

Trading Off Cool Roofs for Insulation

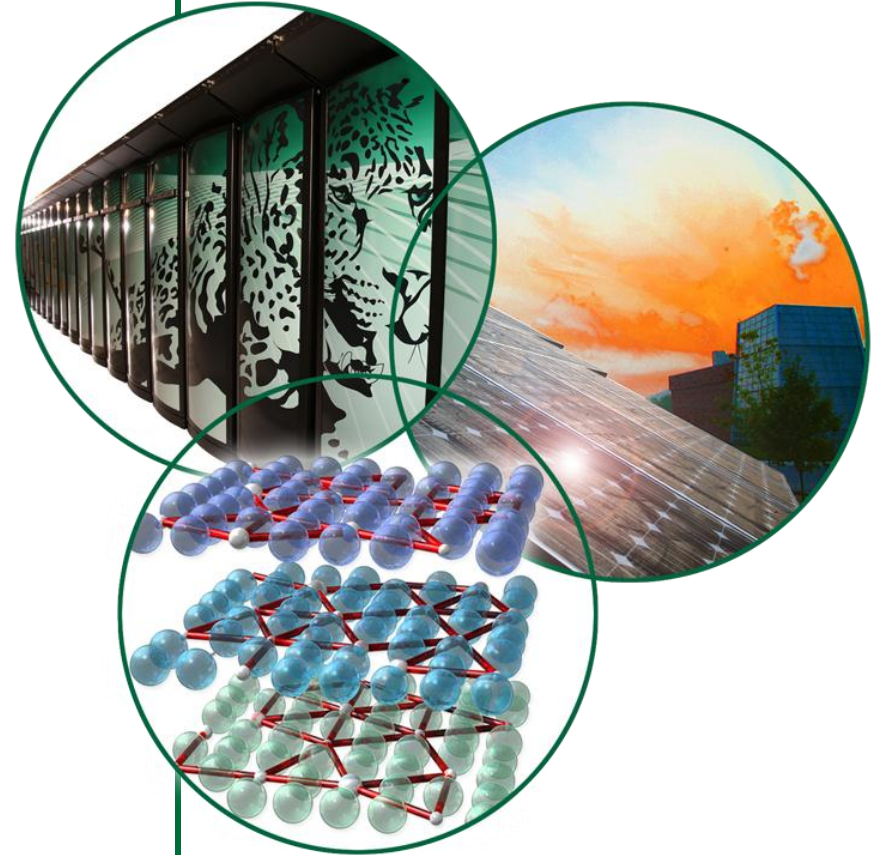
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27 June 2012





Presentation summary

- Estimate the energy equivalency of cool roofs vs. non-cool roofs with additional insulation
- Calculate “energy equal” roofing systems
 - Low and steep slope
 - New construction vs. retrofit
 - Climate

DE-AC05-00OR22725


Guidelines for Selecting Cool Roofs

July 2010



Prepared by the Fraunhofer Center for Sustainable Energy Systems for the U.S. Department of Energy and Oak Ridge National Laboratory under contract DE-AC05-00OR22725. Additional technical support provided by Lawrence Berkeley National Laboratory and the Federal Energy Management Program.

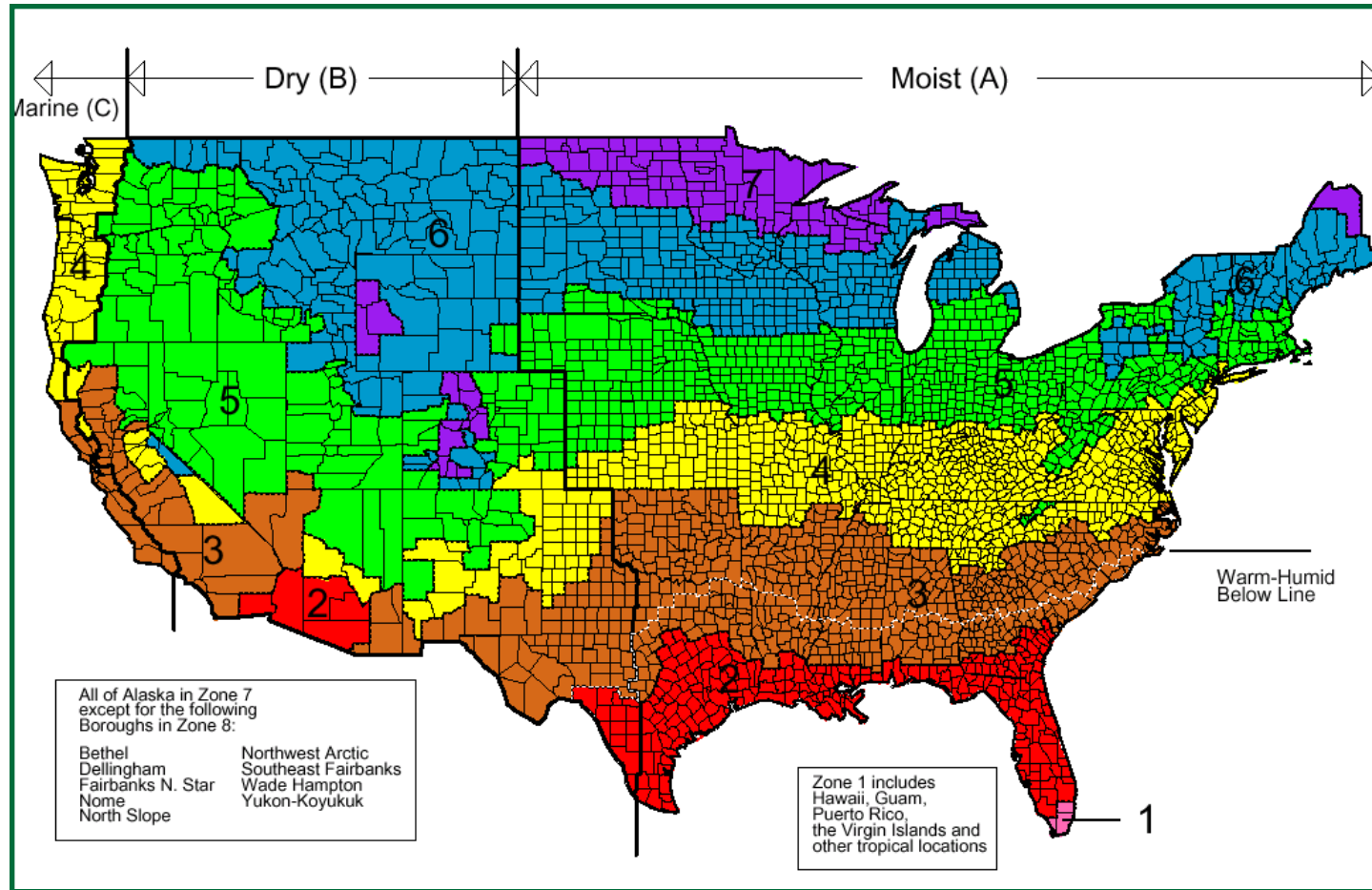
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Calculation tools

- **Low slope roofing**
 - **Simplified Thermal Analysis of Roofs (STAR)**
- **Steep slope roofing**
 - **ASTM C 1340, Standard Practice For “Estimating Heat Gain of Loss Through Ceilings Under Attics” (AtticSim)**

DOE climate zone map



Cities selected for simulations

Climate Zone	Representative City
1	Miami FL
2	Austin TX
3	Atlanta GA
4	Baltimore MD
5	Chicago IL
6	Minneapolis MN
7	Fargo ND
8	Fairbanks AK

Energy prices by climate zone (EIA)

Climate Zone	Electricity, ¢/KWh		Natural Gas, \$/Therm	
	Commercial	Residential	Commercial	Residential
Miami FL	10.12	11.64	1.073	1.62
Austin TX	8.69	11.33	0.711	0.845
Atlanta GA	9.45	10.47	0.905	1.408
Baltimore MD	13.51	12.67	0.973	1.117
Chicago IL	8.55	11.46	0.651	0.662
Minneapolis MN	8.45	10.71	0.642	0.736
Fargo ND	8.09	7.53	0.602	0.652
Fairbanks AK	14.55	17.37	0.794	0.844

IEA February 2012 Energy Costs

Default insulation R-values for low slope cool roof simulations

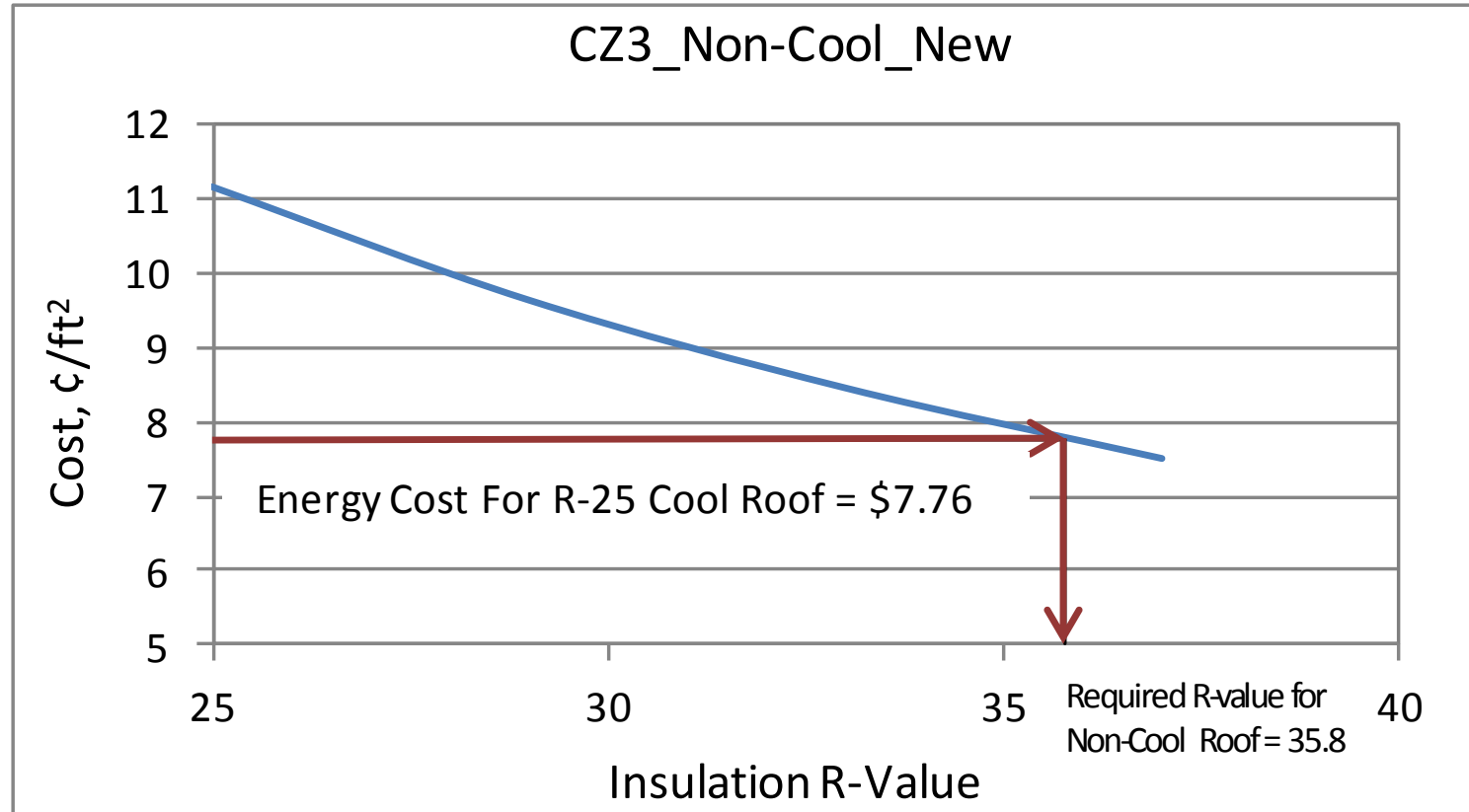
Climate Zone	New Construction	Retrofit Construction
1	20	6
2	25	9
3	25	9
4	30	12
5	30	12
6	30	12
7	35	15
8	35	15

Default surface properties for low slope roof simulations

Roof Type	Solar Reflectance	Thermal Emittance
Cool	0.65	0.90
Non-cool	0.10	0.90

- **Other assumptions**
 - **Heating system efficiencies of 80% (new) and 70% (retrofit)**
 - **Cooling system COPs of 2.5 (new) and 2.0 (retrofit)**

R-values required for non-cool roofs to have similar heating/cooling cost as for low slope cool roof



Amount of additional R-value needed for low slope energy equivalency

Climate Zone	New Construction	Retrofit Construction
1	17	6
2	16	7
3	11	5
4	10	5
5	6	3
6	5	3
7	5	2
8	3	2

Default insulation R-values for steep slope cool roof simulations

Climate Zone	New Construction	Retrofit Construction
1	38	11
2	38	11
3	38	11
4	49	19
5	49	19
6	49	19
7	60	30
8	60	30

Default surface properties for steep slope roof simulations

Roof Type	Solar Reflectance	Thermal Emittance
Cool	0.25	0.90
Non-cool	0.10	0.90

- **Other steep slope assumptions**
 - **No distribution system in attic**
 - **Gable ended roof**
 - **4:12 roof slope**

Amount of additional R-value needed for steep slope energy equivalency

Climate Zone	New Construction	Retrofit Construction
1	3	1
2	2	1
3	0	0
4	-1	0
5	-1	0
6	-2	-2
7	-6	-3
8	-9	-4

Closing summary

- **Additional R-value for low slope roofs**
 - **New construction: 3 to 17 with an average of 9**
 - **Retrofit: 2 to 7 with an average of 4**
- **Additional R-value for steep slope roofs**
 - **New construction: -9 to 3 with an average of -2**
 - **Retrofit: -4 to 1 with an average of -1**

Earthrise from Apollo 8 (December 24, 1968)



We came all this way to explore the moon and the most important thing is that we discovered the Earth.“

Bill Anders, Apollo 8 Astronaut