Demand-Side Options

Village Strategic Energy Planning

Develop a community energy baseline

Develop a common Village energy vision

Identify and support a Village champion

Identify culture and environmental constraints

Identify and evaluate resource options

Demand-Side Options

Supply-Side Options

Integrate supply and demand alternatives

Establish organizational and human resource needs

Strategic Plan

Programs & Projects

Village Objectives

- Energy Reliability & Security
- Off-Grid Electrification
- Minimize Environmental Impacts
- Supply Diversification
- Use of Local Resources
- Economic Development
- Jobs
- Build technical expertise
- Respect for Mother Earth
- Others??

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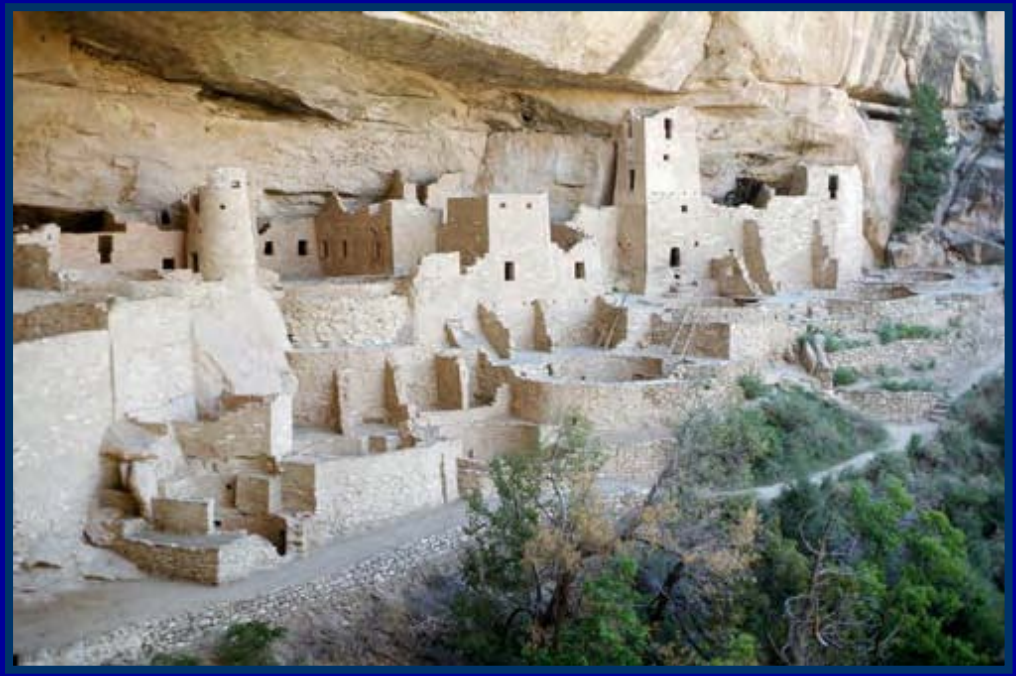
Demand-Side Options

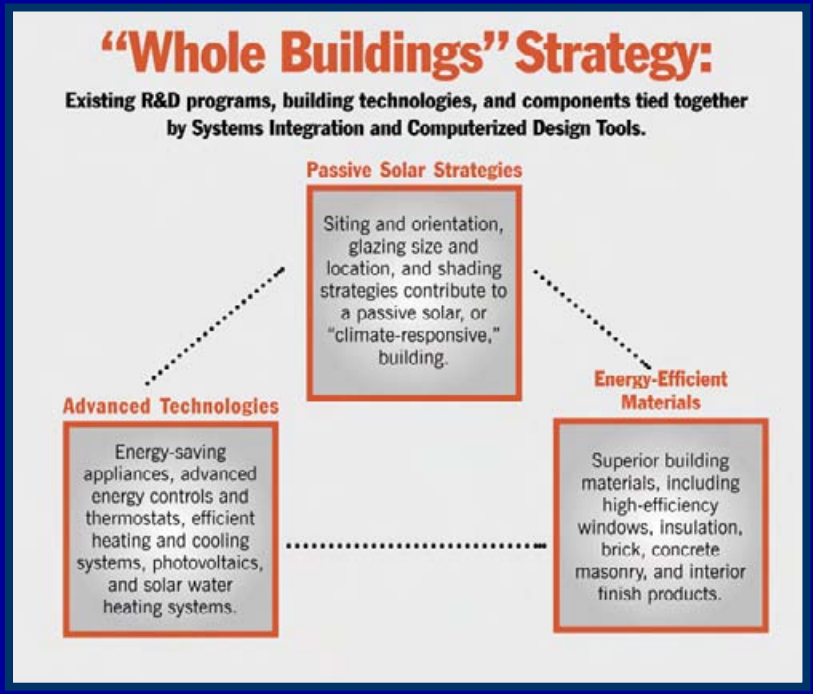
Weatherization

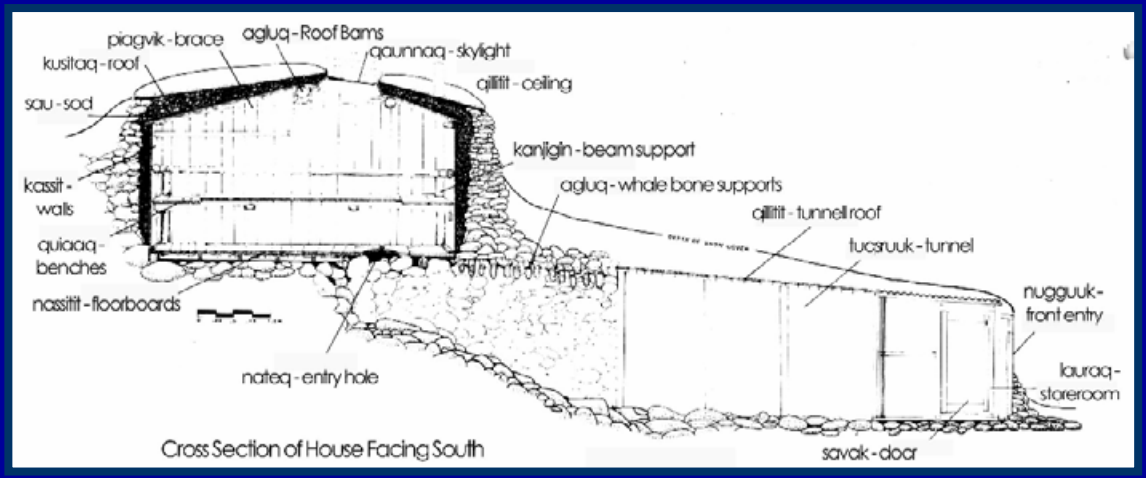
- Efficiency
  - Appliances
  - Lighting
  - Heating & Cooling Systems
  - Commercial & Industrial Loads
- Demand Response and Load Shifting
- Direct Load Control
- Considerations
  - Ranking available measures
  - Measuring effects of actions

Fuel Switching (electricity, gas, propane, wood)

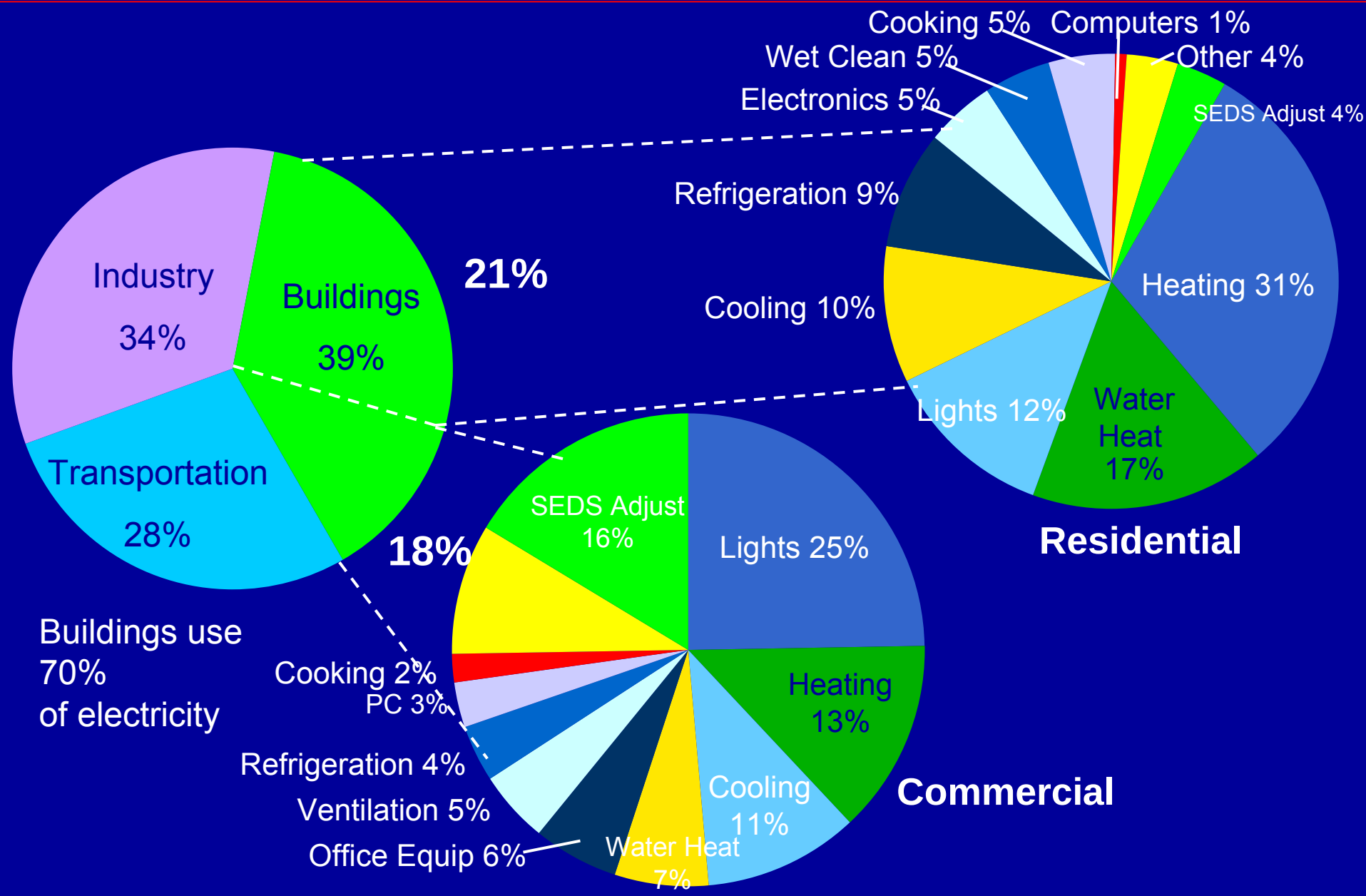
Building Design



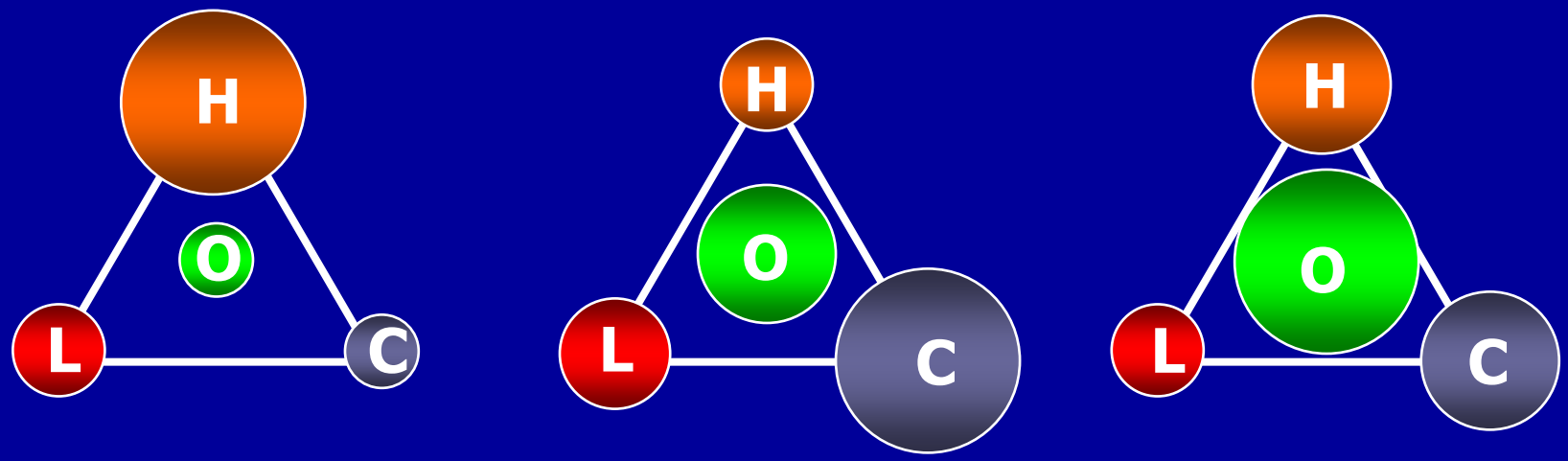




Building Energy Use



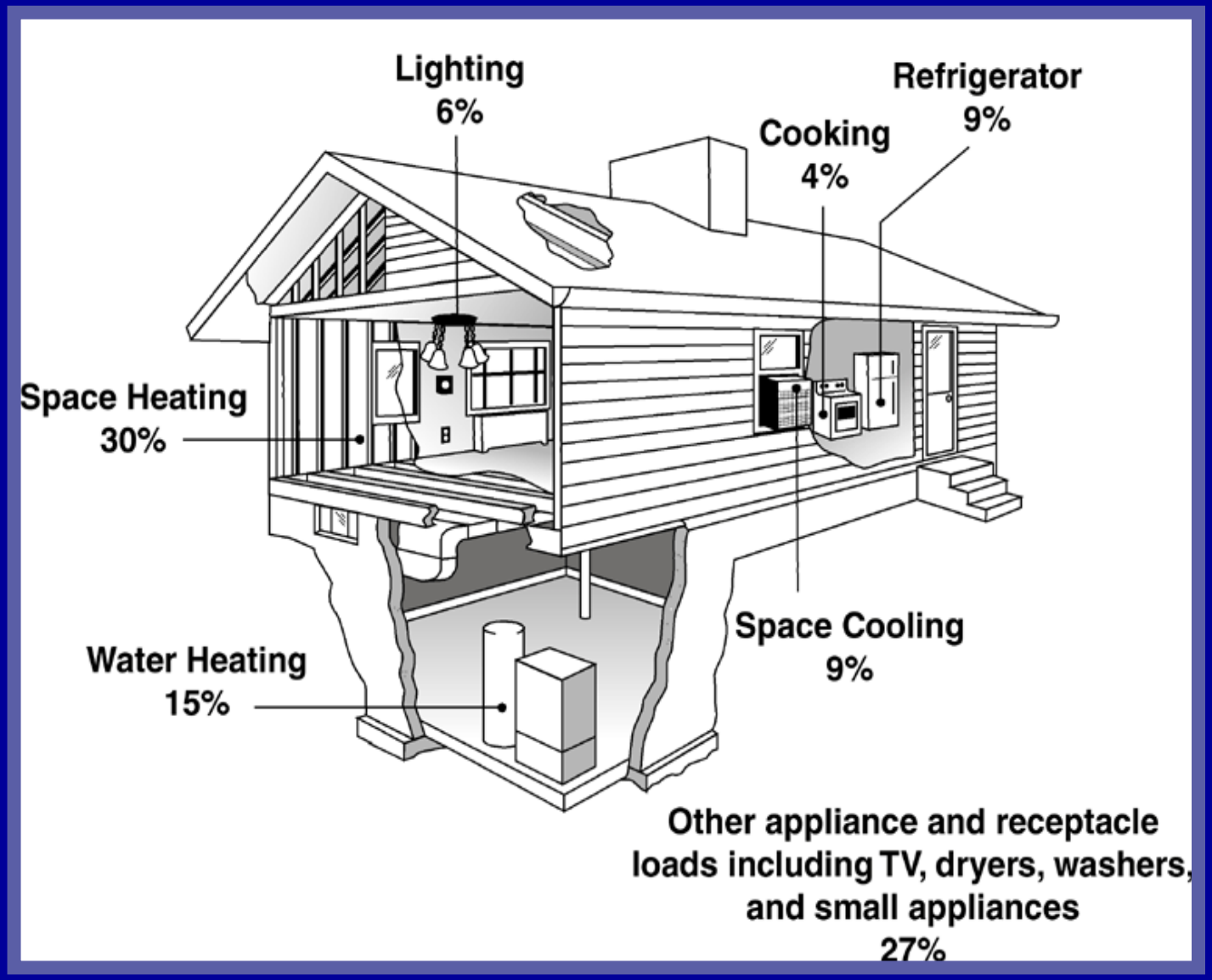
Integrated Design Problem



H = Heating load L = Lighting load C = Cooling load

O = Other, including ventilation & plug loads

Typical Residential Energy Use Profile

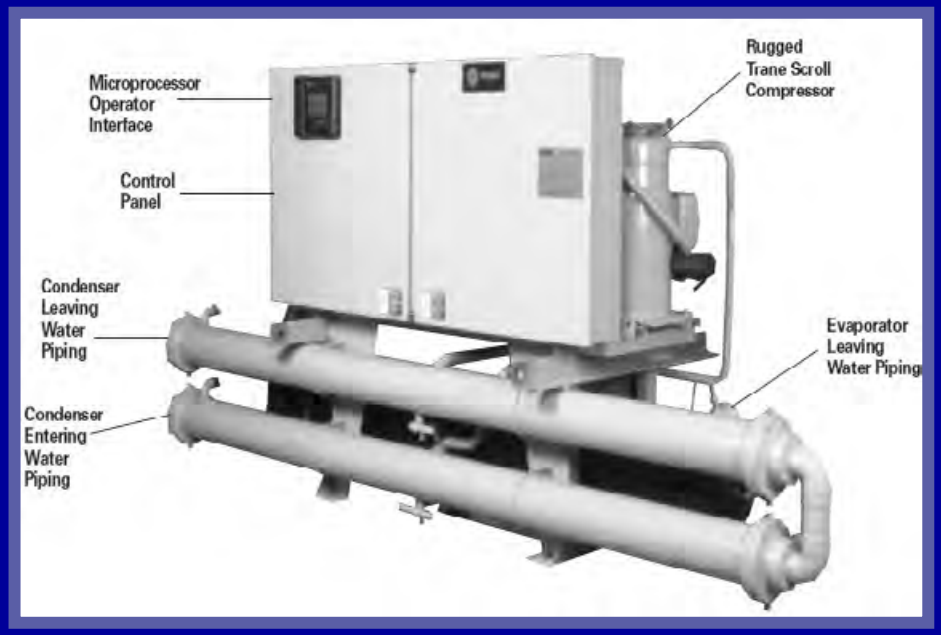


Energy Efficiency 1ST Then Renewables

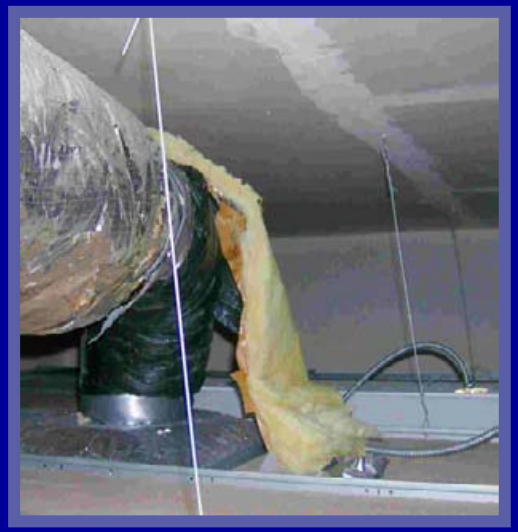
- Every $ spent on efficiency saves at least as much as $2 spent on renewables
- Climate sensitive design (passive solar)
- Long axis of building faces south, south glass with overhangs, 7 – 12% glass area of building floor area
- Limit east, west and north glass

HVAC & Appliance Maintenance

HVAC Replacement



Inadequate Insulation



Infiltration

Controls

Energy Efficiency Options

Energy Star Appliances

Refrigerators – Half as much energy

Clothes Washers – Save up to $110 per year

Oil & Gas Boilers – Save up to 10%

Programmable Thermostats – Save up to $100 per year

Efficient Lighting

If every American changed out 5 lights, we'd save $6 billion/year and the equivalent of 21 power plants.

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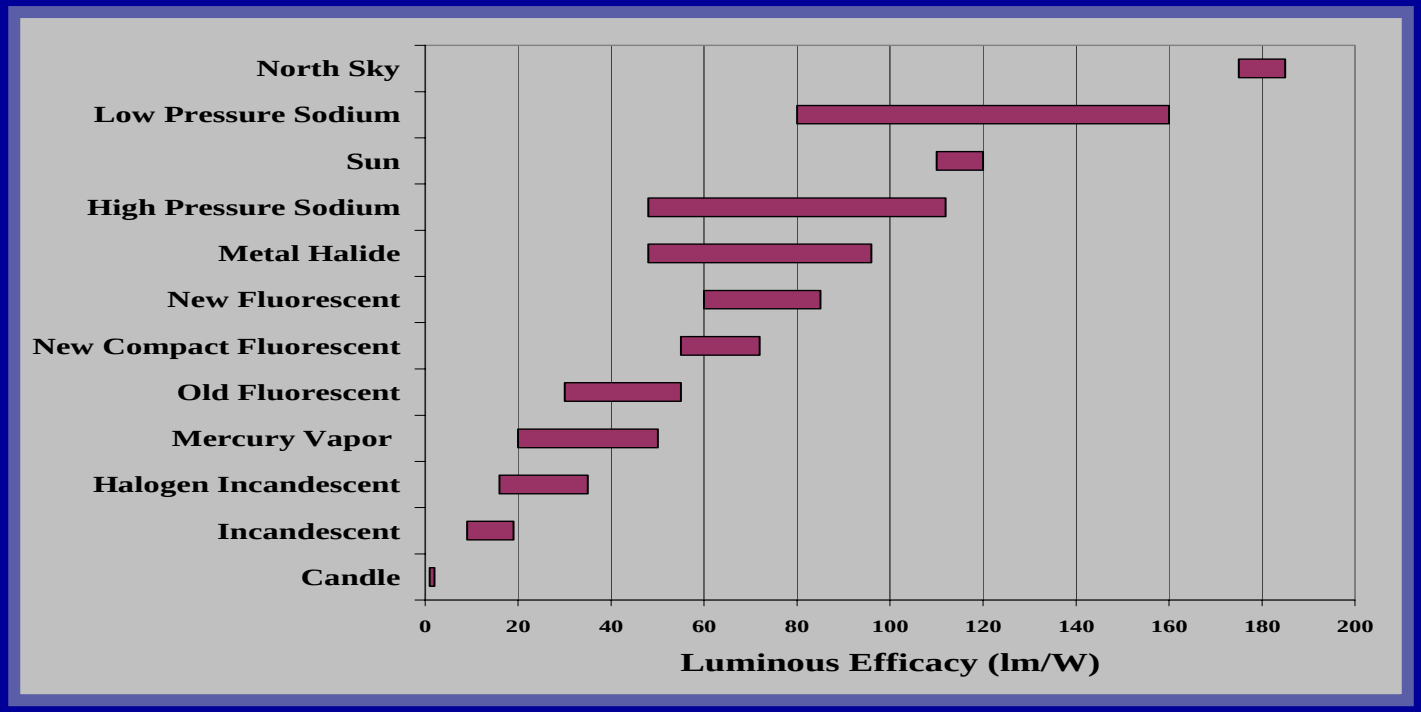

Energy Star Appliances

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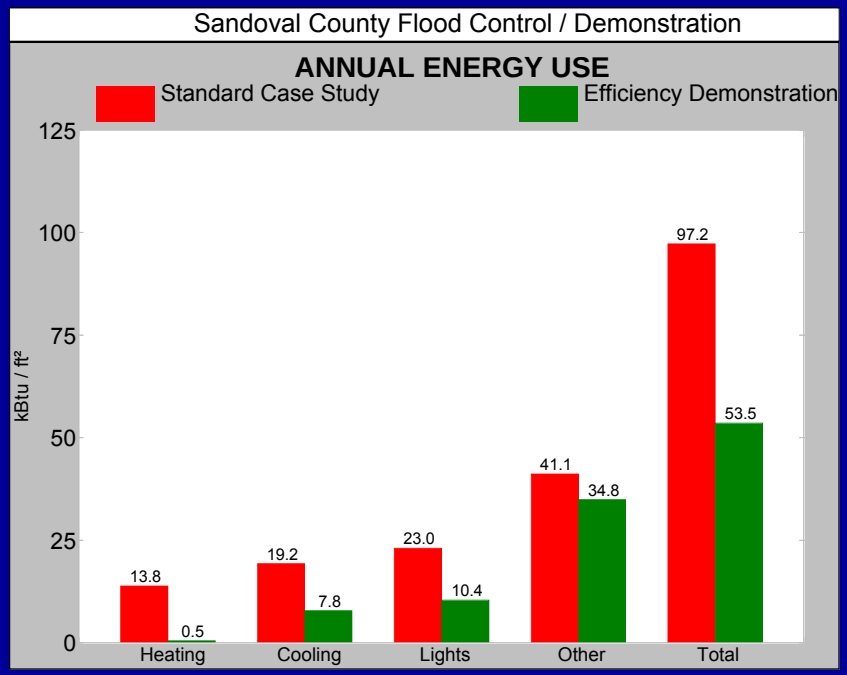
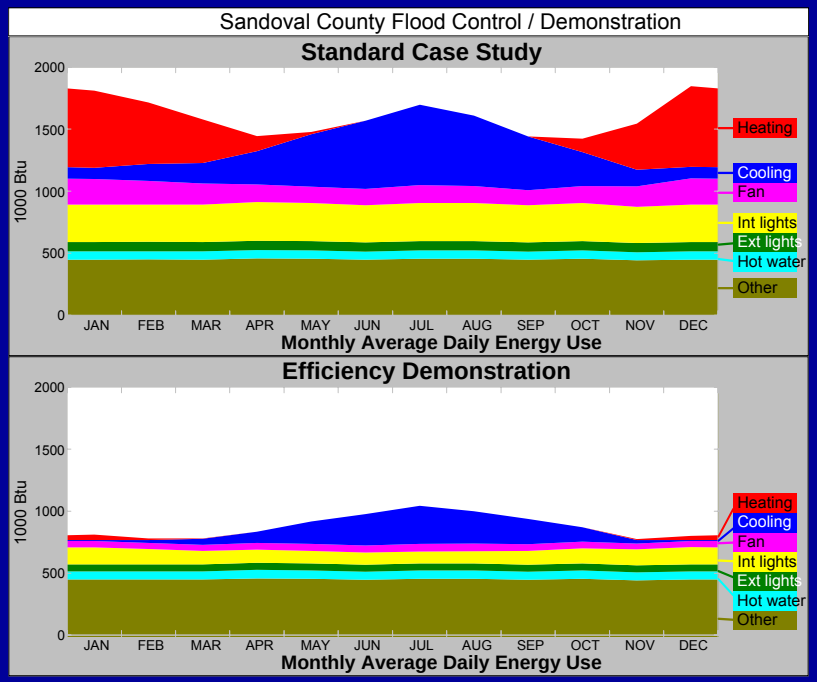
Vision

- Engineer ***whole-building systems*** that effectively integrate passive solar and efficiency strategies to optimize energy consumption such that minimal renewable energy sources can meet remaining needs.

Gather data for Intelligent Decision Making…

- Considers building energy consumption during design phase to optimize energy use
- Several programs: eQuest, DOE2, Energy 10, etc.
- http://www.eere.energy.gov/buildings/highperformance/toolbox.html





LEED

LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN

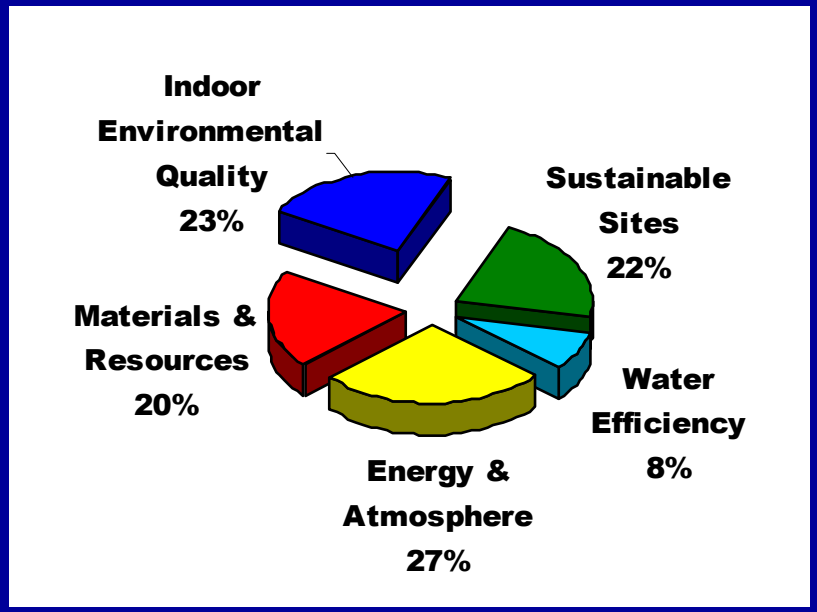
A leading-edge system for designing, constructing, and certifying the world's greenest buildings.

Provides a measure of success related to a national standard.

Similar to DOE program, Sustainable Building Council Guidelines and others

Be aware of LeED

- Energy performance

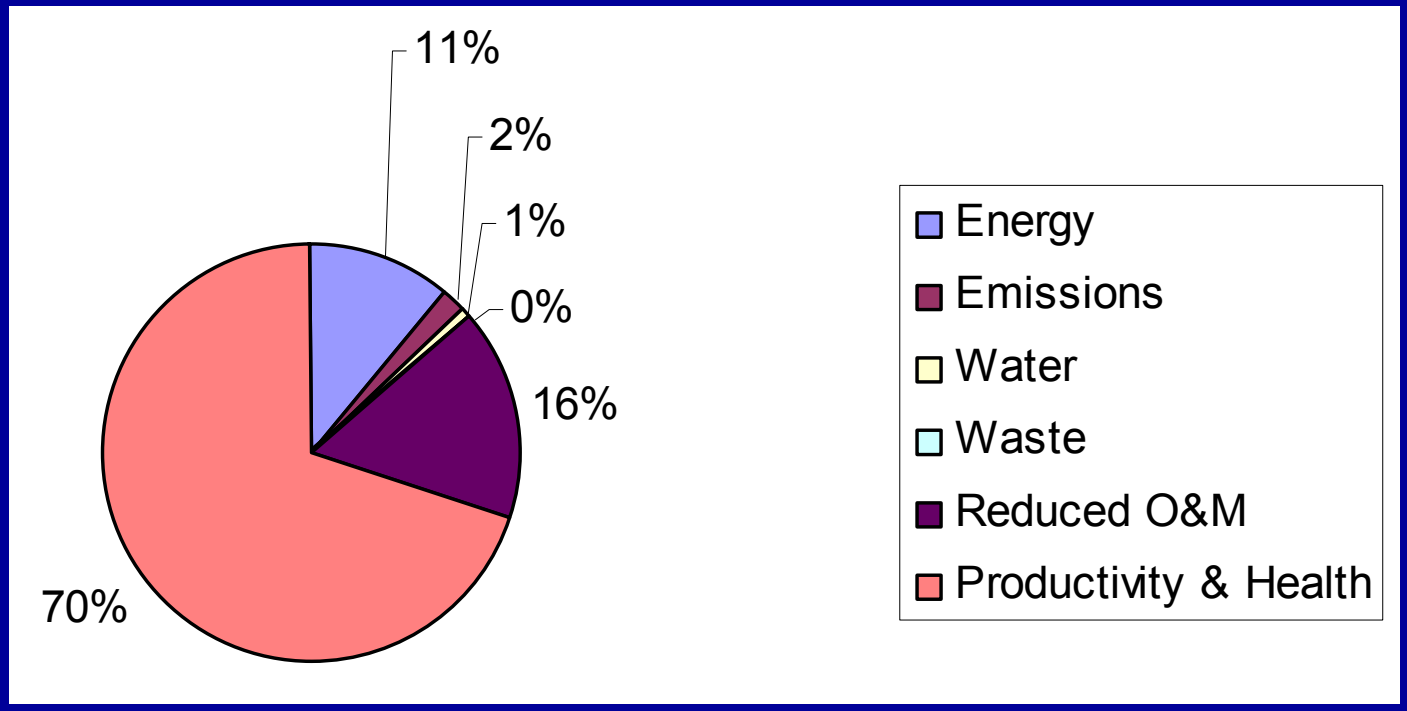


Values and “Cost-Effective”

- What is cost-effective?

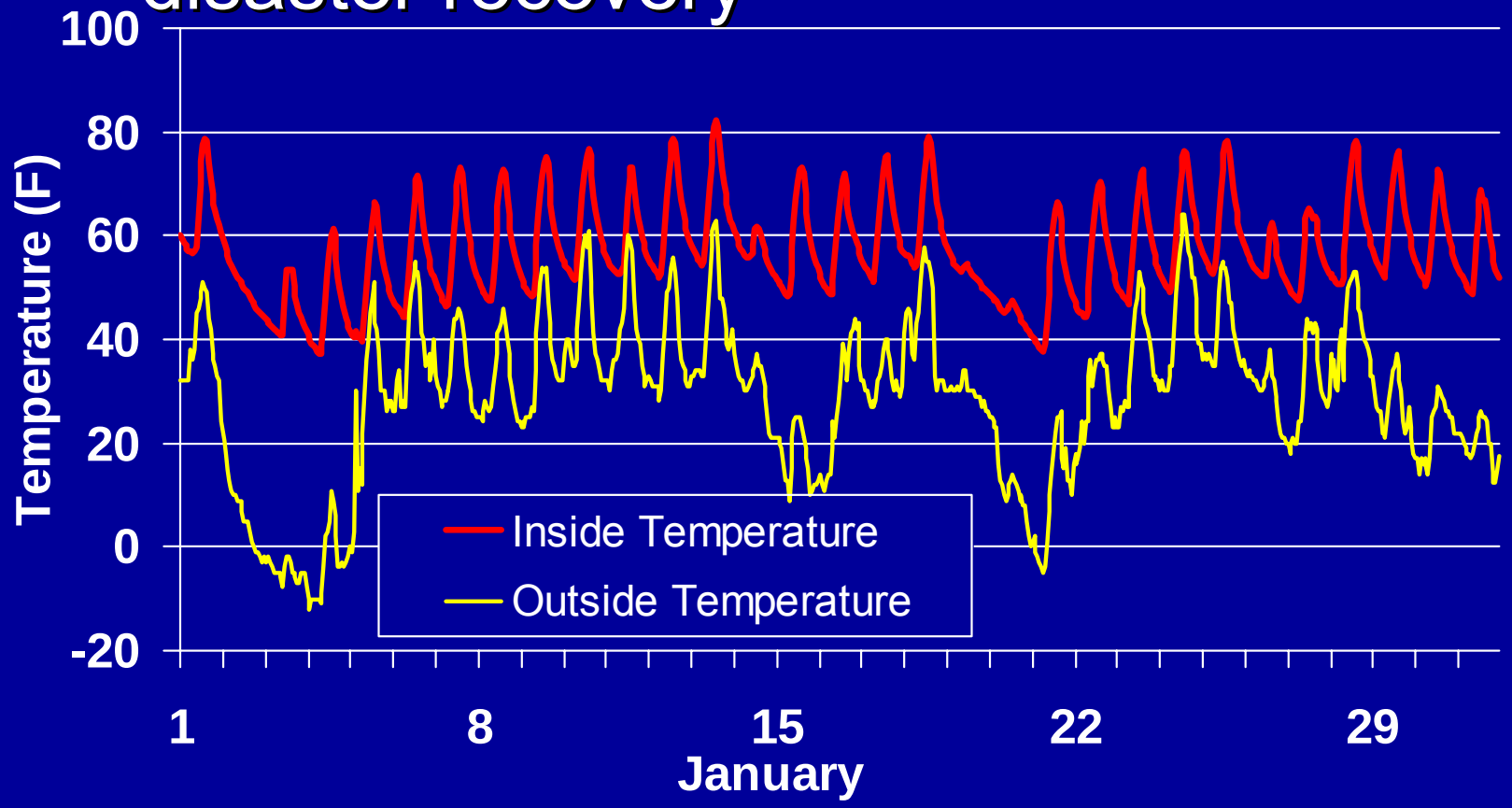
- Economic
- Operational reliability and power stability
- Higher user satisfaction and lower HR costs
- Environmental Impact
- Integrated the energy efficiency and architecture

On average, over a 30-year lifespan of a building, only 2% overall investment goes towards construction.



Values and “Cost-Effective”

- Risk management and disaster recovery

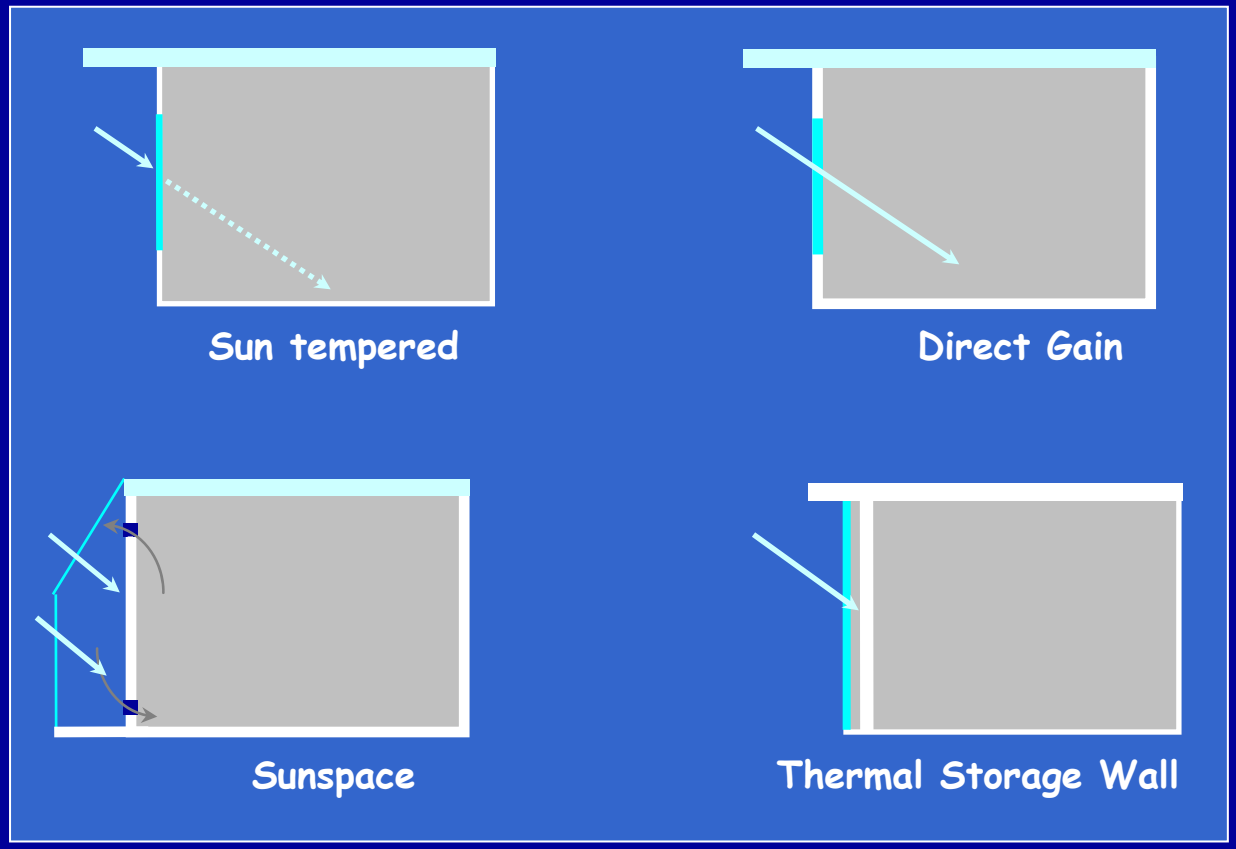


Nine-Step Design Process

ASHRAE Journal, December 1999

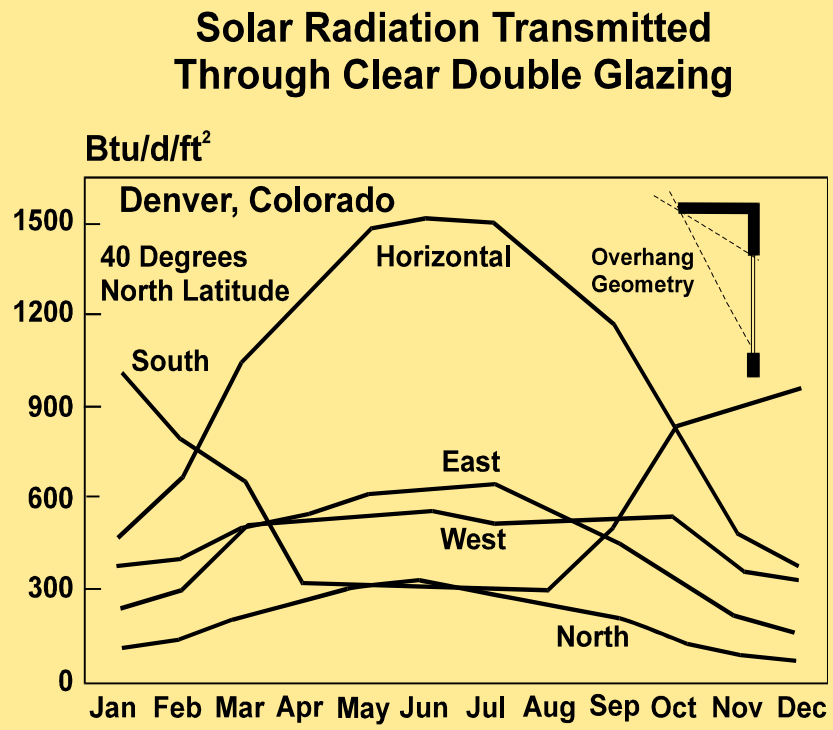
Pre-Design	Design	Construction & Commissioning
1. Simulate a base-case building model and establish goals	5. Architectural team prepares preliminary drawings	8. Rerun simulations before construction design changes
2. Complete parametric analysis	6. Design the HVAC system	9. Commission all equipment and controls. Educate building operator
3. Design team brainstorms solutions	7. Finalize plans and specifications	
4. Perform simulations based on base-case variants		

Passive Solar Strategies



Glazing Orientation is Important

South glazing is uniquely capable of providing heat in winter and blocking heat gain in summer



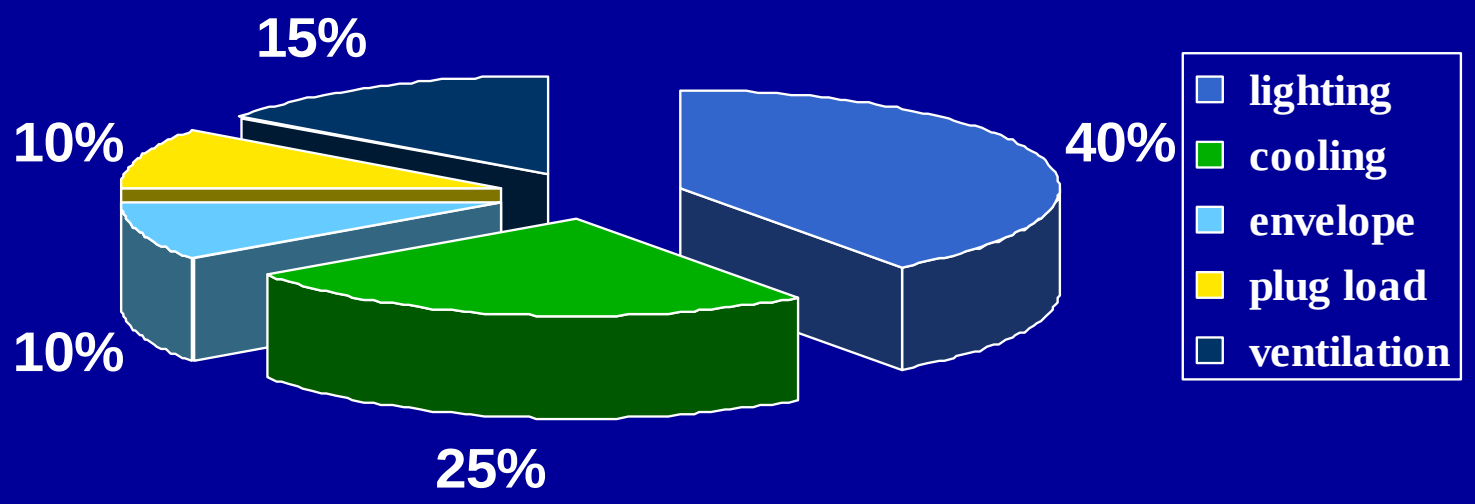
Source: Balcomb, J. D. (1994). *Integrated Design.*

What is daylighting?

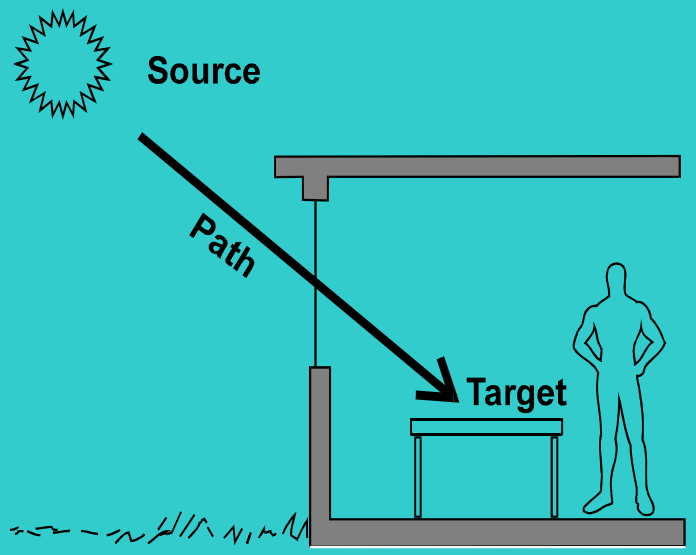
- Daylighting is the <u>controlled</u> admission of natural light into a building with artificial light fixtures dimmed or turned-off to save energy
- A well daylit space has relatively even brightness and reduced contrast ratios
- More windows do not make better daylighting

Lighting Energy Consumption

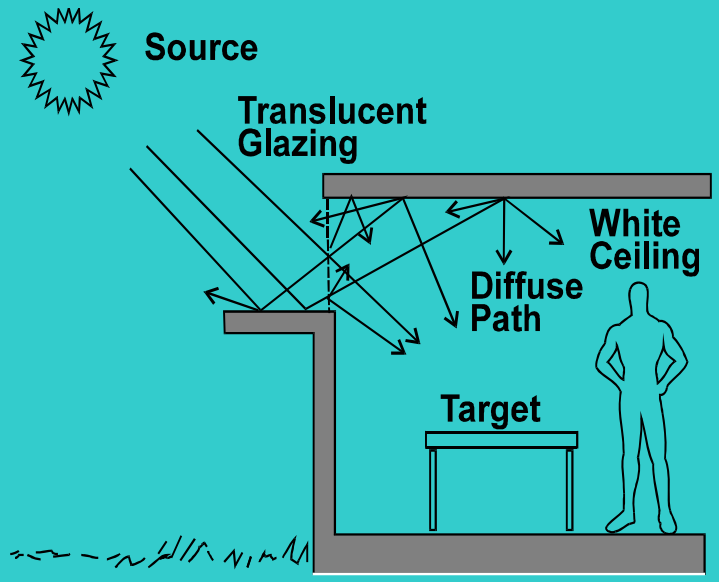
In a typical commercial office building, lighting can be the largest energy load.



Principles of Daylighting



Direct sunlight is a potential source of glare and excess contrast.

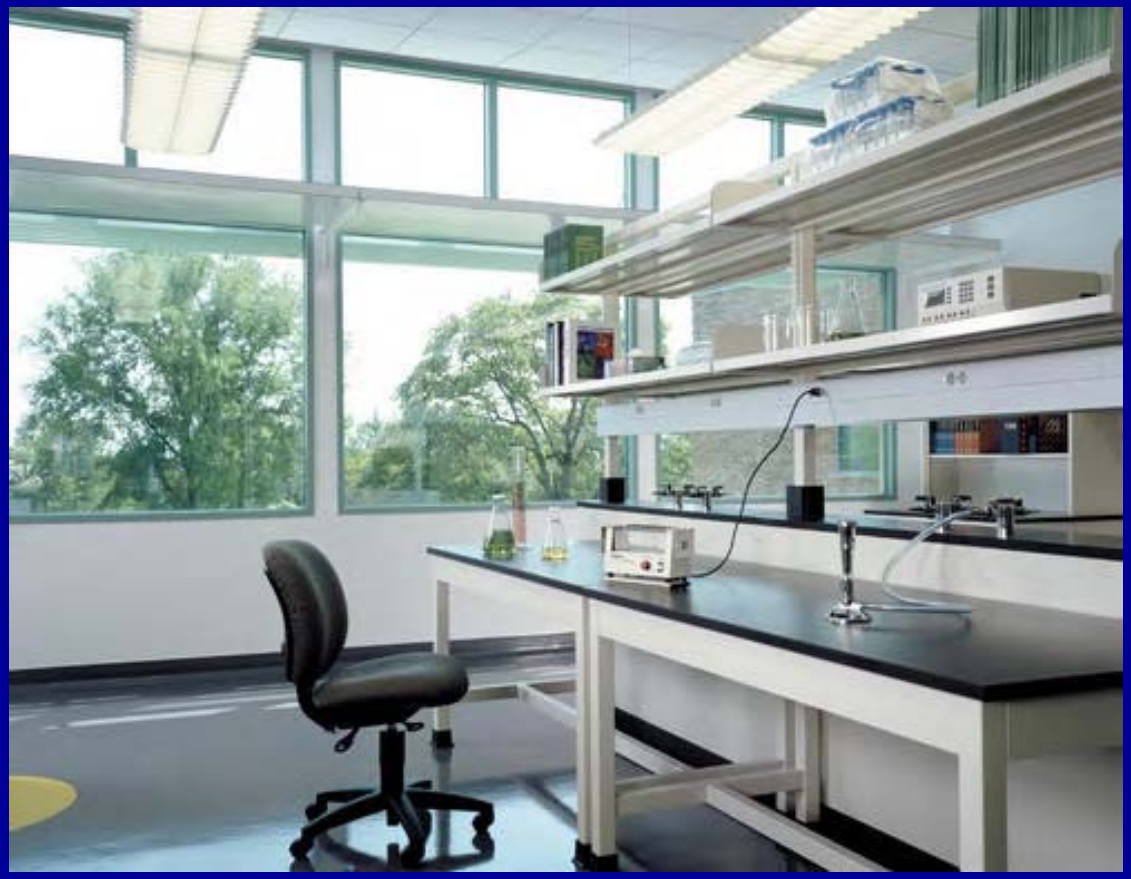


Light shelves and other diffusing surfaces create more even illumination.

Daylighting Design

- Good access to south and north light; minimal east and west light
- Minimize direct beam sunlight on the task
- Reduce window glare and excess contrast ratios in the field of view
- Integrate with electric lighting through luminous controls to achieve energy savings
- Assure excess solar heat gain through windows is controlled

Good daylighting …



Passive Solar Design

Carlisle\Prythero residence, Lakewood,CO

Tierra Concrete Homes

Van Geet Residence

Philip Merrill Environmental Center

- 4 kW PV
- LEED Platinum (V.1)
- 19% Energy Savings below ASHRAE 90.1-1999
- 27% Energy Cost Savings

Use of native landscaping further reduces water consumption.

Philip Merrill Environmental Center

- 31,200 ft^2 Office Building
- Owner – Chesapeake Bay Foundation
- Architect – SmithGroup
- Energy Consultant – SmithGroup
- LEED 1.0 Platinum Certified
- Annapolis, MD
- HDD [65°F] – 4911
- CDD [65°F] – 1134

Philip Merrill Environmental Center (Chesapeake Bay Foundation)

The center's toilets are non-flushing units that recycle waste and reduce the amount of water needed.

CBF Energy Efficient Features

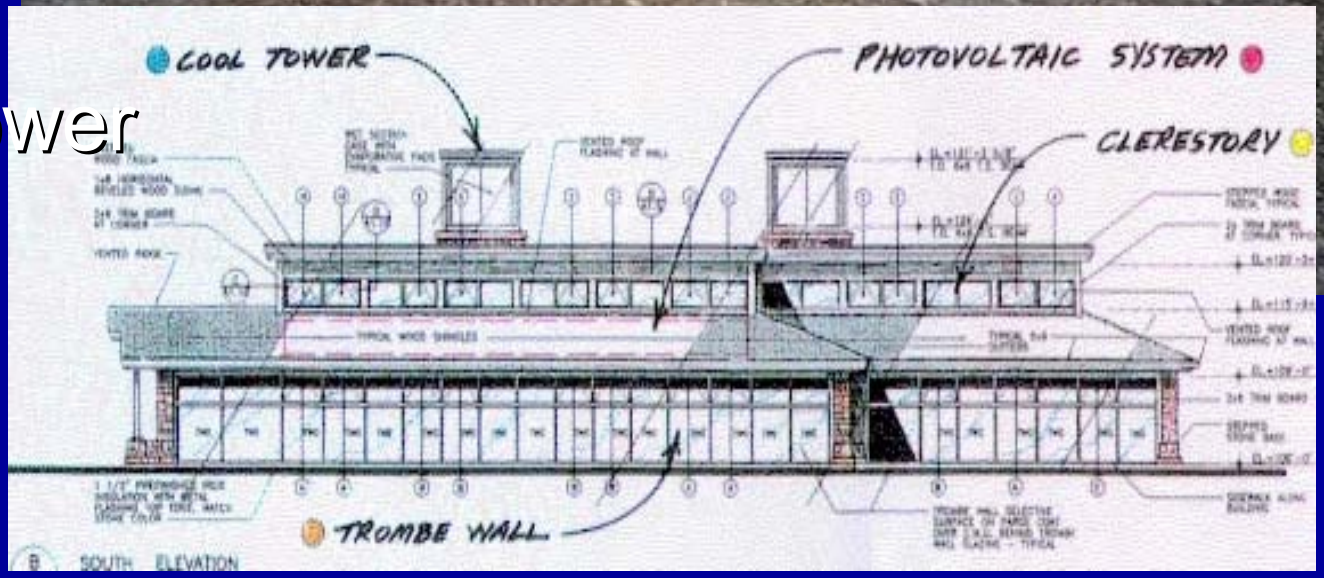
- Well insulated envelope
- Ground-source heat pumps with desiccant wheel
- Natural ventilation
- Daylighting / Lighting system
- PV system
- Solar thermal water system
- Building energy management system

- 0.8 gal/day/person well water use

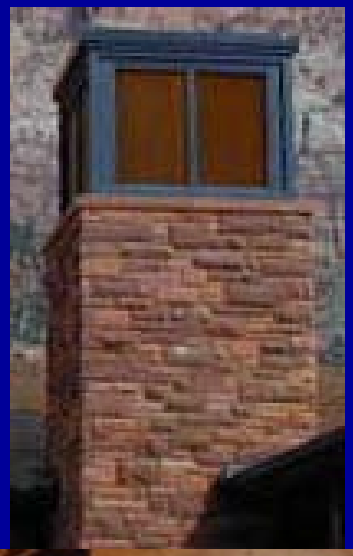
Zion National Park Visitor Center

Zion National Park Visitor Center

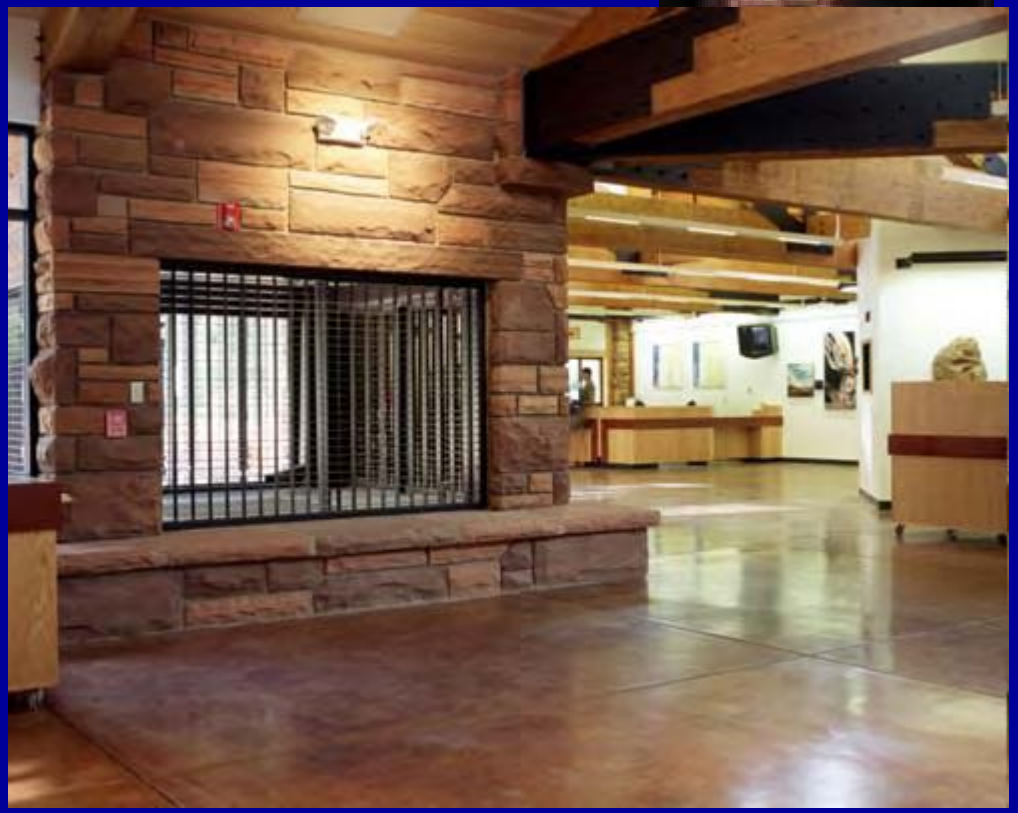
- 70% energy cost savings *and* 30% capital cost reduction
- 10% PV power



Zion Energy Features



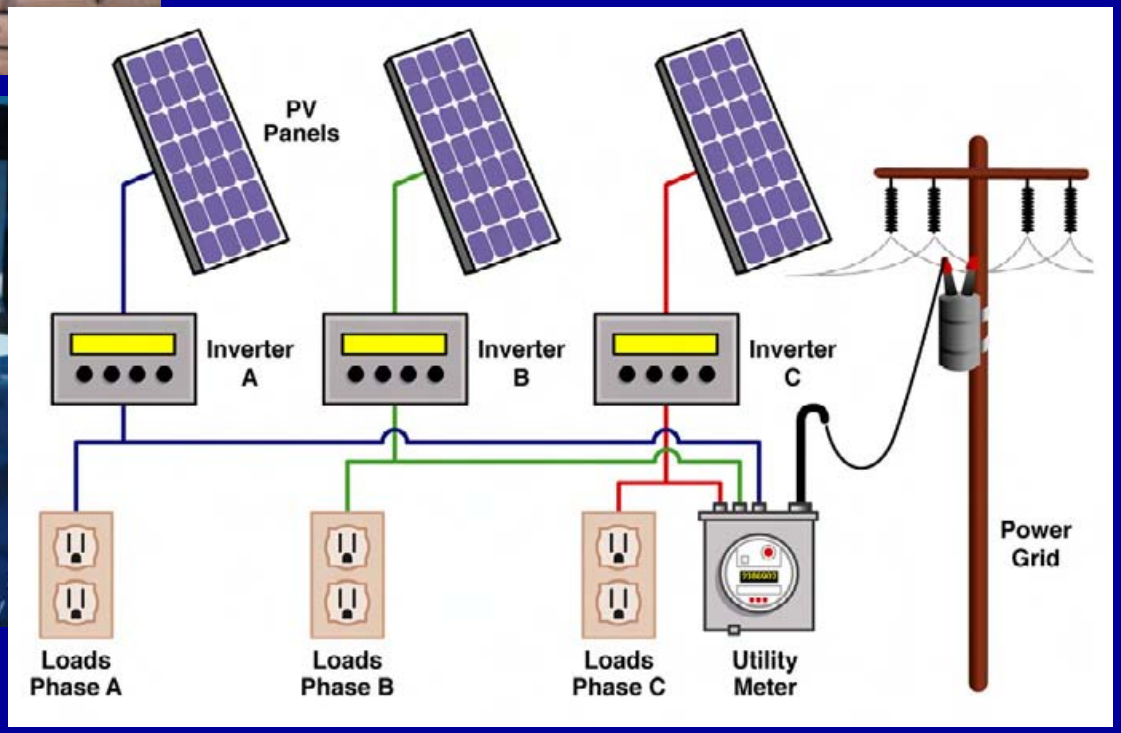
- Daylighting
- Downdraft evaporative cooling
- Trombe wall
- Radiant heating
- Roof photovoltaic (7.2 kW)
- Operation without grid power



BigHorn Center

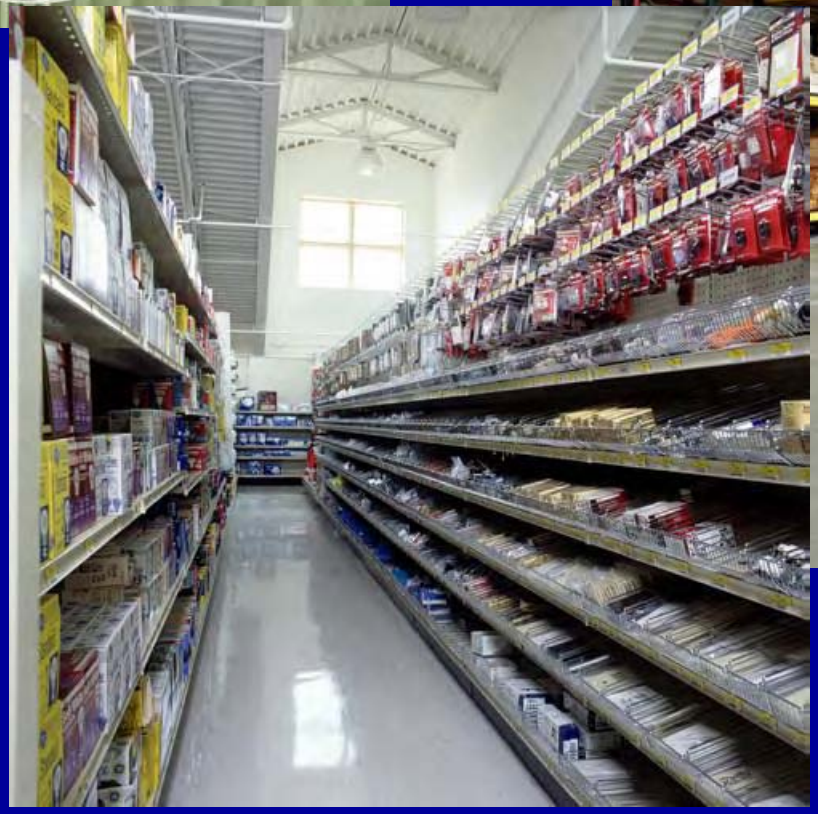
62% savings projected

BigHorn Center (BIPV)

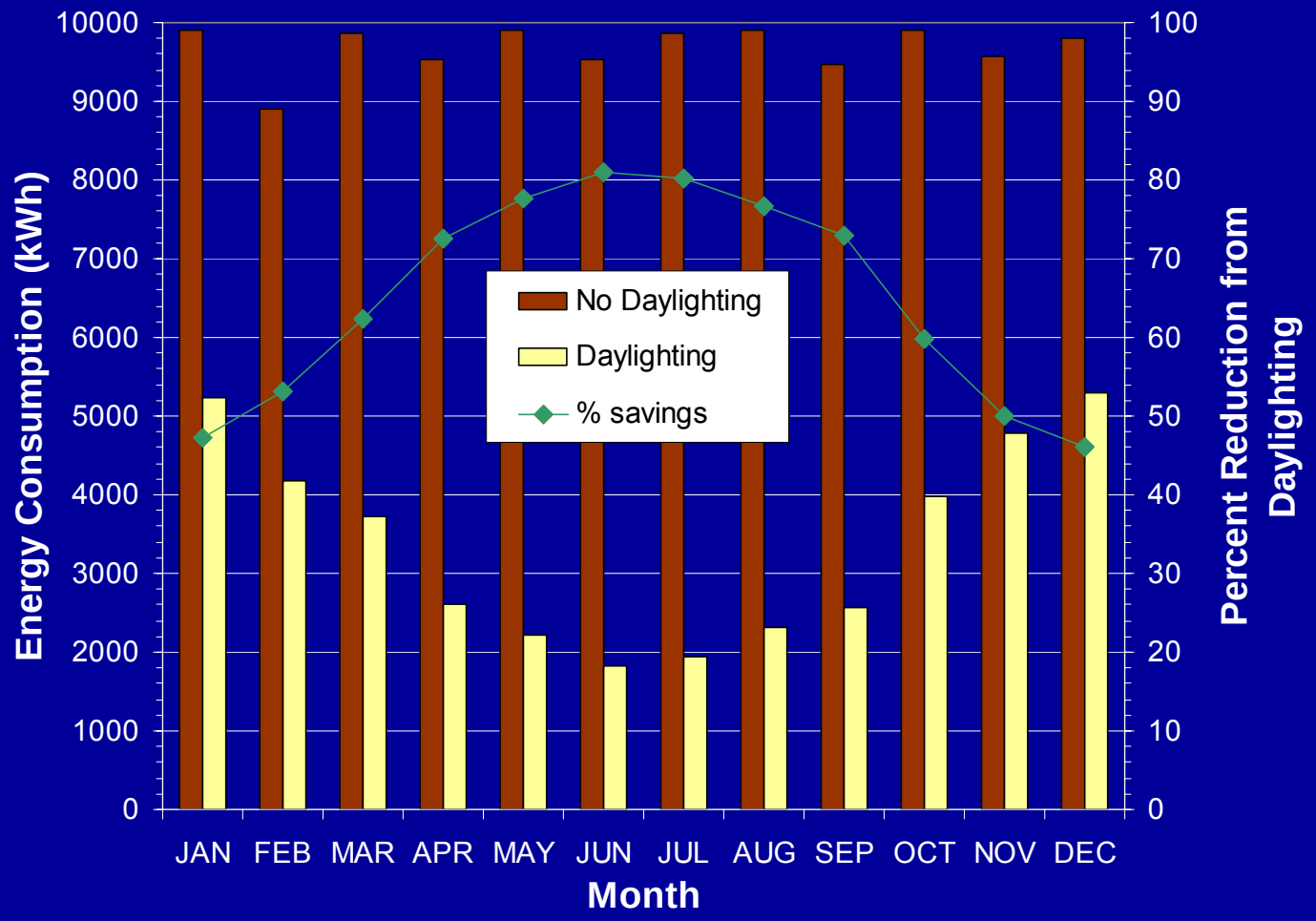


Daylighting

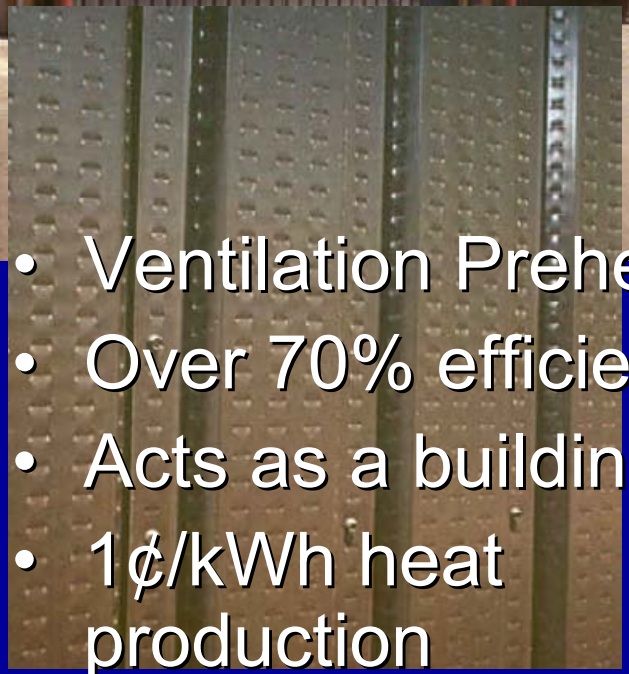
Electric Lighting and Daylighting



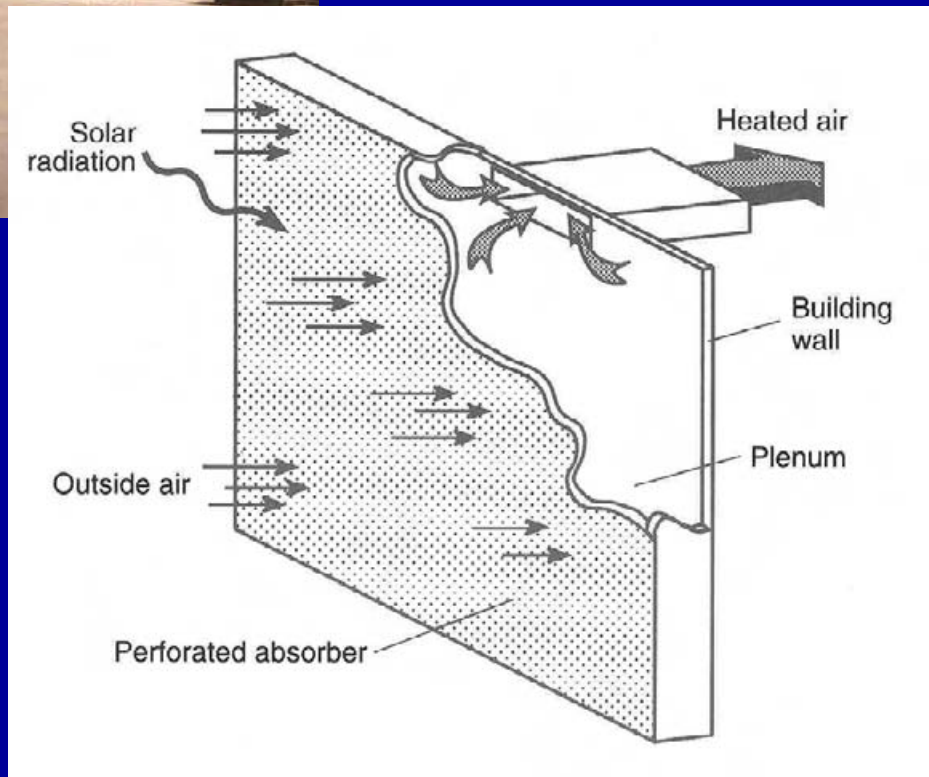
Daylighting System Expected Performance



Transpired Solar Collector



- Ventilation Preheat
- Over 70% efficient
- Acts as a building skin
- 1¢/kWh heat production



Some Resources

- www.buildinggreen.com
- www.usgbc.org (LEED ratings)
- www.highperformancebuildings.gov
- www.aceee.org
- www.nrel.gov/data/pix
- http://www.eere.energy.gov/femp/

What to look for...

- General Rules for Buildings
- Long axis of building faces south
- Minimal **East and West** Windows
  - Should have low SHGC (<0.40)
- Maximize **South** Glazing with high glass for daylighting
  - Design overhangs to shade surfaces in summer
  - Use high SHGC (>0.60)
- Use **North** glass for daylighting and view glass
  - SHGC does not have big energy impact
- Motion and Daylight Sensors to harvest daylighting

What to look for… part II

- Good Insulation Packages
- Energy Star Appliances
- No incandescent lights
- Effective Energy Design
- HVAC sized for the building, type appropriate for climate (Evap cooling in SW, etc)
- Low-Energy is in the Building, not the HVAC system.
- Pay for added building costs with reduced HVAC.
- Use simulations to design building.

What to look for… and how to accomplish

- Low Maintenance design (Stucco, Masonry, clad windows, metal roof, etc.)
- Low water use design
- WHO ELSE IN YOUR TRIBE OR COMMUNITY CAN HELP?
- Who can provide required goods and services?
- How will project be funded?
- Sketch a project time line.

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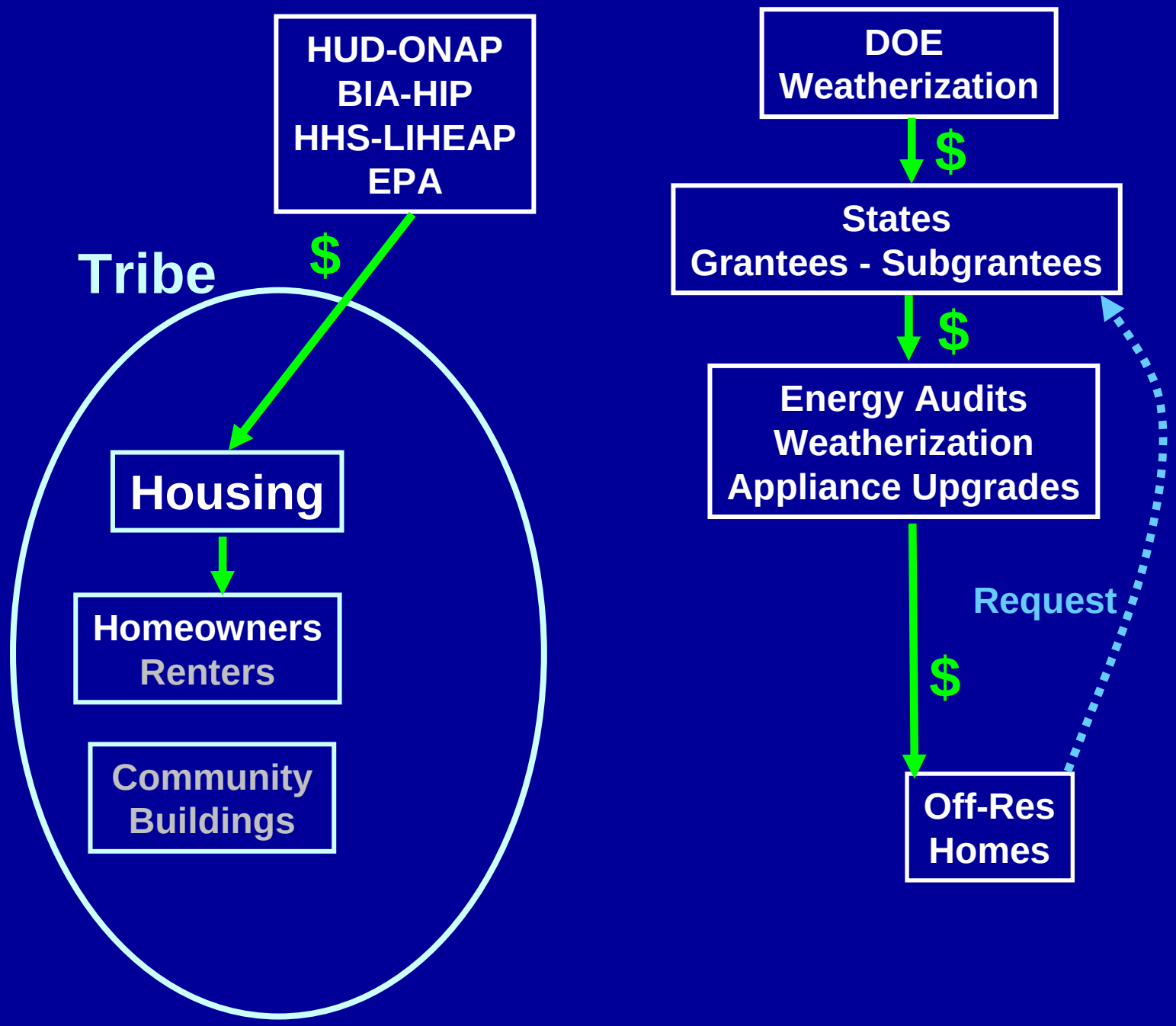
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HHS-LIHEAP
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Community
Buildings
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Weatherization
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States
Grantees - Subgrantees
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Energy Audits
Weatherization
Appliance Upgrades
Request
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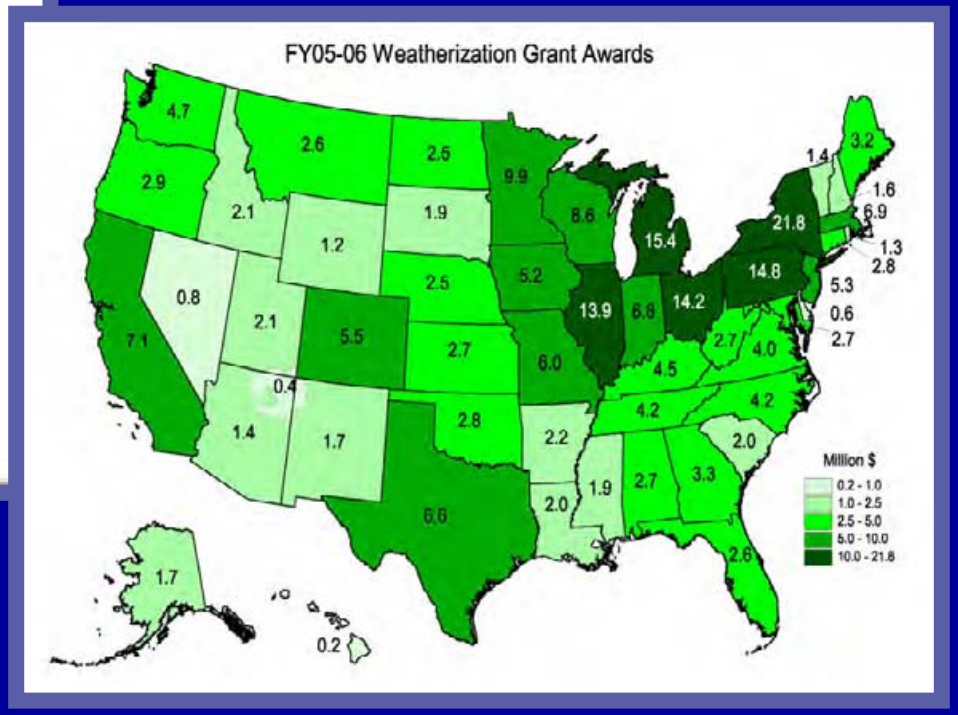
Off-Res
Homes

Figure A

Tapping into the Weatherization Network



http://www.eere.energy.gov/weatherization/

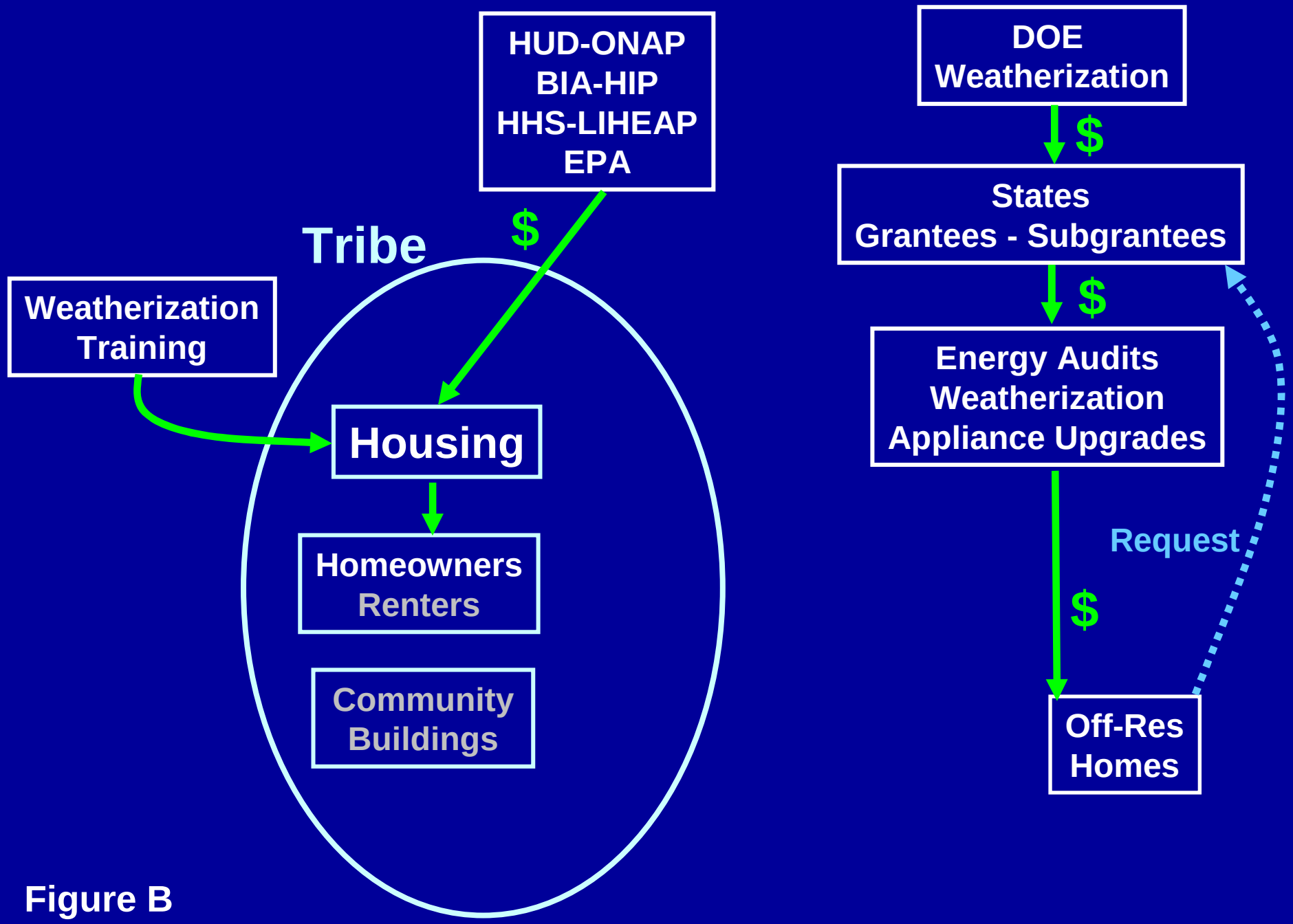

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Figure B

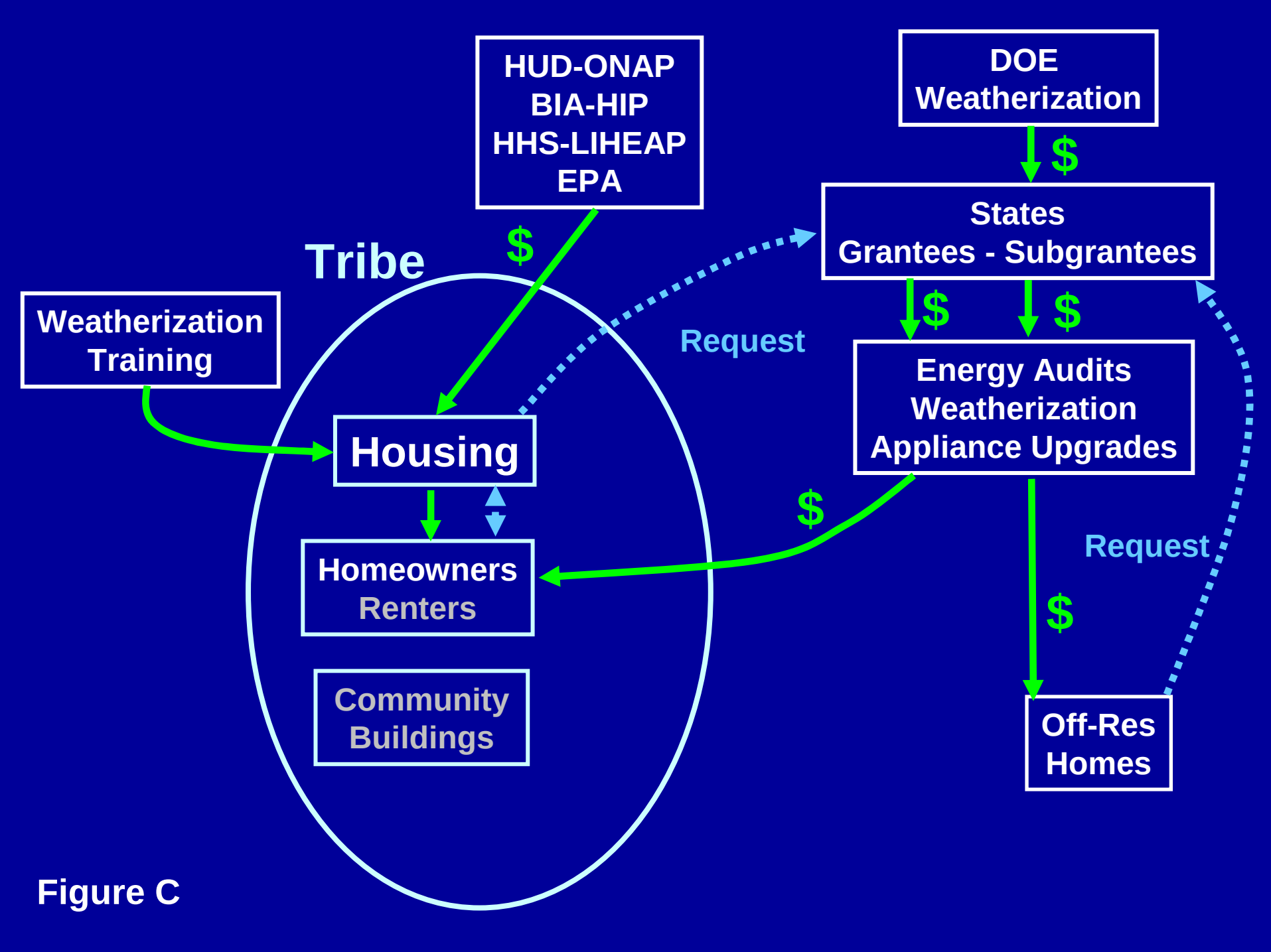
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Figure C

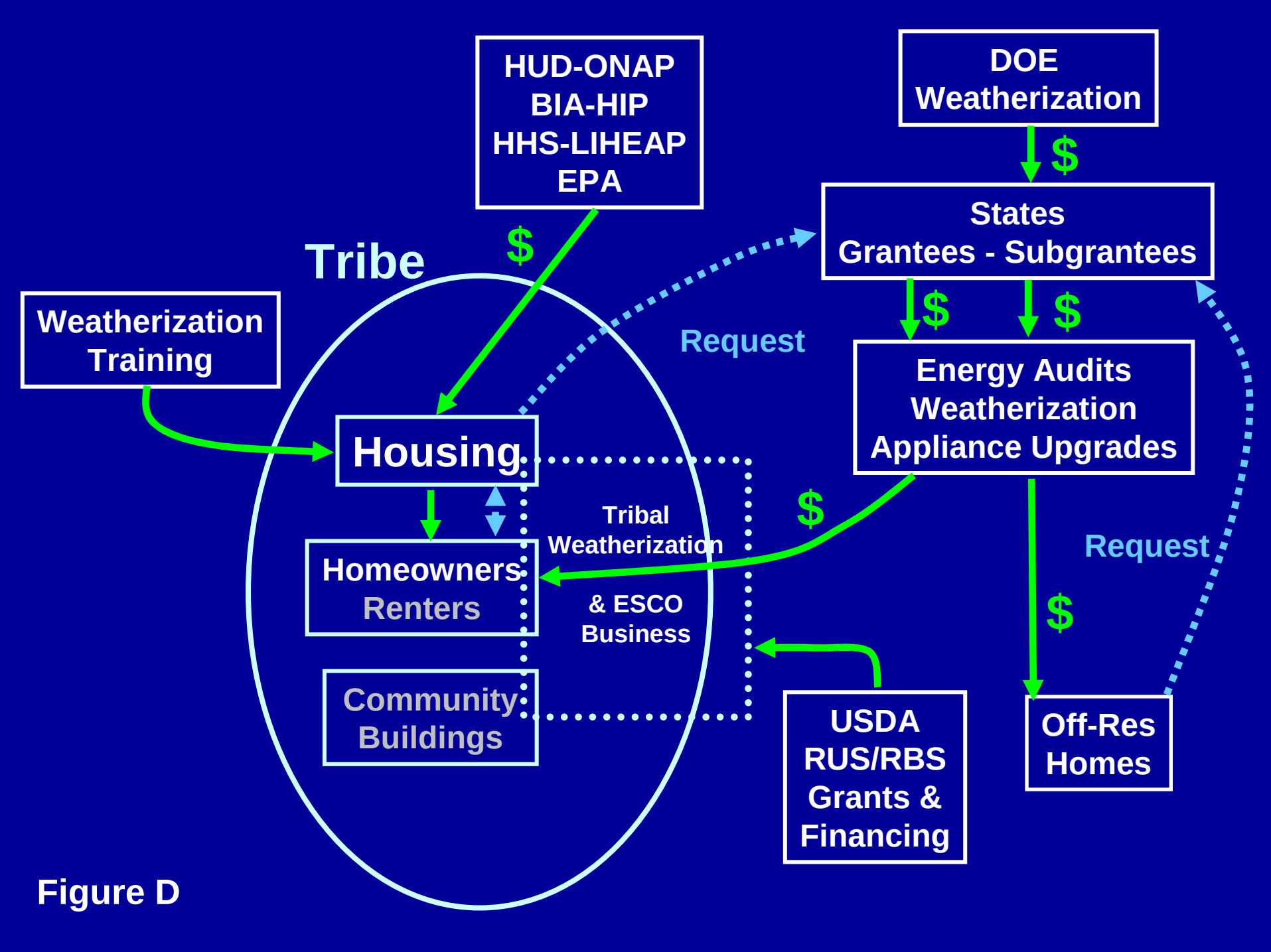
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Figure D