Nearly Zero-Energy Care Home Design in Cold Climate in China

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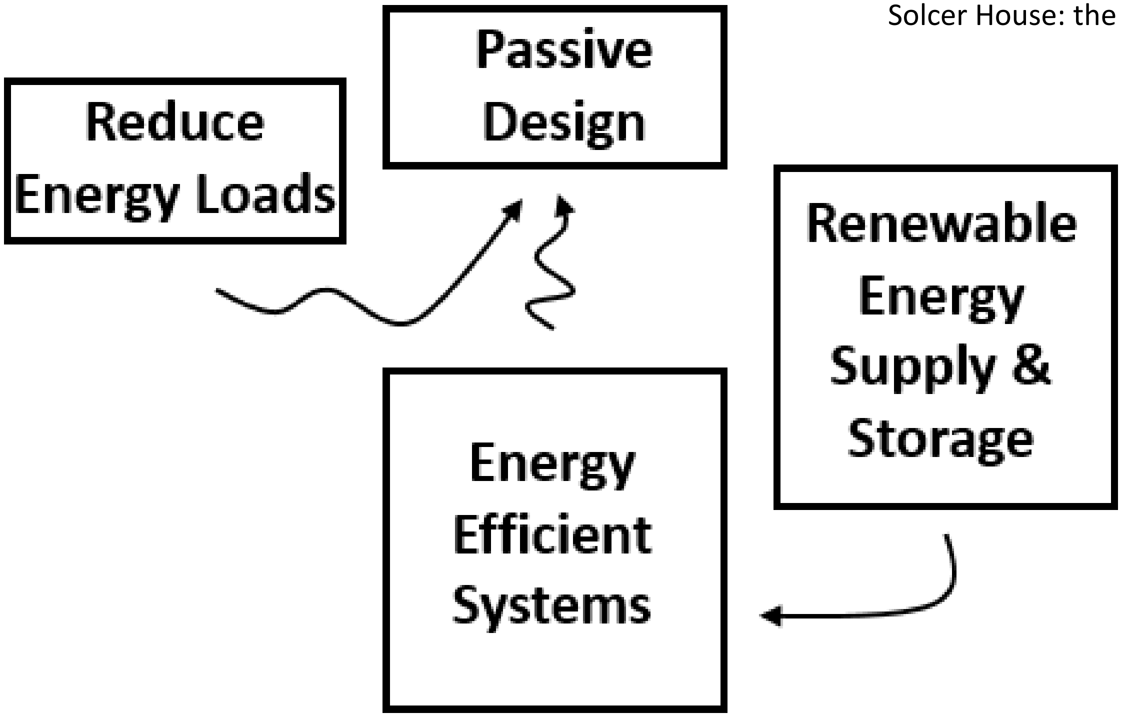
A systems approach

Solcer House: the first energy positive house in Wales



Typical care home design and current practice

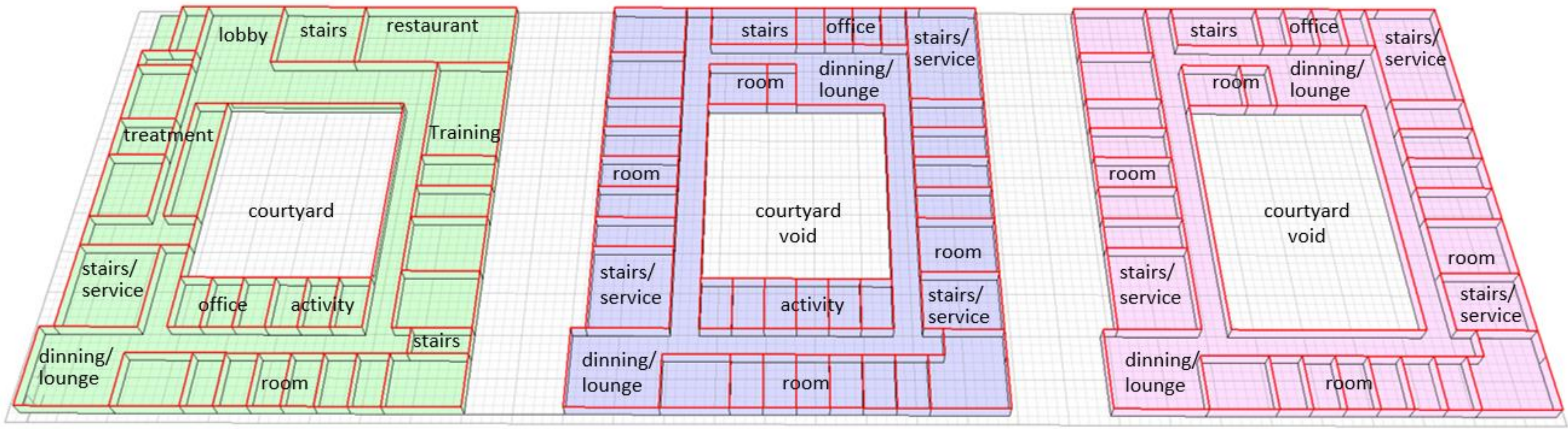


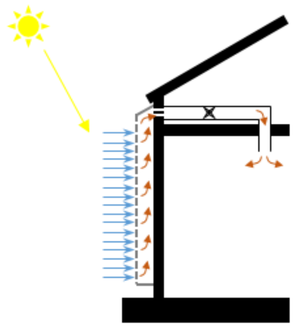
Table 4: Simulation input data for current practice

Internal gains (W/m²)			Ventilation	Fabric efficiency U-value (W/m²/K)	
Rooms	Lighting	Plug load	Fresh air	External wall	0.50
Lobby	9.0	9.5	10L/P/s	Roof	0.45
Office	9.0	15.0	10L/P/s	Ground floor	0.50
Ward room	5.0	6.0	10L/P/s	Glazing	2.7
Exam/ treatment	15.0	30.0	10L/P/s		G=52%
Dinning/ lounge	6.9	3.0	10L/P/s	Systems	Boiler efficiency= 88% Cooling COP=3.2
Kitchen	15.9	50.0	30L/P/s		
Circulation area	7.0	0	10L/P/s		

Notes:

- The building is used 7 days a week, 24 hours a day;
- The designed room temperature used in the simulation is 21 (winter) to 26ºC (summer).
- The occupant's load is based on the design.
- An infiltration rate at 10m³/h/m² @50pa is applied, based on the minimum requirement of British Building Regulation Part L 2A.

Near zero carbon care home design



Transpired Solar Collector

Integrated PV roof

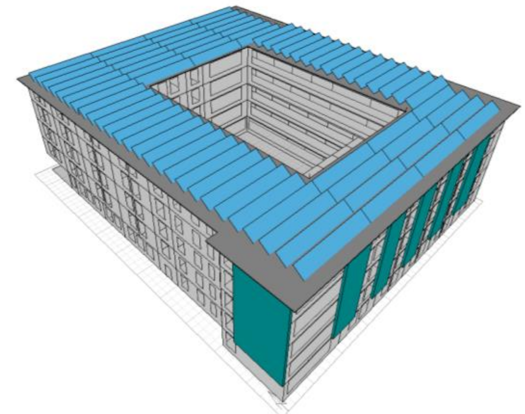


Table 5 Simulation input data for nearly zero-energy design

Internal gains (W/m²)			Ventilation	Fabric efficiency U-value (W/m²/K)	
Rooms	Lighting	Plug load	Fresh air	External wall	0.26*/ 0.15^
Lobby	5.6	4.0*/ 1.5^	10L/P/s	Roof	0.18*/ 0.15^
Office	9.0	7.0*/ 3.0^	10L/P/s	Ground floor	0.22*/ 0.15^
Ward room	2.9	4.0*/ 2.0^	10L/P/s	Glazing	1.60*/ 0.90^
Exam/ treatment	11.6	20.0*/ 10.0^	10L/P/s		G=40%*/ 15%^
Dinning/ lounge	4.6	2.0*/ 1.0^	10L/P/s	Systems	
Kitchen	11.6	40.0*/ 30.0^	30L/P/s	• UTSCs (221.8 m²) • MVHR at 85% efficiency	
Circulation area	4.6	0/ 0	10L/P/s	• PV (1347.5m²), at 17% efficiency	

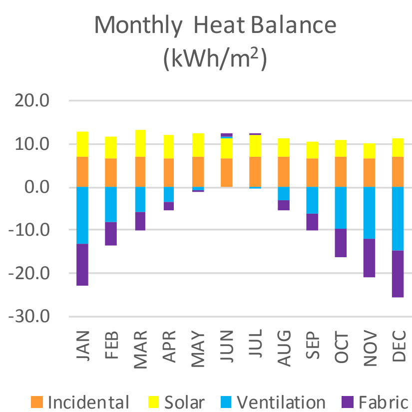
Notes:

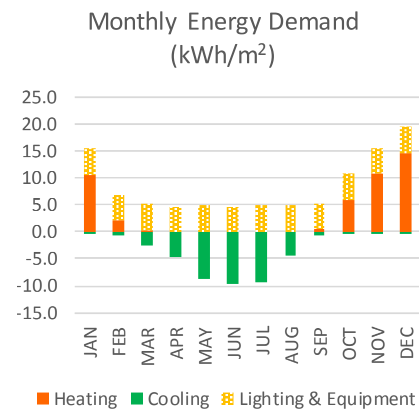
- **The lighting and plug load are based on the SIA 2024.**
- **The occupant's load is the same as the current practice, based on the design.**
- **The infiltration rate is (3m³/h/m² @50pa) are based on the recipe data from the British Building Regulation Part L 2A.**
- *** for good practice, ^ for best practice**

Simulation results

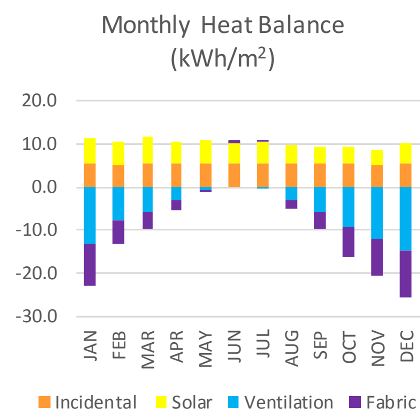
HTB2 (Heat Transfer in Buildings V2) has been used to conduct the building energy simulation.

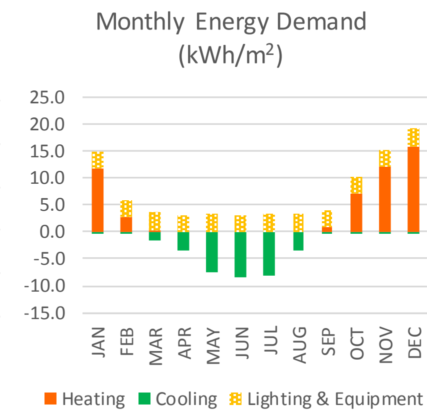
Current practice (121.8kWh/m²/year)



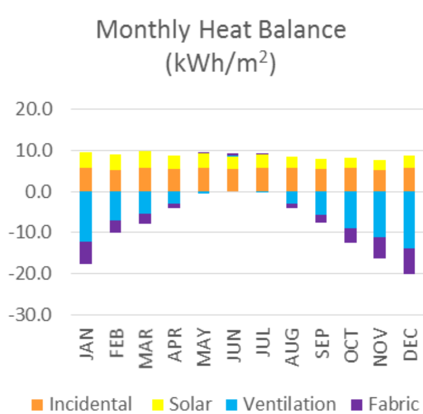


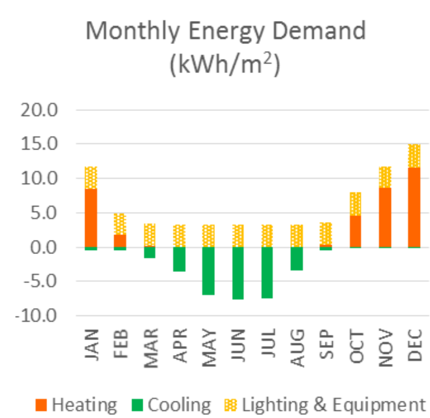
Step 1. Reduced energy loads (107.6kWh/m²/year)



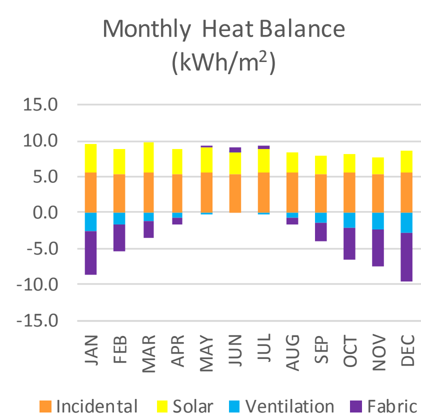


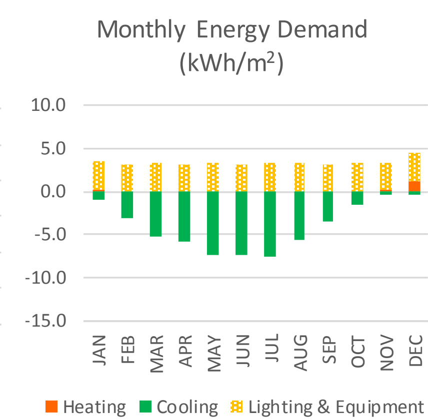
Step 2. Passive design (89.8kWh/m²/year)





Step 3. Efficient HVAC systems (51.7kWh/m²/year)





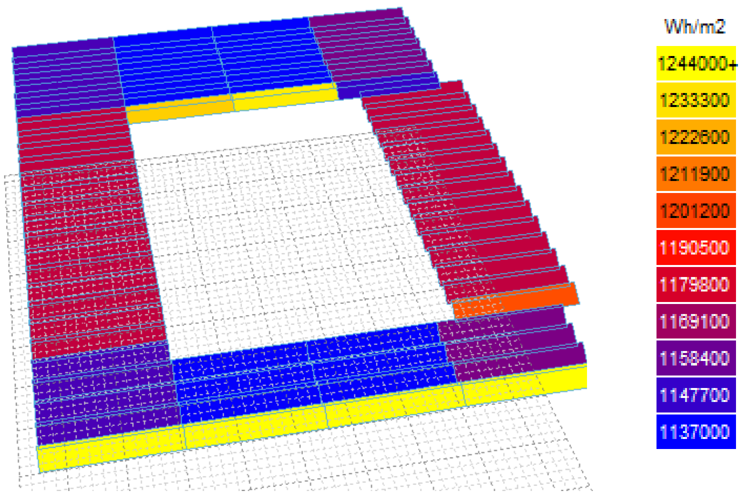
Simulation results (continue)

Cases	Annual energy consumption(kWh/m²)	
Base case: current practice	Heating	51.1
	Cooling	13.0
	Lighting & equipment	57.7
	Total	121.8
Step 1: Reduced energy demand (good)	Heating	57.9
	Cooling	10.6
	Lighting & equipment	39.1
	Total	107.6
Step 1: Reduced energy demand (best)	Heating	61.2
	Cooling	9.7
	Lighting & equipment	30.7
	Total	101.6
Step 2: Passive design (good)	Heating	40.4
	Cooling	10.3
	Lighting & equipment	39.1
	Total	89.8
Step 2: Passive design (best)	Heating	42.2
	Cooling	7.0
	Lighting & equipment	30.7
	Total	79.9
Step 3: Efficient HVAC systems (good)	Heating	1.7
	Cooling	10.9
	Lighting & equipment	39.1
	Total	51.7
Step 3: Efficient HVAC systems (best)	Heating	0.6
	Cooling	7.9
	Lighting & equipment	30.7
	Total	39.2

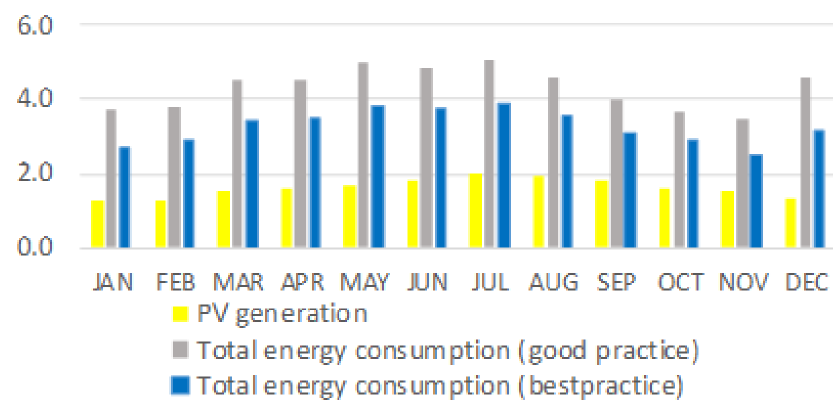
Simulation results

Sketchup+virvil plugin has been used to predict the potential of PV systems.

Step 4. Renewable energy supply (45.6kWh/m^2/year)



Solar access of the roof PV panels

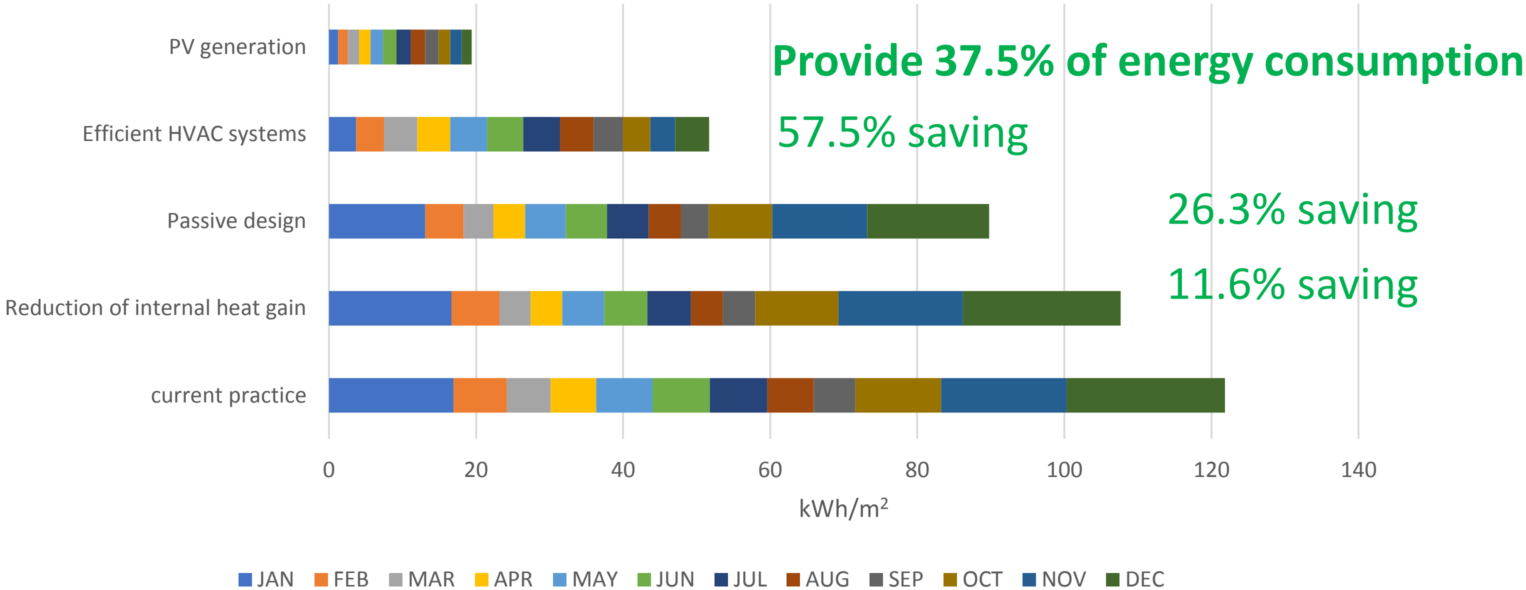


Monthly energy generation vs energy consumption

Goof practice: 37.5%

Best practice: 49.5%

Study conclusion



Total energy consumption (heating, cooling, lighting and equipment) has been reduced from 121.8kWh/m^2/year to 51.7kWh/m^2/year.

Besides the benefit from energy saving, other benefits of the proposed design can be recognized, including:

- Flexible room layout due to the absence of radiators.
- Reduction of the risks of exposure to hot radiator surfaces.
- Improved ventilation to provide good indoor air quality.

Thank you

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