

# ES 70 Introduction to Energy Management

## Energy Balance

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Instructor

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## What is an "Energy Balance?"

- A mathematical relationship, using the principle of the conservation of energy, that shows the energy inputs and outputs of a process or system.  
Earth's Energy Balance
- National Scale
  - Oil & Natural Gas
  - Electric Distribution Systems
- Local Scale--- De Anza
- Commercial Building/Home

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## Energy Balance Uses

- Energy Accounting
  - Distribute Energy Costs
- Set Priorities for Energy Management
- Size Renewable Energy Systems

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## Utility Consumption by Building Type

Building Type	Chilled			Sum
	Electricity	Water	Steam	
	kWh/sf/yr	ton-hrs/sf/yr	lbs/sf/yr	\$/sf/yr
Laboratory	50	9	220	\$ 12.71
Library	10	3	45	\$ 2.87
Computer	35	5	30	\$ 6.66
Office/classroom	15	2	40	\$ 3.23

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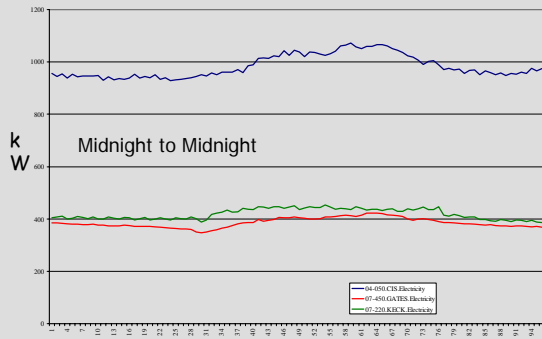
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## Demand Profile - Lab Buildings




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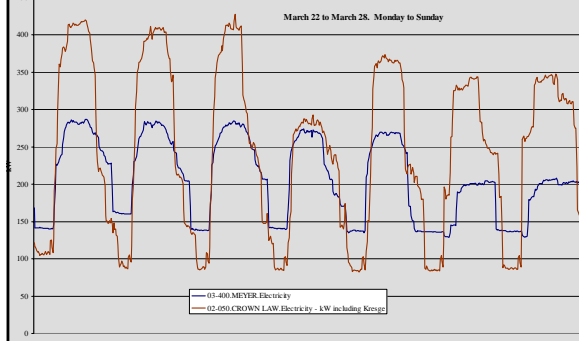
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## Demand Profile -- Classroom




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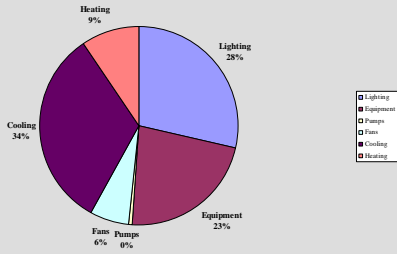
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## Classroom Energy Balance



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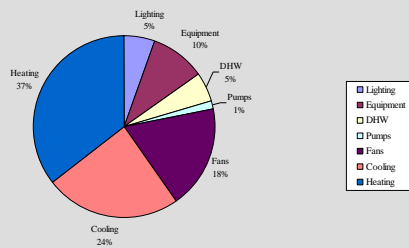
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## Lab Building Energy Balance



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## Electricity

- Energy is the ability to do work
- Power
  - Instant "Demand"
  - Watt (W) or kilowatt (kW)
- Energy
  - Power x Time
  - Watt hour (Wh) or kilowatt hour (kWh)

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## Power vs. Energy

Power X Time = Energy



100 watts X 10 hours = 1kWh

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## Energy vs. Demand



100 watts X 10 hours  
=> 1 kWh energy  
=> 100 W demand



1000 watts X 1 hour  
=> 1 kWh energy  
=> 1 kW demand

April 3, 2001

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## Energy Rates

- Residential
  - Electric: \$0.14/kWh (Baseline)
  - Natural Gas: \$0.86/therm (Baseline)
- Commercial
  - Electric \$0.14 - \$0.17/kWh
    - Including demand and Time of Use
  - Natural Gas \$.70/therm

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## Energy Rates cont.

- Commercial v Residential Rates
- Demand Charges - Peak power
- Time of Use
  - Off Peak - Nighttime, weekends
  - Part Peak - "Shoulder Periods"
  - **Peak - Noon until 6:00 PM !!**

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## Common Conversions

- 1 kWh = 3414 btu
- 1 therm = 100,000 btu
- 1 gallon of gasoline = 150,000 approx.

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## Energy Balance Assumptions

- Energy Data from PG&E bill
  - 3 bedroom home
  - Natural gas heating
  - No AC
  - Other Questions
    - Number of Occupants, Home office?, Age of home, Type of appliances, etc.

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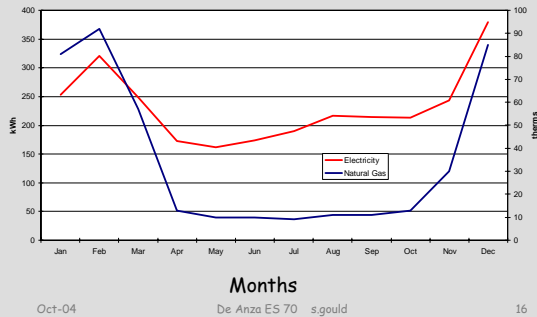
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## Typical Residence



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## Home Use Assumptions

	kWh	Therm				
Jan	253	81	Rates:			
Feb	321	92		Electricity	3414	btu/kWh
Mar	249	57		Natural Gas	100000	btu/therm
Apr	173	13		Electricity	0.140	\$/kWh
May	162	10		Natural Gas	0.83	\$/therm
Jun	174	10				
Jul	190	9				
Aug	217	11				
Sep	215	11				
Oct	213	13				
Nov	243	30				
Dec	380	85				
	2790	422				
			SUM			
BTU	9,525,060	42,200,000		51,725,060		
\$\$	390.6	350.26		740.86		

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## Transportation Assumptions

Miles per gallon	24				
Energy content of	150,000	btu/gallon	(approximate)		
Price of gas	\$ 2.45	gallon			
Car	Miles/day	Days/wk	Weeks/yr	Miles/yr	Gallons/yr
Work	16	5	48	3840	160
Work DeAnza	30	1	30	900	37.5
sub total				4740	198
Play (Beach)	100	1	48	4800	200
Play (Mountains)	500	1	4	2000	83
Other	5	7	52	1820	76
sub total				8620	359
<b>total</b>				<b>13360</b>	<b>557</b>
Gallons of Gas	Gallons	btu	\$		
Work	197.5	29,625,000	\$ 484		
Play	359.2	53,875,000	\$ 880		
<b>total</b>			<b>\$ 1,364</b>		

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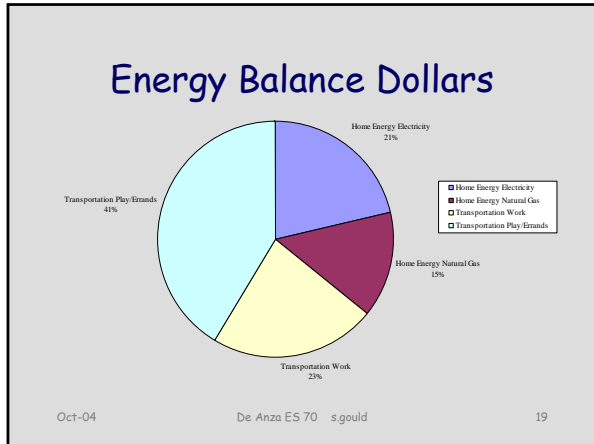
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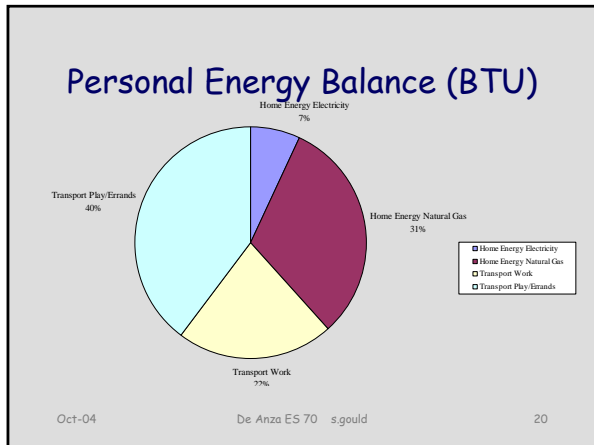
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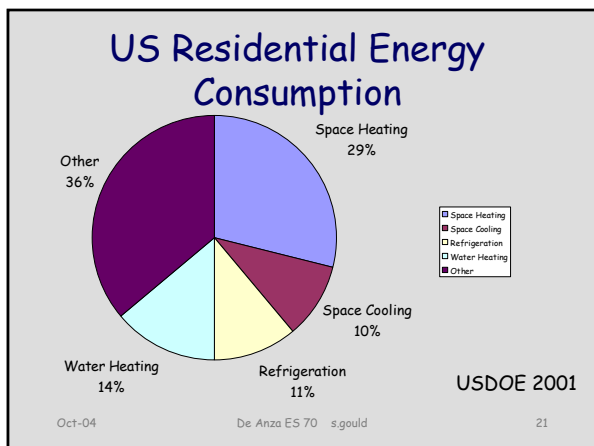
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## Homework Assignment

For next week's discussion and journal entry:

1. Gather assumptions for doing an energy balance. (See example)
2. Prepare to discuss in class next week.

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## More Info

- PG&E Rate Information  
[http://www.pge.com/res/understanding\\_bill/](http://www.pge.com/res/understanding_bill/)
- Residential Energy Use - Rocky Mountain Institute  
<http://finder.rmi.org/efficiency/measures/residential/consumption.asp>

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