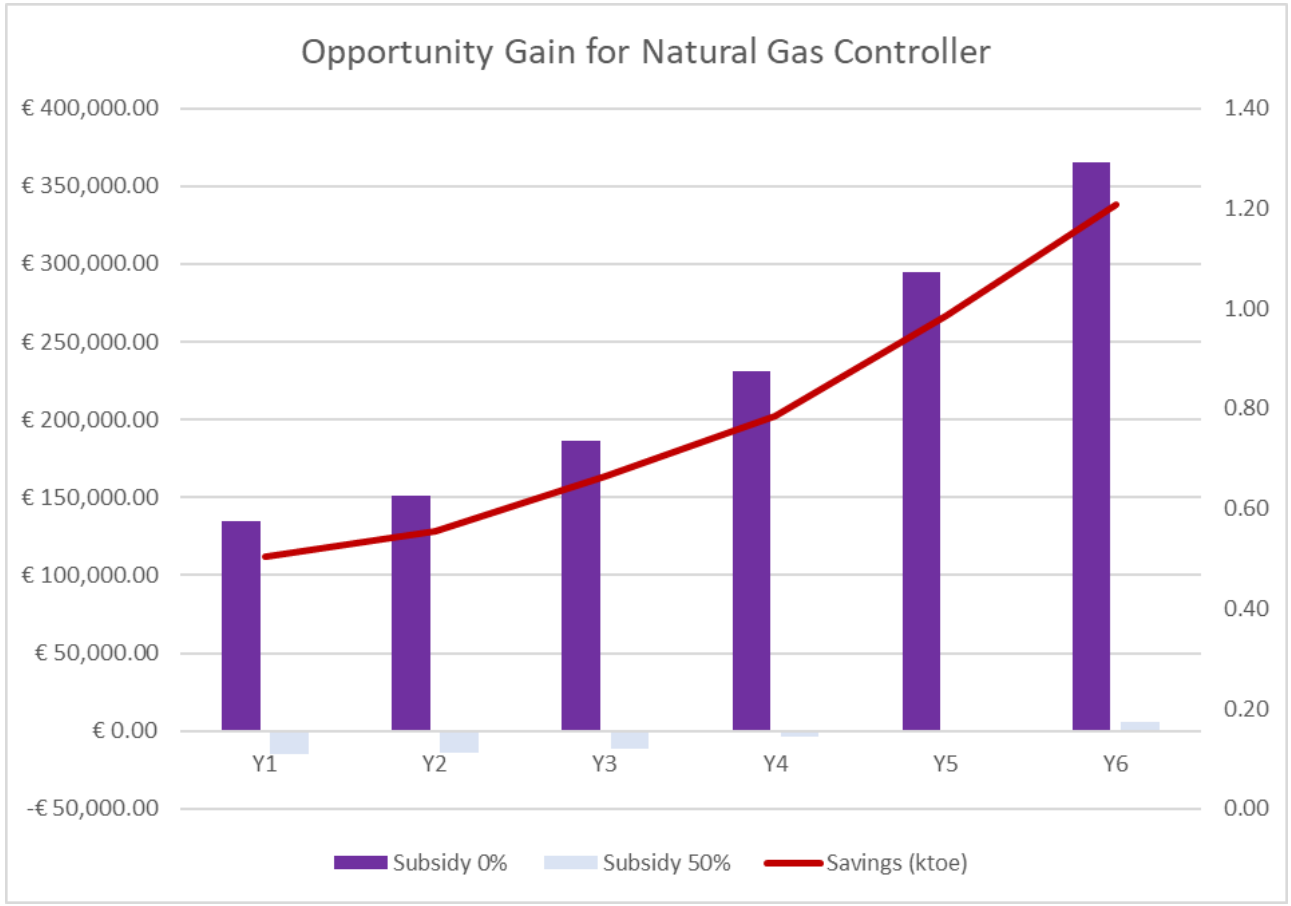

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Decarbonisation: Electrification

Heat Pumps: key driver of EU building electrification effort

- Low carbon emissions: heat pumps use electricity which can be from renewables; hence, they significantly reduce CO_2 emissions compared to gas boilers that burn fossil fuels.
- Versatility (Heating & Cooling): unlike gas boilers, heat pumps can both heat and cool a space, providing year-round comfort without the need for a separate air conditioning system.
- Lower Operating Costs: although initial installation costs may be higher, heat pumps consume less energy, leading to lower heating bills over time, especially in well-insulated homes – specially when installed in homes with local PVs and / or storage
- Future-Proof & Compliant with EU Policies: Heat pumps align with EU decarbonization goals, helping homeowners avoid future bans or restrictions on fossil fuel heating systems ~

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BONUS Challenge: gas-fired boiler efficiency measures phased out from EEOS from 2025-26

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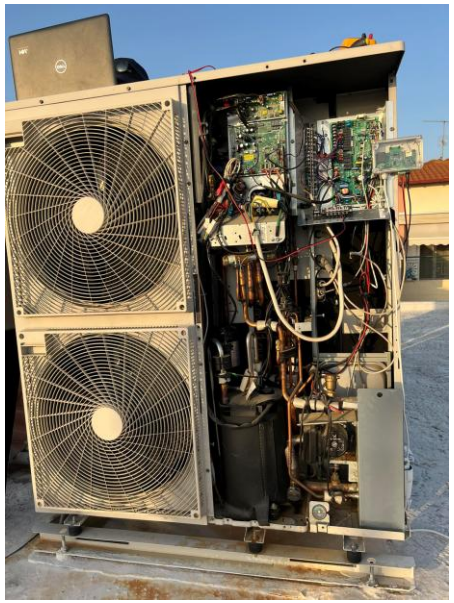
Decarbonisation: Electrification // BC3 multi-energy



LG **MIDEA** **HITACHI** **INVENTOR** **HYUNDAI**

System compatibility is under investigation with several more heatpump vendors including:
DAIKIN, PANASONIC, SYSTEM AIR, BAXI, IMMERGAS

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Decarbonisation: Heat Pump Efficiency

Business Model for DOMX Efficiency 20%

Market analysis

Market size: 40% of a Utility's market share representing customers already making a significant investment. Conversion rate ramping up to 75% leading to ~60% total adoption by Y6

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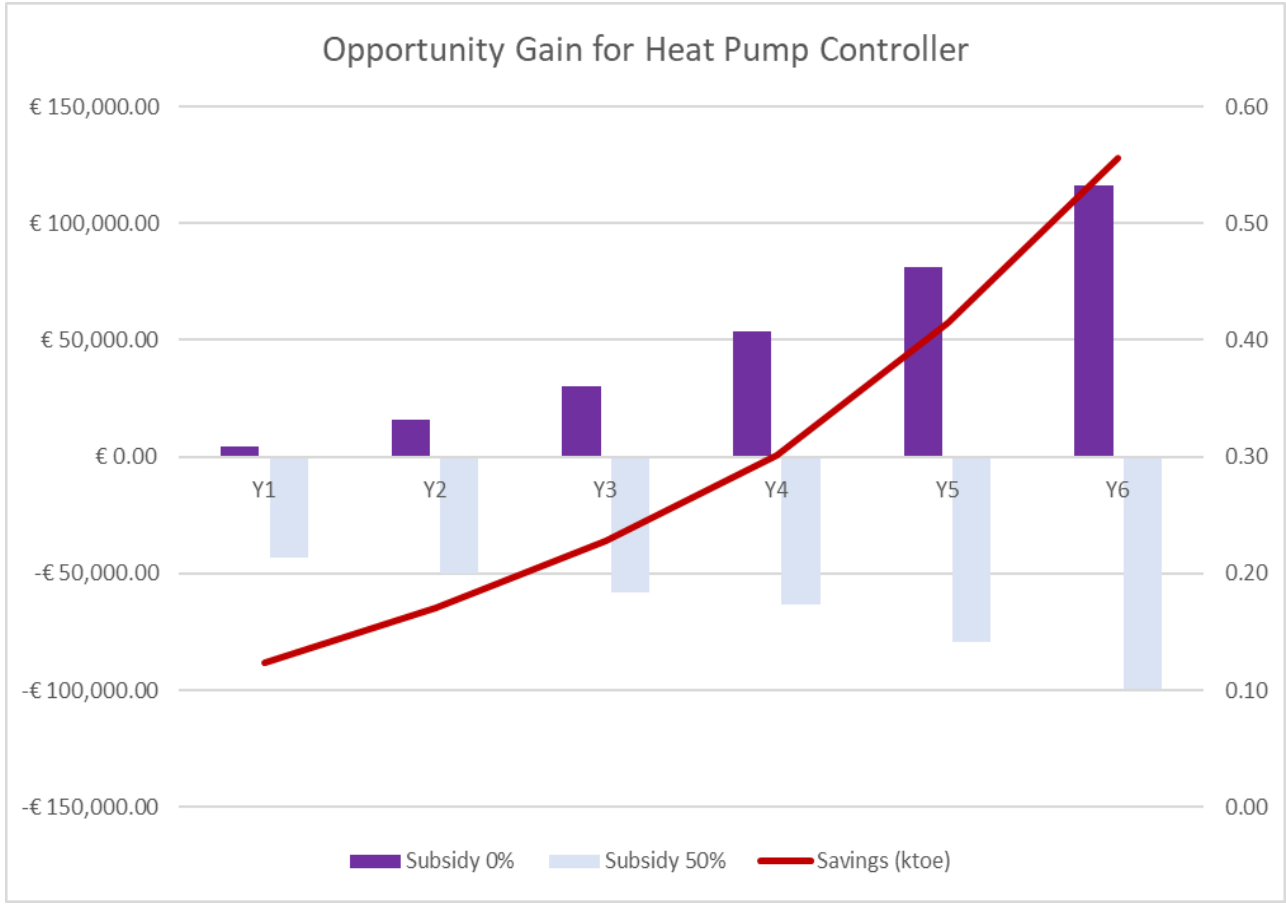
Barriers: compatibility with heat pumps (less critical to gas-fired boilers)



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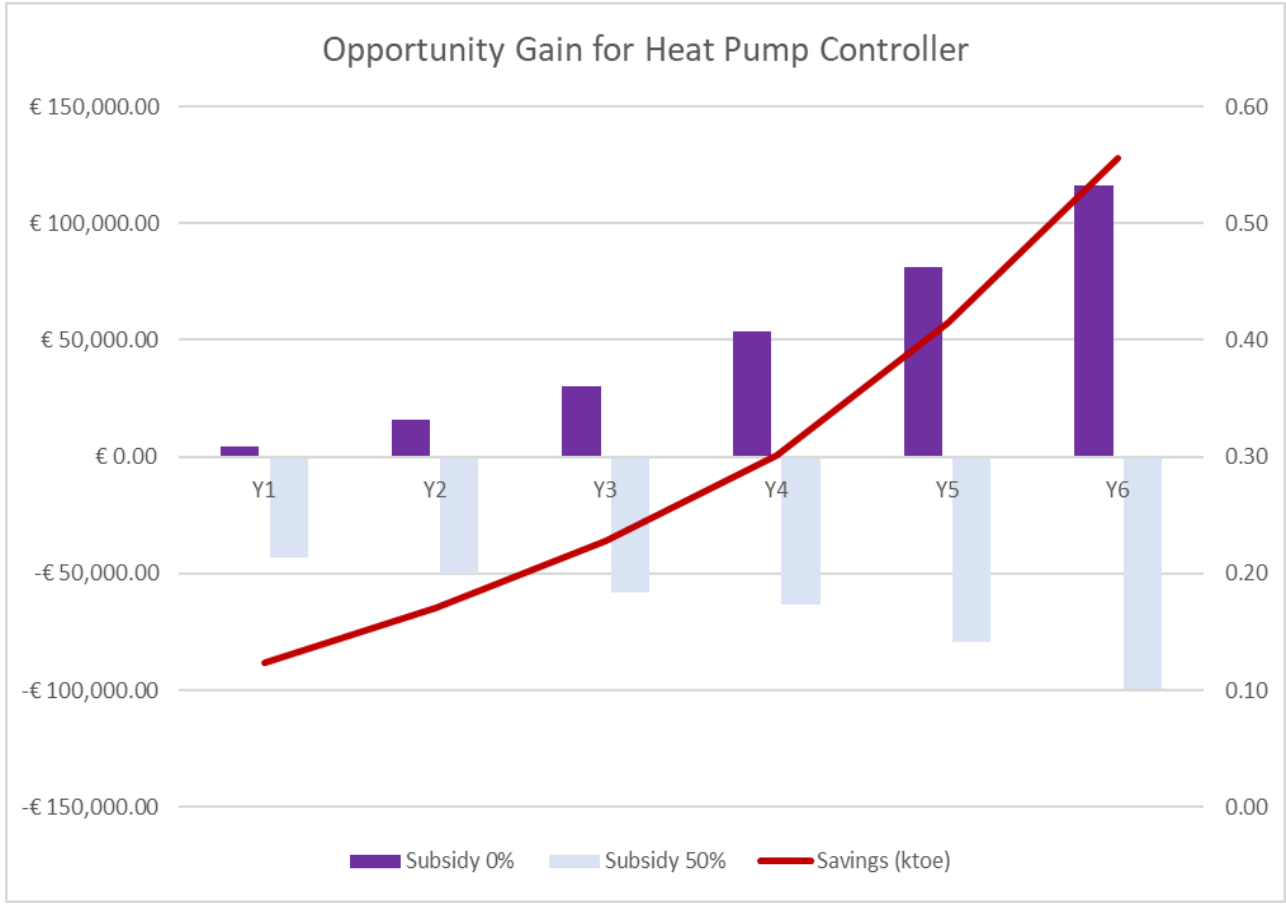

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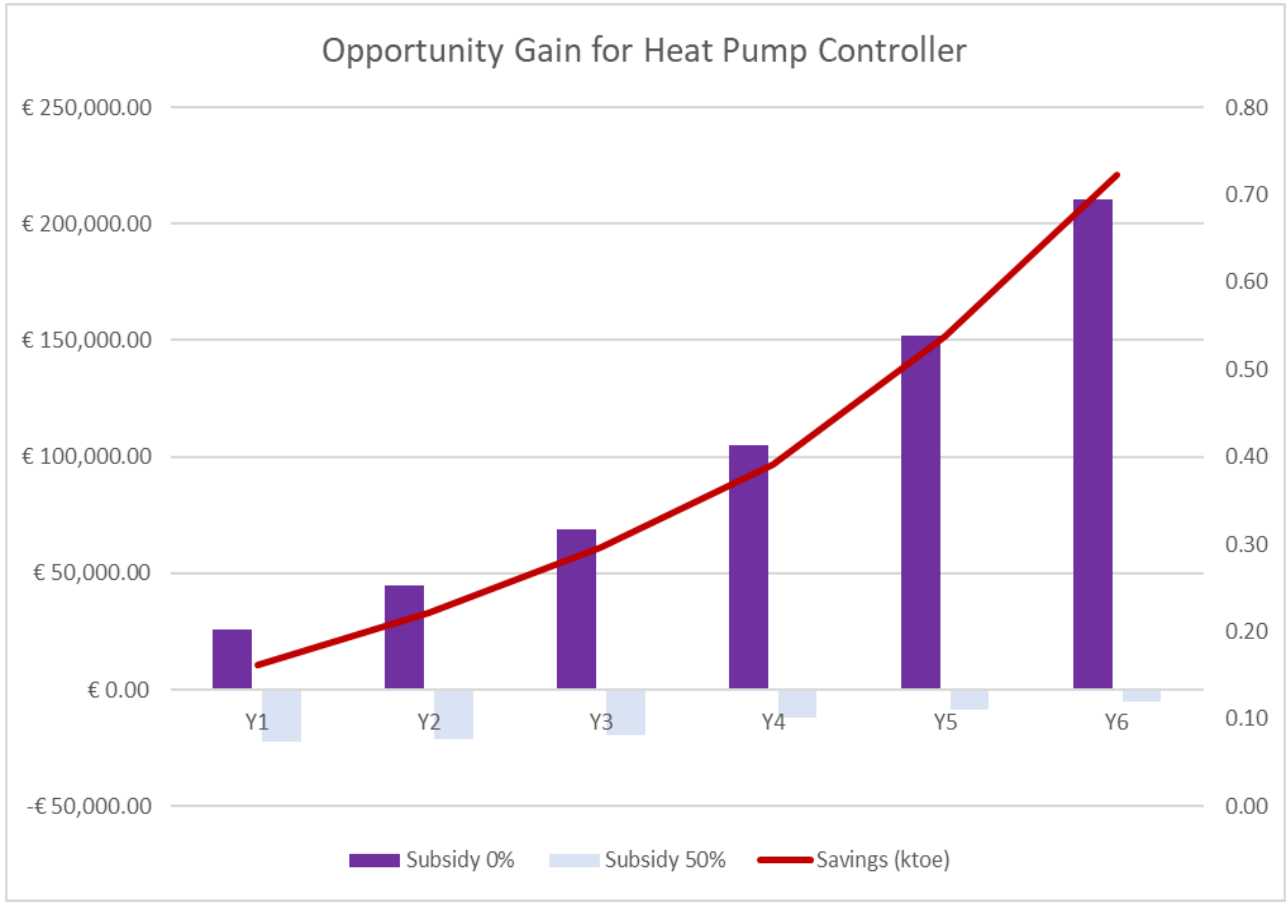

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