FIELD EVALUATION OF NAKED ENERGY'S VIRTU SOLAR THERMAL AND HYBRID PVT COLLECTORS IN COMMERCIAL ENERGY SYSTEMS

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Abstract

In this communication, we provide an overview of Naked Energy's Virtu solar thermal and hybrid photovoltaic thermal (PVT) technology, showcasing its application in various commercial settings. We share field data from customer sites, including office buildings, leisure centers, supermarkets, and student residences, to highlight the real-world performance and system integration of Virtu products. Our discussion covers how these installations meet different heating and power needs while contributing to carbon reduction efforts. We also introduce Naked Energy's Clarity monitoring platform, which tracks and analyzes system performance to help optimize operations. Lastly, we offer a preview of upcoming projects that will incorporate interseasonal heat storage, further expanding the potential of Virtu technology in supporting the transition to sustainable energy.

Keywords: solar thermal, PVT, field data, monitoring, industry

1. Introduction

Decarbonizing heat is a crucial step in addressing global greenhouse gas emissions. Heat generation is a major contributor to these emissions, so finding commercially viable solutions to reduce this impact is essential. Decarbonizing heat can also improve energy security and offer economic benefits through lower fuel costs and increased efficiency. In this context, the commercialization of solar thermal technologies is a key step towards achieving sustainable energy goals.

Naked Energy is a company dedicated to developing, manufacturing, and supplying the Virtu product family, which includes VirtuHOT solar thermal collectors and VirtuPVT hybrid heat and power collectors. Back in 2018, we introduced this technology at its early stage to this conference, sharing field results from a small-scale pilot (Murrell et. al., 2018) [1]. By 2022, we provided a progress update at the joint Eurosun-IEA meeting. As of 2024, we have over 100 commercial and industrial (C&I) scale installations featuring Virtu products in nine countries. This paper recaps the certified Virtu product family and highlights its unique features. We will present field data and integration insights from several recent projects, including an office block, a student residence, a leisure center, a supermarket and a cardboard manufacturing plant. Additionally, we will preview an upcoming project that includes interseasonal storage elements.

This study aims to showcase the growing adoption of solar thermal technologies through the commercialization of Virtu products. By highlighting the scalability and efficiency of Virtu technology, we demonstrate how these innovations are being utilized across various sectors to help decarbonize heat. The increasing number of installations and diverse applications of Virtu products show the technology's effectiveness in real-world settings.

This paper provides insights into several applications where solar thermal technology decarbonizes all or part of the heating demand. Through detailed analysis of recent projects, we illustrate the practical benefits and performance of Virtu products in different environments. These case studies not only highlight the technology's capabilities but also offer valuable lessons on integration and optimization, paving the way for broader adoption and future advancements in solar thermal energy.

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2. Methodology

To evaluate the performance and impact of the Virtu product family, we aggregated real performance data in kilowatt-hours (kWh) of both thermal and electrical energy using our innovative monitoring platform, Clarity24-7. This platform allows us to collect continuous data from our installations, providing detailed insights into their operation and efficiency. The data is anonymized to ensure privacy and confidentiality, while still allowing us to analyze the general use cases for our collectors.

3. Results and Discussion

3.1. System Description

Thermal-only module: The solar thermal collector, VirtuHOT, comprises an optimally designed aluminium absorber inside a vacuum-filled glass tube. It is used to generate heat while being installed on building roofs. With integrated reflectors, a low profile, and a tubular design, it maximizes space efficiency and energy capture. The product, tested by TUV Rheinland and certified under DIN CERTCO (EN 12975-1:2006, EN ISO 9806:2017), achieves peak power production of 400 Wp. An exemplar setup of the product is shown in Figure 1.

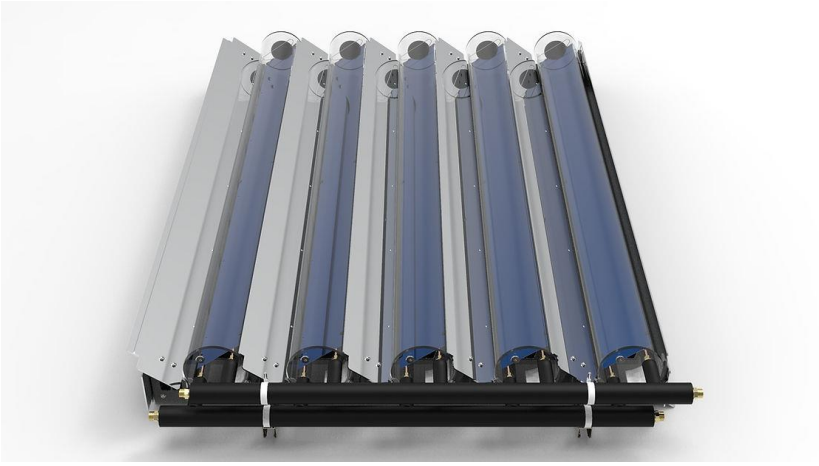

Figure 1. Fully kitted VirtuHOT array

Hybrid Module: The VirtuPVT module consists of photovoltaic cells laminated to a heat exchanger inside a vacuum-filled glass tube. It generates both heat and electricity and can be installed on building roofs, facades and the ground. With integrated reflectors, a low profile and a tubular design, it optimizes space usage and energy capture. The VirtuPVT module integrates PERC-Si PV cells to achieve a thermal capacity of 275 Wp and an electrical capacity of 75 Wp. Both products are designed and manufactured by Naked Energy [2], a British design and engineering firm leading global innovation in solar thermal and solar PVT. An exemplar setup of the hybrid product is shown in Figure 2.

Figure 2. Fully kitted VirtuPVT array

3.2. Field data review

VirtuPVT system, heating & powering the office building:

The Active Office in the UK, equipped with 40 VirtuPVT tubes, provides space heating and hot water for office use. The system, which heats the main thermal store alongside a heat pump, operates at a fluid outlet temperature of 70°C and is installed on a vertical facade. The performance data shows (Figure 3.) that the system delivers stable energy output year after year, despite some seasonal fluctuations due to changes in irradiance. On average, the system produces 2,663 kWh/year of thermal energy and 1,458 kWh/year of electrical energy, which is in line with the predicted values. This reliable performance highlights the effectiveness of VirtuPVT technology in supplying decarbonized heat and power to office buildings.

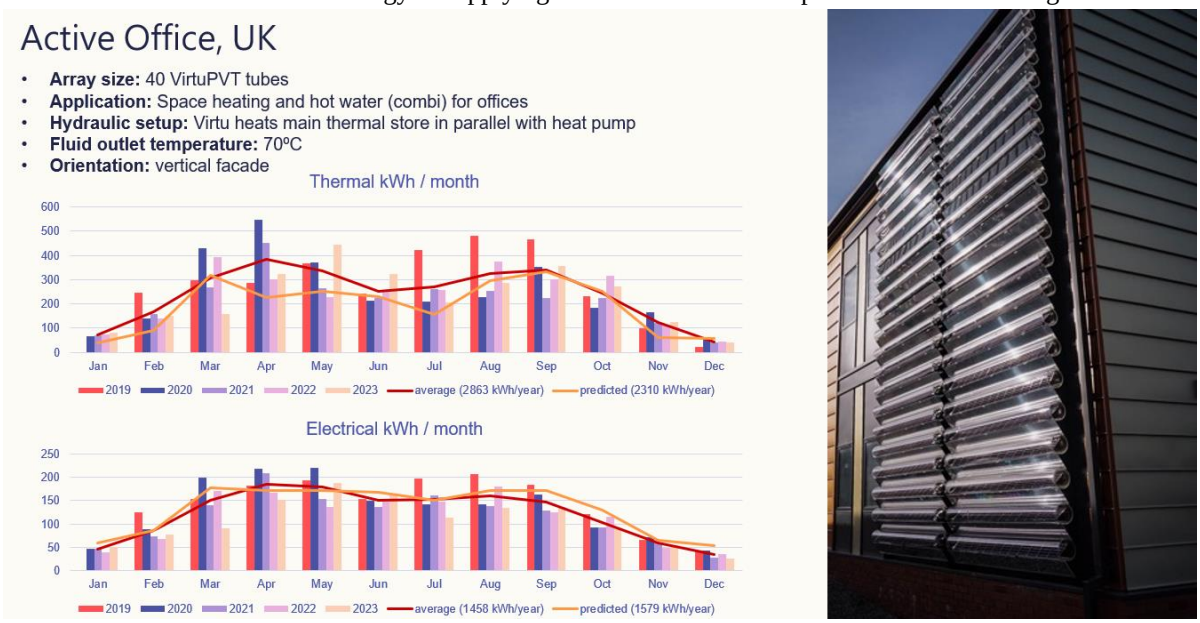

Figure 3. Field data (2019-2023) from the vertical façade array at the Active Office in Swansea, UK

Hybrid system, heating the student residence:

The Halls of Residence in the UK feature 75 VirtuHOT tubes and 60 VirtuPVT tubes for preheating hot water for student accommodations. Installed on a sloped roof, the system operates with a mean fluid temperature of 60°C. The 2023 performance data shows strong thermal and electrical outputs, generating 27,302 kWh/year of thermal energy and 3,185 kWh/year of electrical energy, both exceeding the predicted values of 23,367 kWh/year and 3,361 kWh/year, respectively. This performance (Figure 4.) highlights the system's ability to efficiently meet the hot water demands of a large residential facility, demonstrating the reliability and effectiveness of Virtu technology in such applications.

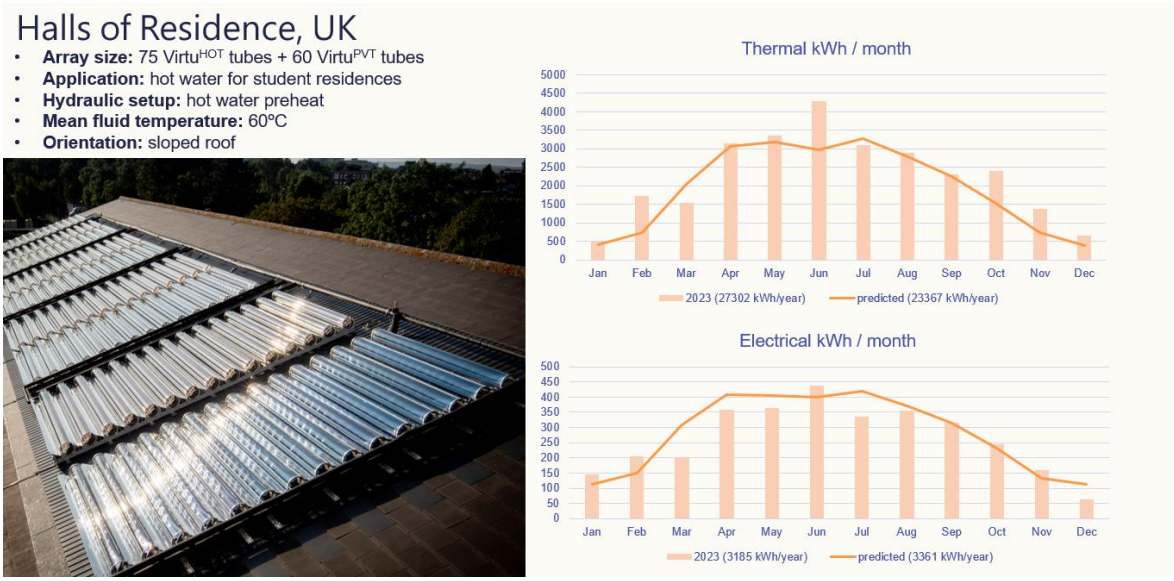

Figure 4. Field data (2023) from the sloped roof array at the student accommodation, UK

VirtuHOT system, heating the leisure center:

The Leisure Centre in the UK, equipped with 420 VirtuHOT tubes, heats its swimming pool via a heat exchanger. Installed on a flat roof (Figure 5.) with a 45° southwest orientation and partial shading from a parapet, the system operates with a mean fluid temperature of 45°C. The thermal output, as shown in the chart, peaks in June and closely aligns with the predicted 82 MWh for the season. Despite some shading and irradiance variations, the system delivered 80 MWh of thermal energy in 2023, demonstrating the effectiveness of VirtuHOT technology in meeting the heating demands of the facility.

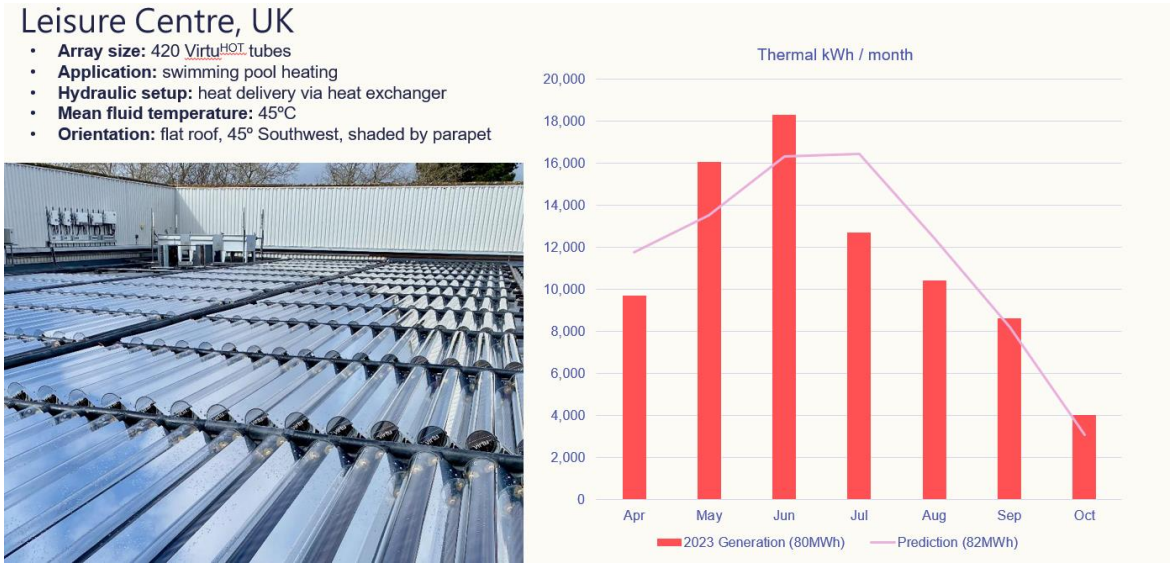

Figure 5. Field data (2023) from the flat roof array at a leisure centre, UK

Hybrid system, heating & powering a supermarket:

The supermarket in the UK uses 5 VirtuPVT and 5 VirtuHOT tubes for preheating hot water in the staff room. Installed on a flat roof, the system operates at a mean fluid temperature of 30°C. Due to mis-calibration, no thermal data is available before June 2022, and post-May 2023 data is missing due to research activities. Despite these issues, the system delivered (Figure 6.) an average of 2,945 kWh/year of thermal energy and 283 kWh/year of electrical energy, exceeding predictions, showing the effectiveness of Virtu technology even with operational disruptions.

Figure 6. Field data (2023) from the sloped roof array at the student accommodation, UK

Upcoming hybrid project, heating & powering a manufacturing facility:

This upcoming project in Figure 7. for Naked Energy exemplifies the extensive integration of VirtuPVT and VirtuHOT technology in a large-scale commercial setting. The building will entirely replace its gas demand by the end of Phase 3, relying solely on a combination of Virtu solar collectors and a ground source heat pump (GSHP) system for both heating and cooling. The graph illustrates the expected monthly energy generation versus demand, showcasing how Virtu systems will meet the building's year-round energy needs. The design also incorporates interseasonal storage, which allows excess summer heat to be stored and utilized during cooler months, ensuring balanced energy supply throughout the year. This project highlights Naked Energy's commitment to providing comprehensive, sustainable energy solutions that cater to both heating and cooling demands in large-scale commercial applications.

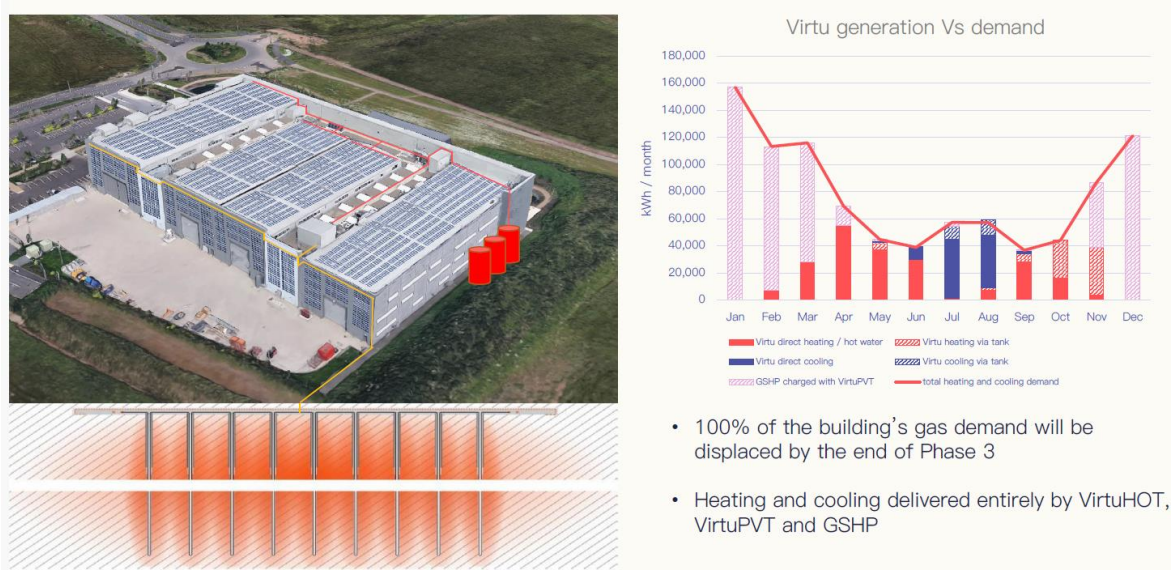

Figure 7. An upcoming project featuring interseasonal storage elements.

4. Conclusions

The presented results showcase the plethora of applications of VirtuHOT and VirtuPVT, where the solar thermal systems are delivering useful, decarbonized heat and power in buildings with varied applications, installation geometries and heating demands. From the national library to an office block, a student residence, a leisure center, a supermarket, and a cardboard manufacturing plant, the data demonstrates the versatility and effectiveness of Virtu technology. These findings underscore the scalability and adaptability of our solar thermal solutions, reinforcing their crucial role in the ongoing efforts to decarbonize heat across diverse sectors.

5. References

[1] S. P. C. W. A. M. A. A. N. J. E.-D. Adrian Murrell, "Development and Field Testing of a Novel Hybrid PV-Thermal Solar," in *Eurosun*, Papperswil, 2018.

[2] "Naked Energy," 30 7 2024. [Online]. Available: https://nakedenergy.com/ .