Passivistas:TheHouseProject
Transforming a 1960's Residential Building in Papagos, Greece

Passivistas: TheHouseProject demonstrates that even in economically difficult times retrofitting existing residential buildings so that they generate more energy than they consume is both financially and technically feasible.

Bringing together a team of experts and finding support from private sector partners as well as via crowdfunding, renovation works were carried out in 2015 and 2016 using materials and technologies available on the market. The cost for transforming the 125 m² two-level structure into a positive energy building (PEB) will be amortised in under seven years by energy savings.

The Passivistas team has made a great contribution to raising awareness and building capacities for PEBs with over 1,000 visitors taking part in open house events and seminars. Whilst the project already has great replication potential in Greece and beyond, scaling up the energy efficient renovation of residential buildings could be catalyzed further by tailored financial solutions, more ambitious regulations, and incentive schemes.

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Table of Contents

EXCESS

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The Positive Energy Building in its Local Context

In 2014, in the midst of a severe economic recession, the Passivistas team and partners embarked on an ambitious project to demonstrate that renovating buildings to a nearly zero-energy building standard (nZEB) was technically and financially feasible in Greece. Indeed, the team surpassed this goal with the deep renovation of a 1960's two-story detached residential building in Athens' suburb Papagos, achieving a building that produces more energy than it consumes. The building was certified as meeting the Passive House Institute's EnerPHit Plus standard and received international attention at the 20th International Passive House Conference in Darmstadt, Germany. It was awarded in the Greek Energy Mastering Awards 2015 for best energy-saving practice.

The 125 m² flat-roofed building had not been inhabited for five years and required a complete retrofit. Reinforced concrete slabs and perforated brick walls had not been insulated and the single-glazed windows had an equally poor thermal performance. Supported by members of the Hellenic Passive House Institute and private sector partners, physical renovation began in early 2015 and the project was completed in 2016. During the renovation phase, energy efficiency measures were implemented and the building was split into an office space in the cellar and a residence on the ground floor. Engineers, technicians as well as students and ordinary citizens were engaged in capacity building and knowledge creation activities. The residential area will continue to be open to the public and professionals for activities, such as guided visits and lectures and the office space functions as the headquarters of the Hellenic Passive House Institute and is used for seminars and training events.

Image 1

Street-side view of the PEB, on side of higher elevation [Source: Stefan Pallantzas]

Image 2

Drone photograph showing the two levels of the PEB & PV Installation on the roof [Source: Stefan Pallantzas]

The Building's Special Features

To address the many thermal bridges and overall poor thermal performance of the building envelope, the Passivistas team installed lightweight 30 cm thick expanded polystyrene on the flat roof and covered this in two layers of asphalt. Furthermore, projecting elements of the building structure, such as balconies and the protruding roof sections, were covered with 5 cm thick expanded polystyrene and coated in 4 mm thick acrylic plaster. Treatments of balcony surface area included ceramic exterior tiles with extruded polystyrene on top and 5 cm polystyrene on the underside.

"…engineers, technicians as well as students and ordinary citizens were engaged in capacity building…"

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To enhance the performance of openings, window frames were re-designed and selected south-facing window openings were enlarged. High performing triple-glazed windows as well as a new entrance door were installed. Moreover, windows on three sides of the building were equipped with automatically controlled sunshades to control solar gains during the summer months.

Having improved the thermal and airtightness of the building envelope, two separate ventilation systems coupled with highly energy efficient air-to-air heat exchanger units were installed. The air-flow rates for both systems were calibrated to address the different expected occupancy levels in the office and residential part of the building with the system for the residential floor further being connected to a ground heat exchanger for air temperature conditioning.

Two split air-conditioning units were installed to heat and cool the building's separate office and residential areas. In order to cover warm water needs, a solar water heater (4.2 m² panels and 200 litre tank) was installed at the rooftop. In October 2016, a 14-panel PV system was added to the roof of the building so that the electricity demand could be covered from renewable energy sources.

Selected Performance Indicators

Energy Demand

Primary energy demand:
85,00 kWhpe/m²y

Breakdown of Energy Consumption

Cooling and dehumidification: 5.55 kWh/m²y

DHW generation: 2.2 kWh/m²y

Household electricity: 15.58 kWh/m²y

Renewable Energy Generation

The PV System produces 127% of energy demand

Building Envelope Performance:

Envelope U-Value: 0.33 W/m²K

Roof: λ=0.030 W/mK

External walls: λ=0.030 W/mK

Floor slabs: λ=0.030 W/mK

Air Tightness Value (n50): 0.60 1/h

Key Technologies Installed

- 2 ventilation units with heat recovery: The units (model Pluggit AD160) were chosen in light of their heat recovery rates exceeding 85 per cent.
- 2 mini-split air-conditioning units: The units (DAIKIN FTXM/RXM Mini Split) which are used for heating and cooling were chosen due to their A+++ efficiency rating.
- Solar Water Heater: The 200 litre water tank (MegaSun 200E) in combination with 4.2 m² solar thermal panels (HELIOAKMI) covers all warm water needs of both the residential and office unit.
- The 14-panel PV system (Argos AVN 250 EP-60 AVENTIA SOLAR) has a capacity of 3.5 kWp and covers 127% of needs.
- Building Energy Management System (BEMS): The system of the Greek company MEAZON measures internal and external temperatures and humidity as well as interior CO_2 levels. Furthermore, it measures electrical consumption for heating, cooling, ventilation, appliances, etc. Monitoring results are published on a monthly basis.

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Non-Exhaustive List of Involved Stakeholders

The Passivistas project team included civil and mechanical engineers as well as architects. It should be emphasised that a range of private companies and suppliers became partners or sponsors without whose support the project could not have been realized.

Project Management	Stefan Pallantzas (Civil Engineer)	**Renovation Design**	Euterpe Tsouti and Fani Kalamatianou (Architects**)**
Energy Certification	Lyberis Lyberopoulos and Vicky Karachaliou (Architects)	**Thermal Bridge Calculation**	Stefan Hatzoulis (Civil Engineer)
PV System Design	Pericles Kottaridis (Mechanical Engineer)	**Thermography**	DI Ioannis Pappas (Mechanical Engineer)
Energy Concept & Supervision	Athanasia Roditi (Architect), Aggeliki Stathopoulou, Elias Igoumenidis and Stefan Pallantzas (Civil Designers)	**Acoustic Study**	Mersina Vitali (Civil Engineer)
Passive House Certifiaction	Susanne Theumer, Gergina Radeva, Dr.Wolfgang Feist (Passive House Institute)		

passivistas.com
THE HOUSE PROJECT

Sponsors & Private Sector Partners

[Source: Passivistas]

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Catalysts, Challenges & Results

Without the initiative of the Hellenic Passive House Institute the Passivistas project would not have been conceived and implemented. Especially considering the economic situation in Greece at the time, realising the demonstration project required strong leadership and an equally strong team of collaborators with a shared vision. Without support from the government, university partners and with a major Greek bank backing out of collaborating, the project faced considerable headwinds. Further, the Greek government introduced capital controls in the week of renovation works beginning, hence the Passivistas team had to embrace creative approaches to ensure that the renovation could be carried out.

With a total renovation cost of 76,000 € of which 57,150 € was spent on energy efficiency improvements (both figures including VAT), the PEB's renovation cost was only 7 per cent higher than for an average conventional renovation in Greece. The team was able to secure numerous private sector sponsors and deals with suppliers to obtain the necessary materials and technologies for work to go ahead. Through these sponsorships approximately seventy per cent of renovation costs could be covered. The project was further underpinned by a crowdfunding campaign that was launched by a German Professor from the Passivhaus Institute in Darmstadt, which generated sufficient funds to pay for a further 10 per cent of the renovation costs.

Whilst the monitored results of energy consumption of the building over the past two years indicates that consumption is rising above the assumptions that qualify the building as a PEB, users are continuously calibrating the system as well as their energy usage and are confident that over a five-year period a positive energy balance will be achieved.

Passivistas' principle focus was to demonstrate that the passive house approach to building retrofits is feasible in Greece. For cost as well as supply-driven reasons less attention was placed on sustainable construction materials. Nevertheless, the positive environmental impacts are clearly evident. Whilst the former owner of the Passivistas property used up to 3,5 tons of oil per winter season, the renovated building does not require a single drop of oil. Moreover, the economic dimension should also be highlighted, with yearly costs for heating of cooling the building decreasing from 4,500 € to zero.

Image 3
More energy efficient windows being installed
[Source: Stefan Pallantzas]

Image 4
Exterior insulation being attached to the walls
[Source: Stefan Pallantzas]

"…the Passivistas team had to embrace creative approaches …"

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Replication Potential

As the Passivistas house is open to visitor groups and hosts regular seminars, the project actively promotes replication. It is estimated that between 1,000 and 1,500 people visited the Passivistas house in the past 5 years alone. Besides collaborating on training and accreditation activities Hellenic Passive House Institute members have in the past realised numerous passive house projects in Greece. Until 2018 projects were mostly new buildings commissioned by well-heeled individuals, but since then a gradual shift has been observed, with broader public interest in energetic building renovations. In light of the fact that the existing residential building stock in Greek cities is highly energy inefficient (building codes specifying insulation requirements were only introduced in 1980), the potential for replication and associated positive environmental impacts of the Passivistas approach is very high.

Regulations and incentivisation schemes for PEBs will undoubtedly affect the extent to which energy efficiency measures in the built environment will be scaled up in Greece. Due to the financial impacts of the COVID-19 pandemic and under pressure from lobbying groups, the Greek government announced in May 2020 that regulations, which demand newly constructed buildings to meet NZEB standards, would be suspended for a one-year period. Whilst understanding that such backtracking may be deemed necessary for broader economic reasons, there will be negative repercussions for the PEB movement in the country. On the subject of incentivising PEBs it should also be noted that in Greece tariffs to feed surplus renewable energy generated by buildings into the grid are rather low.

Lastly, it should be highlighted that opportunities for replication are not limited to Greece alone. The PEB demonstrates that a skilled team of building professionals can successfully retrofit a home to become energy positive in Mediterranean climates, without relying on governmental support schemes and under suboptimal economic conditions. The approach therefore has very high replication potential in the region and beyond.

Conclusions & Lessons Learned

The case study showcases the great potential for retrofitting existing buildings to PEB standards in Greece as well as across Europe. Even without sponsorships and crowdfunding support the payback period for investments made in energy efficiency measures would have been less than 7 years.

Monitoring results confirm that, whilst there is an initial phase in which building technologies and consumption need to be calibrated, off-the-shelf technological solutions can be combined to retrofit buildings to produce more than they consume.

The Passivistas project had to overcome numerous challenges, such as limited access to funds due to capital controls, partners in the initial business plan dropping out and local technicians lacking experience in passive house construction. The project team overcame these by exploring creative financing options and bringing on board a range of private sector partners.

Whilst the current economic and regulatory climate may not be particularly favourable for scaling up PEBs in Greece at the moment, the potential for replication Passivistas in the country and beyond remains high. The financial and environmental case for energy efficient renovations is strong and the building stock of energy inefficient residential buildings in Greece is huge.

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- https://www.construction21.org/case-studies/h/passivistas-thehouseproject.html
- Passive House Data Base: https://passivehouse-database.org/?fbclid=IwAR0c-7KnmL_vfCEN0yLlOCvat4UOTZ2X1e-H7fSIZcuV1XoitkJeyPQXtJY#d_4539
- http://www.slideshare.net/pallantzas/passivistasthehouseproject
- http://passivistas.com/
- Various PDFs provided by the Hellenic Passive House Institute.

Local Context Details

Address: Anastaseos 112, Papagos 156 69, Greece

Geographic Coordinates [Google | EPSG:4326 – WGS 84]: 37.990805, 23.800853

Local Government: Municipality of Papagos - Cholargos

Population: 44,539 [2011]
Total Area Administered: 7.325 km^2

Climatic Zone [Köppen]: [Csb] Coastal Mediterranean

Municipal Budget: 32,054,935.63 € [2020]

The Greek Electricity Grid : Lignite 23.55%, Natural Gas 28.4%, Hydro-Power 19.10% % RES 29.33%.

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Further Images & Plans of the PEB

Image 5

Drone footage showing the rooftop solar installation
[Source: Stefan Pallantzas]

Image 6

Drone footage showing the PEB & its neighbourhood
[Source: Stefan Pallantzas]

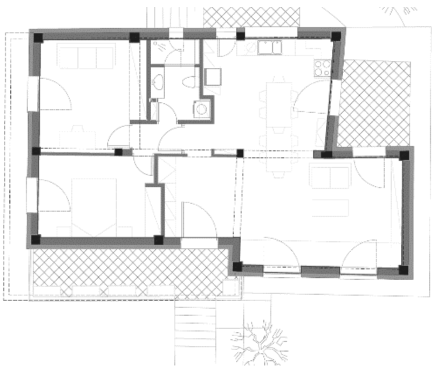
Image 7

Close-up of the newly insulated and rendered building envelope
[Source: Stefan Pallantzas]

Image 8

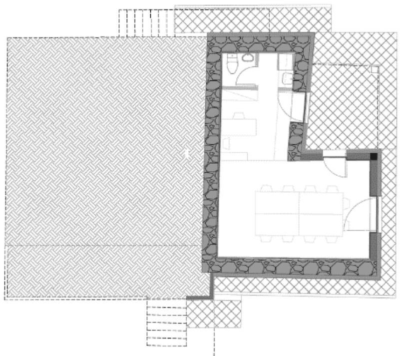
Photograph of the PV-system being installed
[Source: Stefan Pallantzas]

Image 9



Floorplan of the ground floor, used as a residence
[Source: Stefan Pallantzas]

Image 10



Floorplan of the cellar, used as an office
[Source: Stefan Pallantzas]

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