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Effects of Hydraulic Integration on the Performance of Solar Thermal and Heat Pump Combisystems

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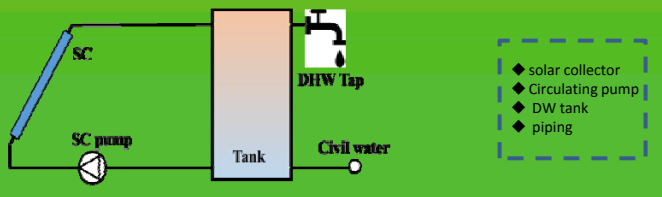
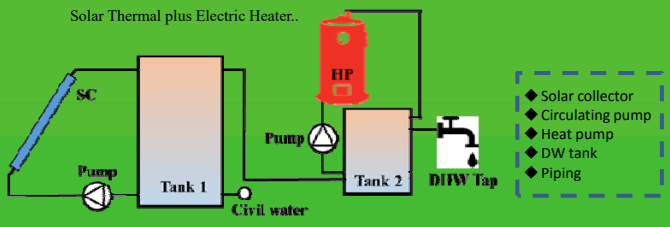
Project Content

Three models were simulated using TRNSYS software: a conventional solar domestic hot water (SDHW) system, a single-tank solar combisystem, and a dual-tank solar combisystem. To determine the effect of climate conditions, two metropolitan cities in Taiwan were simulated. Results showed that the dual-tank solar combisystem employed in both Taipei and Kaohsiung had the lowest electrical consumption and operating cost. Ultimately, the incremental capital costs of the solar combisystems were considered, and realistic payback periods were calculated to determine economic feasibility.

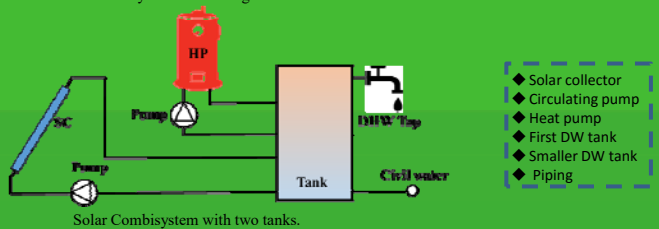
- The combisystem with dual tanks is able to collect and store more solar energy.
- In particular, the contribution of solar thermal energy to overall energy demand in Kaohsiung increases to 60% in the summer months.
- In Kaohsiung, particularly, the addition of the storage water tank in the solar combisystem substantially improves the contribution of solar thermal energy in monthly energy requirements.



Solar Thermal plus Electric Heater..



Solar Combisystem with a single tank.



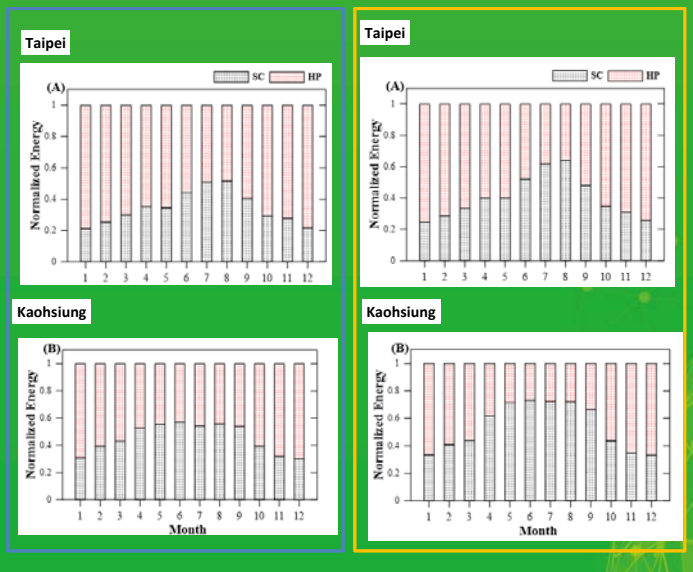
Solar Combisystem with two tanks.

Research Highlights and Key Technologies

	SDHW	Combisystem with a single tank	Combisystem with dual tanks
Taipei			
Annual operating cost	334	117	111.5
Heat pump	N/A	920	920
Second tank	N/A	N/A	460
Kaohsiung			
Annual operating cost	225.5	95	89
Heat pump	N/A	920	920
Second tank	N/A	N/A	460

Currents Results

single-tank solar combisystems | dual-tank solar combisystems



- Despite the lowest operating cost of the combisystem with dual tanks compared with the other two systems, the increment of capital prices for additional equipment is significant. The more components that are added to the system, the higher the startup cost is.

Conclusions

With the addition of a secondary storage tank, the interference of heating performance was curtailed in the dual-tank combisystem, which showed benefits for increased seasonal SF and decreased electrical load. The solar combisystem with dual tanks were superior to the other two systems based on identical water delivery temperature, water draw schedule, and environmental conditions. However, when the capital costs are considered, the payback periods of the combined SC-HP DHW systems in Taipei are more appealing than those in Kaohsiung, and the single-tank system is more cost-effective than the dual-tank system. The economically optimal choice conflicts with the technically optimal choice. This suggests that computer simulation is crucial for estimating the performance of SC-HP DHW systems and for optimizing hot water systems economically and technically according to climate conditions and geographic locations.