HEART

THE FUTURE OF SMART ENERGY HOMES – IN 32 WORDS.

A glossary of terms to learn about smart energy homes and integrated renovation toolkits.

TABLE OF CONTENTS

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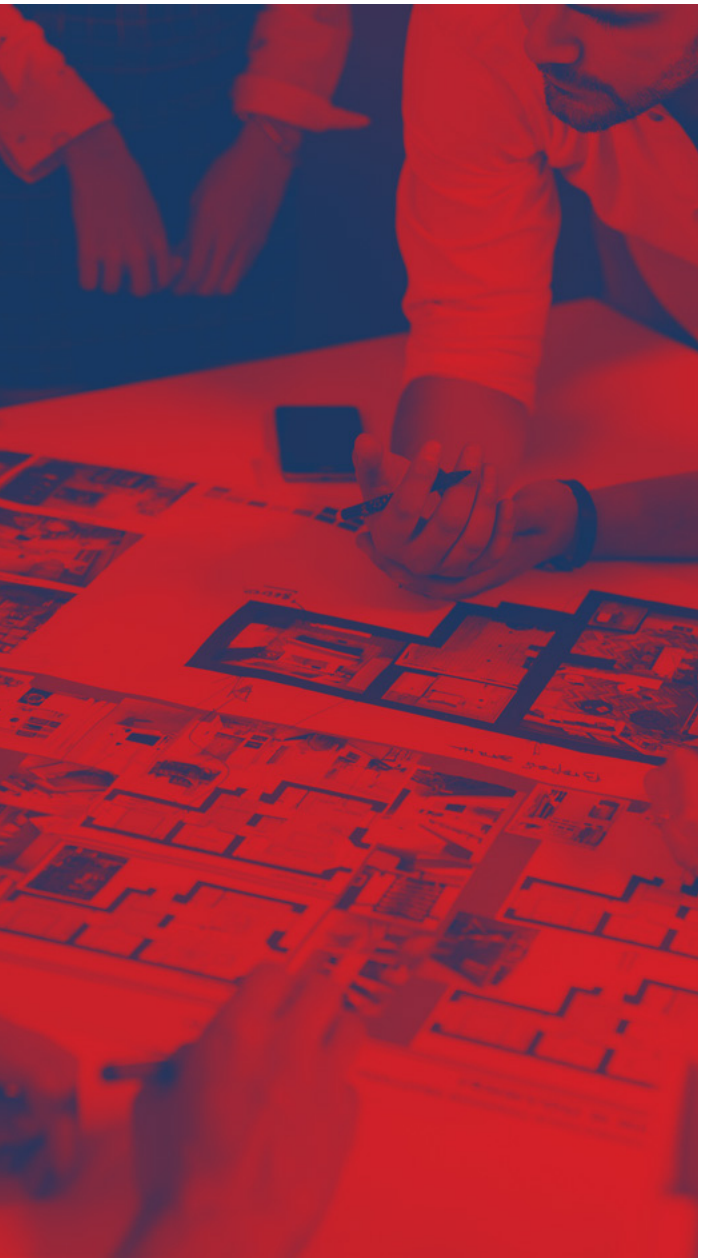


INTRODUCTION

The evolutions in integrated deep retrofit modules are moving fast. New technologies are being developed that can result in important cost, time and quality benefits for housing providers.

The EU-funded HEART project, is one of those promising projects that currently develops a multifunctional retrofit toolkit. This one-stop-shop solution will include different components like BEMS, HVAC, BIPV, MIMO and ET's that are optimally being fine-tuned – at the design and operation stages.

The heart of... HEART is a cloud-based computing platform that includes DSS and energy management features that help housing providers design and manage the new generation of smart energy buildings.

If any of these terms raised your eyebrows, then read on. This glossary of terms is intended to help you understand some important technical terms in the dynamic field of deep retrofit technologies used currently in the EU.

GLOSSARY OF TERMS

AMQPS - ADVANCED MESSAGE QUEUING PROTOCOL

A queuing system designed to connect servers to each other (S2S). Devices in smart homes must communicate with each other (D2D). Device data then must be collected and sent to the server infrastructure (D2S). That server infrastructure has to share device data (S2S), possibly providing it back to devices, to analysis programs, or to people.[1]

> ***Use in HEART:*** *To connect devices and components in the HEART retrofit toolkit with the cloud-servers. See Work Package 3 of HEART: Integrated Optimization of the Whole System*

BAS - BUILDING AUTOMATION SYSTEM

A system with an automatically centralized control of a building's heating, ventilation and air conditioning, lighting and other systems. BAS core functionality keeps building climate within a specified range, provides light to rooms based on an occupancy schedule, monitors performance and device failures in all systems, and provides malfunction alarms to building maintenance staff. The objective is to improve occupant comfort, efficient operation of building systems, reduction in energy consumption and operating costs, and improved life cycle of utilities. A building controlled by a BAS is often referred to as a "smart building", or (if a residence) a "smart home". Most commercial, institutional, and industrial buildings built after 2000 include a BAS.[2]

> ***Use in HEART:*** *The BAS is an integrated part of the BEMS and relies on the evolutionary intelligence of the HEART cloud-system. See Work Package 3 of HEART: Integrated Optimization of the Whole System*

BUILDING ENVELOPE

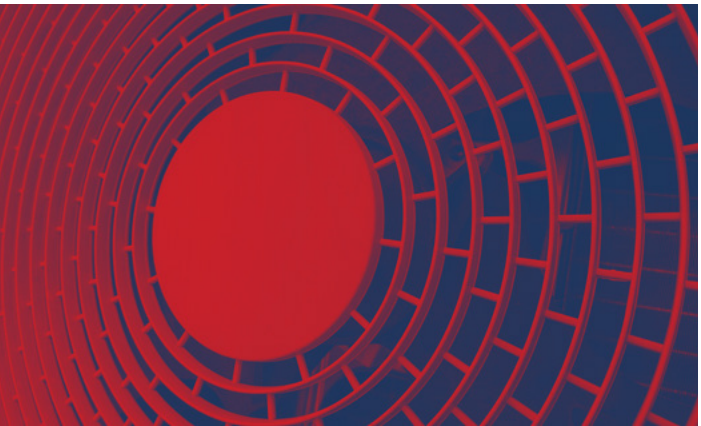
The physical separator between the conditioned (inside) and unconditioned (outside) environment of a building or dwelling including the resistance to air, water, heat, light, and noise transfer.[3] The building envelope is composed of Vertical envelope (façades) and the Horizontal envelope (roof). The EU EPBD Directive uses definition it as: the integrated elements of a building which separate its interior from the outdoor environment.

> ***Use in HEART:*** *as one of the partners, García Rama, will supply the pre-fabricated façade solutions for HEART retrofit toolkits Work Package 7 of HEART: Energy efficient envelope technologies*

BEMS - BUILDING ENERGY MANAGEMENT SYSTEM

IT-based monitoring and control systems that tie into existing energy-related data streams of a building's infrastructure, such as its heating, ventilation, and air conditioning (HVAC) and lighting systems, and provide visualization and analysis of that data to enable better energy-related decision-making. Among the reasons to use a BEMS are energy and cost savings/management, monitoring and control of energy consumption and usage, alerts in case of problems, monitoring and protection of the equipment/assets.[4]

> ***Use in HEART:*** *Building owners, such as social housing providers, will be able to improve the management of the energy system in their buildings and detect malfunctions at an early stage. Work Package 3 of HEART: Integrated Optimization of the Whole System, Work package 4 of HEART: Decision Support System and Building Energy Management System, Work Package 4 and Work Package 5 of HEART: Multi-input and Multi-output Power Controller (MIMO)*



BIPV - BUILDING-INTEGRATED PHOTOVOLTAICS

Photovoltaic materials that are used to replace conventional building materials in parts of the building envelope such as the roof, skylights, or facades. The advantage of integrated photovoltaics over more common non-integrated systems is that the initial cost can be offset by reducing the amount spent on building materials and labor that would normally be used to construct the part of the building that the BIPV modules replace.[5]

> ***Use in HEART:*** *BIPV are one of the renewable energy sources in the HEART toolkit. Work Package 7 of HEART: Energy efficient envelope technologies*

CLOUD-BASED

Refers to applications, services or resources made available to users on demand via the Internet from the servers of a cloud computing provider. Companies typically utilize cloud-based computing as a way to increase capacity, cost-efficiencies, enhance functionality or add additional services on demand without having to commit in-house staff or infrastructure.[6]

> ***Use in HEART:*** *the system's central core consists of a cloud-based computing platform which concentrates managing and operational logic to support decision-making in planning and construction as well as energy performance enhancement and monitoring during operation. Work package 4 of HEART: Decision Support System and Building Energy Management System*

DEEP RENOVATION

There is no legal definition at EU level of "deep renovation". In general, it is understood, that the renovated buildings energy reductions are 75% or more compared to the status of the existing building(s) before the renovation.[7] The EU Energy Efficiency Directive (EDD) – requires that Member States establish a long-term strategy for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private which includes policies and measures to stimulate cost-effective deep renovations of buildings, including staged deep renovations. There is, however, a legal definition in the EPBD for 'major renovation': the renovation of a building where the total cost of the renovation relating to the building envelope or the technical building systems is higher than 25 % of the value of the building, excluding the value of the land upon which the building is situated; or more than 25 % of the surface of the building envelope undergoes renovation.[8]

> ***Use in Heart:*** *the aim for the HEART toolkit is to ensure up to 90% energy saving on heating, cooling and DHW. Work Package 2 of HEART: Continuous Update of the Intervention Context, Constraints and Opportunities*

DSS – DECISION SUPPORT SYSTEM

A decision support system (DSS) is an information system that supports business or organizational decision-making activities. DSSs serve the management, operations and planning levels of an organization (usually mid and higher management) and help people make decisions.[9]

> ***Use in HEART:*** *the DSS will concentrate on reducing simulation and optimization time in the design phase and on improving the analysis of operation phase data to optimize system design and technologies, exploiting calibration procedures. Activities will be also focused to maximize the effectiveness of the adaptive-predictive energy management strategy, maximizing the use of external information (i.e. weather data, energyprices, etc.). Work package 4 of HEART: Decision Support System and Building Energy Management System*

EPBD – ENERGY PERFORMANCE OF BUILDING DIRECTIVE

The EPBD is the European Union's main legislative instrument aiming to promote the improvement of the energy performance of buildings within the European Union. It was inspired by the Kyoto Protocol which commits the EU and all its parties by setting binding emission reduction targets.[10]

> ***Work Package 2 of HEART:*** *Continuous Update of the Intervention Context, Constraints and Opportunities*

ENVELOPE TECHNOLOGIES

Technical solutions related to the opaque components and fenestration of the (vertical and horizontal) building envelope aimed at the improvement of the thermal and acoustic performance (External thermal insulating systems); of ventilation, passive cooling, thermal inertia (Ventilate façades); improving of overshadow, daylight control (Solar shadings); improving of heat gain, solar cooling (Passive solar energy systems); renewable energy use, autonomous energy production (Active solar energy systems); improving performances of fenestration, (glass envelope, windows with high-performing glass).[11]

> ***Work Package 7 of HEART:*** *Energy efficient envelope technologies*

EPC – ENERGY PERFORMANCE CERTIFICATE

EPCs are a rating scheme to summarise the energy efficiency of buildings in the European Union. According to EU Directive a certificate recognised by a Member State or by a legal person designated by it, which indicates the energy performance of a building or building unit, calculated according to a methodology adopted by each Member State in accordance with the EPBD.[12]

ENERGY STORAGE

Energy storage is the capture of energy produced at one time for use at a later time. A device that stores energy is generally called an accumulator or battery. Energy comes in multiple forms including radiation, chemical, gravitational potential, electrical potential, electricity, elevated temperature, latent heat and kinetic. Energy storage involves converting energy from forms that are difficult to store to more conveniently or economically storable forms.[13] Due to the instability of the renewable energy supply, thermal energy storage technologies are also crucial to the widespread application of renewable energy in buildings.[14]

> ***Work Package 6 of HEART:*** *Components for Heat Generation, Emission and Storage*

FINAL ENERGY CONSUMPTION

The total energy consumed by end users, such as households, industry and agriculture. It is the energy which reaches the final consumer's door and excludes that which is used by the energy sector itself. EU The EPBD Directive defines 'primary energy' as energy from renewable and non-renewable sources which has not undergone any conversion or transformation process. Final energy consumption excludes energy used by the energy sector, including for deliveries, and transformation.[15]

> ***Work Package 2 of HEART:*** *Continuous Update of the Intervention Context, Constraints and Opportunities*

HEAT PUMP

According to the EU EPBD, a Heat Pump is a machine, a device or installation that transfers heat from natural surroundings such as air, water or ground to buildings or industrial applications by reversing the natural flow of heat such that it flows from a lower to a higher temperature. For reversible heat pumps, it may also move heat from the building to the natural surroundings.[16] The HEART project will integrate heat pumps from HELIO.[17]

> ***Work Package 6 of HEART:*** *Components for Heat Generation, Emission and Storage*

HVAC - HEATING, VENTILATION AND AIR CONDITIONING

Heating, ventilation, and air conditioning (HVAC[1]) is the technology of indoor and vehicular environmental comfort. Its goal is to provide thermal comfort and acceptable indoor air quality. HVAC system design is a subdiscipline of mechanical engineering, based on the principles of thermodynamics, fluid mechanics and heat transfer.[18]

> ***Work Package 6 of HEART:*** *Components for Heat Generation, Emission and Storage*

IEQ - INDOOR ENVIRONMENTAL QUALITY

This refers to the quality of a building's environment in relation to the health and wellbeing of those who occupy space within it. IEQ is determined by many factors, including lighting, air quality, and damp conditions.

> ***Work Package 3 of HEART:*** *Integrated Optimization of the Whole System*

IHDM - IN-HOME DISPLAY MONITORS

An IHDM (also called Home energy monitor or User Interface) provides feedback on electrical energy use. Devices may also display cost of energy used, and estimates of greenhouse gas emissions. Various studies have shown a reduction in home energy use of 4-15% through use of home energy display. Electricity use may be measured with an inductive clamp placed around the electric main, via the electric meter, by communicating with a smart meter, or by direct connection to the electrical system. Online displays are also available which allow the user to use an internet connected display to show near real-time consumption on a tablet, smart phone or PC.[19]

> ***Work package 4 of HEART:*** *Decision Support System and Building Energy Management System*

IOT – INTERNET OF THINGS

The network of devices such as vehicles, and home appliances that contain electronics, software, sensors, actuators, and connectivity which allows these things to connect, interact and exchange data. The IoT involves extending Internet connectivity beyond standard devices, such as desktops, laptops, smartphones and tablets, to any range of traditionally dumb or non-internet-enabled physical devices and everyday objects. Embedded with technology, these devices can communicate and interact over the Internet, and they can be remotely monitored and controlled.[20]

> ***Work package 4 of HEART:*** *Decision Support System and Building Energy Management System*

LCC – LIFE CYCLE COSTS

The total cost of ownership over the life of an asset. Also commonly referred to as "cradle to grave" or "womb to tomb" costs. Costs considered include the financial cost which is relatively simple to calculate and also the environmental and social costs which are more difficult to quantify and assign numerical values. Typical areas of expenditure which are included in calculating the whole-life cost include planning, design, construction and acquisition, operations, maintenance, renewal and rehabilitation, depreciation and cost of finance and replacement or disposal.[21]

> ***Work Package 3 of HEART:*** *Integrated Optimization of the Whole System*

LOAD MANAGEMENT

Load management, also known as demand side management (DSM), is the process of balancing the supply of electricity on the network with the electrical load by adjusting or controlling the load rather than the power station output. This can be achieved by direct intervention of the utility in real time, by the use of frequency sensitive relays triggering the circuit breakers (ripple control), by time clocks, or by using special tariffs to influence consumer behaviour. Load management allows utilities to reduce demand for electricity during peak usage times (peak shaving), which can, in turn, reduce costs by eliminating the need for peaking power generation.[22]

> ***Work package 4 of HEART:*** *Decision Support System and Building Energy Management System*

MIMO - MULTIPLE-INPUT MULTIPLE-OUTPUT (MIMO) CONVERTERS

MIMOs have been identified as a cost-effective approach for energy harvesting and dispatching in hybrid power systems such as those envisioned in future smart homes and DC microgrids. MIMO DC–DC converters, are envisioned as key components that interact with other elements such as distributed generation and modern electronic loads in future residential buildings with growing number of consumption loads and appliances using DC, e.g. portable devices, LED lights.

> ***Work Package 5 of HEART:*** *Multi-input and Multi-output Power Controller (MIMO)*

NEM - NET ENERGY METERING

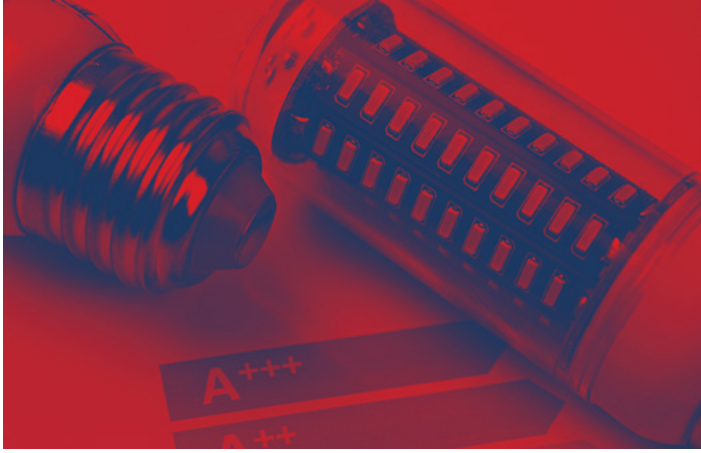
NEM allows consumers – or prosumers - to use the value of the surplus of their own generated electricity at a different moment. This is particularly important with renewable energy sources like wind and solar, which are non-dispatchable (when not coupled to storage). E.g. net metering allows citizens or communities to use the net kilowatt credit of their solar power generated during the day at night, or wind from a windy day later in the month or year. Net metering policies can vary significantly by country or region. Most net metering laws involve monthly or annual roll over of kWh credits, a small monthly connection fee, monthly payment of deficits (i.e. normal electric bill) and a settlement of any residual credit. Net metering uses a single, bi-directional meter and can measure current flowing in two directions. Net metering can be implemented as an accounting procedure, without requiring any special metering or arrangement. A “feed-in tariff”scheme requires a separate meter, and pays for all self-generated energy at a specific rate, while net metering requires only one meter.[23]

> ***Work package 4 of HEART:*** *Decision Support System and Building Energy Management System*
>
> ***Work Package 2 of HEART:*** *Continuous Update of the Intervention Context, Constraints and Opportunities*

PEAK SHAVING

Peak shaving is a mechanism to reduce peak demand. This is achieved by using an energy storage system. It avoids the installation of capacity to supply the peaks of a highly variable load. Energy storage provides fast response and emission-free operation. Peak shaving installations are often owned by the electricity consumer, rather than by the utility.[24]

> ***Work package 4 of HEART:*** *Decision Support System and Building Energy Management System*



PLUG LOAD

Plug load is the energy used by products that are powered by means of an ordinary power plug. This term generally excludes building energy that is attributed to major end uses (HVAC, lighting, water heating, etc.) It typically includes office and general miscellaneous equipment, computers, elevators and escalators, kitchen cooking and refrigeration, laundry washing and drying, lighting exempt from the lighting power allowance, and other energy uses.[25]

> ***Work package 4 of HEART:*** *Decision Support System and Building Energy Management System*

PV – PHOTOVOLTAICS

The conversion of light into electricity using semiconducting materials. A photovoltaic system employs solar panels, each comprising a number of solar cells, which generate electrical power. Solar PV has specific advantages as an energy source: once installed, its operation generates no pollution and no greenhouse gas emissions, it shows simple scalability in respect of power needs and silicon is largely availability. PV systems have two major disadvantages: the power output works best with direct sunlight and the production is concentrated in hours that do not usually match the peaks in demand in human activity cycles.[26]

> ***Work Package 7 of HEART:*** *Energy efficient envelope technologies*

SAAS - SOFTWARE AS A SERVICE

A software licensing and delivery model in which software is licensed on a subscription basis and is cloud-based. SaaS is typically accessed by users using a thin client, e.g. via a web browser.[27]

> ***Work package 4 of HEART:*** *Decision Support System and Building Energy Management System*

SMART HOME

There is no official definition for what a smart home is. Based on the 2018 revision of the EPBD, the EU is promoting smart building technologies, in particular through the establishment of a Smart Readiness Indicator (SRI) for buildings. This indicator will allow for rating the smart readiness of buildings, i.e. the capability of buildings (or building units) to adapt their operation to the needs of the occupant, also optimizing energy efficiency and overall performance, and to adapt their operation in reaction to signals from the grid (energy flexibility). The smart readiness indicator should raise awareness amongst building owners and occupants of the value behind building automation and electronic monitoring of technical building systems and should give confidence to occupants about the actual savings of those new enhanced functionalities.[28]

SMART METER

The EU Energy Efficiency Directive defines a Smart Metering systems an electronic system that can measure energy consumption, providing more information than a conventional meter, and can transmit and receive data using a form of electronic communication. Smart meters enable two-way communication between the meter and the central system of the supplier. Communications from the meter to the network may be wireless, or via fixed wired connections. smart meters with energy monitors, also known as in-home display monitors (IHDM). The roll-out of smart meters is claimed to be one strategy for saving energy. While energy suppliers could save from their introduction, benefits to users of electricity depends on their using the information to change their pattern of energy use. For example, smart meters may facilitate taking advantage of lower off-peak time tariffs, and selling electricity back to the grid with net metering.

> ***Work package 4 of HEART:*** *Decision Support System and Building Energy Management System*

SMART GRID

A smart grid is an electrical grid which includes a variety of operation and energy measures including smart meters, smart appliances, renewable energy resources, and energy efficient resources. Electronic power conditioning and control of the production and distribution of electricity are important aspects of the smart grid.[29] In the EU, the ETIP Smart Networks for Energy Transition (SNET) role is to guide Research, Development & Innovation (RD&I) to support Europe's energy transition, more specifically, for Smart Networks for Energy Transition.[30]

> ***Work Package 2 of HEART:*** *Continuous Update of the Intervention Context, Constraints and Opportunities*

SMART FAN COIL

A fan coil unit (FCU) is a simple device consisting of a heating and/or cooling heat exchanger or 'coil' and fan. It is part of an HVAC system found in residential, commercial, and industrial buildings. A fan coil unit is a diverse device sometimes using ductwork, and is used to control the temperature in the space where it is installed, or serve multiple spaces.[31] The Smart Fan Coils used in the HEART toolkit are from STILLE and include sensors that will monitor Air Relative Humidity, Temperature, Water Temperature, Water Flow and an Accelerometer will also be used to prevent and notify potential earthquakes. They support NarrowBand-IoT communications and (backup) WiFi connection.[32]

> ***Work Package 6 of HEART:*** *Components for Heat Generation, Emission and Storage*

TBS - TECHNICAL BUILDING SYSTEMS

According to the EPBD, Member States need to optimise the energy use of technical building system and set system requirements of technical building systems which are installed in existing buildings. System requirements shall cover at least: heating systems; hot water systems; air-conditioning systems; large ventilation systems; or a combination of such systems.

> ***Work Package 3 of HEART:*** *Integrated Optimization of the Whole System*

UI - USER INTERFACE

In the industrial design field of human–computer interaction, the UI is the space where interactions between humans and machines occur. The goal of this interaction is to allow effective operation and control of the machine from the human end, whilst the machine simultaneously feeds back information that aids the operators' decision-making process. The UI should not be confused with the physical device on which it appears (see IHDM).[33]

> ***Work package 4 of HEART:*** *Decision Support System and Building Energy Management System*

NZEB - NEARLY ZERO-ENERGY BUILDING

A building that has a very high energy performance and where the nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby, in accordance to the specifications of the EPBD.

> ***Work Package 2 of HEART:*** *Continuous Update of the Intervention Context, Constraints and Opportunities*

The HEART website provides an overview to understand how these elements are interconnected in the toolkit
heartproject.eu/synoptic-outline

DID WE MISS ANY BUZZWORD TO BETTER UNDERSTAND SMART ENERGY HOMES? LET US KNOW!

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The European Federation of Public, Cooperative & Social Housing

ENDNOTES

1 Source: https://www.electronicdesign.com/iot/understanding-protocols-behind-internet-things, https://en.wikipedia.org/wiki/Advanced_Message_Queuing_Protocol

2 Source: https://en.wikipedia.org/wiki/Building_automation

3 Source: https://en.wikipedia.org/wiki/Building_envelope

4 Source: http://blog.schneider-electric.com/building-management/2015/02/26/better-sustainability-bems-building-energy-management-system/

5 Source: https://en.wikipedia.org/wiki/Building-integrated_photovoltaics

6 Source: https://www.webopedia.com/TERM/C/cloud_based.html

7 Source: http://www.gbpn.org/sites/default/files/08.DR_TechRep.low_.pdf

8 Source: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1550511746391&uri=CELEX:32010L0031

9 Source: https://en.wikipedia.org/wiki/Decision_support_system

10 Source: https://en.wikipedia.org/wiki/Directive_on_the_energy_performance_of_buildings

11 Source: http://www.streamer-project.eu/ D2.4.pdf

12 Source: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX-:32010L0031&qid=1550511746391&from=EN

13 Source: https://en.wikipedia.org/wiki/Energy_storage

14 Source: https://www.mdpi.com/journal/energies/special_issues/Building_renewable_energy

15 Source: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Final_energy_consumption

16 Source: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX-:32010L0031&qid=1550511746391&from=EN

17 Source: https://www.heliotherm.com/en/

18 Source: https://en.wikipedia.org/wiki/HVAC

19 Source: https://en.wikipedia.org/wiki/Home_energy_monitor

20 Source: https://en.wikipedia.org/wiki/Internet_of_things

21 Source: https://en.wikipedia.org/wiki/Whole-life_cost

22 Source: https://en.wikipedia.org/wiki/Load_management

23 Source: https://en.wikipedia.org/wiki/Net_metering

24 Source: https://new.abb.com/distributed-energy-microgrids/applications/energy-storage-applications/peak-shaving

25 Source: https://en.wikipedia.org/wiki/Plug_load

26 Source: https://en.wikipedia.org/wiki/Photovoltaics

27 Source: https://en.wikipedia.org/wiki/Software_as_a_service

28 Source: https://smartreadinessindicator.eu/

29 Source: https://en.wikipedia.org/wiki/Smart_grid

30 Source: https://www.etip-snet.eu/about/etip-snet/

31 Source: https://en.wikipedia.org/wiki/Fan_coil_unit

32 Source: http://stillegroup.com/

33 Source: https://en.wikipedia.org/wiki/User_interface