

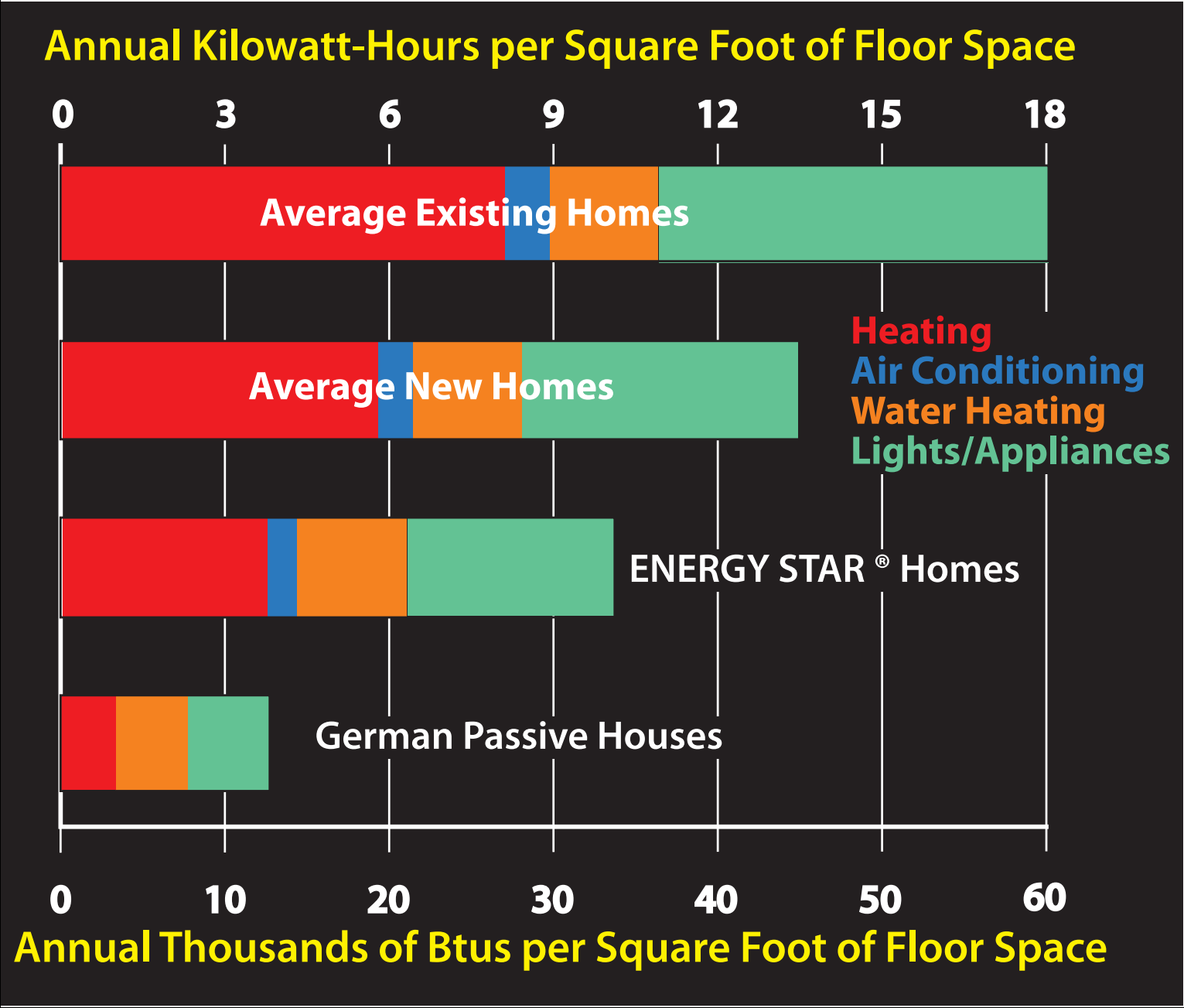
TOWARD CARBON NEUTRALITY



CHEC 4.0: Comprehensive Home Energy Curriculum

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Housing Energy Consumption Compared

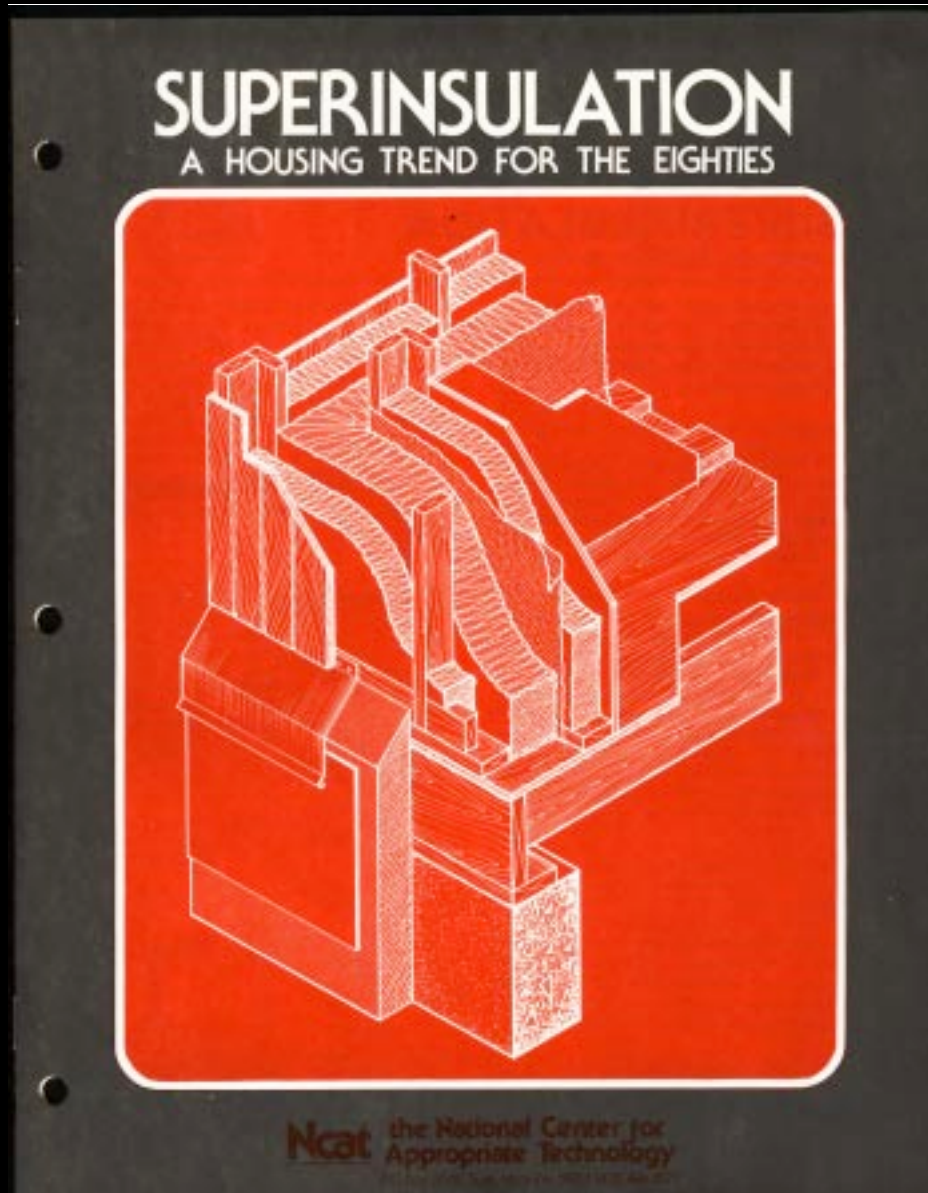


Multiple Benefits of a Systems Approach

- **Deep reductions in power and energy**
- **Improved comfort and air quality**
- **Avoided complexities of the incremental approach**
- **Integrated space heating, water heating, and ventilation with heat carried by ventilation air**
- **Baseline comfort assured during power outages and fuel shortages**
- **Improved opportunity to use renewables**



Superinsulated Homes Evolution



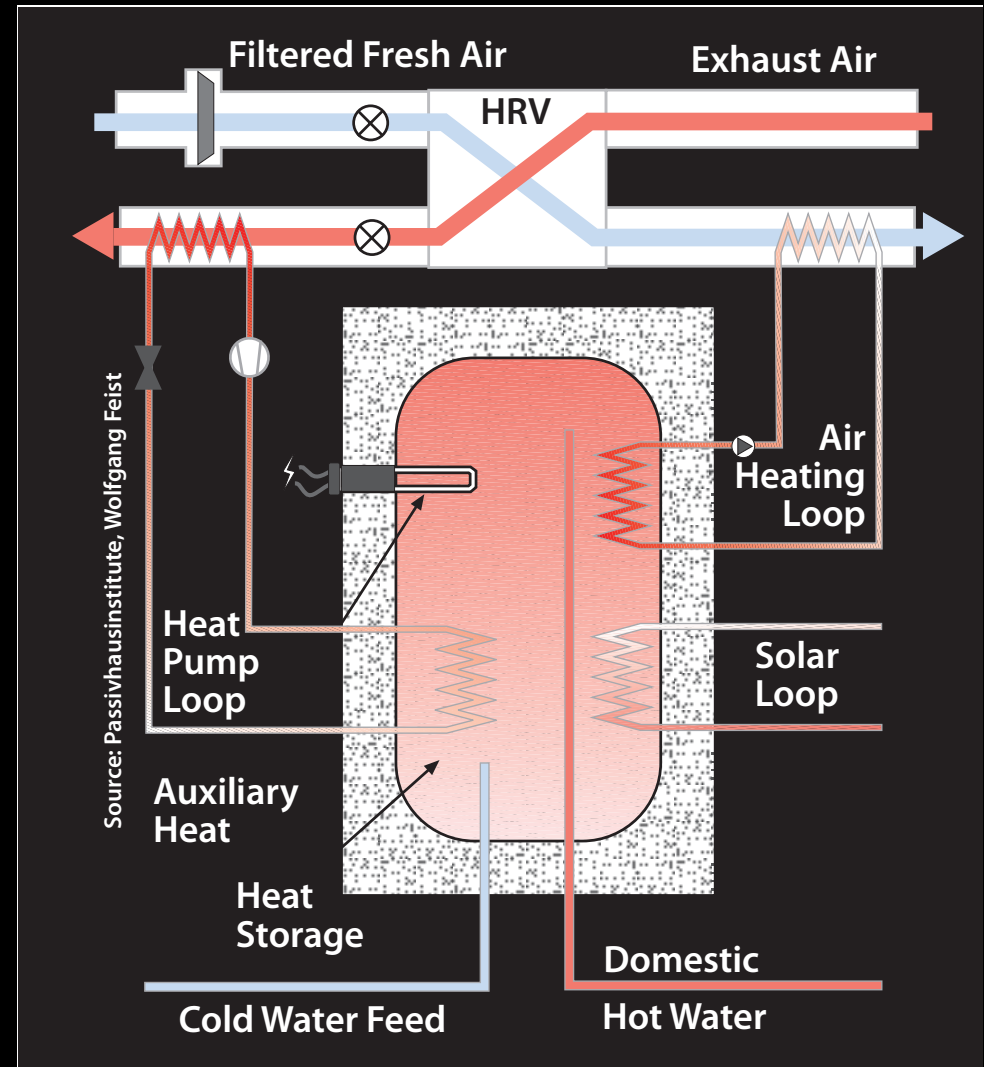
- **Harold Orr and Gene Leger**
 - Early superinsulated homes
- **Bob Corbett & Brian Curran**
 - Buffalo Homes factory-built superinsulated homes
- **Amory & Hunter Lovins**
 - Factor 10 engineering
- **Wolfgang Feist**
 - Passive House Institute

German Passive House Imperatives

- **Superinsulation**
- **Defeat thermal bridging**
- **Airtight construction**
- **Heat-recovery ventilation**
- **Space heating using ventilation air**
- **No complex shapes**
- **No conventional heating system**
- **No refrigerated cooling**

Heating and Cooling Strategy

- **Provide ducted central ventilation**
 - 20–30 cfm/person
- **Heat and cool the building with the ventilation air**
- **Avoid cooling if possible**
 - If needed, provide it with a heat pump
- **Heat domestic water with the same equipment as space heating**
- **Store heat in a central storage tank**



Czech Out These Expectations

- Clothes dryers are only for rich people
- It is stupid to use electric lights during the day if you have windows
- 3 footcandles is plenty of light for indoor sports
- 80 degree water is suitable for showering
- Indoor sports facilities don't need heating systems
- Indoor temperatures of 60 to 90 degrees are acceptable: Japanese standards

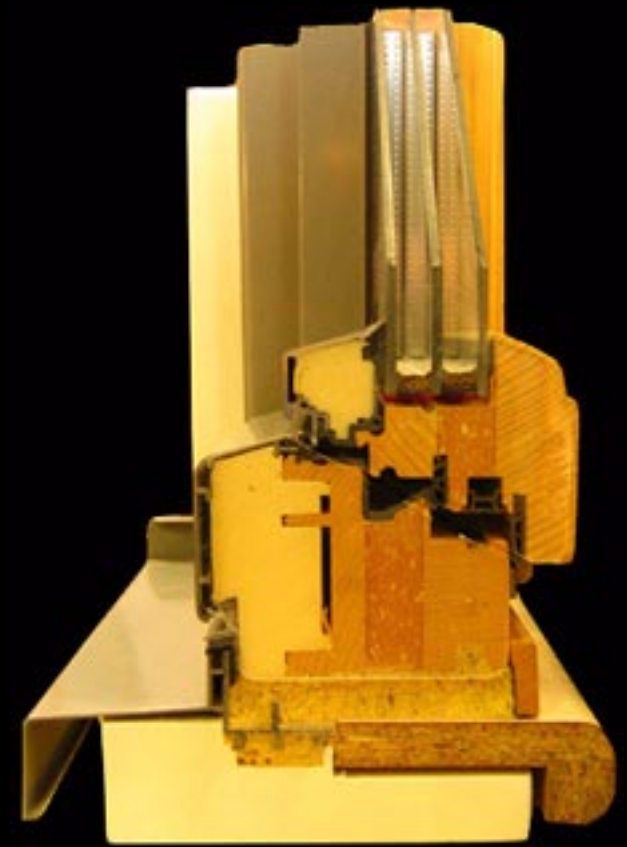
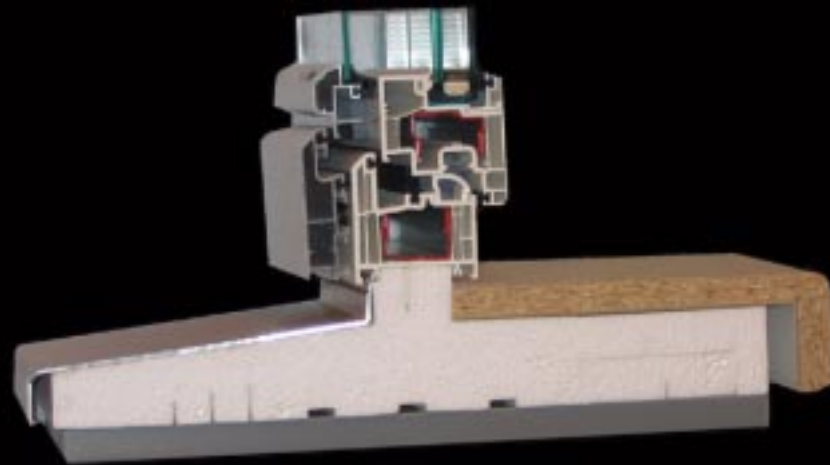


Passive House Standards

- **Install no more than 1 watt of heating per square foot of floor space.**
- **Use no more than 1.5 kWh per square foot of floor space for heating annually.**
- **Use no more than 4 kWh per square foot annually for all home energy.**
- **Install a heat-recovery ventilator in every home. Use the ventilation air to deliver heating and cooling.**
 - 15-30 cfm/person
- **Use renewable energy whenever possible to satisfy these loads.**

Thermally Advanced Window Installations

- The most advanced window installations seek to eliminate thermal bridges with foam, cork, and rubber gaskets
- Foam undersills reduce thermal bridging at this important juncture



Non-Technical Challenges

- **Teach that deep reductions are the way for consumers to be green**
- **Promote the building trades as the noble helping professions of the future**
- **Challenge corporations to reduce waste and embrace conservation**
- **Implement inverted rates, time of use, and energy taxes**
- **Limit installed heating and cooling capacity**
- **Roll back universal air conditioning**

Summit Goals and Objectives

- **Characterize energy reduction potential**
- **Propose metrics and terms to establish common ground**
 - Energy per square foot
 - Cost per square foot
- **Develop broad strategies for achieving deep energy reduction**
- **Identify technical and market innovations**
- **Align existing programs with metrics**
- **Discuss how to move government, industry, and citizens**
 - Revise expectations and behavior

