PLANT, MACHINERY & EQUIPMENT VALUATION

#05

Real Estate Valuation and Plant, Machinery & Equipment Valuation

An indispensable alliance for valuing the energy efficient transformation of the European building stock

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The revision of the Energy Performance of Buildings Directive (EPBD) currently in progress will bring significant regulatory pressure accelerating the decarbonisation of buildings, in the first instance with the upgrading of the 15% worst-performing building stock.

Technical building systems are an integral and key part of the Directive, with a new provision that:

"Member States shall ensure that the requirements they set for technical building systems reach at least the latest cost-optimal levels." *(Article 11(1), subparagraph 4)*

The same Article underscores the overarching, transversal importance of technical building systems to the building's energy efficiency and to the goals of the Directive:

"Member States shall ensure that, when a technical building system is installed, the overall energy performance of the altered part, and where relevant, of the complete altered system, is assessed. The results shall be documented and passed on to the building owner, so that they remain available and can be used for the verification of compliance with the minimum requirements laid down pursuant to paragraph 1 and the issue of energy performance certificates." *(Article 11(4))*

Property valuation is one of the pillars of climate change mitigation and adaptation and needs to rapidly deploy the skills necessary to support the EPBD strategies in order to achieve a totally decarbonised building stock by 2050. **Technical building systems are consubstantial to a complete and meaningful determination of the building's value. They have to be analysed, not only with regard to their condition and useful life, but also in terms of fulfilment of the national requirements ensuing from transposition of the EPBD including their contribution to determining the hierarchical, alphabetical grade or class on the building's energy performance certificate.**

Property valuation must foresee the risk posed by technical systems for each kind of building. Technical systems are subject to safety, energy efficiency and environmental legislation and standards which are liable to periodic review. In addition, the EPBD is placing limits on the use of equipment which had complied until now with specific legislation and standards. Valuers will need to identify the areas where equipment will have to be upgraded as well as areas where it will be possible to retain technical installations able to comply with legislation as long as they are well maintained.

For example, the valuer could identify equipment in a technical building system serving for heating and cooling the building which could be non-compliant with the EPBD or could prejudice the building's energy certification grade, while not implying replacement of all the components of the plant.

Take the example of dedicated heating, ventilation and air conditioning (HVAC) systems. Their size depends on the function of each building, and they are made up of various individual pieces of equipment which, as a whole, provide the building with treated air, offering stable conditions in terms of comfort and quality of indoor air, along with domestic hot water. **These systems can keep pace with buildings' useful life because, although their components have a shorter useful life, scheduled replacement is possible without jeopardising the viability of the technical system of which they form part. Consequently, it will also be possible to introduce the adaptations required by the EPBD and its recasts, without having to replace buildings' HVAC systems completely.**

The image illustrates an existing HVAC system for a building. The system comprises Air Handling Units (AHUs) responsible for ventilation and heating and for cooling the treated air entering the building, units to cool the air – chillers, and units to heat the air – boilers. Domestic hot water is also produced by a boiler. The technical system is the subject of scheduled maintenance and complies with current legislation, but the building has a low EPC rating. The goal is to increase its energy efficiency significantly and ensure that all its equipment has zero direct GHG emissions, i.e., does not generate any on-site carbon emissions.

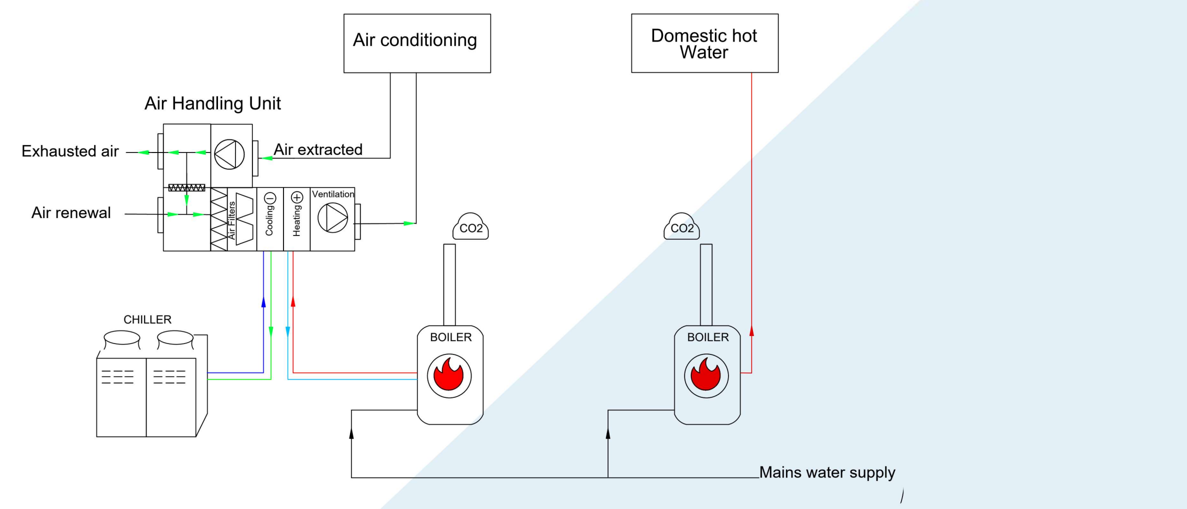
Various solutions could be adopted, as shown in the image below. These may or may not be fully implemented, depending on their contribution wholly or individually to the building's overall energy performance.

Examples include the following improvements (amongst others):

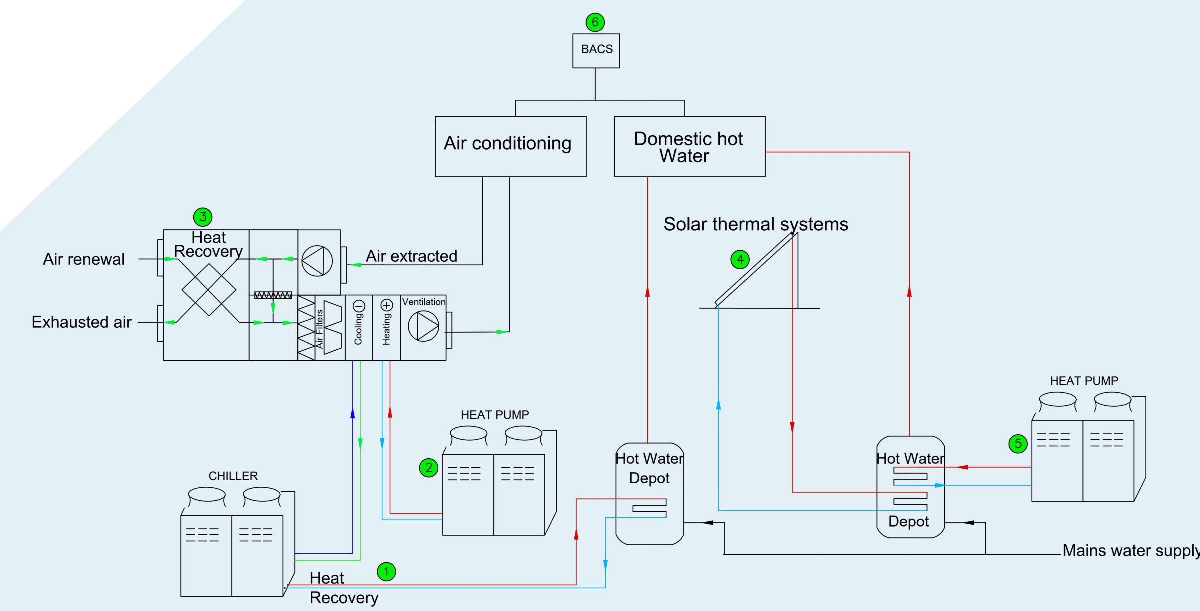
1. Installation of a chiller with heat recovery, so that some of the thermal energy given off by the equipment can be recovered and diverted to heat domestic water;
2. Replacement of the boiler used to heat the air with a heat pump unit offering much greater energy efficiency and generating zero direct emissions;
3. Installation of a heat recovery module in the AHU unit, making it possible to recover some of the thermal energy contained in the air extracted from the building and transfer it to the renewed air to be introduced to the building;
4. Installation of a solar thermal system to heat domestic water;
5. Replacement of the boiler used for domestic hot water with a high temperature heat pump;
6. Installation of a building automation and control system (BACS) for technical management of the HVAC system, as well as other technical building systems.

All the illustrated improvements contribute to greater energy efficiency of the HVAC system, helping to make use of the thermal energy which would be given off, reducing heating needs for air conditioning and domestic hot water and, finally, contributing towards a decrease in the building's electricity consumption and elimination of fossil fuel sources.

Example: Technical building systems for heating and cooling



Some strategies for improving the building energy certification grade, applied to the Example



It is not the goal of property valuation to implement the rehabilitation plan for technical systems, nor to determine buildings' energy performance in accordance with an alteration of one of their technical systems, but it should identify and analyse systems, their condition and maintenance, and the target equipment to be prioritised in rehabilitation work in line with the latest EPBD-compliant national regulation so as to inform property clients of the new variables impacting the property's valuation.

Depending on the size of the building and the importance of its technical installations, collaboration between property valuers and PME valuers can contribute strongly to its energy efficiency valuation, with a view to minimising the risk of error in the overall determination of value and attaining excellence, fulfilling the objectives of the EPBD.

Overview of the key technical building systems elements that valuers must assess

6. 'technical building system' means technical equipment for space heating, space cooling, ventilation, domestic hot water, built-in lighting, building automation and control, on-site ⇨ **renewable energy** ⇦ ~~electricity~~ generation ⇨ **and storage** ⇦, or a combination thereof, including those systems using energy from renewable sources, of a building or building unit;

   EPBD Recast COM(2021) 802 final 15.12.2021 Article 2(6) showing inserts to and deletions from the existing Directive

Heating and cooling systems, Building Automation and Control Systems (BACS), built-in lighting systems, energy regeneration in lifts, escalators and travelators, electric vehicle charging infrastructure and on-site electricity generation systems are amongst the technical building systems with the highest impact on the building's energy performance.

Technical building systems are planned to provide various technical solutions tailored to the specific use of each building, the type of system required and available energy sources, guided by the applicable mandatory standards and legislation governing their design, construction materials and energy efficiency and the safety of persons and property.

Heat Pumps

Systems using fossil fuel based energy sources include those supplying ambient heating and domestic hot water such as boilers, but the current EPBD revision provides that, as of 2027, Member States may no longer subsidise fossil fuel boilers. Alternative solutions with zero direct GHG emissions exist, such as heat pumps.

A heat pump is characterised by a refrigeration system that promotes circulation of a fluid (refrigerant gas) in a closed system, which changes status and condition to provide energy exchange through the system's coils. Coils make up the condensation unit usually placed on the outside and the evaporation unit normally placed inside which will be responsible for heating or cooling the space to be treated. Where the fluid is water, the evaporator will be placed inside the tank to be treated.

Refrigeration systems may simply cool the environment to be treated, as in the case of chillers, or heat and cool it, through a process of inversion of the refrigeration cycle, in which case they are known as heat pumps.

The refrigerant gases currently used in refrigeration systems are subject to legislation which imposes minimum standards of use in terms of atmospheric heating potential (AHP), along with maintenance standards for fluorinated gas systems covering both procedures and the accreditation of maintenance companies. The gases currently used in these systems have no influence on depletion of the ozone layer and have medium-to-low global warming potential (GWP). Under pressure from the legal requirement to seek environmentally friendly solutions, the industry has been developing gases with ever lower GWP without compromising the systems' energy efficiency and has been developing alternatives to replace them with other natural gases having nearly zero environmental impact.

Heat pumps are highly energy efficient. Taking the example of heating, the energy efficiency of any given heating system depends on the relationship between the quantity of thermal energy supplied and the quantity available to operate it. Considering electrical resistance [heating], energy efficiency is '1', i.e., the heating power produced is equal to the nominal power absorbed by the equipment. In the case of a heat pump with energy efficiency of '3', this means that the thermal energy it produces corresponds to 3 times its nominal absorbed power.

Apart from ambient heating and domestic hot water, heat pump systems can also provide power for ambient cooling, offering a complete solution which can be incorporated in a thermal power plant serving one or more buildings or as an individual system serving a unit or part of a building. These systems can produce thermal energy in combination with passive systems (which use alternative energy sources), as in the case of thermal solar collectors for heating water, aerothermal systems which make use of existing thermal energy in the air and geothermal systems which capture the energy in the soil, benefiting from a constant temperature of around 16°C year-round.

The table below details some of the solutions found in buildings using heat pump units.

SYSTEM TYPOLOGY	FUNCTION	EXAMPLES OF EQUIPMENT
Direct Expansion Systems (Refrigeration Systems)	Ambient Heating / Cooling	**Split:** Consisting of an outdoor unit and an indoor unit.
		Multisplit: Consisting of one outdoor unit and several indoor units.
		VRF - Variable refrigerant flow - Consists of one outdoor unit and several indoor units.
		Rooftop: Compact unit for connection to air-conditioning distribution networks.
Indirect Expansion Systems (Refrigeration Systems)	Ambient Heating / Cooling	**Chiller:** Cold water production unit.
		Heat pump: Cold/hot water production unit.
		Fan coils: Climate control terminal units (placed in the spaces to be air-conditioned).
		AHU: Air handling unit for connection to air-conditioning distribution networks.
		UTAN: New air handling unit for connection to air-conditioned air distribution networks.
		URC: Heat Recovery Units (recovery of the energy contained in the exhausted air from inside the building).
Heating systems	Ambient Heating / Domestic hot water	**Heat pump:** Hot water production unit.
		Underfloor heating: Systems powered by the heat pump unit for floor heating.
		Radiators: Terminal heating units fed from the heat pump unit (placed in the spaces to be heated).
Heating systems	Pool water heating	**Heat pump:** Hot water production unit.

Building automation and control systems (BACS)

7.'building automation and control system' means a system comprising all products, software and engineering services that can support energy efficient, economical and safe operation of technical building systems through automatic controls and by facilitating the manual management of those technical building systems;
EPBD Recast op. cit. , Article 2(7) (unchanged vis-à-vis existing Directive)

BACS ensure technical management of all the equipment in the building, in terms of its operation, energy rationalisation and the safety of persons and property. The systems found in buildings are controlled and monitored electronically by means of the BACS communications interfaces which communicate directly with the equipment's controllers through bus communication lines with user-friendly navigation.

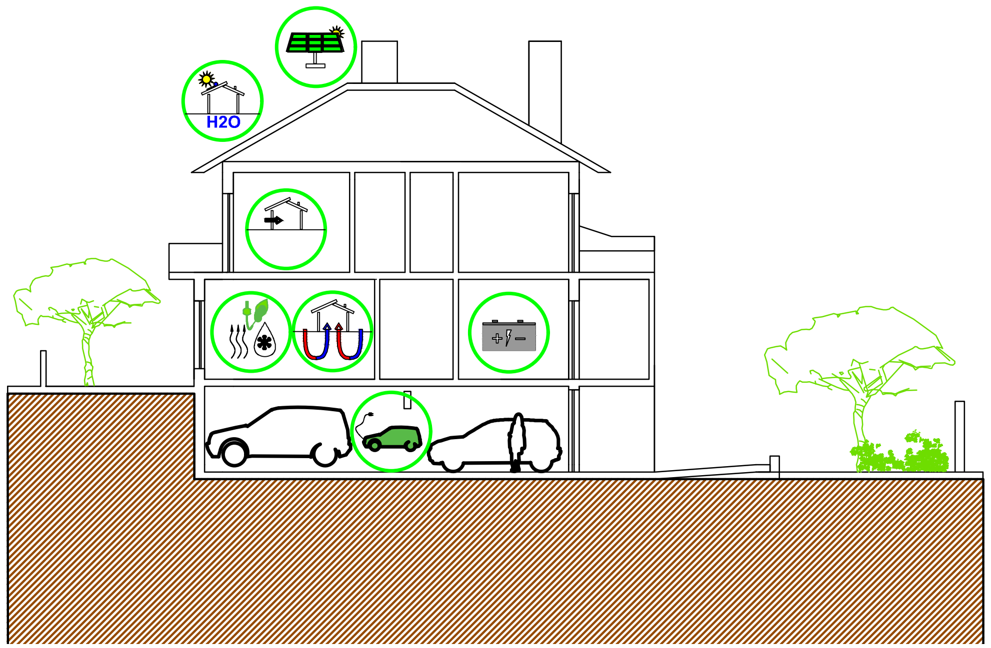
BACS enable continuous, comparative monitoring, recording and analysis of energy consumption and efficiency, providing information on the building's actual or potential energy performance, as well as communication and interaction between all the technical systems. This includes active and passive air-conditioning, domestic hot water, ventilation, smart lighting and mechanical access (lifts, escalators and travelators) systems.

Electric vehicle charging infrastructure

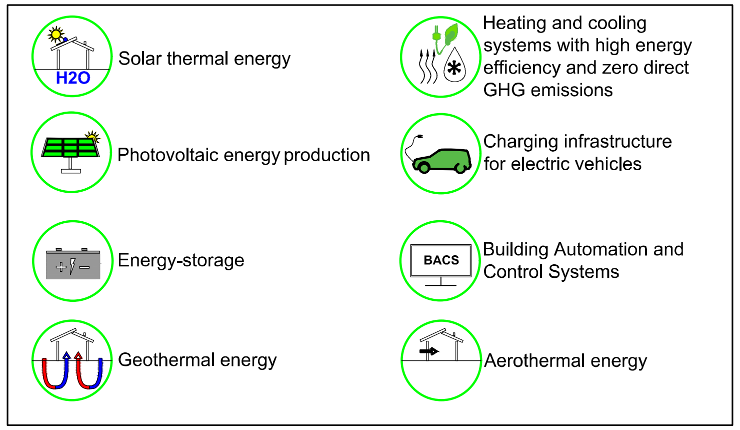
This is another of the strategies of the EPBD, which, in conjunction with revision of the Deployment of Alternative Fuels Infrastructure Regulation, sets down minimum requirements for buildings' infrastructure for sustainable mobility so as to accommodate the increasing use of electric vehicles (also regulated by other European Green Deal legislation: no more manufacture of internal combustion cars as of 2035). The charging infrastructure could be standard, simply using normal electrical sockets, or rapid, using chargers with specific rapid charging sockets. Bidirectional or reversible chargers are available on the market and these can charge the batteries of electrical vehicles or be used to supply power to the building.

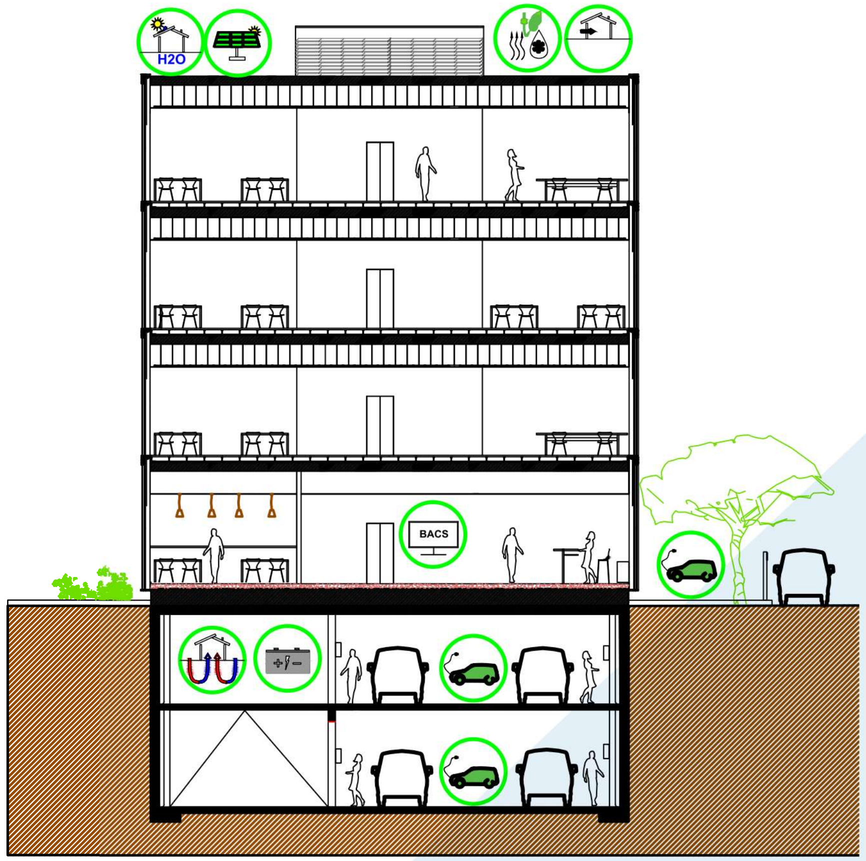
On-site electricity generation systems in buildings

On-site electricity generation systems in buildings, such as photovoltaic systems, must also be considered in the light of the EPBD. Their operation is based on absorption of solar radiation and its conversion into direct current (DC) electricity which is then converted into alternating current (AC) electricity by means of an inverter. After conversion, all the power may be used locally or injected into the public grid. Currently, the technology has been fully developed by electricity distribution companies, who offer various on-site electricity generation system solutions, integrated within the grids of the buildings and associated with smart energy meters.



Example of measures in residential buildings





Example of measures in commercial and service buildings

In building renovations, the main measures involving their technical systems must focus as a priority on those directly influencing the building's energy performance, such as heating and cooling appliances, on-site electricity generation systems and electric vehicle charging infrastructure. In the case of commercial and service buildings, BACS should also be considered.

Conclusions

- Rehabilitation of the European building stock is under way and requires all operators in the sector to come together to achieve the objectives set for decarbonisation by 2050.
- Certain buildings, depending on their size and function, have very large technical systems and costs, so their configuration and type of equipment will have a direct influence on the building's energy performance classification and determine the property valuation.
- Property valuation reports should include an analysis of technical building systems, identifying cases where their sustainable rehabilitation is likely to be necessary, with a view to enhancement of their energy performance and compliance with the EPBD-enhanced national regulation.
- An alliance between property valuation and plant, machinery and equipment valuation is essential, in justified cases, to keep up with current and future requirements and also provide the market with support and confidence in the future of the property business.

Ana Caldeira Martins is a member of the European Plant, Machinery & Equipment Valuation Standards Board. She is a specialist engineer responsible for electromechanical and HVAC projects for buildings and various subways, a valuer of PME and industrial installations and a PME course co-author and trainer.

Podcasts

- **Assessing the value at risk in the energy performance of European buildings –** *EV interviews Peter Sweatman, Chief Executive of Climate Strategy*
- **Cutting the crap in real estate valuations – Pricing the decarbonisation transition –** *EV interviews Xavier Jongen, Managing Director, Catella Residential*