# **Research projects within PVT at Technical University of Denmark**

WORKSHOP ON PV-THERMAL SYSTEMS, October 9, 2019

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DTU Byg Institut for Byggeri og Anlæg

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# **Project #1**

- Experimental investigations of PVT collectors installed i various ways.
- Characterize performance
  - Wall mounted
  - Roof mounted
- Insulation in contact with concrete free air flow
- Funded by:
  - Danish Energy Agency through EUDP grant no. 64017-05157
  - Fonden af 20. December journal no 155808-15-JAS
  - Martha og Paul Kerrn-Jespersens Fond.











Roof mounted – air flow behind collector

Wall mounted – direct contact with thermal mass or insulated



#### **Direct contact vs. insulated facade BI-PVT**



Fig. 5: Inlet and outlet fluid temperature and tilted irradiance for 16/08/2019.

# **Project #2**

DTU

- Experimental investigations of a PVT system with heat pump, DHW tank and buffer tank.
- Get knowledge of the interplay between the heat pump, storage tanks and PVT collector
  - Yearly performances
  - Validated simulation model
  - Improve performance
  - Parameter variation

- Funded by:
  - Danish Energy Agency through EUDP grant no. 64017-05157





### **PVT** demonstration system at DTU test facilities



3 m<sup>2</sup> uninsulated PVT panels – aluminum absorber

160 L DHW tank

200 L cold storage with glycol

6 kW heat pump





## **Control strategy**





### Simulation – component models → full model





# **Project #3**

• Monitor PVT pilot system



- Heat pump
  - Danfoss Varius Pro+
  - 3-12 kW modulating
- 14 PVT modules, aperture area: 35 m<sup>2</sup>
- **38 modules producing electricity**, aperture areal: 95 m<sup>2</sup>
- 7.5 kWh Fronius battery
- Funded by ELFORSK programme



## **Measurements - overview**



#### **Measurements**

- Space heating demand
- Hot water consumption
- Electricity consumption
- Indoor climate
- Battery
- Heat pump
- PVT panels: Heat
- PVT and PV panels: Electricity
- Inverters
- System temperatures



# **Experience from pilot system**

- System works as planned with acceptable heat pump efficiency and electricity production
- System can heat the house, even on the coldest days
- Heat pump oversized:
- On/off operation
- Relative low COP
- Large cooling of PVT panels
- Large quantities of ice on the panels
- Quality of installation of vital importance:
- Roof rain tight
- Attic well ventilated
- Pipes and tanks well insulated
- Panels, heat pump, tanks, battery correctly installed

## **Project #4**

- Simulation studies on various PVT systems
- Determine good designs for PVT system
  - PVT vs. PV + T
  - Types of storages
- Simulation of pilot projects
- Funded by:
  - Saxhoff fonden

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