# Solar Evaluation Committee

**Report to the Master Planning Committee**

**9 December 2015**

# Solar Energy for Kendal?

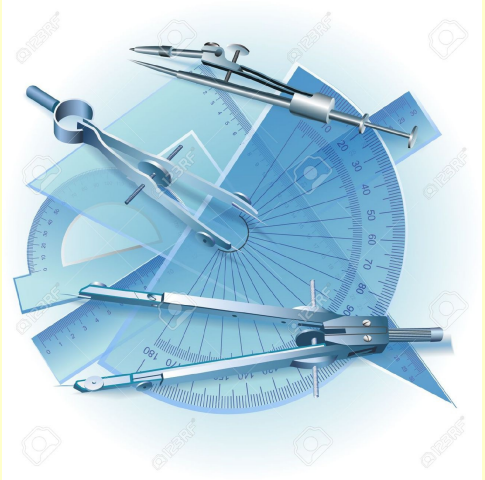
**Why?**

**What?**

**Where?**

**When?**

**How Much?**



# Why?

**To Do Our Part in Making Oberlin Green**

**Kendal's Annual Electric Bill**

**$463,090.01 (July 2014-June 2015)**

**Kendal's Average Electric Usage**

**4,809,600 Kilowatt-Hours per year**

**400,800 Kilowatt-Hours per month**

**13,228 Kilowatt-Hours per day**

# What?

**Focus on Solar Electric**

- **30% Tax Credit Good Until December 2016**
- **4.1 Kilowatt-Hours per square-meter per day**

**Photovoltaic Solar Collectors**

- **5,800 square meters (13,228/4.1*1.8)**

# Where?

## to put 5,800 square meters

**Carport Roofs**

800 square meters

**Cottage Roofs**

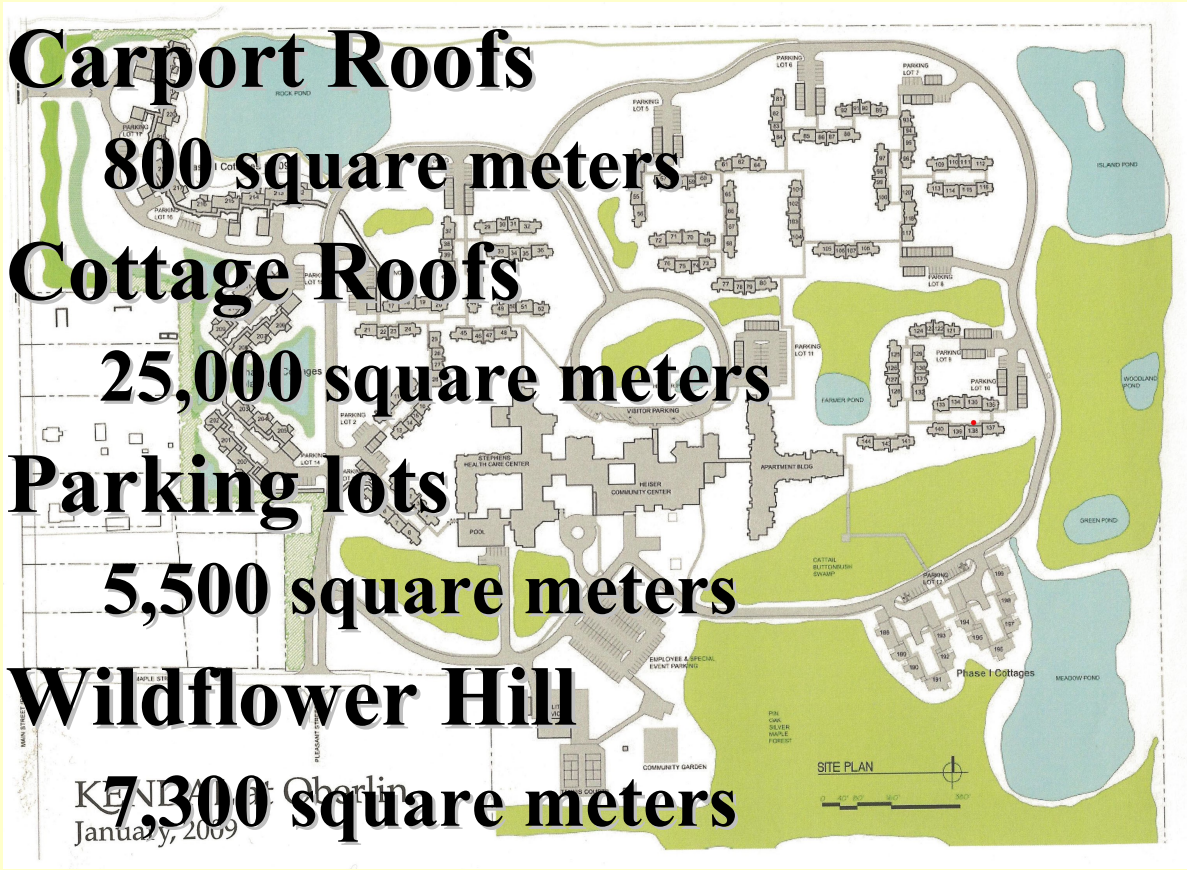
25,000 square meters

**Parking lots**

5,500 square meters

**Wildflower Hill**

7,300 square meters




# When?

**30% Federal Tax Credit**

- **Expires December 2016**

**Contract Time**

- **2 Months**

**Design and Build Time**

- **9 Months**

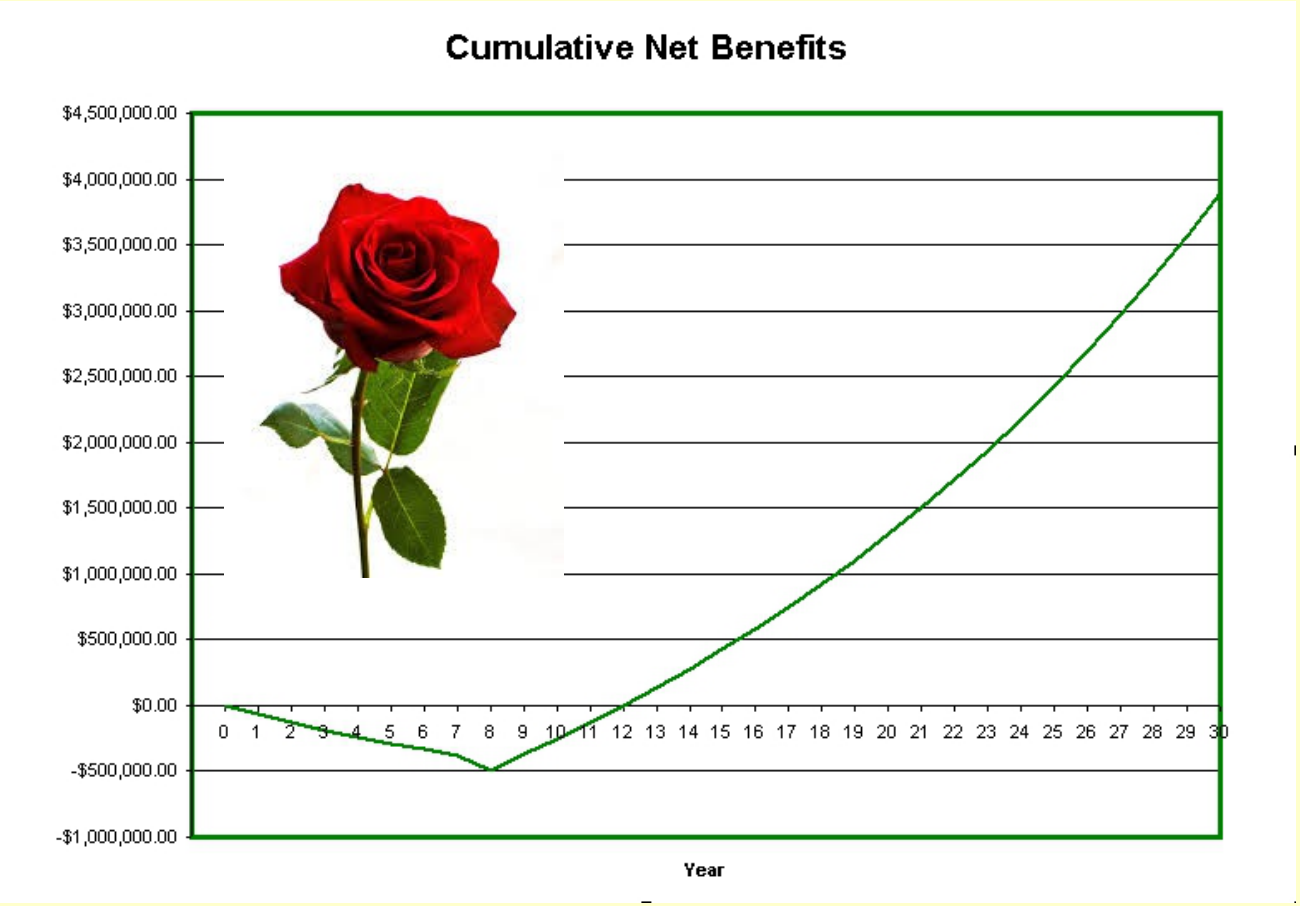
**Need Board Decision by January 2016**

# How Much?

- Ground Arrays $2,000 per KW
- Rooftop Arrays $3,000 per KW
- Canopy Arrays $4,500 per KW
- Storage $3,500 per KW

- 500KW Array $1,500,000

# Payback
## Vendor Estimate



# A Closer Look At The Data

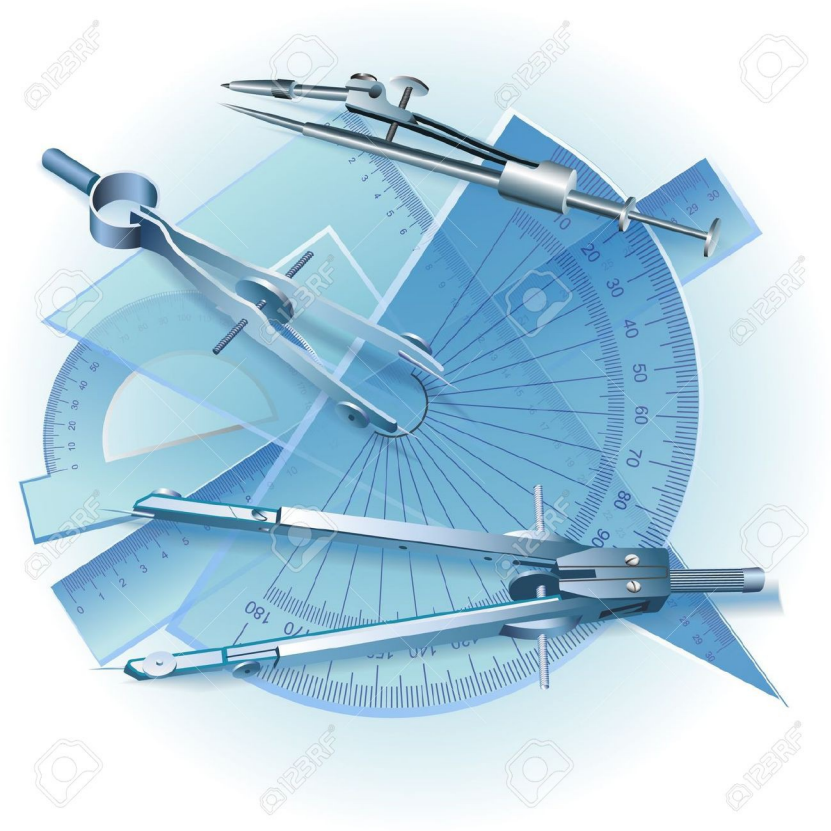
Why?

What?

Where?

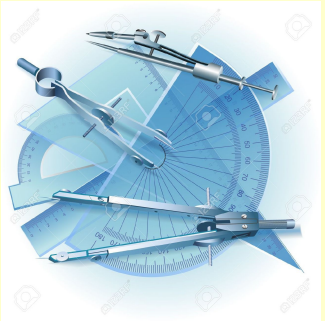
When?

How Much?

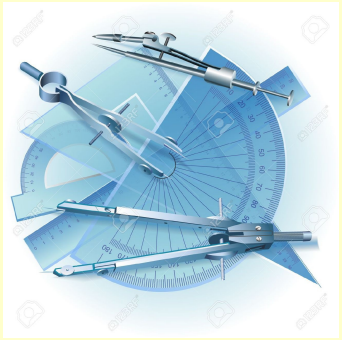


# Why?

- We Don’t Need Solar For Green Electricity
- Our Electricity Is Relatively Cheap
- Solar Doesn’t Produce When We Need It
  But Storage Technology Isn’t Ready Yet
- We Don’t Know How Much We Need

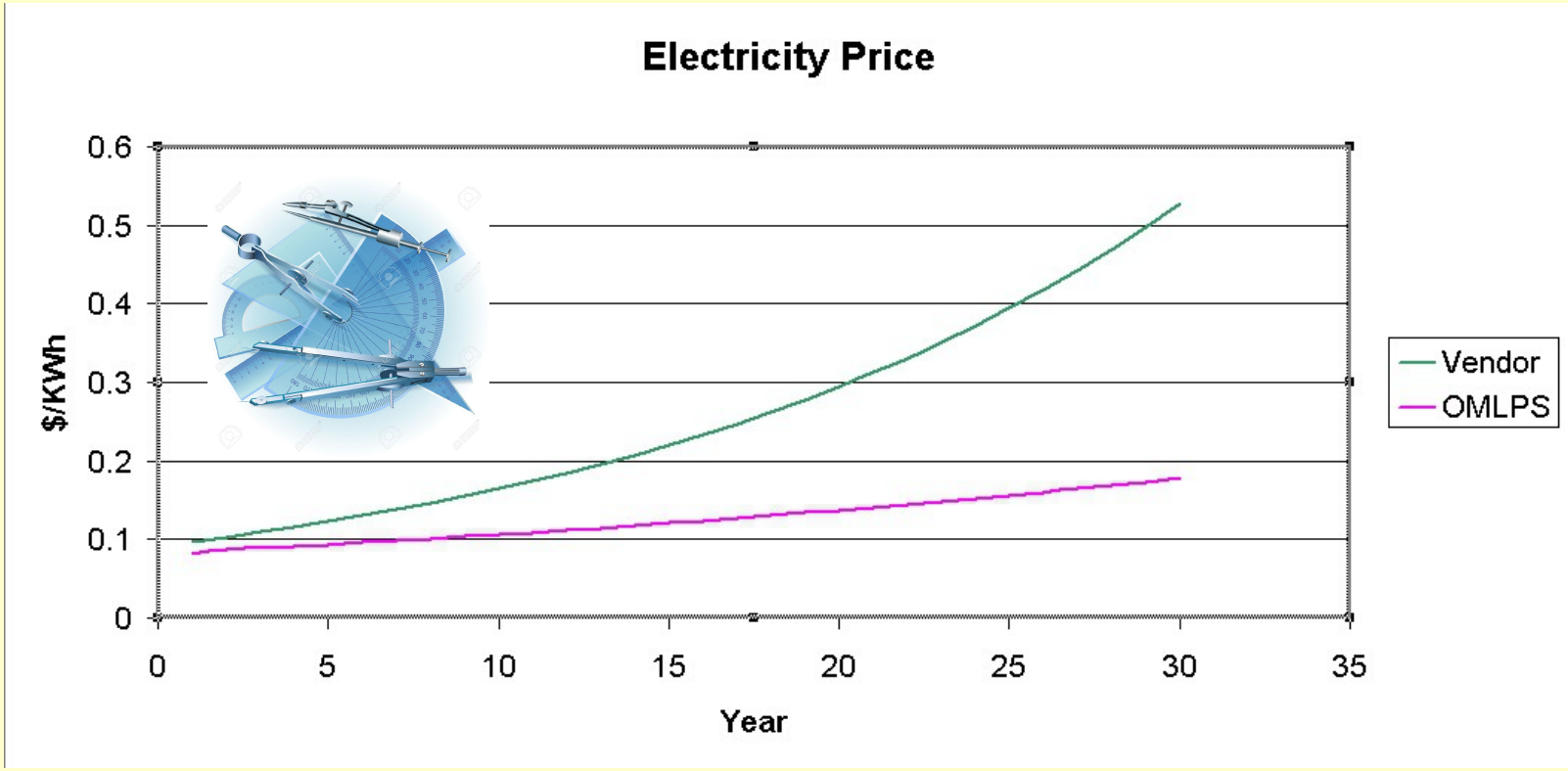


# Oberlin Municipal Light and Power

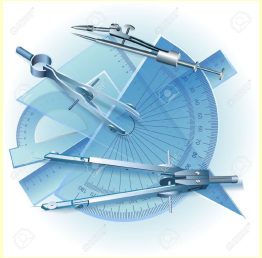


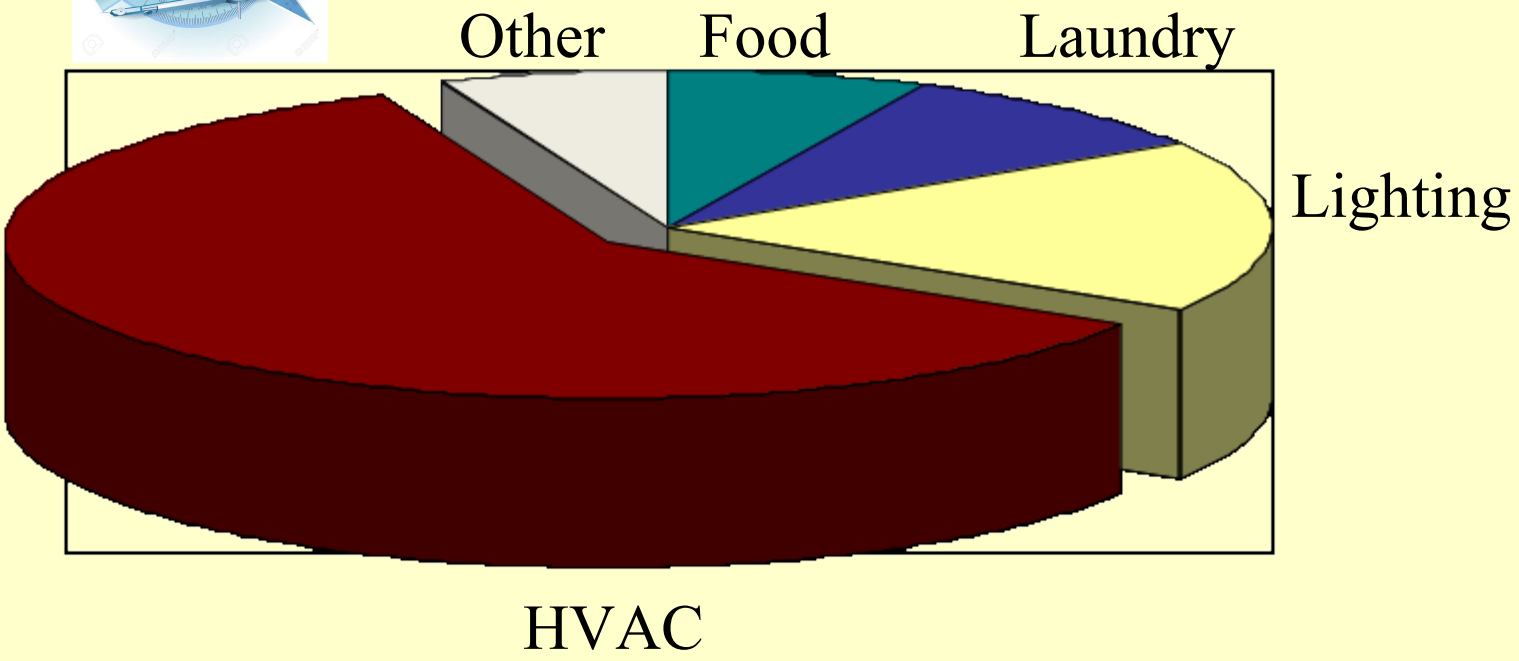
- 87% Renewable Energy Now
- 90% By Next Year
- Kendal Uses About 5% of OMLPS Power
- They Can't Use Our Excess Power, Especially When Their Demand Is Low

# Cost of Electricity
# Vendor Estimate vs. OMLPS

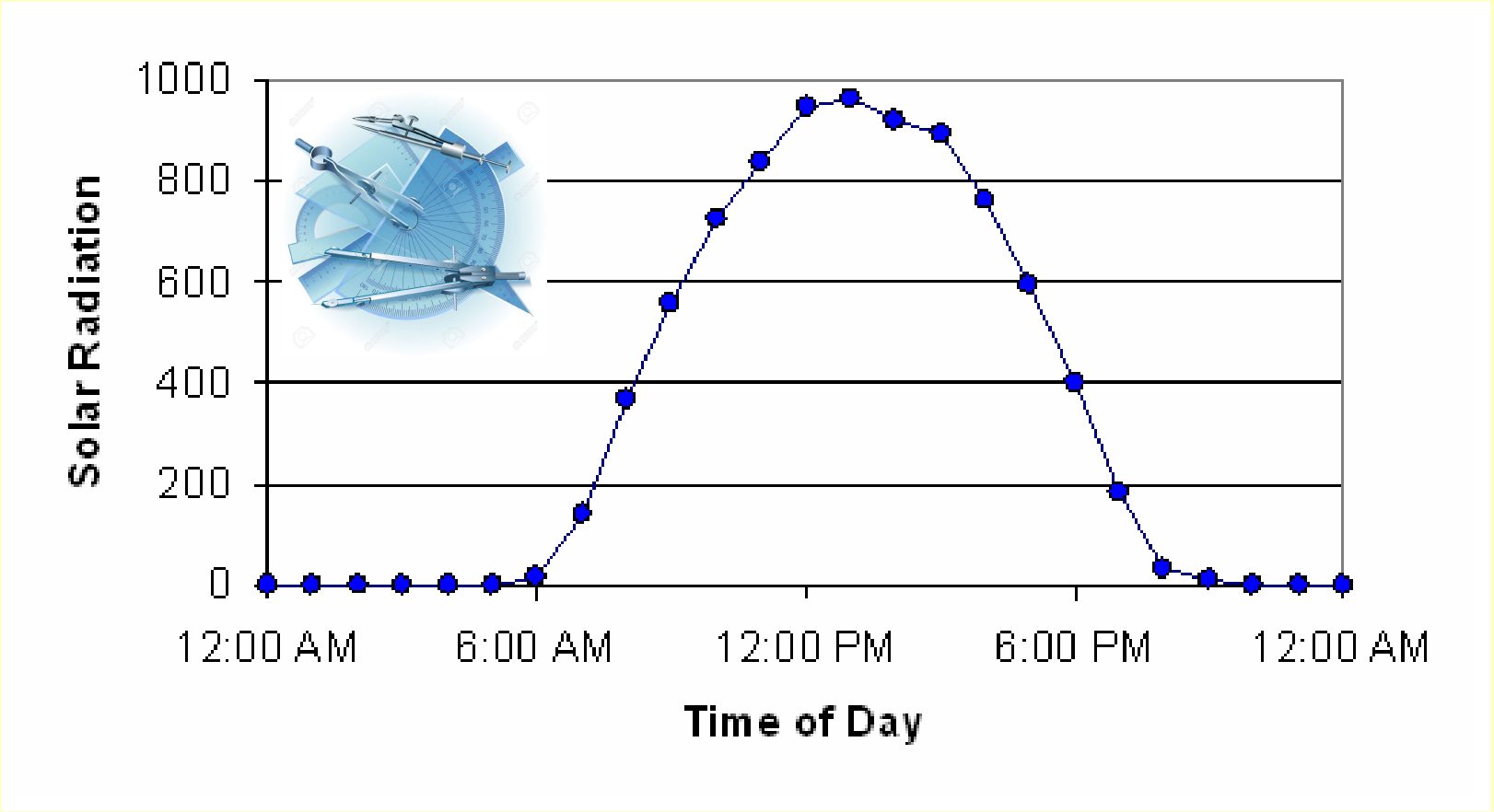


# Expected Energy Use



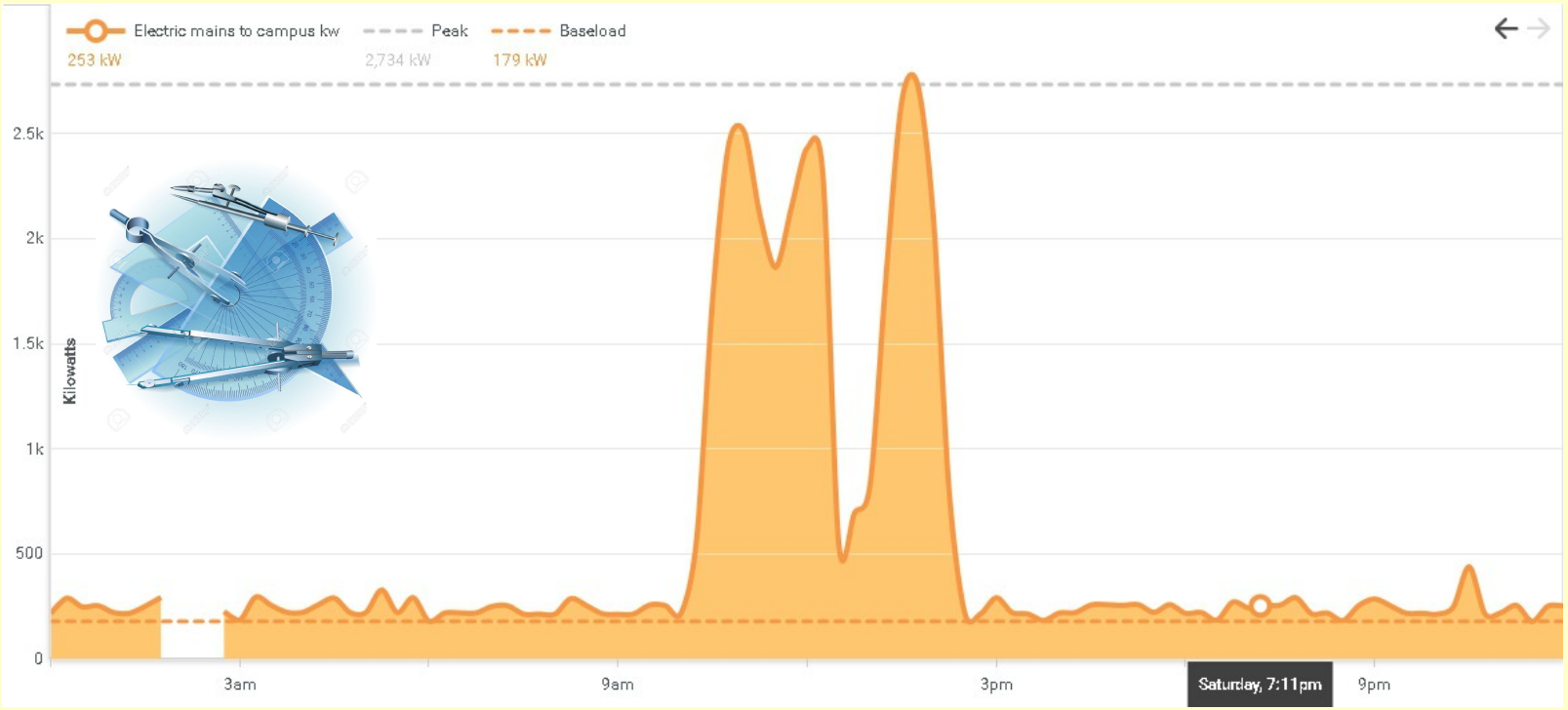


# Solar Radiation

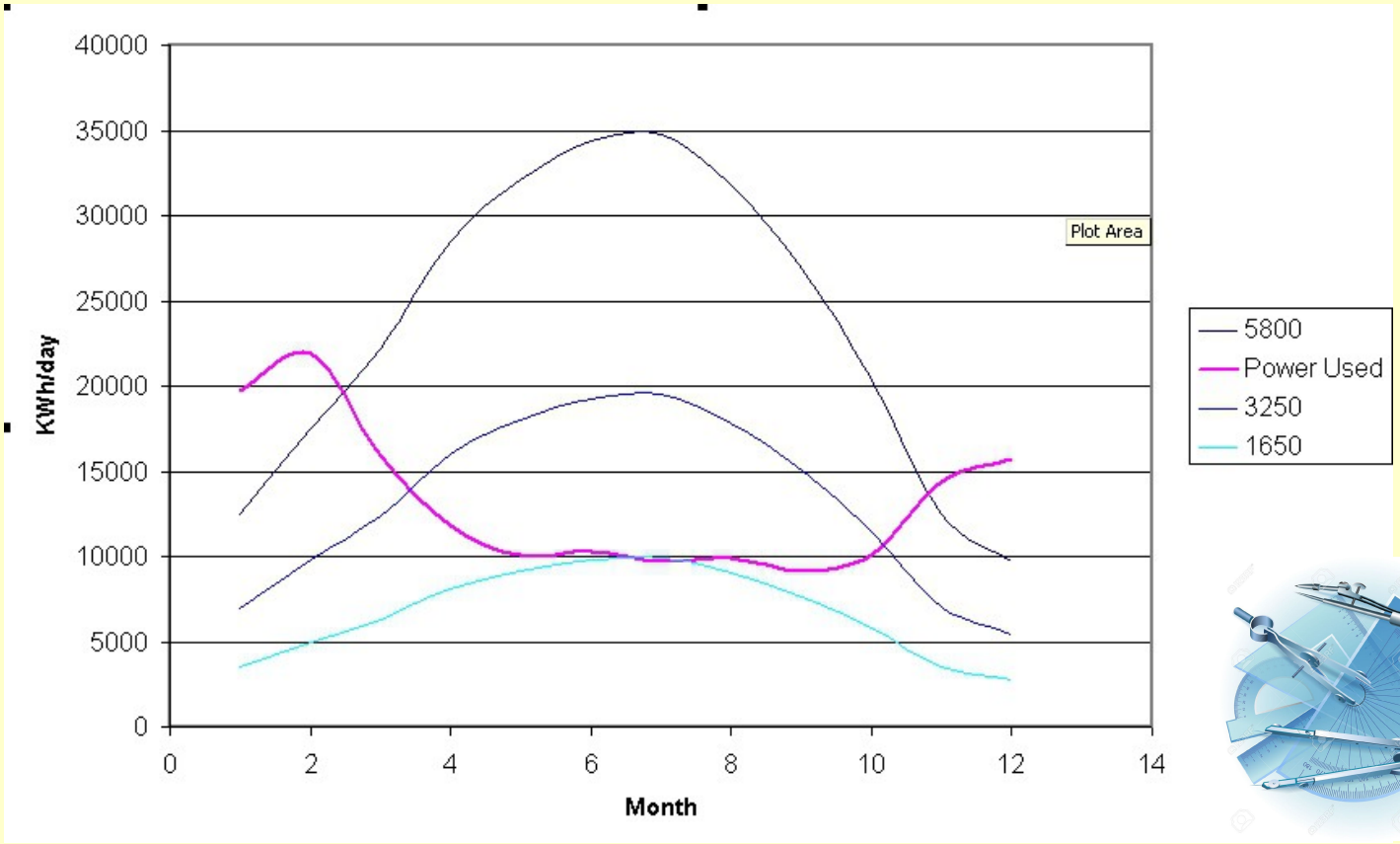


# Daily Energy Use

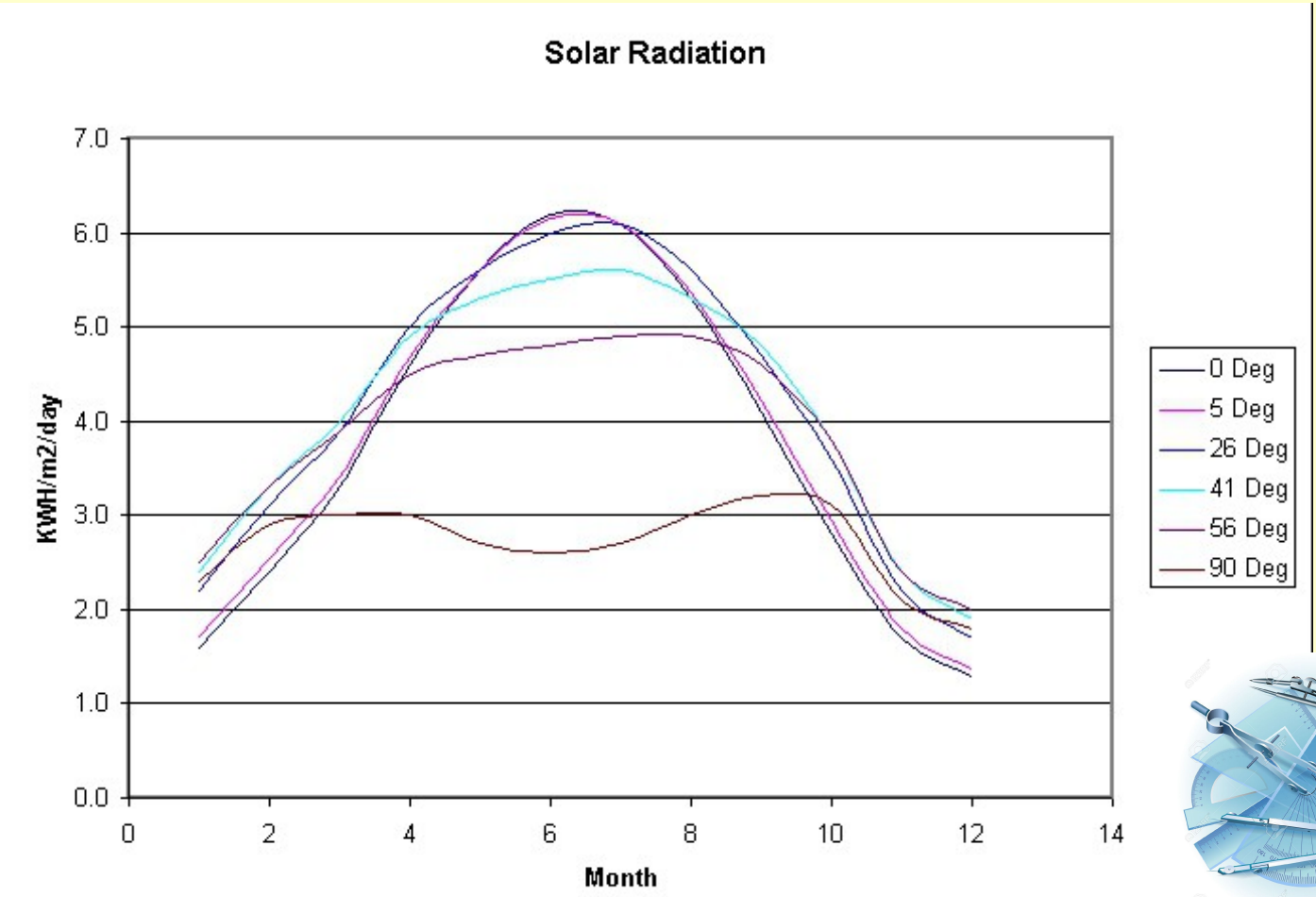
# One Day?

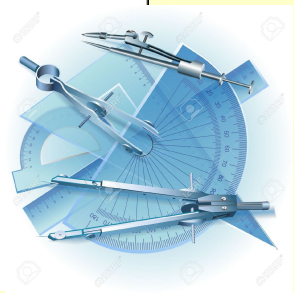

Electric mains to campus kw
253 kW
Peak
2,734 kW
Baseload
179 kW
2.5k
2k
1.5k
1k
500
0
Kilowatts
3am
9am
3pm
Saturday, 7:11pm
9pm

# Monthly Energy Use vs. Availability



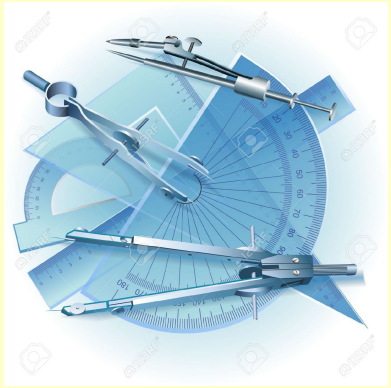
# Tilt For Need?



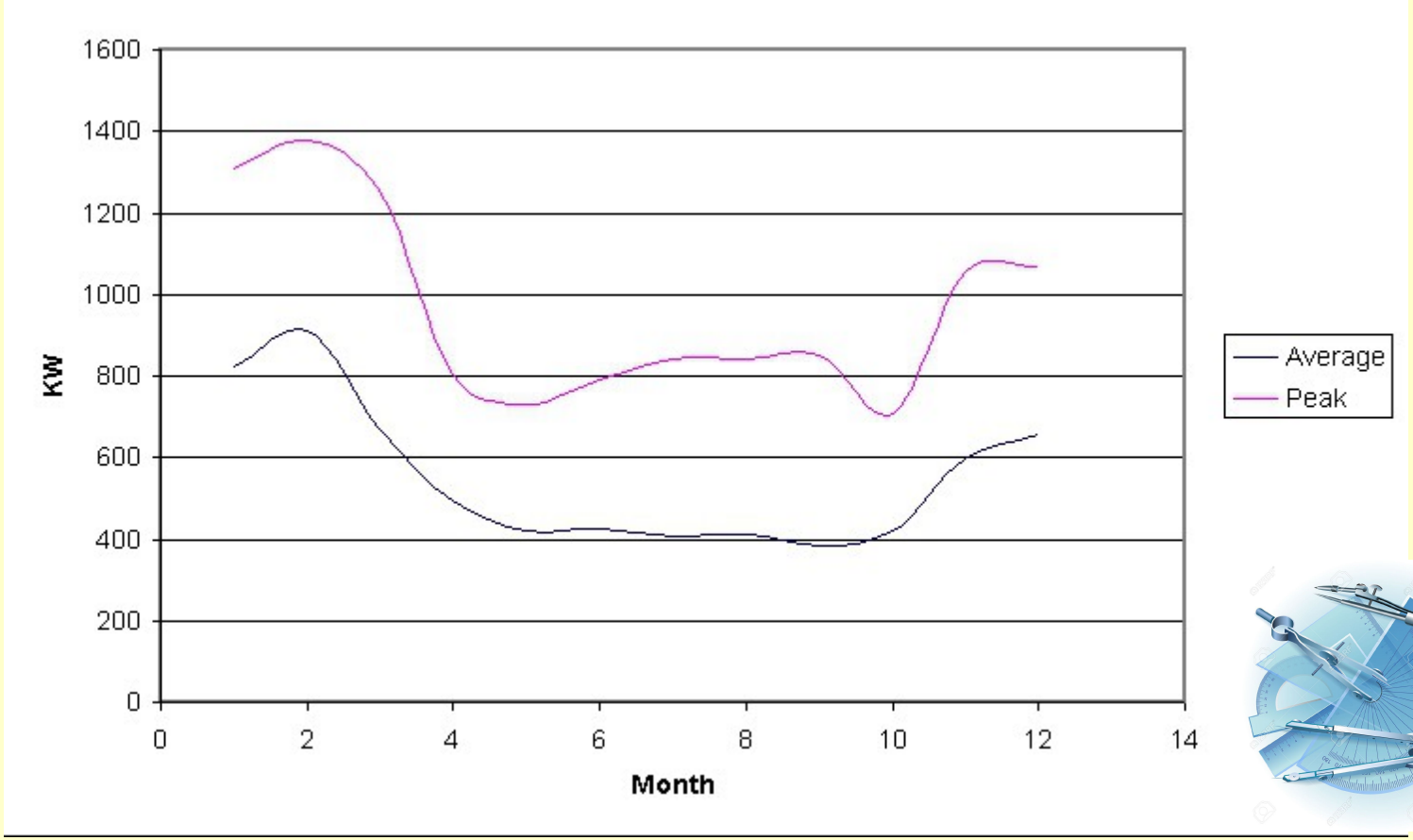



# Demand Cost vs. Use Cost

- Use Cost
  - Average $0.086 per KWh
  - Annual $344,291 plus taxes
- Peak Demand Cost
  - Price $8.69 per 15min peak/Month KW
  - Annual $101,047 plus taxes

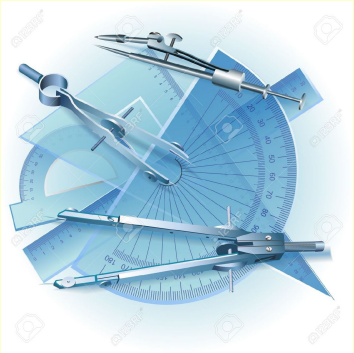


# Peak Demand vs. Average



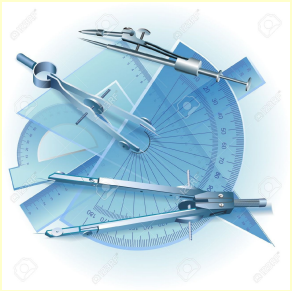
# We Don't Know Our Energy Use

- Reductions In Progress
  - Insulation Upgrades
  - Ground Source Heat Pumps
  - Energy Management Upgrades
- Duration of Electric Use Peaks
- Causes of Electric Use Peaks

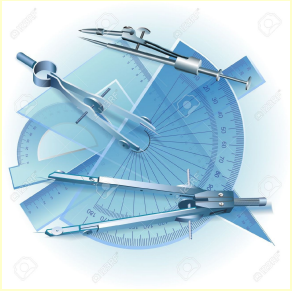


# Energy Storage

- Lead-Acid Battery Technology
  - Not Worth Having
- Lithium-Halide Technology
  - Not Available In Our Time Frame?
- Water Storage
  - 40ft diameter 100ft high tower per 100KWh
- How Much Is Enough?
  - Data Not Available to Decide

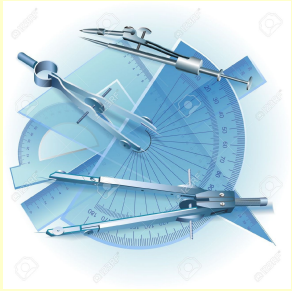


# What? And Where?



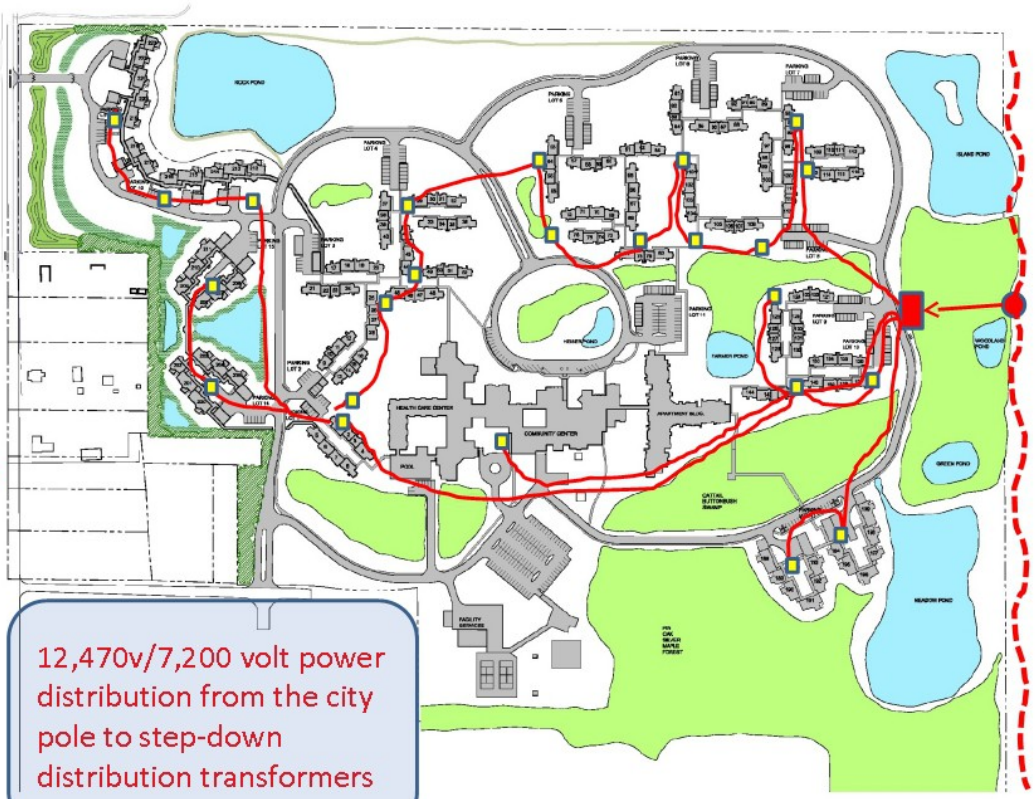
- We Can Use A Mix Of Arrays
  - Ground, Roof or Canopy
- Solar Arrays Will Be In Somebody's View
- Getting The Power Where It is Needed Is Both Inefficient and Expensive
- Fences Are Needed For Ground Arrays

# View Isn’t Green



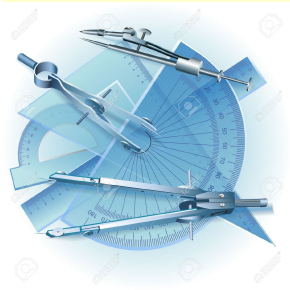
# Power Distribution

**SITE PLAN - HOW THE POWER GETS DISTRIBUTED ON CAMPUS**



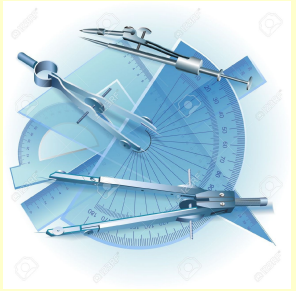
- Power Pole at edge of property.
- Underground to main switchgear enclosure.
- Underground 3 phase distribution to local transformers
- Local distribution step-down transformers

12,470v/7,200 volt power distribution from the city pole to step-down distribution transformers



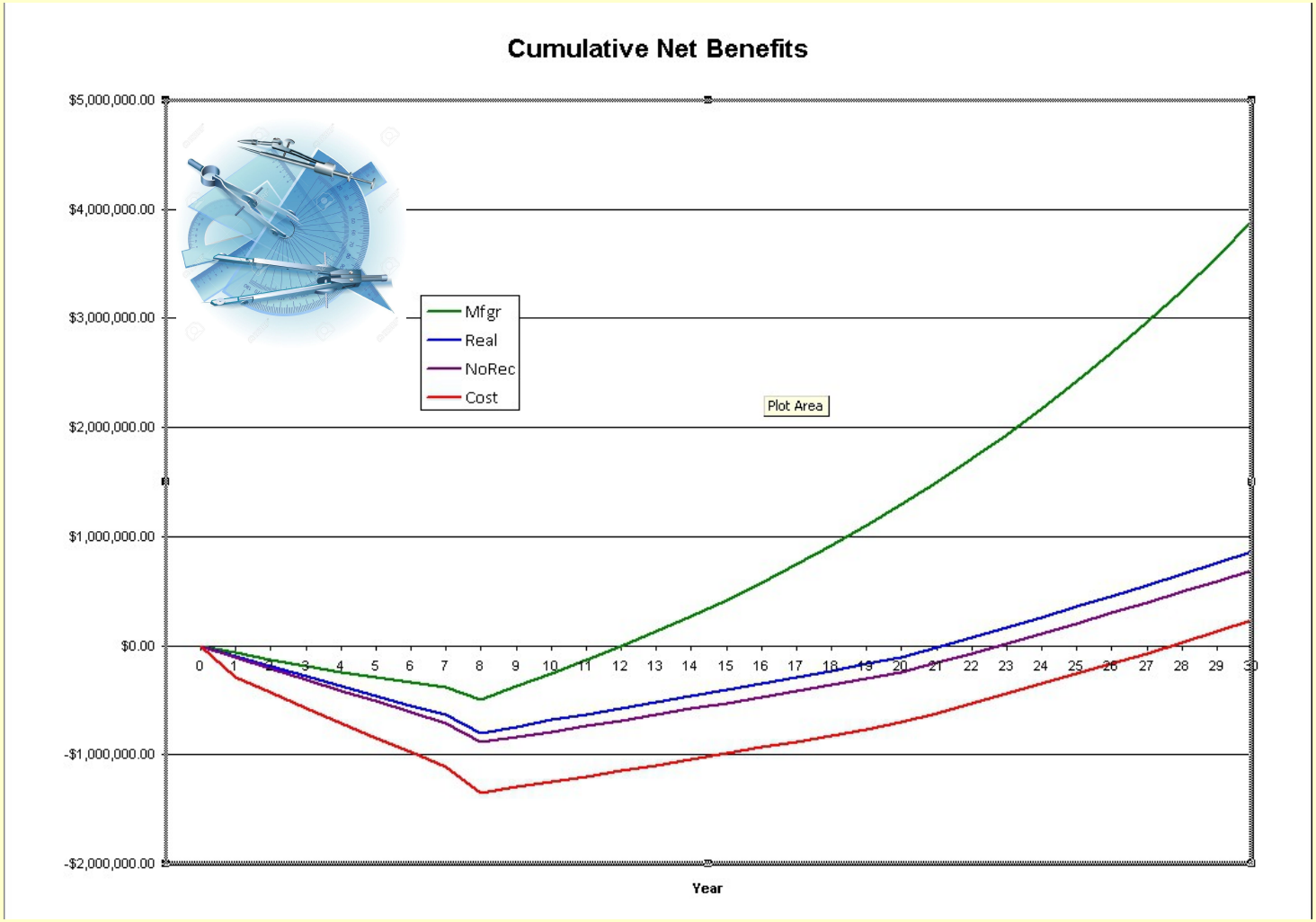
# Other Financial Factors

- Construction Cost Overruns
- Operation and Maintenance Costs
- Equipment Replacement Reserve
- Sale of Renewable Energy Credits
- Third Party Lease Profits



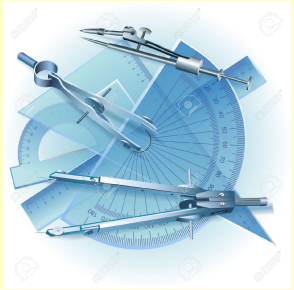
- Increased Financial Liability

# More Realistic Payback



# When?

- Time Is Short For Funding $1.5M
  - What about $500K or $100K
  - Solar Augmentation For Emergency Power
- Can't Integrate Into Garage Plans by 2016



# Where to Go From Here?

- Gather Energy Use Data For A Year
- Track Solar and Storage Technology
- Look at Solar Water Preheat
  - Domestic Hot Water Most Promising
  - No Time Constraint
  - Green vs. Gas