



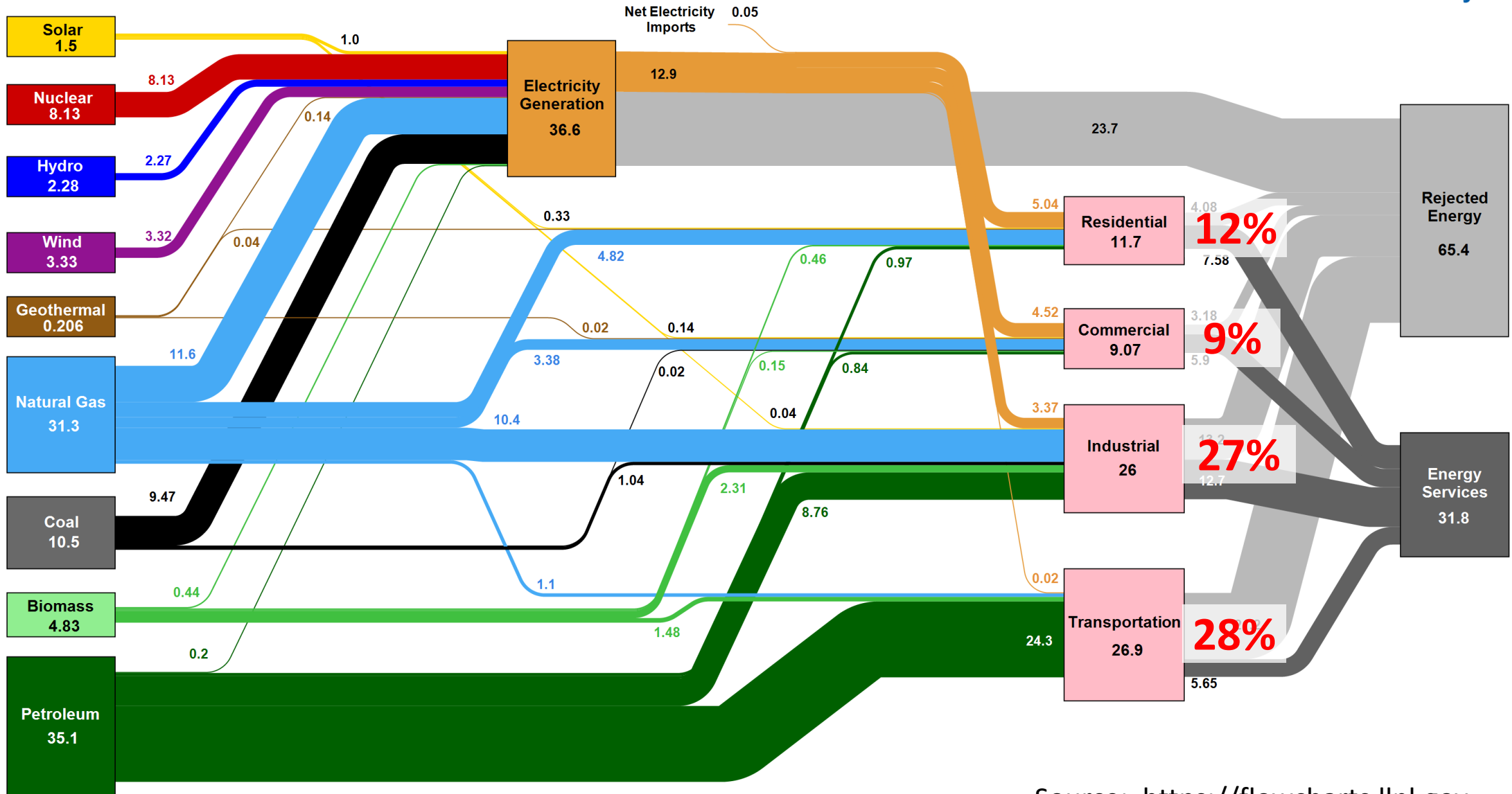
# Thermal Energy Storage for Low Carbon Buildings



*May 2023*  
*Jim Leidel*



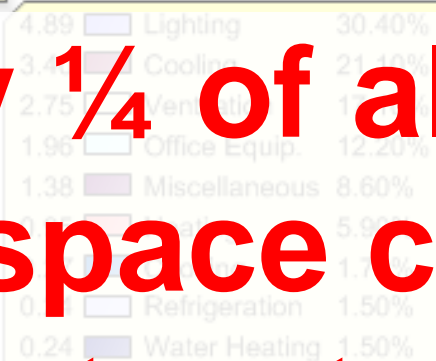
# Estimated U.S. Energy Consumption in 2021: 97.3 Quads



# Approximately 40% of USA energy is for buildings

Here is an example of a commercial office building load in the SE Michigan climate. Electric use = 4,944 MMBTU/yr (**60%**). Natural gas use = 3,357 MMBTU/yr (**40%**). Space Heating, Cooling + HW Heating = 4,612 MMBTU/yr (**55%**). Using this example building, 40% of USA energy x 55% thermal = approximately 1/4 of all energy.

Electric Intensity (kWh/sqft) -- Large Office Buildings



Natural Gas Intensity (kBtu/sqft) -- Large Office Buildings



**So, roughly 1/4 of all USA energy goes to thermal space conditioning and domestic hot water heating**

Total Electric Intensity (kWh/sqft, annual basis): 16.10  
Average Electric Consumption per Establishment (kWh/yr): 1,449,000  
Average Electric Consumption per Establishment (kBtu/yr): 4,943,988  
Average Enclosed Floorspace per Establishment (sqft): 90,000

Total Gas Intensity (kBtu/sqft, annual basis): 37.30  
Average Gas Consumption per Establishment (kBtu/yr): 3,357,000  
Average Enclosed Floorspace per Establishment (sqft): 90,000

# Thermal Storage Applications

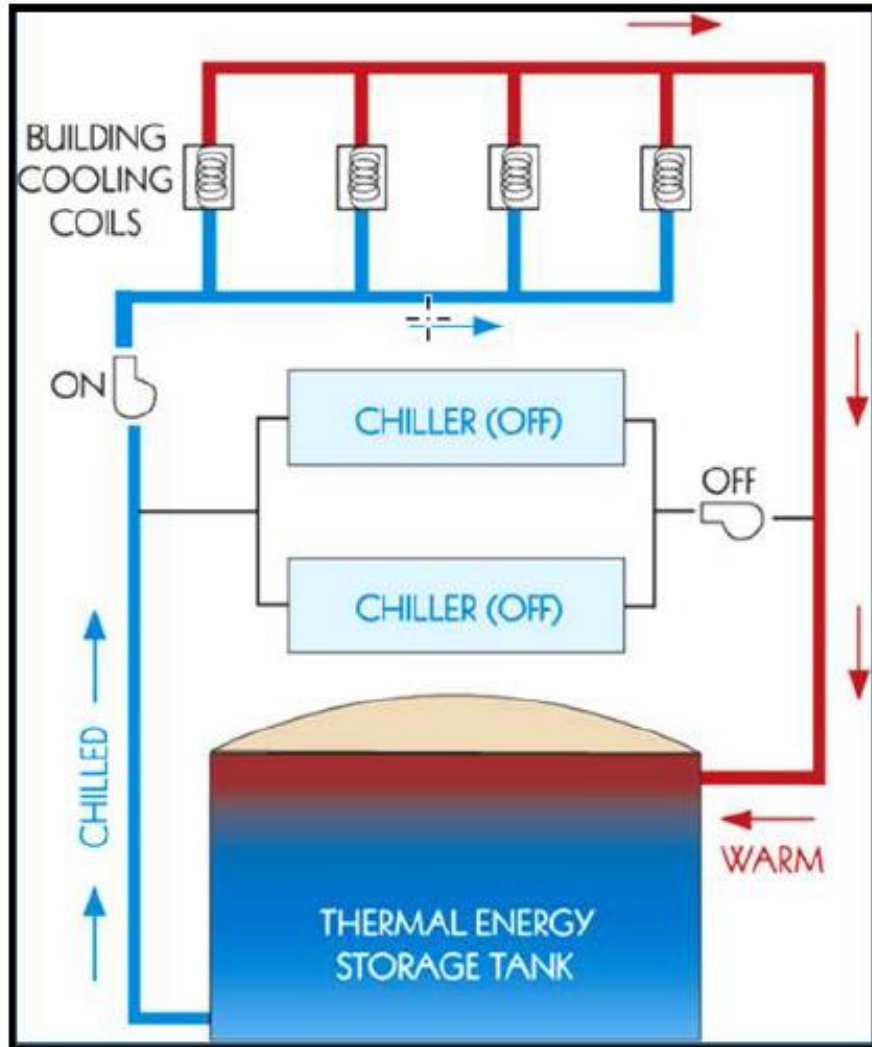
## **HEATING**

- Hot water storage
  - Buildings
  - Greenhouses
  - Cogeneration systems
  - District energy systems
  - Grid load management
- Seasonal energy storage
- Solar thermal systems
  - Hot water
  - Molten salts
- Phase change materials
- Thermo-chemical storage

## **COOLING**

- Chilled water storage
- Phase change materials
- Ice storage systems
  - Demand management/peak reduction
  - Load shifting from night to day
- Seasonal energy storage

# Load shifting example: Ice storage





# Thank you.

Jim Leidel  
Principal Technical Consultant  
DTE Gas Major Accounts  
[james.leidel@dteenergy.com](mailto:james.leidel@dteenergy.com)