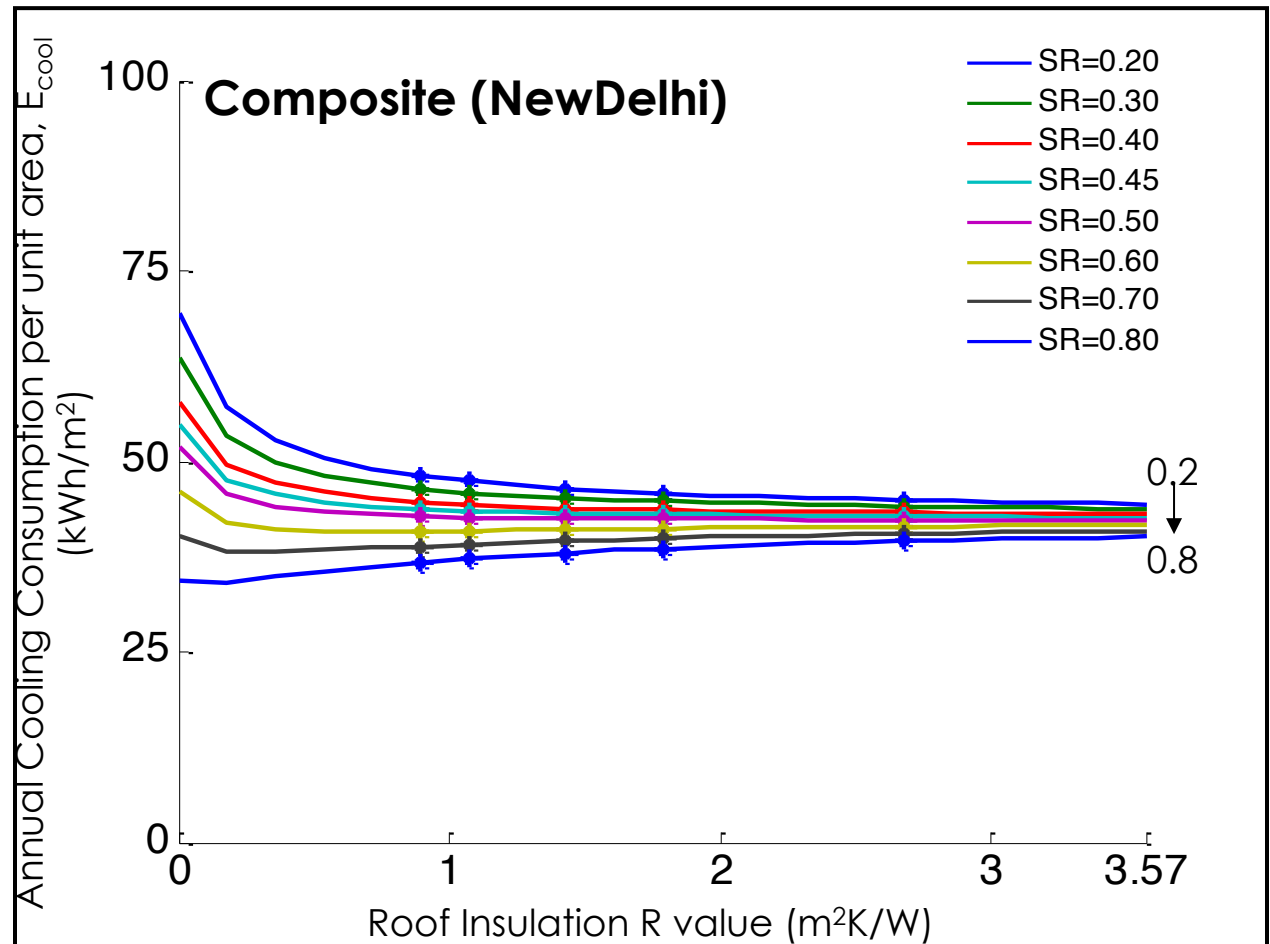


Roof Insulation requirement for a building with Cool Roof

Annual cooling energy consumption per unit area (kWh/m^2)- E_{cool} variation with roof insulation thermal resistance, R value ($\text{m}^2\text{K}/\text{W}$) for different roof solar reflectance (0.2-0.8), for composite climatic zones of India.

- Increasing roof R value, E_{cool} increases for high SR values (≥ 0.7) while for low SR values ($\sim < 0.6$) E_{cool} decreases.

- Increasing roof R value $> \sim 1.61 \text{ m}^2 \text{ K}/\text{W}$ for any value of roof SR results in $< 5\%$ change in E_{cool} .

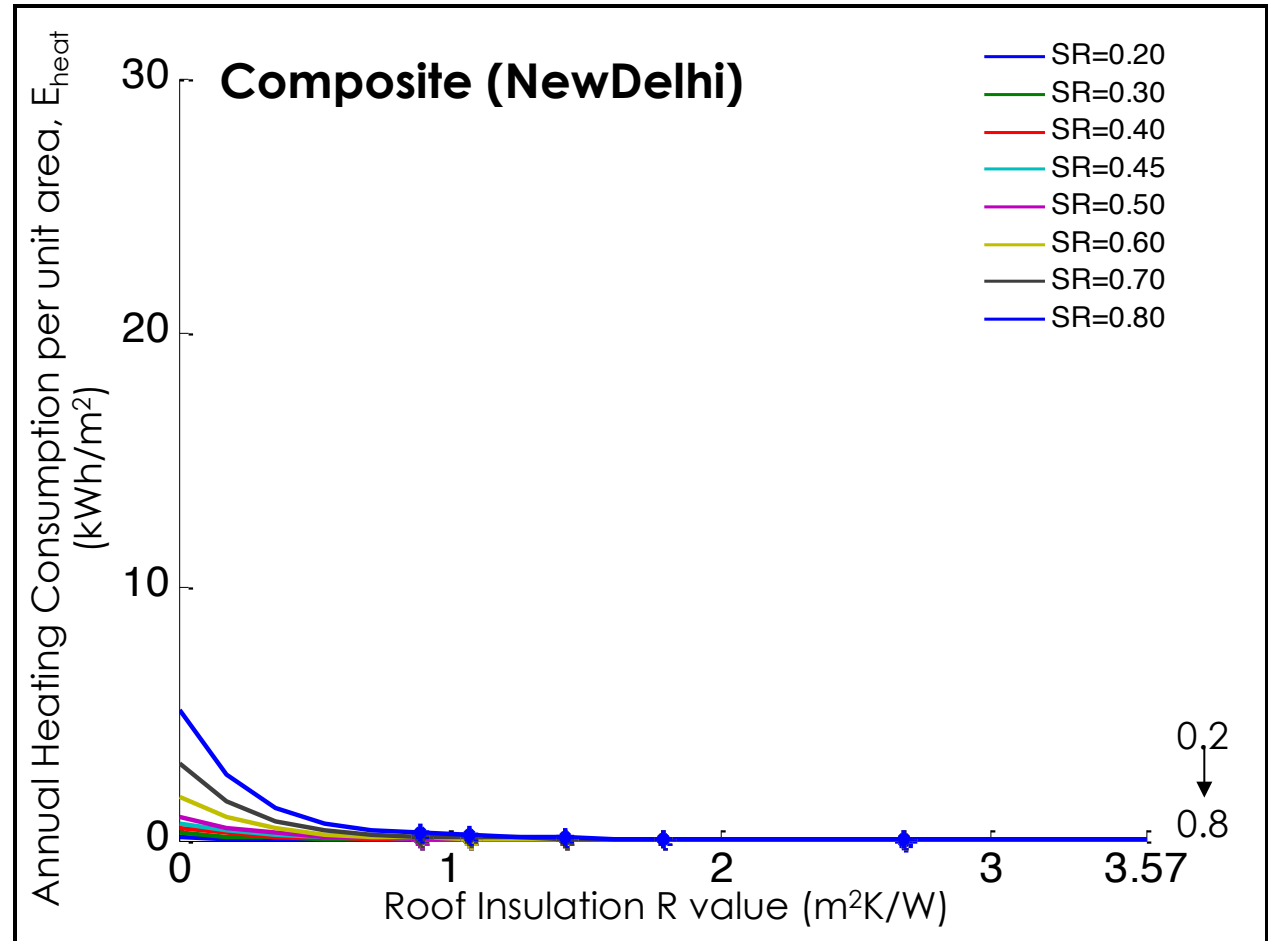


Roof Insulation requirement for a building with Cool Roof

Annual heating energy consumption per unit area (kWh/m^2), E_{heat} variation with roof insulation thermal resistance, R value ($\text{m}^2\text{K/W}$) for different roof solar reflectance (0.2-0.8), for composite climatic zone of India.

- With increasing roof R value, E_{heat} decreases for all SR values considered (0.2-0.8).

- There is $< 5\%$ decrease in E_{heat} with increasing R value $> \sim 2.68 \text{ m}^2\text{K/W}$ for composite climate



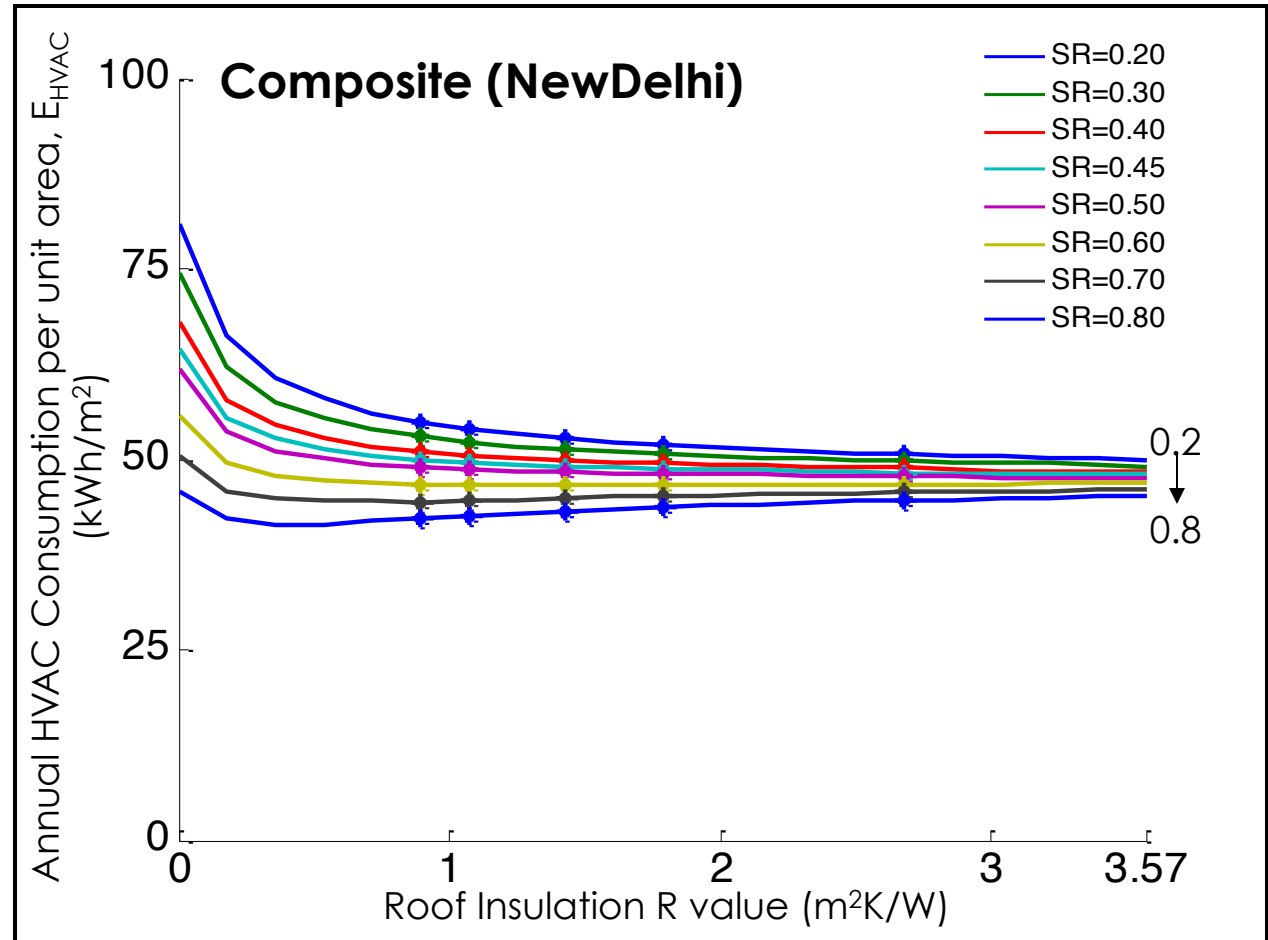
Roof Insulation requirement for a building with Cool Roof

Annual HVAC energy consumption per unit area (kWh/m^2), E_{HVAC} variation with roof insulation thermal resistance, R value ($\text{m}^2\text{K}/\text{W}$) for different roof solar reflectance ($0.2-0.8$), for composite climatic zone of India.

- Increasing roof R value, E_{HVAC} increases for high SR values (≥ 0.7) while for low SR values ($\sim < 0.6$) E_{HVAC} decreases.

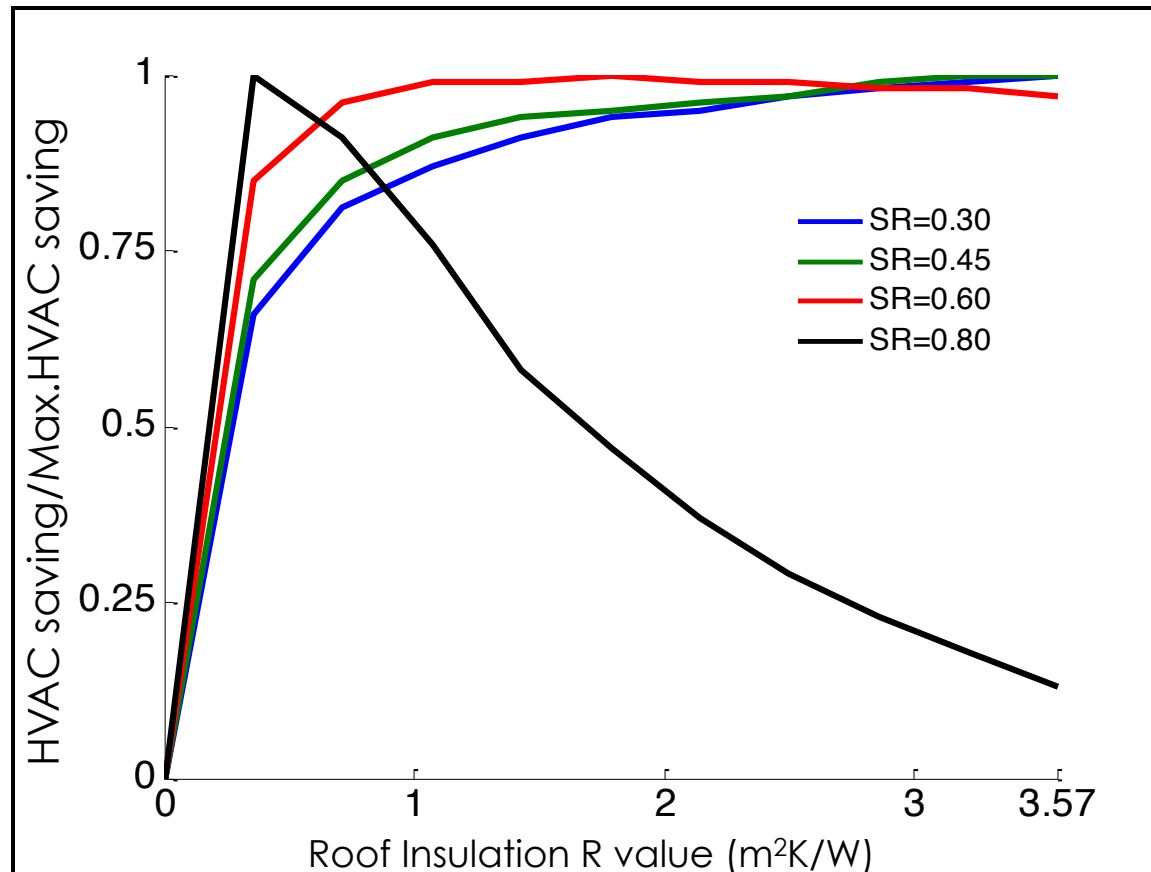
- Increasing roof R value $> \sim 1.61 \text{ m}^2 \text{ K}/\text{W}$ for any value of roof SR results in $< 5\%$ change in E_{HVAC} .

- E_{HVAC} variation doesn't follow E_{cool} variation because of the heating penalty



Roof Insulation requirement for a building with Cool Roof

The normalized annual HVAC energy savings (kWh/m^2) variation with roof insulation thermal resistance - R value ($\text{m}^2\text{K}/\text{W}$) for different roof solar reflectance values- SR values of 0.3, 0.45, 0.6, and 0.8, for Composite Climate-New Delhi.



Roof Insulation requirement for a building with Cool Roof

Internal rate of return, IRR (%) for installing an additional roof insulation thickness of 5mm on a roof with different roof insulations (R values) and with SR value of 0.45 for New Delhi.

Roof Insulation R value (m ² K/W)	Thickness of the insulation, considered in this study (mm)	IRR (%)
0.18	5	147%
0.36	10	48%
0.54	15	27%
0.71	20	19%
0.89	25	12%
1.07	30	8%
1.25	35	5%
1.43	40	4%
1.61	45	-3%