

Calculation Log

Investment sector (according to the sectors selected in the summary)	Investment component (by sector)	Estimated cost per investment component (EUR)	Estimated cost per investment sector (EUR)	Source	Brief description of the calculation	
Public buildings	Wall insulation, doors and windows replacement, modernization of heating pipe distribution and local heat node within each building/modernization & exchange of the local energy heating systems (phase I project till 2030). This include both buildings connected/not connected to the DH. These public buildings will be managing and monitoring through central IT platform for energy management including also part of Smart City/IoT (including also smart grids approach). Phase I, till 2030. (around 62 300 m2), Phase II till 2040 (around 89 000 m2). The calculations include both phases.	3 761 000,00	3 761 000,00	Energy audits, data from market, expertise knowledge, know-how from similar projects	Estimated square of walls 17300 m2, with U-value factor $U_w=0,2 \text{ W}/(\text{m}^2\cdot\text{K})$ (around 90 EUR/m2 of walls). Estimated square of windows+doors 7600m2 (estimated cost for windows & doors is around 290 EUR/m2). Windows with U-value factor $U_w=0,9 \text{ W}/(\text{m}^2\cdot\text{K})$. Doors with U-value factor $U_w= 1,1 \text{ W}/(\text{m}^2\cdot\text{K})$.	
Residential buildings	Phase I, till 2030 include wall insulation, doors and windows replacement for residential buildings (usable/heating area around 180 000 m2 within multifamily buildings and with some small part one family buildings). These buildings actually connected to the DH. Phase II (between 2030-2040) - wall insulation, doors and windows replacement for residential buildings connected to the DH (multifamily buildings with estimated usable/heating area of 230 000 m2). The project includes the modernization of heat nodes with appropriate automation and interfaces for monitoring and remote control + modernization of the heat distribution system and domestic hot water preparation (DHW) - costs for both phases.	17 214 000,00	27 183 000,00	Energy audits, data from market, expertise knowledge, know-how from similar projects	Estimated total square of walls = 112 000 m2 with U-value factor $U_w=0,2 \text{ W}/(\text{m}^2\cdot\text{K})$ with thickness of insulation 150 mm (estimated cost 90 EUR/m2 of walls). Estimated total square of windows+doors = 24600m2 (estimated cost 290 EUR/m2). Windows with factor U-value $U_w= 1,0 \text{ W}/(\text{m}^2\cdot\text{K})$. Doors with U-value factor $U_w= 1,1 \text{ W}/(\text{m}^2\cdot\text{K})$.	
	Phase I (till 2030) include wall insulation, doors and windows replacement for residential buildings not connected to the DH (usable/heating area of 100 000 m2 together for one family/multifamily buildings). Phase II (between 2030-2040) wall insulation, doors and windows replacement for residential buildings not connected to the DH (usable/heating area of 130 000m2 within multifamily buildings). Calculations include both phases.	9 969 000,00			Energy audits, data from market, expertise knowledge, know-how from similar projects	Estimated square of walls 66300 m2 with U-value factor $U_w=0,2 \text{ W}/(\text{m}^2\cdot\text{K})$ insulation thickness 150 mm (estimated cost 90 EUR/m2 of walls). Estimated square of windows+doors = 13800m2 (estimated cost 290 EUR/m2). Windows with U-value factor $U_w= 1,0 \text{ W}/(\text{m}^2\cdot\text{K})$. doors with U-value factor $U_w= 1,1 \text{ W}/(\text{m}^2\cdot\text{K})$.
Building integrated renewables	PV installation on the Public buildings. ----- Rooftop installation for all public buildings and on the buildings of municipal companies with power installation 2,12 MWp (phase I, till 2030) and 0,79 MWp (phase II, till 2040). These PV installation will be managing and monitoring through central IT platform for energy management including also part of Smart City/IoT (including also smart grids approach). This PV installation will be also included within VPP (Virtual Power Plant) approach/solutions. The calculations include both phases.	3 100 000,00	23 920 000,00	Energy audits, data from market, expertise knowledge, know-how from similar projects	New installation: PV roof-top and PV on the building elevation with total 3000 kWp (with estimated cost 1 100 EUR/kWp).	
	PV installation on residential buildings. ----- PV installation for the whole residential family and multifamily buildings 4 MWp (phase I, till 2030) and 6 MWp (phase II, between 2030 - 2040). These PV installation will be managing and monitoring through central IT platform for energy management, including also part of Smart City/IoT (including also smart grids approach). This PV installation will be also included within VPP (Virtual Power Plant) approach/solutions. The calculations include both phases.	11 000 000,00			Energy audits, data from market, expertise knowledge, know-how from similar projects	New installation: PV roof-top and PV on the building elevation with total 10000 kWp (with estimated cost 1 100 EUR/kWp).
	Switch from natural gas to new hybrid installation for the one family houses Heating pumps+PV+heat storage (hybrid) installation for the one family buildings (phase I, till 2030) and (phase II, till 2040). The calculations include both phases.	9 820 000,00			Energy audits, data from market, expertise knowledge, know-how from similar projects	New hybrid installation (heat pumps/HP+PV installation+heat storage) for each house. 900 one family houses with estimated cost 7000 EUR/for HP+heat storage each house with total PV installation 3200 kWp (1 100 EUR/kWp).
District heating	Development & Construction new heating network for cogeneration Hydrogen Plant.	1 680 000,00	5 040 000	Energy audits, data from market, expertise knowledge, know-how from similar projects	Construction of the heating network (with length around 4 km, cost of 1km - about 420 000 EUR)	
	Development and construction new micro heating network for decentralized heating source - "clean energy islands". Phase I, till 2030.	1 260 000,00			Energy audits, data from market, expertise knowledge, know-how from similar projects	Long of the network 3 km with estimated cost is about 420 000 EUR/km)
	Development and construction new micro heating network for decentralized heating source - "clean energy islands". Phase II, between 2030-2040	2 100 000,00			Energy audits, data from market, expertise knowledge, know-how from similar projects	Long of the network 5 km with estimated cost is about 420 000 EUR/km)

Smart grids	Central IT platform for managing energy for all infrastructure in the city including: big data analysis, machine learning, microgrids management, managing demand energy vs supply, IoT etc.,	4 700 000,00	13 340 000	Energy audits, data from market, expertise knowledge, know-how from similar projects	estimated cost for IT platform 4 700 000 EUR
	Smart meters for buildings, lamps, PV and heating source etc.	8 640 000,00		Energy audits, data from market, expertise knowledge, know-how from similar projects	32 000 points/objects, estimated cost 270 EUR/per each point/object
Sustainable urban mobility			0		
Innovative energy infrastructure	Decentralized and distributed energy production on Hybrid installation: integrated PV (photovoltaic) + Heating pumps (HP) ----- Decentralized heating source for city communities (multifamily buildings, phase I - till 2030). This will also include necessary micro heating network for connecting with block buildings. The planned heat power will be around 1 MW (2 x 0,5 MW, Hybrid installation -> HP+PV). These technology measures/solutions are aimed at moving away from central heating networks currently based on a coal source and replacing them with low-temperature heating microgrids based on hybrid installations (PV + HP). The decentralized sources ("energy islands") will be managing and monitoring through central IT platform for energy management including also part of Smart City/IoT.	7 600 000,00	86 000 000,00	Energy audits, data from market, expertise knowledge, know-how from similar projects	The hybrid installation with 1 MW (2 x 0,5 MW), where estimated cost is around 3 800 000 EUR/for each 0,5 MW
	Decentralized and distributed energy production on Hybrid installation: integrated PV (photovoltaic) + Heating pumps. ----- Construction decentralized heating source ("energy islands") for city communities (multifamily buildings, phase II - between 2030-2040). This will also include necessary micro heating network for connecting with block buildings. The planned heat power will be around 1,5 MW (3 x 0,5 MW, Hybrid installation -> HP+PV). These measures/solutions are aimed at moving away from central heating networks currently based on a coal source and replacing them with low-temperature heating microgrids based on hybrid installations (PV + HP). The "energy islands" will be managing and monitoring through central IT platform for energy management including also part of Smart City/IoT (including also smart grids approach).	11 400 000,00		Energy audits, data from market, expertise knowledge, know-how from similar projects	Decentralized heating source for city communities (multifamily buildings). The planned heat power will be around in total 1,5 MW (3 x Hybrid installation -> HP+heat storage+PV), estimated cost 3 800 000 EUR/for each 0,5 MW
	Electrolyser, for Green Hydrogen production plus necessary infrastructure (ie. storage) for store hydrogen as compressed. ----- It is assumed that around 7 GWh of electricity will be produced from some of the energy, produced from all PV installations in the city. This energy will be used for the production Green Hydrogen and for storage processing. The Green Hydrogen will be used to produce energy based on the hydrogen fuel cell/CHP system as an element of the energy balancing system (as part of the VPP) for the city's needs (hydrogen will be used as an "energy carrier/fuell" and as an "energy store").	15 000 000,00		Energy audits, data from market, expertise knowledge, know-how from similar projects	Electrolyser, for Green Hydrogen production plus necessary infrastructure including storage for storing hydrogen as compressed.
	Development of the new PV farms. ----- Development of the new PV farms with total 21 MWp (phase I, till 2030 + phase II, till 2040). Calculations include both phases	23 100 000,00			PV installation 21000 kWp (1 100 EUR/kWp).
	Heat storage (big installation).	23 400 000,00			TTES heat storage, a tank placed underground. Approximate volume of the tank - 78,000 m3 construction cost per 1m3 is around 300 EUR/m3
	Hydrogen fuell cell/CHP (based on the Green Hydrogen)	5 500 000,00		Energy audits, data from market, expertise knowledge, know-how from similar projects	The Hydrogen fuell cell with about 300 kW/CHP (production heat power and energy power from Green Hydrogen) with estimated cost 2 400 000 EUR; Necessary technical infrastructure (including storage supporting fuel cell etc.) with estimated cost 3 100 000 EUR
Public lighting	Public lamp replacement.	1 400 000	1 400 000,00	Energy audits, data from market, expertise knowledge, know-how from similar projects	Changing 3500 high pressure sodium public (street light) lamps into the LEDs. Estimated cost 400 EUR/per point (lamp)
Add other sector			0		
Expected size of total investment			160 644 000		