Taking into account the elements expressed previously, for the case of Bucharest demo-site the following KPIs were defined:

A. Key performance indicators KPIs (Technology) – for each technology (HP, PV, PVT, TES tank)

The KPIs (Tech) will be calculated:

- as part of the feasibility study (for proposed schemes, based on them, the optimal scheme is selected),
- after implementation and will be monitored during the period of operation.

B. Key performance indicators KPIs (System) – for the technological configuration

The KPIs will be calculated:

- as part of the feasibility study (for proposed schemes, based on them, the optimal scheme is selected),
- after implementation and will be monitored during the period of operation.

C. Key performance indicators KPIs (Building) – for Target Building

The KPI's (Building) will be calculated:

- during the audit (initial assessment)
- as part of the feasibility study (for proposed schemes, based on them, the optimal scheme is selected),
- after implementation and will be monitored during the period of exploitation.

D. Key performance indicators KPIs (DH) – for the district heating system of UPB

The KPI's (DH) will be calculated:

- during the audit (initial assessment)
- as part of the feasibility study (for proposed schemes, based on them, the optimal scheme is selected),
- after implementation and will be monitored during the period of operation.

For exemplification, in the following paragraph, some of the energetic KPIs are defined and determined during the pre-assessment phase [4][5].

Specific heating energy demand:

$$q_h = \frac{Q_h}{A \cdot Year} \left[\frac{\mathrm{kWh}}{\mathrm{m}^2\, year}\right] \quad (1)$$

where, Q_h $[kWh]$ represents the yearly thermal energy for heating required by the building and A $[m^2]$ represents the area of the building.

Specific cooling energy demand:

$$q_c = \frac{Q_c}{A \cdot Year} \left[\frac{\mathrm{kWh}}{\mathrm{m}^2\, year}\right] \quad (2)$$

where, Q_c $[kWh]$ represents the yearly thermal energy for cooling required by the building.

Specific DHW energy demand:

$$q_{DHW} = \frac{Q_{DHW}}{A \cdot Year} \left[\frac{\text{kWh}}{\text{m}^2\ year}\right] \quad (3)$$

where $Q_{DHW}[kWh]$ represents the yearly thermal energy required for domestic hot water by the building.

Specific total thermal energy demand:

$$q_{total} = \frac{Q_{total}}{A \cdot Year} = q_h + q_c + q_{DHW} \left[\frac{\text{kWh}}{\text{m}^2\ year}\right] \quad (4)$$

Specific total primary energy equivalent:

$$E_{total,echiv} = \frac{q_h}{\eta_{heating}} + \left(\frac{q_c}{COP_{Cooling}} + \frac{q_{DHW}}{\eta_{DHW}}\right) \cdot a_{conv} \left[\frac{\text{kWh}}{\text{m}^2\ year}\right] \quad (5)$$

Where $\eta_{heating}$ [%] represents the efficiency of the transformation of the primary energy (natural gas) into heat, $COP_{Cooling}[-]$ represents the efficiency of the cooling system, $\eta_{DHW}[\%]$ is the efficiency of the domestic hot water production system and $a_{conv}[-]$ is the conversion factor of final energy into primary energy [7].

Specific total CO_2 equivalent:

$$CO_{2\,total} = \frac{E_{CO_2\,total}}{A \cdot Year} \left[\frac{\text{kg}}{\text{m}^2\ year}\right] \quad (6)$$

Where $E_{CO_2\,total}$ $\left[\frac{kg}{year}\right]$represents the total emissions of CO_2 related to the total primary energy consumed to satisfy the thermal demand of the building. It is calculated by using “Ordinul 2641/2017” [7].

Table 1 provides the energetic KPI’s for the target building with the current thermal installations (before WEDISTRICT retrofitting scenario).

Table 1. **KPI’s of Target Building**

KPI	U.M	Value
Specific heating energy demand	[kWh/m^2 year]	240.1
Specific cooling energy demand	[kWh/m^2 year]	24.97
Specific DHW energy demand	[kWh/m^2 year]	1.17
Specific total thermal energy demand	[kWh/m^2 year]	266.24
Specific total primary energy equivalent	[kWh/m^2 year]	292.25(1)
Specific total CO2 equivalent	[kg/m^2 year]	59.92(2)

All the calculations were performed with the surface of Target Building of 532 m^2
(1) The calculation was performed considering the conversion factor from final energy to primary energy of 1.17, according to national order “Ordinul 2641/2017”.

(2) The calculation was performed considering the conversion factor from primary energy to CO2 production of 0.205, according to national order "Ordinul 2641/2017".

The WEDISTRICT new thermal supply unit that will be installed, implies production of thermal energy based on renewable energy sources and the thermal connection between UPB DH and Target Building will be re-designed. Therefore, it is necessary to define the renewable energy ratio for both Target Building and UPB DH.

The renewable energy ratio (RER), or share of renewables, is the fraction of renewable primary energy used by network compared to total primary energy consumed in order to fulfil the heating and cooling demand [8].

Considering the system boundaries presented in Figure 4, the equation for RER is explained below.

$$RER = \frac{E_{Pren}}{E_{Ptot}} \cdot 100\ [\%] \tag{7}$$

where

- $\boldsymbol{E_{Pren}}[kWh/year]$**:** Renewable primary energy used by UPB DH/Target Building.
- $\boldsymbol{E_{Ptot}}[kWh/year]$: Total primary energy used by UPB DH/Target Building.

In the current case, both KPI are equal to zero since the there is no renewable primary energy used by either of subsystems.

$$RER_{UPB\ DH} = \frac{E_{Pren}}{E_{Ptot}} \cdot 100 = 0\ [\%] \tag{8}$$

$$RER_{TB} = \frac{E_{Pren}}{E_{Ptot}} \cdot 100 = 0\ [\%] \tag{9}$$

The energy evaluation of the current situation of the other subsystems was carried out in order to establish the necessary measures to be applied for the reintegration of the Target Building in the DH system of UPB, with the new heat supply solution of the building.

4. Conclusions

In the context of the establishment and functioning of the internal energy market and from the perspective of the need to protect and conserve the environment, the ***EU's energy policy aims*** mainly at:

- promoting energy efficiency and energy saving;
- development of renewable energy sources;
- depletion of greenhouse gas emissions (GHG) [9].

The Romanian energy strategy 2019-2030, with 2050 perspective is a programmatic care document that defines the vision, that establishes the fundamental objectives of the process of creating an energy sector and indicates the national, the EU and the global landmarks that influence and determine policies and decisions in the field energy. The strategic energy vision is to create a sustainable energy sector [9].

It is obvious that the implementation of the WEDISTRICT project is in accordance with most of the objectives of the strategy. In this sense it is mentioned:

- Efficient heating of buildings;
- Ensuring access to electricity and heat for all consumers;
- Energy efficiency, the main priority of the new reform package;
- Promoting energy from renewable sources.

Within the framework of this article, the management of implementing a pilot project which started in October 2019 was addressed. Until the moment of this writing, the pre-Investment phase was conducted in which the energy audit and feasibility study led to the opportunity of implementing the proposed solution. The optimal technical and economical solution along with monitoring the energy performance of the system was assessed and will be further assessed using the key performance indicators. Along with the KPIs presented in this article, economical and social KPIs were also considered [10].

The energy audit of the Target Building led to the opportunity of implementation of a new solution for the thermal energy supply of the building, which ensures heating, cooling and domestic hot water. It integrates technologies based on renewable sources, namely: ground-to-water heat pump, PVT or PT, photovoltaic panels (to ensure the supply of electricity of the thermal supply unit).

The proposed solution also involves the development of a new heat, cold and DHW distribution system of the building.

The energy capacities of the proposed solution will ensure:

- the interior comfort in the building spaces
- the safety and flexibility of the supply thermal energy unit
- the delivery in the DH system of UPB of a share of heat energy produced from renewable sources (dependable on the operating regime)

The decision of the final form of the hybrid geothermal-solar system was taken based on dynamic simulations that were conducted and, on the results, obtained from the feasibility study along with the key performance indicators. Further, the system will be monitored using the key performance indicators.

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