NEWTONPROJEKT Collective Housing: a Role-Model for Residential Positive Energy Buildings

Realised in 2018, the NEWTONPROJEKT in Berlin can be seen as a great model for the future of residential PEB construction in Germany and elsewhere. Benefiting from attractive financing options for energy efficient buildings and applying a collective user-centric approach to property development, the building ensemble delivers not only more energy than it consumes but incorporates a host of environmental considerations.

NEWTONPROJEKT House 1, which is the focus of the case study, uses renewable and recyclable materials where feasible and its residents benefit from adaptable, accessible and comfortable apartment units. Moreover, sustainable mobility solutions have been incorporated in the design and the collaborative planning approach has created a stronger sense of community. A key success factor underpinning this project was the partnership with the local district heating network operator. Not only is renewably generated electricity exported to the grid during times of surplus, but also solar thermal heat can be fed back into the network. Such an integrated approach would greatly enhance the replication potential and broader adoption of PEBs in Germany and beyond.

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The Positive Energy Building in its Local Context

The NEWTONPROJEKT House 1 is part of a group of buildings conceived as a “Solar-Plus-Energy” community in the borough of Adlershof in the German capital Berlin. Located approximately 13 km to south-east of the city centre in the district of Treptow-Köpenick, the area is best known for its sizeable research and innovation cluster with high-tech firms, research institutions and media companies having relocated here over the years. A lesser known fact is that alongside this development, Adlershof is also a site of considerable new residential construction with approximately 17 hectares of greenfield land allocated for such development under the “Wohnen am Campus” scheme.

Whilst the three NEWTONPROJEKT houses were designed by separate architectural practices, the ensemble was planned and realized in close collaboration to meet the needs and sustainable development aspirations of the private building cooperative. Further, great attention was placed on coordinating the design language used for the buildings (particularly colours and façades) to ensure visual cohesion.

Reflecting the community-centric approach that underpinned the development, many building functions and services are distributed across the development with the proportional costs for these covered by owners in all three buildings. House 3 features a cellar in which storage units for all NEWTONPROJEKT residents are located and the cellar of House 2 accommodates the utility rooms for the entire building ensemble. The underground carpark with a capacity for 16 vehicles and located underneath the central communal green space serves residents of all three buildings. The total project cost for the NEWTONPROJEKT ensemble was approximately 10.86 M€, which equates to 3,416 €/m^2 of livable floor space. The three buildings together have 3,179 m^2 of floor space.

NEWTONPROJEKT House 1 has a total floor space of 1,085 m^2 distributed across four floors. It does not have a cellar. Architecturally, the building stands out in particular for its precisely detailed and elegantly proportioned façade with integrated PV panels facing the shared green space. Generously dimensioned *sun rooms* are located behind the large openable windows on this side of the building which connect to the living rooms of each of the 13 apartment units. Auxiliary rooms as well as circulation spaces are oriented towards the street on the north-eastern side with smaller windows to minimize heat loss.

Image 1

Street-side view of House 1, where auxiliary rooms and circulation spaces are located [Source: Andrea Kroth]

Image 2

View of the House 1’s façade with PV-panels and sun rooms, facing the gardens [Source: Andrea Kroth]

“The NEWTONPROJEKT was conceived as a Solar-Plus-Energy community.”

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The building core of the NEWTONPROJEKT House 1 was constructed using reinforced concrete and external insulated walls were prefabricated off-site to expedite the construction process and lower the costs. By specifying a structural core, the overall depth of prefabricated panels could be decreased as the panels do not have to carry loads from the above floors. Construction work on House 1 was completed in 2018 at a total cost of just over 2.51 M€ (2,317 €/m^2), which includes proportionate costs for shared green spaces, foundations, cellar space in the other two buildings, PV installations, etc.

The project has received two German awards, namely the "KlimaSchutzPartner des Jahres 2015" (the climate protection partner award in the category for *promising and innovative planning approaches*) as well as the first prize "Gebäude.2050" for energy efficiency (in the *ideas for pioneering buildings and quarters* category). Most recently, the project was awarded the 2019 sustainable energy concept prize in a competition for Germany's best residential buildings, initiated by the publishing house Callwey.

Selected Performance Indicators

Energy Demand

Annual primary energy demand: 14.7 kWh/m^{2}y

Breakdown of Energy Consumption

Domestic hot water: 19 kWh/m^{2}y

Ventilation: 0.29 kWh/m^{2}y

Heating: 25 kWh/m^{2}y

Renewable Energy Generation

Photovoltaics: 20.01 kWh/m^{2}y

Solar Thermal: 25.96 kWh/m^{2}y

Building Envelope Performance:

Walls: 0.118 W/m^{2}K
Roof: 0.094 W/m^{2}K
Air Tightness Value: 0.60 1/h

Greenhouse gas emissions of Building:
2,87 kgCO_2/m^{2}y [EnEV calculation (2016)]

The Building's Special Features

The building was conceived and planned to meet the German "KfW-Effizienzhaus 40 Plus" standard, which specifies that a building must have a 40% lower primary energy demand and 55% reduced heat loss compared to a building that complies with minimum requirements set by the current German regulation for energy saving in buildings (the minimum reference figure is calculated by multiplying primary energy demand by a factor that reflects the energy source). Performance monitoring in fact confirms that the building actually surpasses these performance levels and produces more energy than it consumes.

Building on passive house principles, the building envelope of House 1 was designed to achieve a high thermal performance with triple glazed windows specified for the majority of openings and generous amounts of insulation in building walls. As one would expect from a passive house, the design team also placed considerable emphasis on air tightness to ensure that the ventilation and heating system could work as efficiently as possible.

The apartment units of House 1 are nearly entirely heated with air that is warmed by a heat recovery system which extracts over 85% of energy from air that is removed from interior spaces. This air is then distributed in the individual apartments through decentralised ventilation systems. The only classical radiators to be found are the heated towel racks in the bathrooms.

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It should also be noted that the apartments' *sun rooms* are integral elements of the overall energy concept as they function as climate buffers. During winter, the extra thermal barrier as well as solar gains significantly reduce heating needs, whilst in summer the large expanses of glass can be opened to naturally ventilate the common rooms of apartment units. Further, excessive solar gains during warmer months can be controlled by exterior shading.

Going beyond the operational energy performance of the building, the design team for House 1 also considered lifecycle aspects by choosing sustainable building materials and ensuring that building components could be disassembled and recycled after their functional lifetime.

The building and the NEWTONPROJEKT ensemble overall incorporate a number of environmental and social sustainability features that deserve special mention. The user-centric approach to designing House 1 resulted in apartment layouts and features that take into consideration the need to adapt to changing user needs and physical abilities with floor plans being flexible and bathrooms featuring floor-level shower trays for easy access.

Additional environmental sustainability considerations include the specification of permeable ground level surfaces of outdoor spaces so that rainwater does not have to be discharged via storm drains but is absorbed into the ground instead. The underground car park, which serves all three buildings, is equipped with electric vehicle charging stations and 110 bicycle parking spaces are located in the basement as well as in the courtyard area.

Lastly, it should be highlighted that the design of NEWTONPROJEKT House 1 delivers a number of additional co-benefits for its occupants, including (1) excellent indoor air quality as a result of the ventilation system; (2) improved health and comfort associated with a well thought-through energy concept that uses *sun rooms* as climate buffers and the solid building core's ability to capture and slowly releases heat; as well as (3) greater acoustic comfort associated with using wood as a key building material.

Key Technologies Installed

- Solar thermal system: Hot water is produced for self-consumption and surplus is fed into the district heating network via a heat transfer station. The water heating system features decentralised legionella-free hot water stations so that water can be preheated centrally at a lower temperature and heat loss can be minimised.

- Photovoltaic system: Electricity generated by the PV system (79,000 kWh/y) is distributed to all apartments (which have an estimated demand of 74,000 kWh/y). Surplus electricity is fed into the grid.

- Ventilation system: The decentralised ventilation systems feature highly efficient heat recovery technology that can extract over 85% of heat from exhaust air.

- 96 kW battery to enable a renewable energy self-consumption rate of over 50%.

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Non-Exhaustive List of Involved Stakeholders

The NEWTONPROJEKT ensemble was realised by forming a private building cooperative in which a multigenerational group of individuals and families joined forces and were deeply involved in the planning process from the outset. A series of workshops was organised to discuss the energy concept of the 3-building ensemble to carefully weigh technological and building design specifications as well as financial considerations. The companies that were involved in the project and significantly contributed to its success are listed below. Highlighted partners were largely responsible for realising House 1 as well as some of the shared infrastructure and spaces.

Contractor
Newtonprojekt GbR
https://newtonprojekt.de

Architect
Deimel Oelschläger Architekten Partnerschaft
http://deo-berlin.de/

Structural Engineer & Building Physics
Lichtenau Himburg Tebarth Bauingenieure GmbH
http://lht-bauing.de/

Building Services
pi Passau Ingenieure GmbH
www.pi-gruppe.com

Project Management
Büro 1.0
https://www.buero-1-0.de/

Energy Consulting
Low-E Ingenieurgesellschaft
https://low-e-ingenieure.de/

Landscape Architect
Dr. Ing. Gabriele Holst
http://www.gestaltungfreiraum.de/

Open Space Concept
DMSW architektur und landschaft
http://www.dmsw.de/

Coordinating Agency for Collective Real Estate Development
AREA - Agentur für räumliche Entwicklungsalternativen
http://www.area-berlin.de/

It should be noted that the German Federal Environmental Foundation (DBU) contributed funds for the energy concept development over a two-year period. In addition, the Federal Ministry for Economic Affairs and Energy awarded a grant for the ongoing monitoring and related scientific research on the NEWTONPROJEKT to the Ostfalia University of Applied Sciences, Faculty of Supply Engineering. Lastly, it should be mentioned that besides structural engineering works, the company Lichtenau Himburg Tebarth Bauingenieure GmbH was also responsible for calculating thermal insulation, thermal bridges and verifying KfW-40-Plus as well as energy saving regulation (EnEV) compliance.

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Catalysts, Challenges & Results

As specifications of the NEWTONPROJEKT were decided upon by a *collective of owners* (this form of property development is called “Baugemeinschaft” in Germany), a key enabling factor for successful planning were the frequent workshops to discuss technological approaches and their financial implications. Without regular facilitated consultations with the future occupants, it would have been difficult to achieve consensus. Whilst this model of real estate development requires more time and effort it should be noted that the joint venture brought together individuals from different walks of life with a common interest in sustainable development. The process of developing the NEWTONPROJEKT undoubtedly helped form a sense of community amongst the residents. Also, as aforementioned, the user-centric approach to designing the PEB has resulted in numerous health and wellbeing benefits for occupants.

With regard to economic enabling factors, the German KfW bank’s attractive financing schemes for energy efficient buildings deserves a special mention. Having designed the building to meet the *KfW-Effizienzhaus 40 plus* standard, the project developers gained access to a credit line of up to 120,000 € per apartment unit at an interest rate of -0.49% (with repayment bonuses of up to 30,000 € per unit). In order to qualify for this credit, the building had to meet ambitious energy efficiency targets, integrate renewable energy generation technology, include battery storage, a ventilation system coupled with heat exchangers and include user interfaces to allow occupants to monitor their electricity consumption. Another financial benefit can be attributed to the aforementioned “Baugemeinschaft” approach, which cut out real estate agency service costs as well as the profit and risk margins a traditional developer would typically apply.

A key success factor relates to the agreement reached with the district heating network operator BTB which allowed for heat to be transferred to the grid. The net-metering contract between the development scheme “Wohnen am Campus” and the operator BTB represents a win-win situation with the operator receiving heat from renewably generated sources and projects such as the NEWTONPROJEKT being able to draw from the grid when shortfalls occur (usually in wintertime). To enable this exchange, the operator created a lower temperature (65°C instead of the usual 110°C) hydrologically separated sub-network so that solar thermal generation could be effectively harnessed.

Image 3

Photo taken during the construction process of the NEWTONPROJEKT [Source: Newtonprojekt GbR]

Image 4

View from an apartment unit’s sun room, facing the green space [Source: Andrea Kroth]

“…the NEWTONPROJEKT undoubtedly helped form a sense of community…”

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Replication Potential

With construction costs comparable to traditional real estate development projects and much lower life-time running costs, the NEWTONPROJEKT demonstrates that joint ventures are a very attractive model for PEB replication. It should be noted, however, that the community behind this project had the clear ambition to decrease their environmental impact and were prepared to adapt their behaviour as PEB occupants to maximise self-consumption of renewable energy. An ambitious PEB can only be realized with equally ambitious and supportive clients.

With regard to technological solutions, the PEB itself uses market-ready technologies that have been tried and tested. Coming to an arrangement that allowed surplus heat energy to be fed into the grid served to really boost the PEB's performance, which highlights the importance of such integration across Europe.

Overall, the building has significant replication potential, particularly in Continental, Oceanic and Nordic climates as the building does not incorporate technologies to cool indoor temperatures. To enhance the replication potential in countries outside of Germany, generous financing schemes might have to be introduced. To make the KfW programme's "plus-energy standard" even more attractive and further increase the replicability of PEBs in Germany, it may be prudent to loosen some of the strict minimum requirements and focus on transparent calculations / energy modelling instead. The NEWTONPROJEKT costs could have been reduced further without compromising the ensemble's positive energy performance, if certain requirements for the avoidance of thermal bridges had been more flexible. Moreover, if the standard also included guidance on sustainable building materials, the overall sustainability performance of PEBs could be increased.

Conclusions & Lessons Learned

NEWTONPROJEKT House 1 showcases how collective approaches to real estate development can lower overall costs and make the integration of PEB technology economically viable. Reaching a consensus of a group of future owners on design and specification requires intensive communication and can prolong the planning phase of a construction project. In the case of the NEWTONPROJEKT prospective owners that were keen to embrace energy efficiency and renewable energy generation measures were specifically targeted to join the collective. In a more traditional "Baugemeinschaft" views on sustainable development may diverge more significantly, thus impeding the realisation of a PEB.

As has been recognised by the receipt of awards, the building can be truly seen as a model project for residential PEBs in Germany. The unique arrangement with the heating district network operator, the attractive financing opportunities for energy efficient buildings and the effective collaboration of the involved companies contributed greatly to the success of the NEWTONPROJEKT.

Reaping the rewards of this successful PEB realisation are the owner-occupiers themselves. The user-centric approach resulted in adaptable and accessible apartments with low running costs, the integration of broader sustainability considerations, such as the use of renewable and recyclable building materials, environmentally friendly rainwater management and sustainable mobility solutions. Moreover, residents benefit from health and wellbeing co-benefits related to the building's design and specifications. Lastly, the more time-intensive engagement process during the building planning stage was well invested as it instilled a sense of community that would not have been possible otherwise.

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- For all the involved companies for permitting the use of their logos.
- The architectural photographer Andrea Kroth for her kind permission to use photos of the building and Newtonprojekt GbR for granting permission to publish building photos & visualisations.
- Deimel Oelschläger Architekten Partnerschaft for their valuable contributions to the case study text.

Selected References

Energy performance and key technologies:

- http://www.deo-berlin.de/images/Presse/DBU-Abschlussbericht-AZ-31562.pdf [GER]
- https://www.construction21.org/deutschland/case-studies/de/newtonprojekt-haus-1-berlin-adlershof.html
- Energy mix: https://www.cleanenergywire.org/factsheets/energy-use-city-berlin

Further Resources in German:

- https://www.adlershof.de/news/baugemeinschaft-newtonprojekt-feiert-richtfest/
- https://www.energietage.de/fileadmin/user_upload/2018/Vortraege/5.01_Kuehl_Newton-Projekt.pdf

Local Context Details

Address: Newtonstraße 12, 12A, 12489 Berlin, Germany

Geographic Coordinates [Google | EPSG:4326 – WGS 84]: 52.433433, 13.528544

Local Government: City of Berlin

Population: 3,769,495 [2019]

Total Area Administered: 891.68 km²

Municipal Budget: 27 819 million € [2018]

Total annual GHG emissions: 16 326 000 t [2016]

Climatic Zone [Köppen]: [Dfb] Humid Continental Mild Summer | Wet All Year

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Further Images & Plans of the PEB

Image 5

Cropped rendering of the communal green space & buildings
[Source: Newtonprojekt GbR]

Image 6

Rendering of NEWTONPROJEKT House 1
[Source: Newtonprojekt GbR]

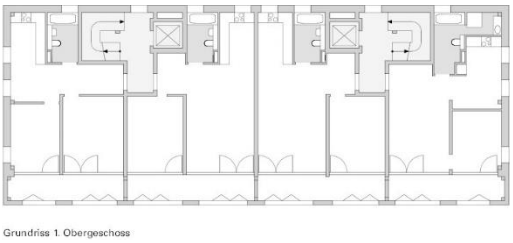
Image 7

Entryway to one of the building's two staircases
[Source: Andrea Kroth]

Image 8

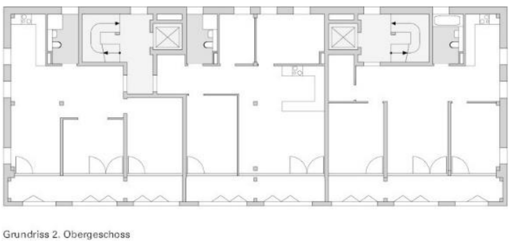
Photograph of the PV-system integrated into the façade of House 1
[Source: Andrea Kroth]

Image 9



Floorplan of the building's 1st floor
[Source: Deimel Oelschläger Architekten]

Image 10



Floorplan of the building's 2nd floor
[Source: Deimel Oelschläger Architekten]

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