

MRT Compliance Calculation Software

- The sum of the temperature and area of the air plus all the individual surfaces in a room, and their angle to the occupant
- relative to how much heat the occupant himself is absorbing or emitting

Check out:

Center for the Built Environment (CBE)

Thermal Comfort Tool – FREE

<http://comfort.cbe.berkeley.edu/>

- ASHRAE Standard 55-2013
Thermal Comfort Tool Version 2

Center for Built Environment Thermal Comfort Tool

Select method:

Air temperature
 °C

Mean radiant temperature
 °C

Air speed
 m/s

Humidity
 %

Metabolic rate
 met

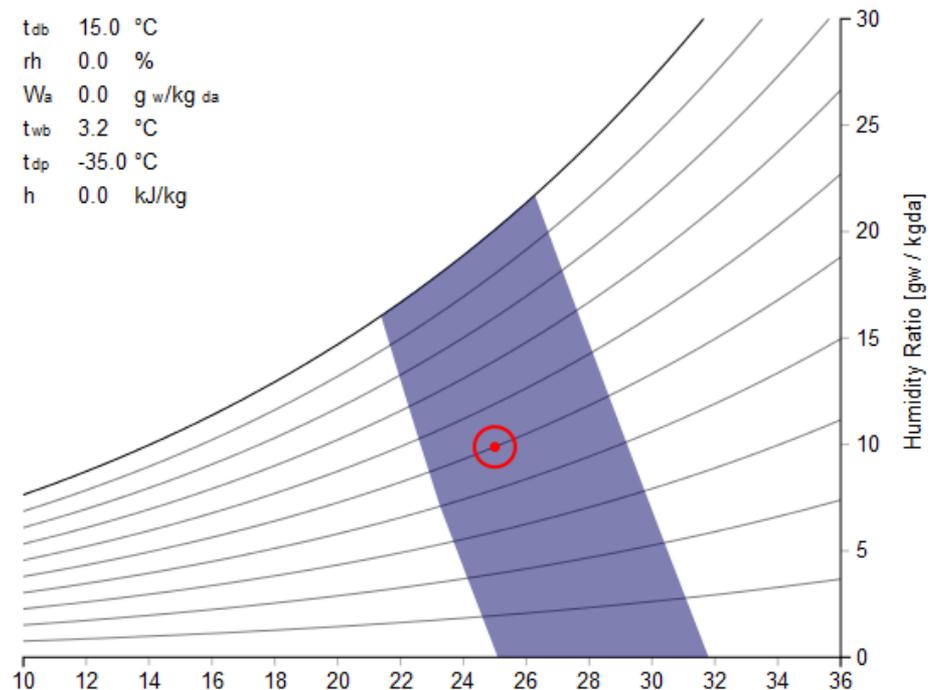
Clothing level
 clo

Globe temp | SolarCal | Specify pressure | SI IP | Local discomfort | ? Help

✓ Complies with ASHRAE Standard 55-2013

PMV -0.13
 PPD 5%
 Sensation Neutral
 SET 24.5°C

t_{db} 15.0 °C
 rh 0.0 %
 W_a 0.0 g w/kg d_a
 t_{wb} 3.2 °C
 t_{dp} -35.0 °C
 h 0.0 kJ/kg



Comfort Calculator

Comfort Calculator (ISO7730-1993)

Air Temperature (°C): 22



71.6° F

Radiant Temperature (°C): 21



69.8° F

Relative Humidity (%): 34.7



Air Velocity (m/s): Barely noticeable 0.2



Activity Rate (met): Seated/relaxed 0.8

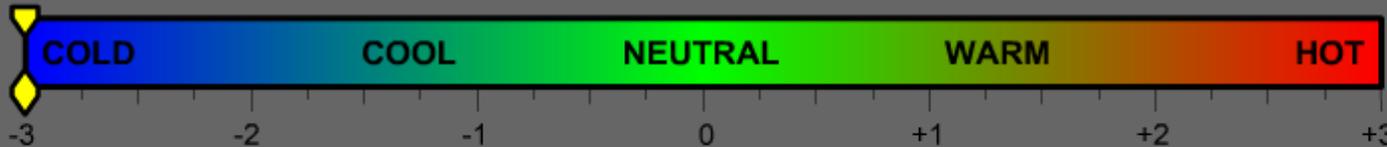


Clothing Level (clo): Trousers and shirt 0.7



Predicted Mean Vote: -3

Percentage People Dissatisfied: 99.1%



© Dr A Marsh | Square One | www.squ1.com

PMV: Thermal Sensation Scale ASHRAE Std 55 Appendix K-1

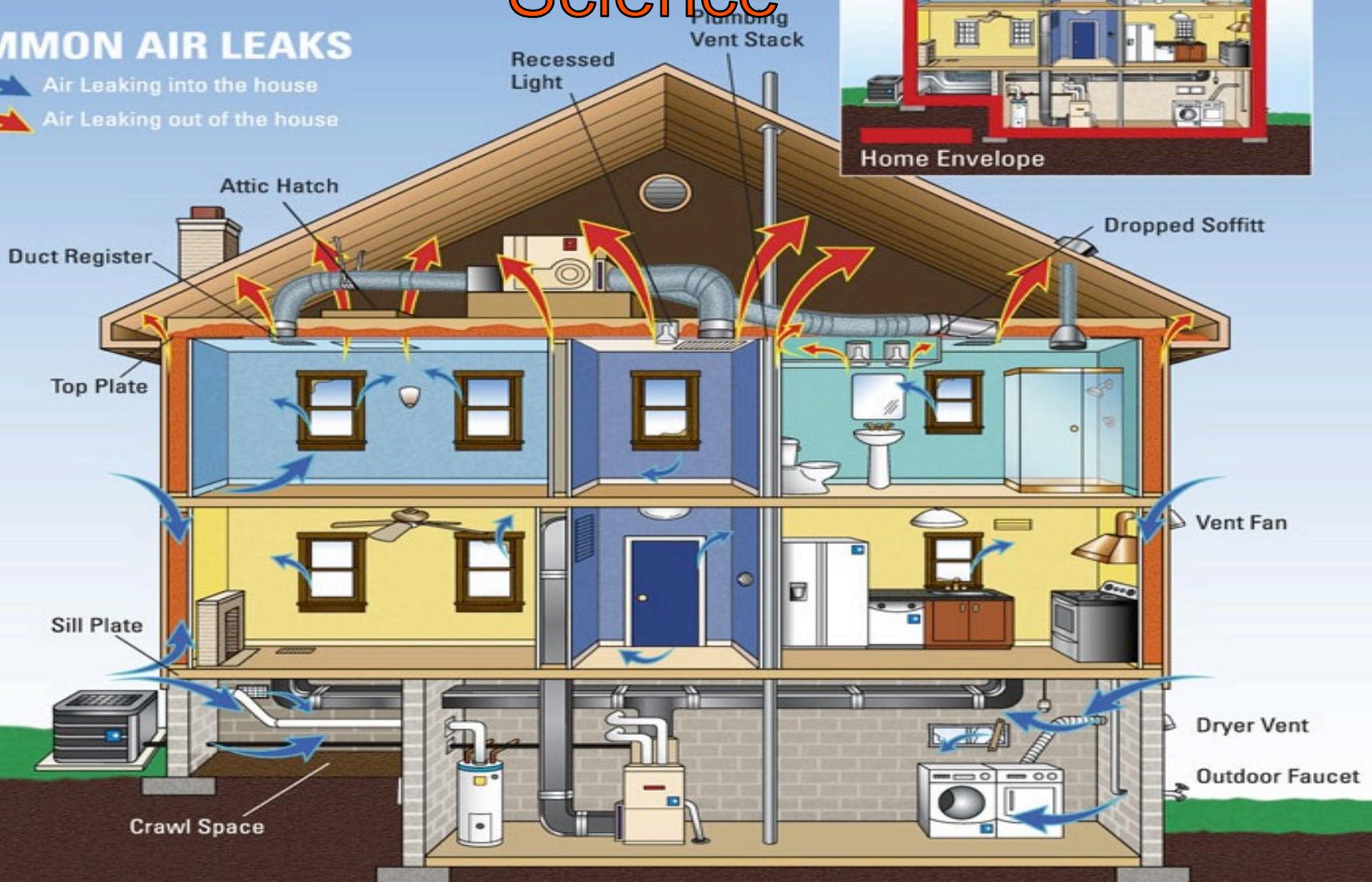


Building Science



COMMON AIR LEAKS

 Air Leaking into the house
 Air Leaking out of the house



Source: U.S. EPA

Control Strategies -- Low Tech

- Raise (or lower) MRT with window coverings, wall hangings, radiator reflectors, shading
- Raise (or lower) clo-value – low tech/high tech
- Change balance point temperature / Tstat set point
- Use different living space
- Arrange furniture to maximize (or minimize) radiant gain
- Use *radiant* space heaters for local comfort

Concentrate On Where The Family Spends Their Time



Change the Surface Temperature the Body 'Sees'

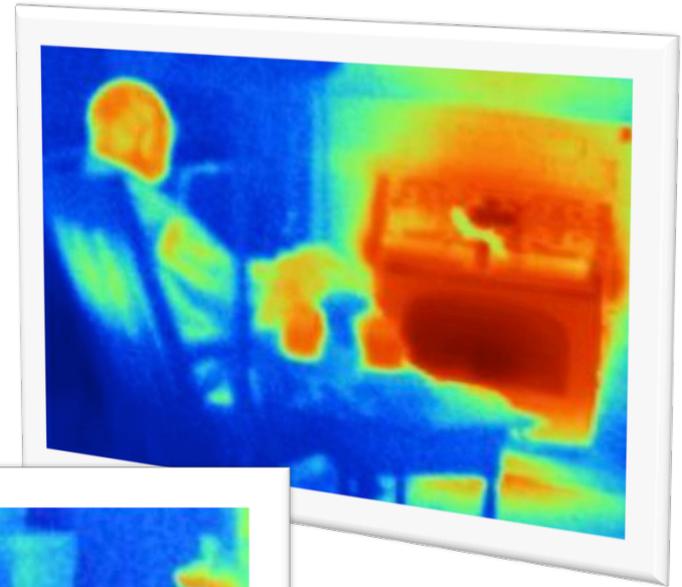
Window surface:
56.7° F



Sheer drape : 65.7° F
Sheer & Vinyl: 68.5° F

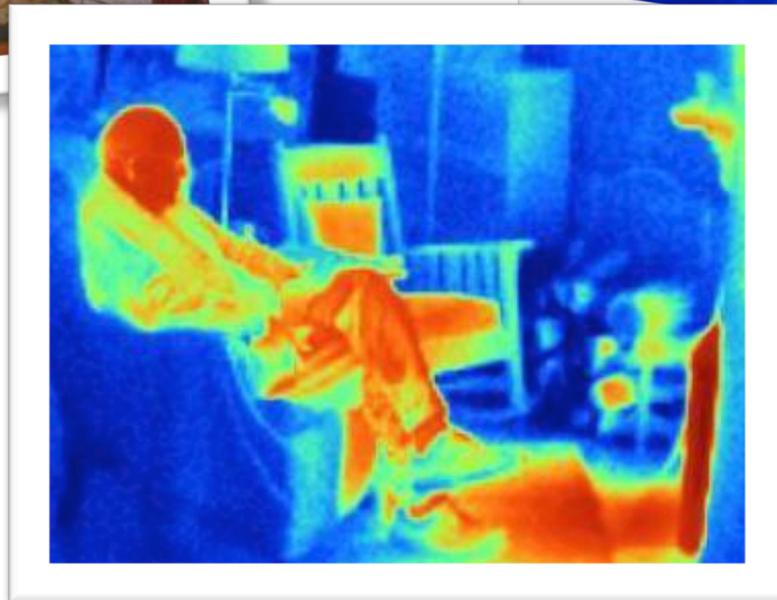


Use Radiant Asymmetry to Benefit



**18th and 19th Century
comfort strategy:
snuggle up to the
heat source!**

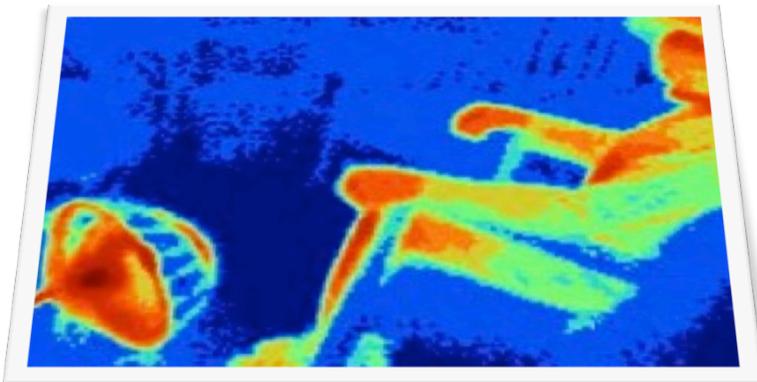
Timeless?



Space Heaters—Type & Hype



Photo of newspaper ad



Heat People,
Not Space!

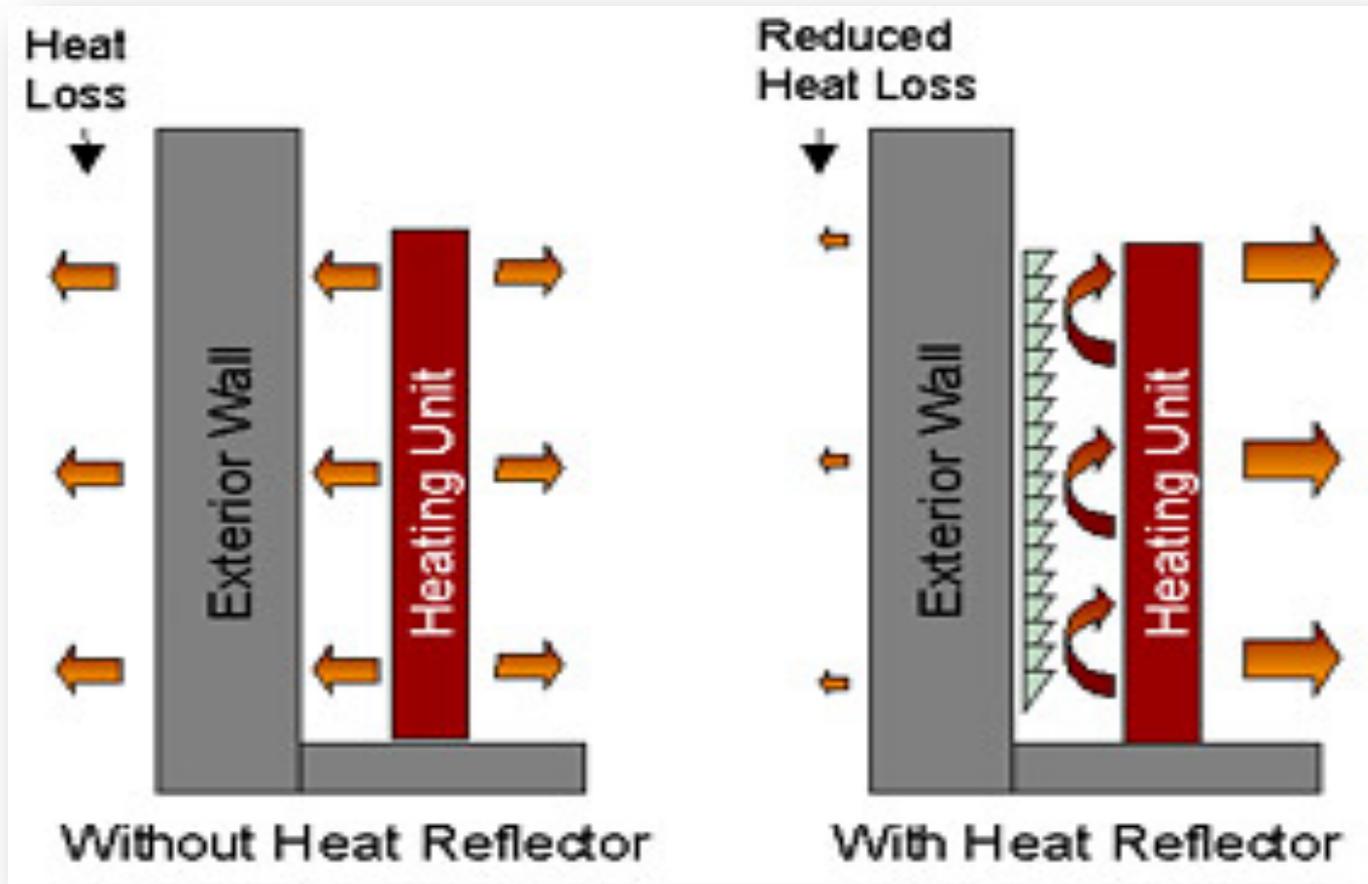
Maximize Radiant Heat Transfer

Radiant heat transfer is based on temperature and emissivity and can either be reflected or absorbed much like light.

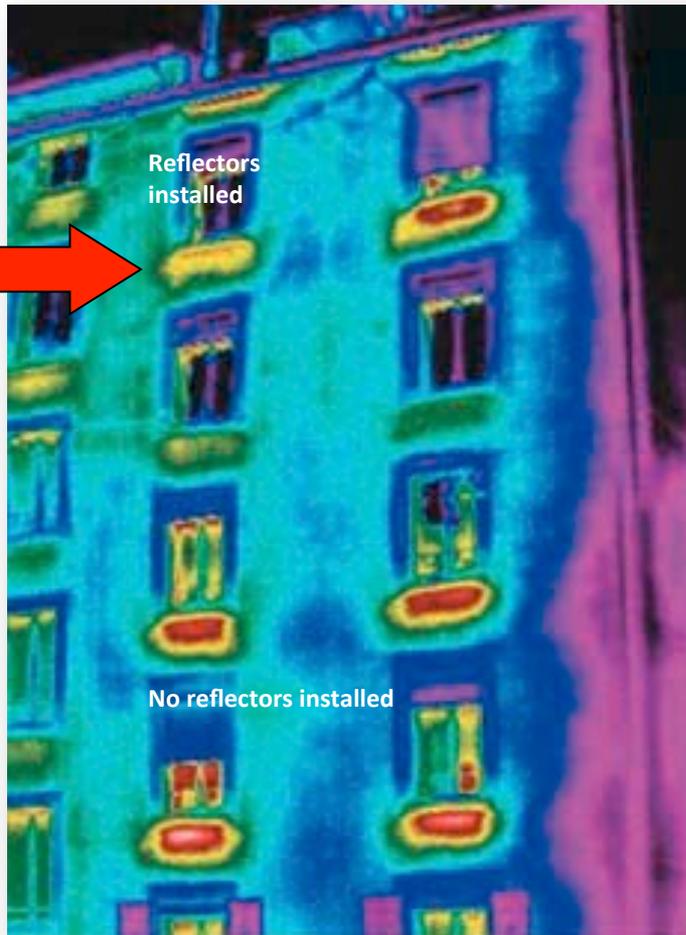


Old Reflective Technology

How Heat Reflectors Work



Impact of New Reflective Technology



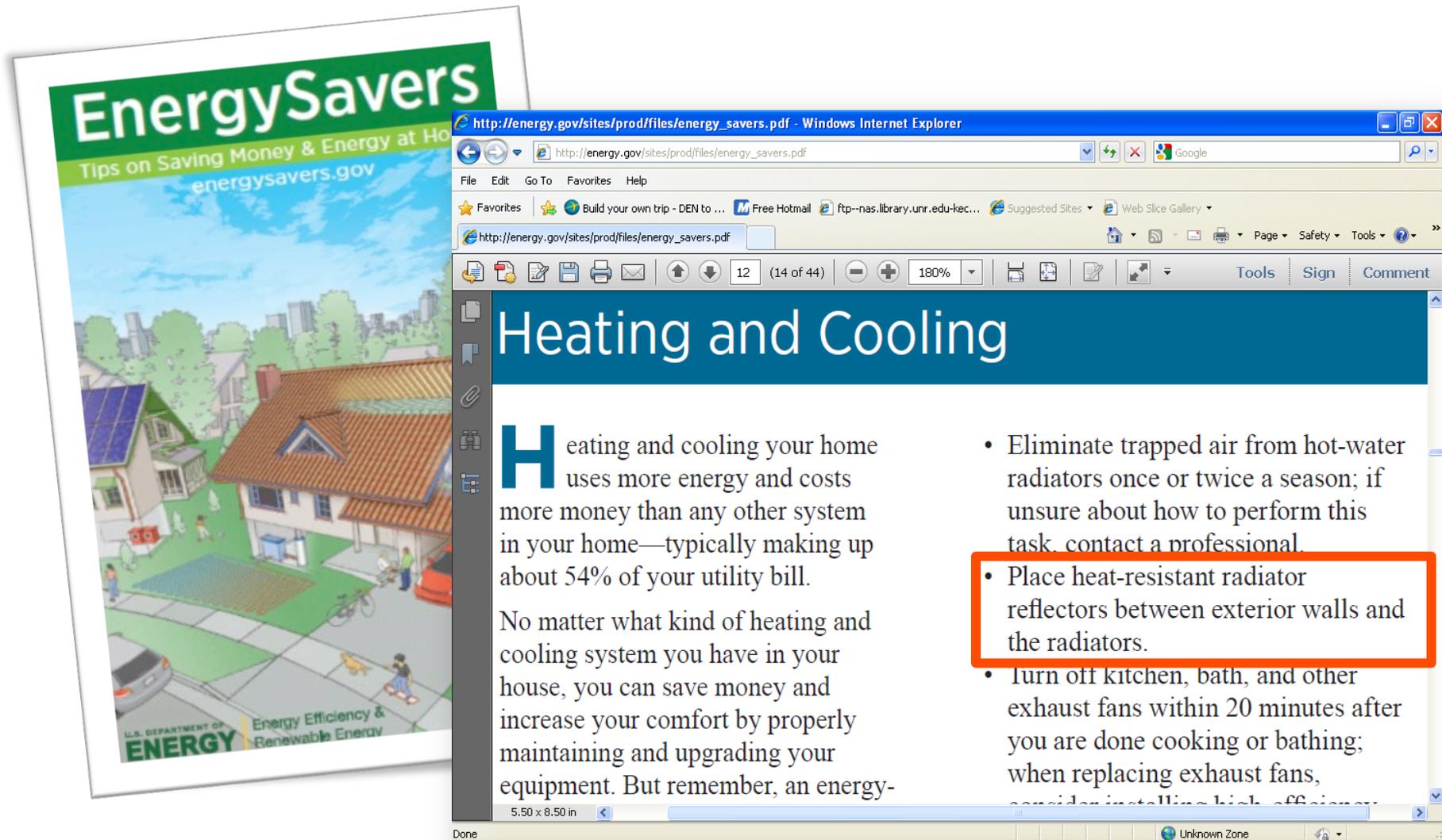
Infrared of Actual Case Building

- **Novitherm™**
- **U of Waterloo Solar Energy Lab tested**
 - Reflect 94% of both long & short wave infrared heat
- **Reflector Design**
 - Improves radiation and convection

Suitable Behind Radiators & Fin-Type Convectors



DOE Recommends Them



The image shows a physical 'EnergySavers' guide on the left and a screenshot of a web browser on the right. The guide features the title 'EnergySavers' in large green letters, with the subtitle 'Tips on Saving Money & Energy at Home' and the website 'energysavers.gov'. It includes an illustration of a suburban neighborhood with solar panels and a U.S. Department of Energy logo. The browser screenshot shows the URL 'http://energy.gov/sites/prod/files/energy_savers.pdf' and the title 'Heating and Cooling'. The main text discusses the energy costs of heating and cooling, and a list of recommendations is provided, with one item highlighted in an orange box.

EnergySavers
Tips on Saving Money & Energy at Home
energysavers.gov

U.S. DEPARTMENT OF ENERGY Energy Efficiency & Renewable Energy

http://energy.gov/sites/prod/files/energy_savers.pdf - Windows Internet Explorer

http://energy.gov/sites/prod/files/energy_savers.pdf

Heating and Cooling

Heating and cooling your home uses more energy and costs more money than any other system in your home—typically making up about 54% of your utility bill.

No matter what kind of heating and cooling system you have in your house, you can save money and increase your comfort by properly maintaining and upgrading your equipment. But remember, an energy-

- Eliminate trapped air from hot-water radiators once or twice a season; if unsure about how to perform this task, contact a professional.
- Place heat-resistant radiator reflectors between exterior walls and the radiators.
- Turn off kitchen, bath, and other exhaust fans within 20 minutes after you are done cooking or bathing; when replacing exhaust fans, consider installing high-efficiency

Done Unknown Zone

Easy to Use



Measure



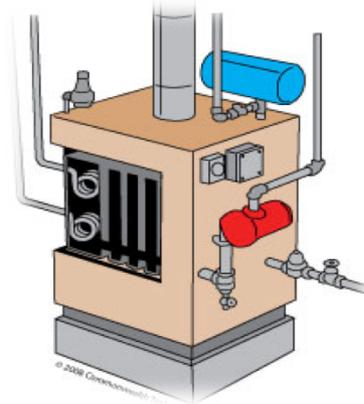
Size



3M Tape



Install



Lower °F



25+ Years Benefit

NRCan QuSum Software Real Savings



Control Strategies- High Tech

www.wristifyme.com

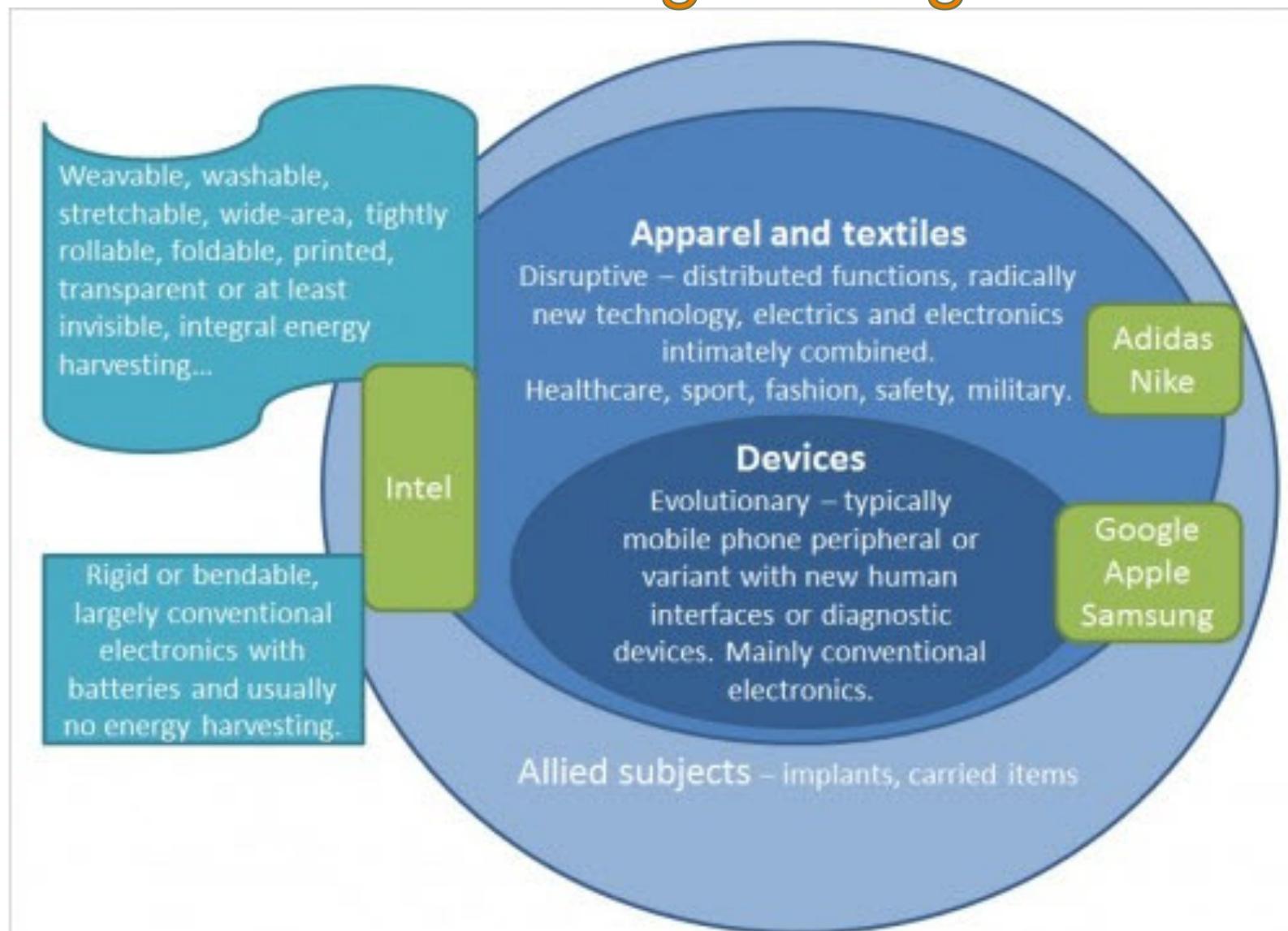


The Pajamas Warming Pouch.



The Temperfect heated-and-cooled office chair can make occupants comfortable in a wider range of ambient temperatures, according to a study at the UC-Berkeley Center for the Built Environment.

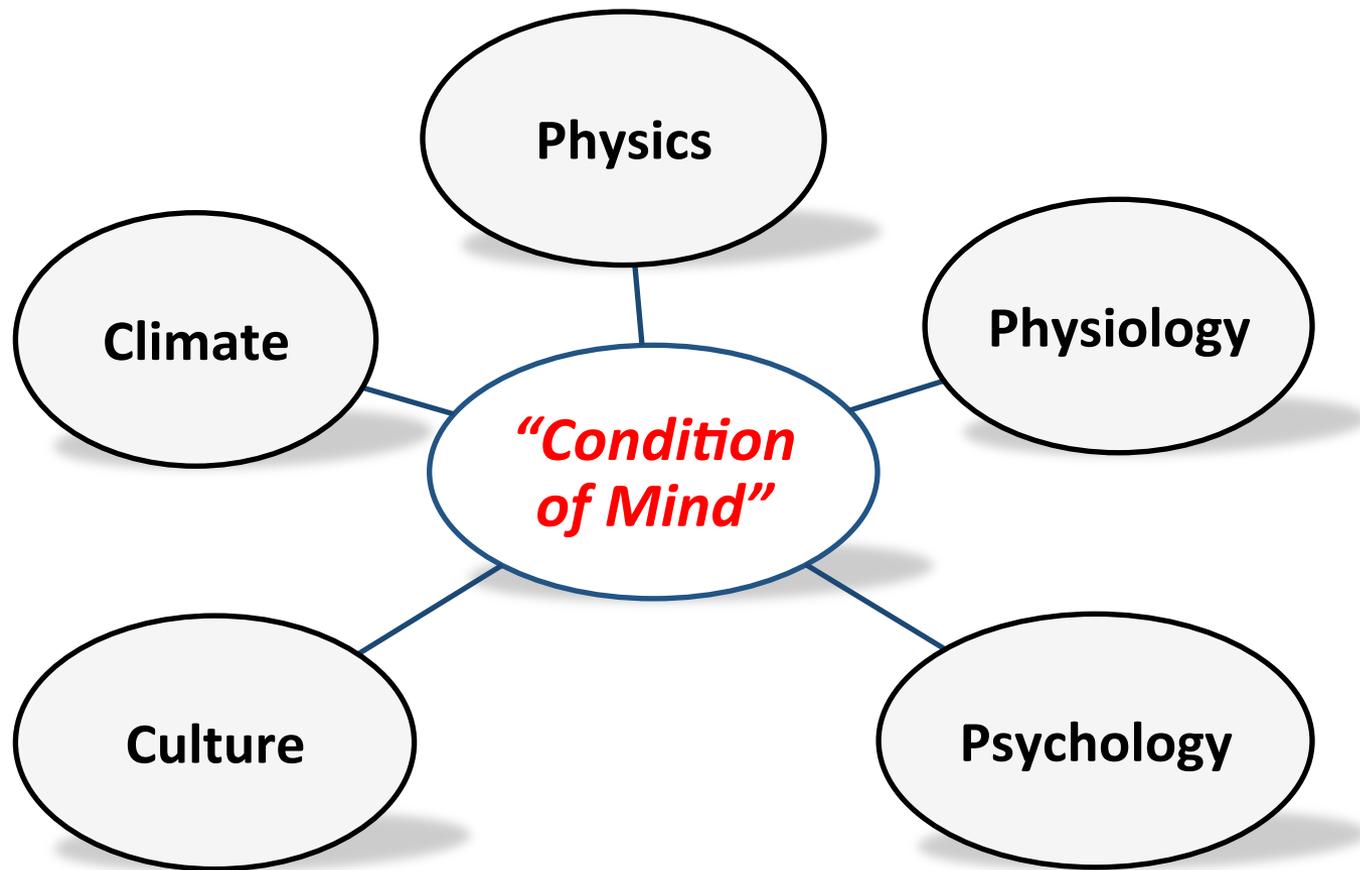
Control Strategies- High Tech



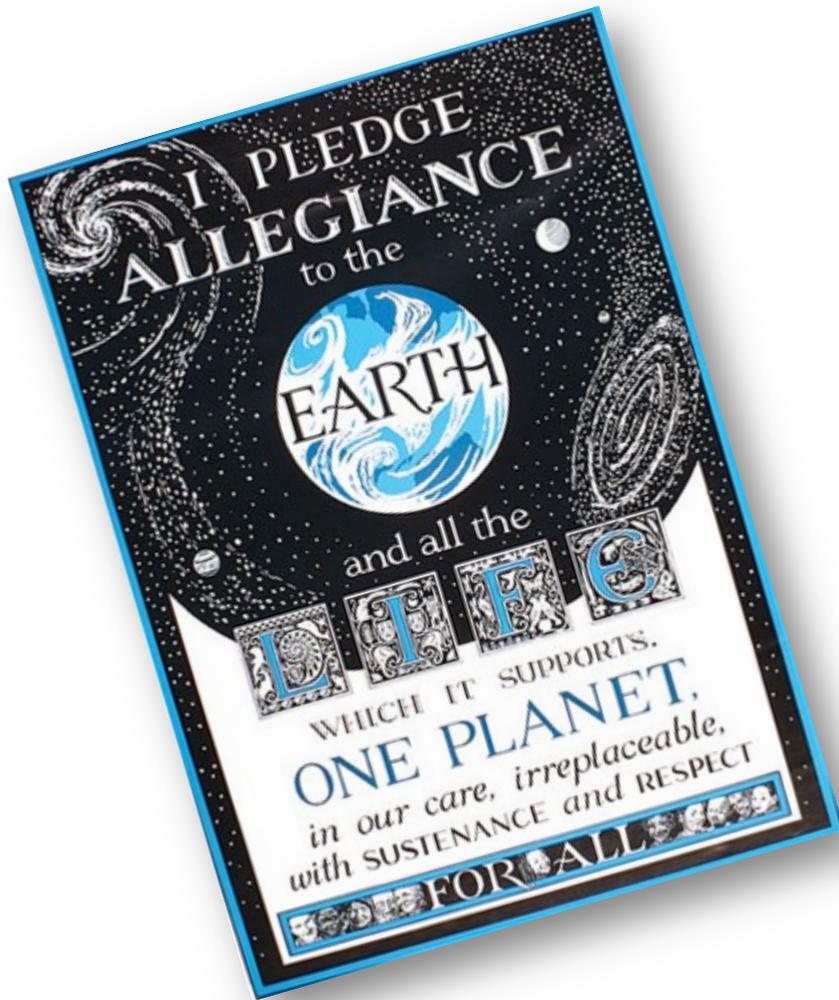
Resources & Tools

- P. Ole Fanger, Thermal Comfort: Analysis and Applications in Environmental Engineering, 1970, NY, McGraw Hill
- ASHRAE Standards for purchase <http://www.techstreet.com/products/1868610>
- Robert Bean Thermal Comfort Ambassador. *Many thermal comfort links. Top notch resource* www.homeheating.com
- Comfort Calculator <http://www.healthyheating.com/solutions.htm#.VpWC7U-M6Dk>
- Climate Science in Four Pictures Sightline.org/FlashCards
- Allison Bailes III physicist, author, & blogger at Energy Vanguard <http://www.energyvanguard.com/blog-building-science-HERS-BPI/bid/48800/Naked-People-Need-Building-Science>
- An Annotated Bibliography of Comfort Research http://www.lancaster.ac.uk/fass/projects/futcom/comfort_biblio.pdf
- Emma Bryce TED talk on Metabolism
- Insulation: First The Body, Then The Home <http://www.lowtechmagazine.com/2011/02/body-insulation-thermal-underwear.html>
- Thermal Comfort Tool – FREE--Center for the Built Environment (CBE) <http://comfort.cbe.berkeley.edu/>
- Linda Wigington, Creative Comfort & Deep Energy Reductions www.thousandhomechallenge.org
- Coping with Comfort Complaints: Top Causes, Investigation Methods, and Solutions Webinar http://homeenergypros.lbl.gov/forum/topics/bpi-launches-homeowner-blog?xg_source=msg_mes_network

Beyond Building Science to the Comfort Crossroads



Climate Science in 4 Pictures



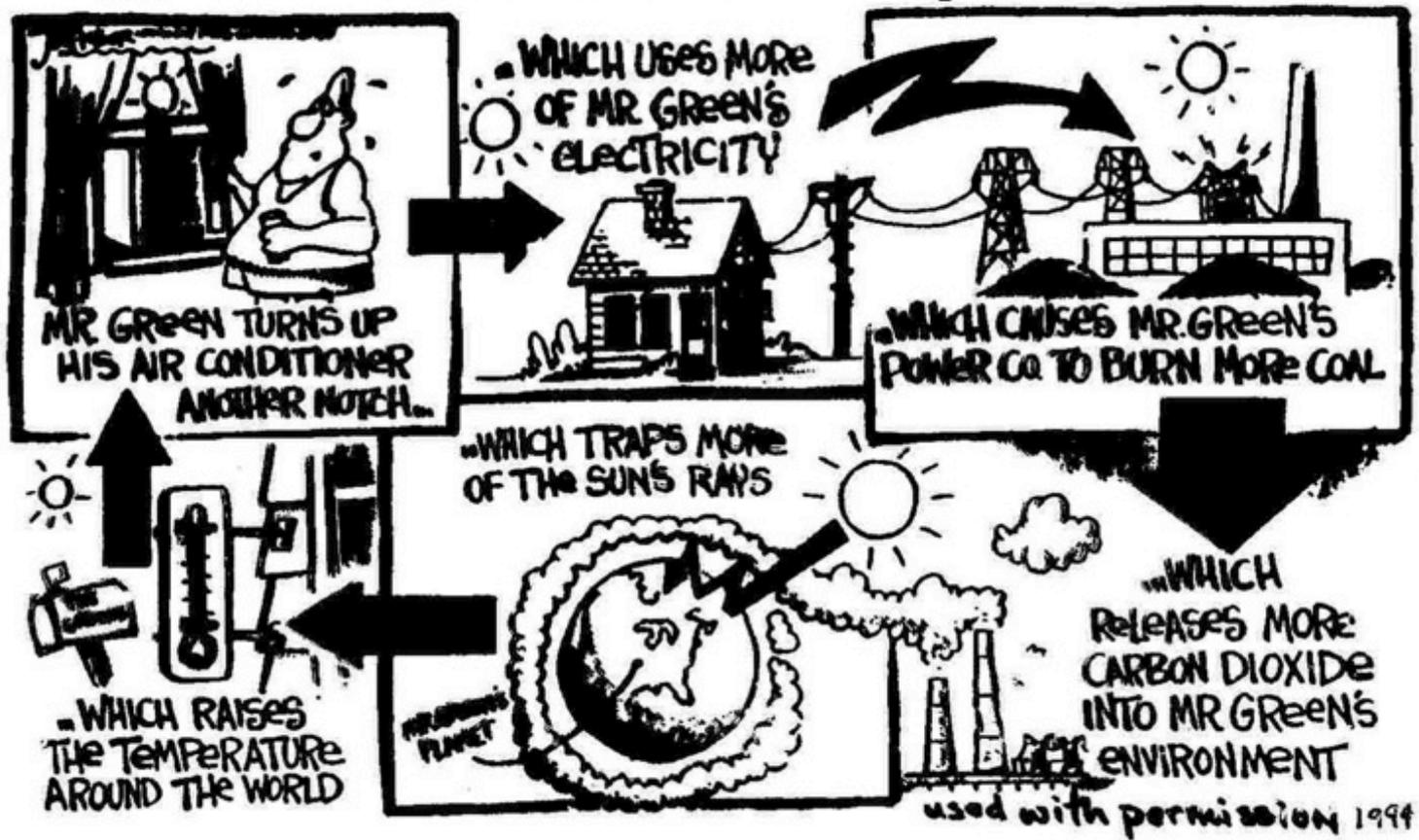
	<p>Heat-trapping blanket</p>	<p>When we burn coal, oil, and gas, the carbon dioxide released builds up and forms a blanket that traps heat in the atmosphere and disrupts the climate.</p>
	<p>Regular vs. RAMPANT carbon dioxide</p>	<p>Regular levels of carbon dioxide are natural—and okay, but burning coal, oil, and gas releases rampant levels of carbon dioxide and it's disrupting the climate.</p>
	<p>Oceans = climate's HEART</p>	<p>Like the human heart circulates blood and regulates body temperature, the world's oceans circulate heat and moisture, regulating our climate system. Burning fossil fuels puts stress on oceans, damaging their ability to keep the climate stable.</p>
	<p>Osteoporosis of the sea</p>	<p>The same way our bones' chemistry can change and become brittle, carbon dioxide from fossil fuels is causing "osteoporosis of the sea." This ocean acidification damages shells that protect sea creatures and disrupts marine ecosystems.</p>

Great Resource →

Source: Sightline.org Flash Cards

Driven by Comfort & Convenience ?

The "Green"house effect explained:



Joe Heller, Green Bay Press-Gazette.

Highly Interactive Earth Systems

Key Question Going Forward

How can we change and/or foster comfort perceptions that improve our individual, community, and societal resilience?

Tomorrow belongs to those who can hear it coming.

~ David Bowie

What Do YOU Think?

Feedback Welcome



Rana Belshe
Conservation Connection
Consulting
715-334-2707
ranabelshe@centurytel.net

**With THANKS to colleagues in comfort
Tom Wilson, Linda Wigington, Larry Kinney & Robert Bean**

