



PVT solar collectors: a key technology for buildings thermal demand

Introduction

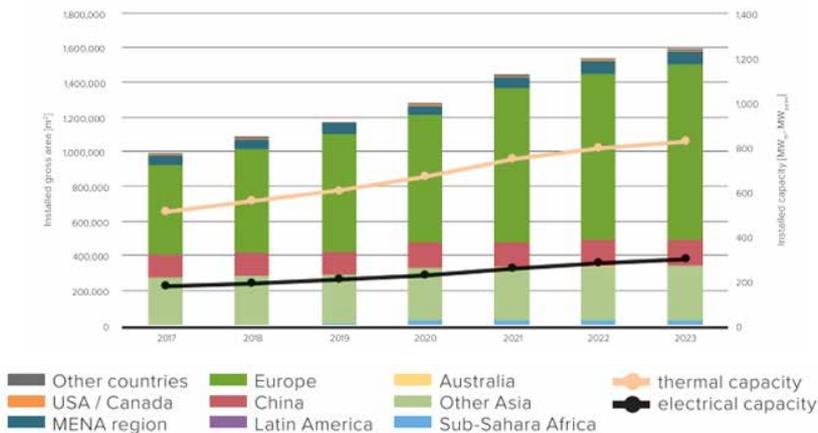
Solar hybrid collectors, also known as PVT collectors, combine photovoltaic and thermal technologies in a single unit to produce simultaneously electricity and heat. The electricity is produced using a PV laminate, while the heat is produced by a heat absorber which recovers heat from the PV¹. PVT collectors offer different integration possibilities to be combined with other technologies.

According to the heat transfer fluid used, these collectors can be classified as PVT liquid-based collectors and PVT air-based collectors; there are also diverse research tendencies in which PVT collectors are combined with other materials or technologies such as phase-change materials (PCM), nanofluids and concentration technologies^{2,3}.

Thanks to the combination of PV and solar thermal technologies, the overall energy efficiency

is better than that of the single PV panels, and the production by square meter can increase up to 60-80% depending on the specific PVT collector and the operating conditions⁴. This advantage is relevant in central urban areas, where there are usually multifamily and commercial buildings in which the roof space to install PV panels are limited and optimization is required to effectively reduce CO₂ emissions^{1,5}.

Over the past 16 years, technology has been gaining importance, registering sustained growth. Currently, the most common PVT installed are liquid-based PVT collectors; in 2023 the total PVT collector area installed was more than 3 million square meters, placed mainly in Europe (64%), followed by Asia (20%) and China (9%)⁵. Within Europe, the most active countries were France and Germany, which account for almost half of the total PVT collectors installed.



PVT collector area and capacity evolution ⁵

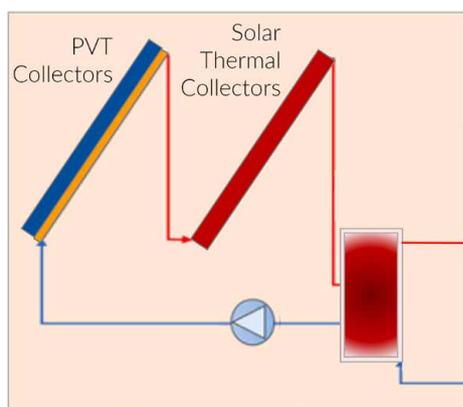


Approach and results

Considering the PVT collector type and weather conditions of the location, this technology may be used for diverse applications, (pool heating, domestic hot water production and low-temperature heating in buildings). More recent R&D projects, such as MiniStor, are developing wider applications in which PVT technology is combined with other renewable technologies such as conventional solar thermal collectors, heat pumps, as well as energy storage technologies to produce heating, cooling and optimize the renewable energy production and their use^{6,7}.

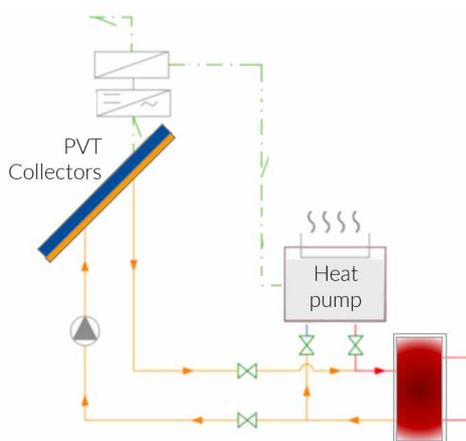
Particularly, the combination of PVT with heat pumps (HP) is a key strategy for the electrification of the thermal demand in buildings and reducing Europe's dependence on gas and other fossil fuels. In this line, the demonstration sites in the MiniStor project consider two types of heat system production using PVT collectors: one in combination with other solar technology and the other in combination with heat pumps. Additionally, the integration with innovative energy storage technologies, such as the MiniStor system, is also a relevant issue to be implemented across the buildings.

PVT systems in combination with other solar technologies



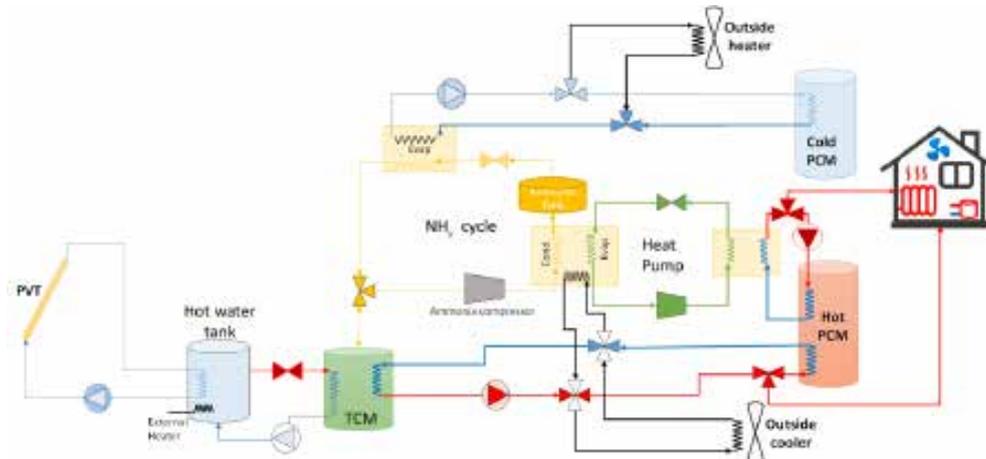
- 🏠 Increase the fluids' temperature according to the requirements, taking advantage of the hybrid installations.
- 🏠 Integration with complementary solar thermal technologies, to improve the solar thermal contribution to the thermal demand for domestic hot water and heating⁸.

PVT systems in combination with heat pumps



- 🏠 Integration with high-efficiency heat pumps to facilitate the electrification of the thermal demand of buildings⁹.
- 🏠 Direct thermal contribution to meet the thermal demand, and indirect contribution that improves the heat pump's performance
- 🏠 Electricity production to be used directly by heat pumps to meet the thermal demand.

Integration with thermal and electrical technologies



- 🏠 Integration with innovative electrical and thermal storage technologies to optimize the use of solar resources⁹.
- 🏠 To be used with hybrid systems, for heat and cold production such as MiniStor, to maximize the renewable contribution to thermal demand¹⁰.

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