



# Should I Get a Solar Array for my House?

The Regulations, Available Equipment, and Benefits

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# Scope

- Explore the considerations in the decision to install a PV System on my house
- Limited to my particular example:
  - Unincorporated Jefferson County
  - Connected to the Xcel Energy grid
- Equipment, rebates, codes, standards
- Investment merits of a PV System

# Subsidies and Rebates

- Xcel Solar Rewards Program<sup>1</sup>
  - Rebate of \$2 / Watt Capacity
  - \$2.50 / Watt Renewable Energy Credit
- Federal Tax Credit<sup>2</sup>
  - Expired December 31, 2007
  - HR5351 Passed by the House in February<sup>2</sup>
    - I couldn't find any progress since then
    - Would extend the credit to December 31, 2014
    - Would increase maximum credit from \$2,000 to \$4,000

<sup>1</sup>[http://www.xcelenergy.com/XLWEB/CDA/0,3080,1-1-2\\_41004\\_43476-23075-2\\_358\\_571-0,00.html](http://www.xcelenergy.com/XLWEB/CDA/0,3080,1-1-2_41004_43476-23075-2_358_571-0,00.html)

<sup>2</sup><http://www.govtrack.us/congress/bill.xpd?bill=h110-5351>

# Utility Agreements

## ■ Solar Rewards Contract<sup>1</sup>

- Net metering
- Equipment must have at least a 5 year warranty and meet applicable standards and regulations
- Must be free of shading within  $\pm 60^\circ$  horizontal and  $15^\circ$ - $90^\circ$  vertical
- New equipment only
- 20 year term
- Must continue to operate or pay back rebate and credit pro-rata

<sup>1</sup><http://www.xcelenergy.com/docs/retail/conmrkts/SolarRewardsContract-v2.pdf>

# Utility Agreements

- Small Generation System Interconnection Agreement<sup>1</sup>
  - Must comply with “Safety, Interference, Interconnection Guidelines for Co-Generators, Small Power Producers and Customer Owned Generators”
  - Must comply with relevant Rules of the Colorado PUC
  - Must undergo a design review
  - Utility has right to inspect the system and witness testing
  - Must perform commissioning test as required by applicable codes and standards including IEEE 1547.1
  - Must receive written approval prior to changes
  - Must have \$300,000 liability insurance

<sup>1</sup><http://www.xcelenergy.com/docs/retail/conmrkts/InterconnectionAgreement.pdf>



# Homeowner's Association

- Submit a picture of what it will look like from the street
- Obtain approval signatures from adjacent neighbors
- Submit Project Submission Form
- Equipment (excluding panels) must be concealed from view on the street

# Net Metering

- Included in Xcel's Solar Rewards agreement
- You pay for the net energy you draw from the grid at normal rates
  - Approx. \$0.08-\$0.09 / kWhr + \$6.25
- They will pay for the net energy you supply to the grid at their cost
  - No greater than \$0.032 / kWhr in winter

Rates based on the Xcel Energy tariff with the Public Utility Commission:  
[http://www.xcelenergy.com/docs/psco\\_elec\\_entire\\_tariff.pdf](http://www.xcelenergy.com/docs/psco_elec_entire_tariff.pdf)

# Codes & Regulations

## ■ Jefferson County Adopted Codes<sup>1</sup>

### □ National Electric Code 2005

- Detailed and specific Requirements for photovoltaic systems in Article 690
- NEC 2008, if adopted later, would add a requirement that equipment be identified and listed for the application

### □ Fire Codes May Apply

## ■ West Metro Fire District<sup>2</sup>

### □ International Fire Code 2006

<sup>1</sup>[http://www.co.jefferson.co.us/building/building\\_T45\\_R14.htm](http://www.co.jefferson.co.us/building/building_T45_R14.htm)

<sup>2</sup>[http://www.westmetrofire.org/docs/2007/codes/2007\\_03\\_FireCode.pdf](http://www.westmetrofire.org/docs/2007/codes/2007_03_FireCode.pdf)



# Site Suitability





# Site Suitability





# Site Suitability





# Site Suitability



At most, 30 X 130 Watt Modules would fit.

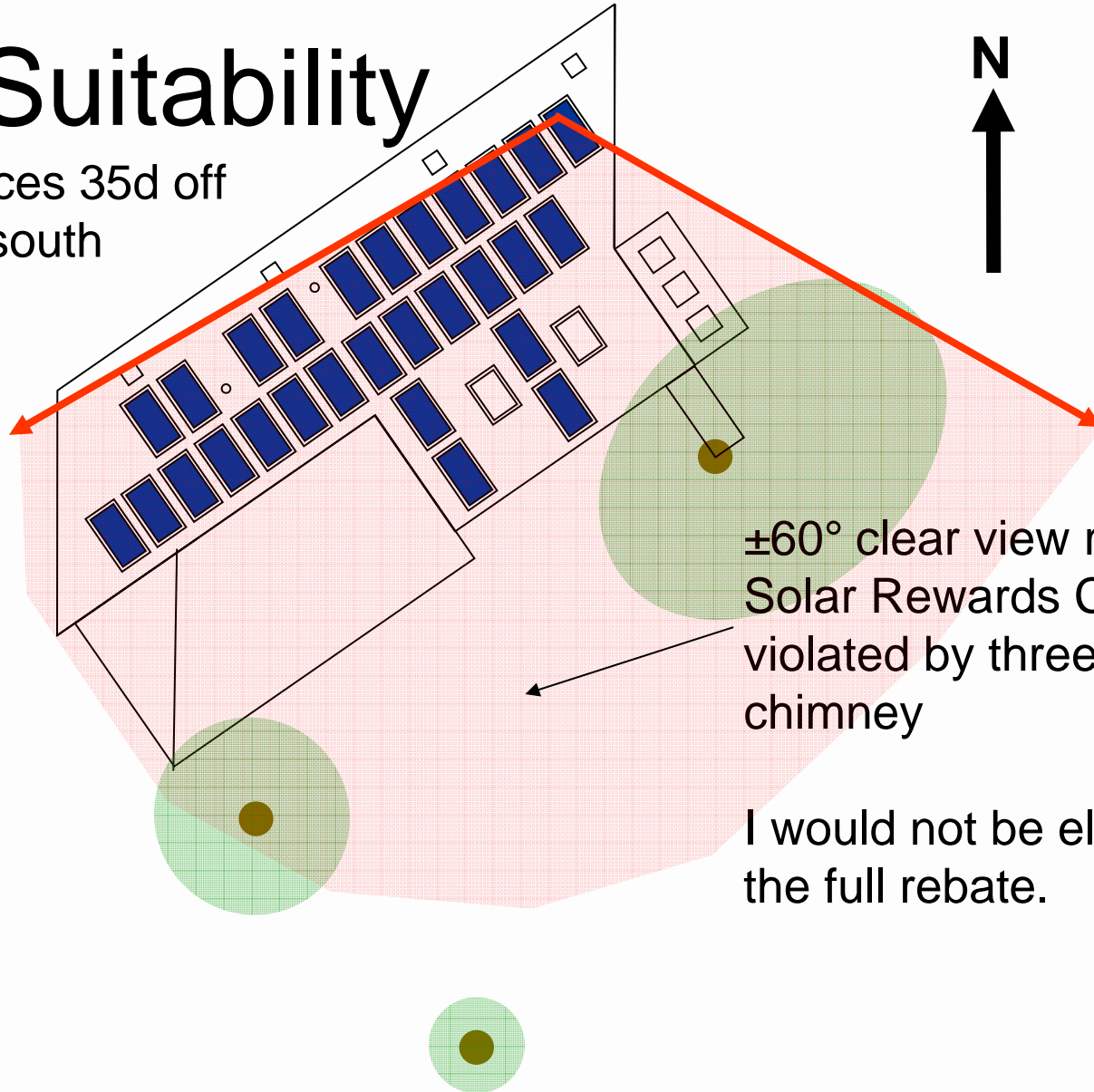


# Site Suitability



# Site Suitability

Roof faces 35d off  
of true south



±60° clear view required by  
Solar Rewards Contract is  
violated by three trees and  
chimney

I would not be eligible for  
the full rebate.

# Insurance

- Presently have homeowner's insurance through State Farm
- They said a PV system would be considered part of the structure and therefore already covered
- However, we may have to increase the amount insured
- The Xcel Interconnection Agreement requires \$300,000 liability insurance



# Maintenance

- No maintenance requirement anticipated
  - I am assuming no batteries

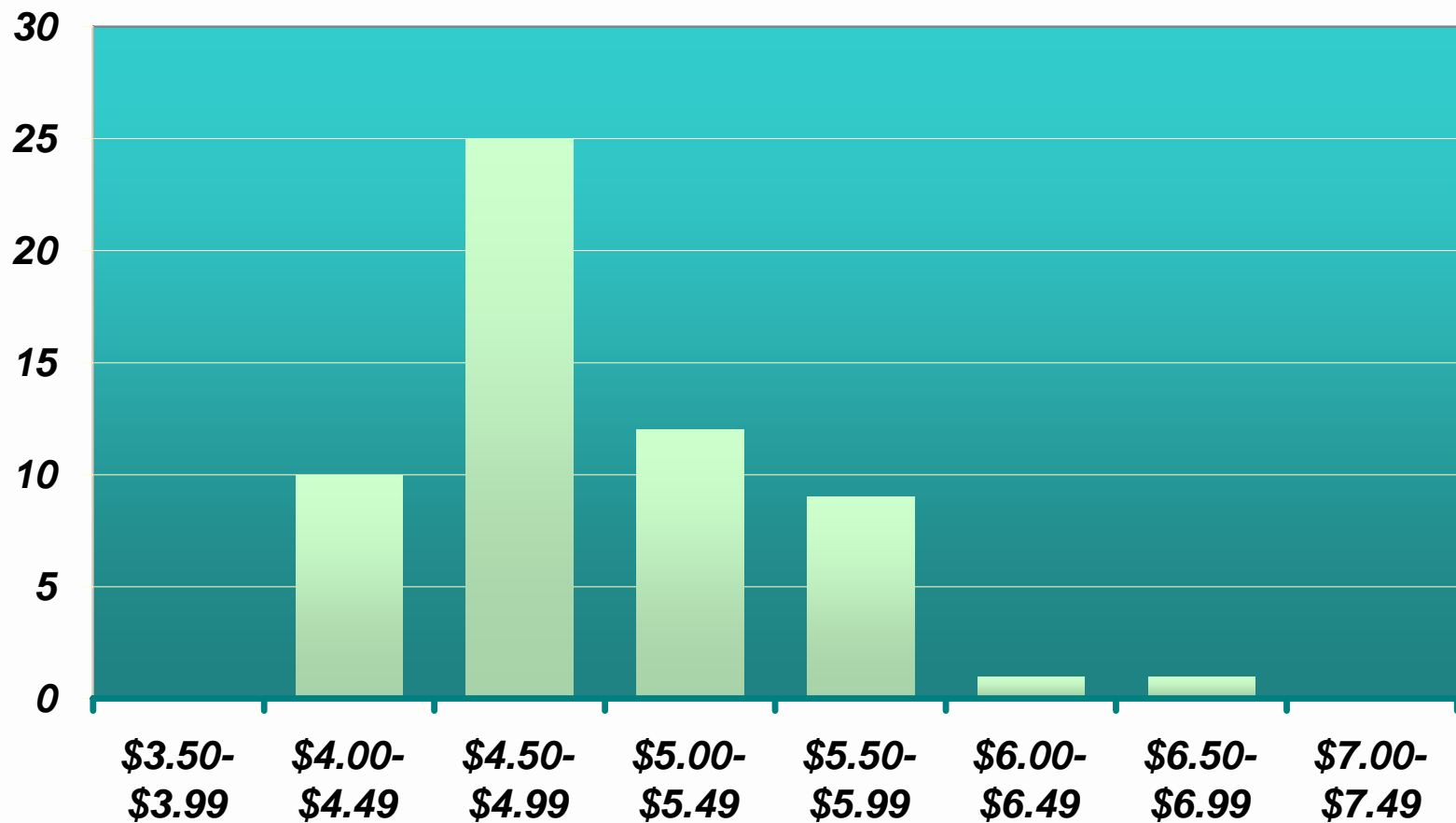


# Equipment - Modules

- Xcel Energy requires modules from the Go Solar California list of eligible equipment
- Researched on the Web to find pricing for some of the modules on that list
- All of the modules priced were UL listed
- Power output warranties ranged from 20 to 25 years

# Equipment - Modules

*Histogram of PV Module Price/Watt Data*

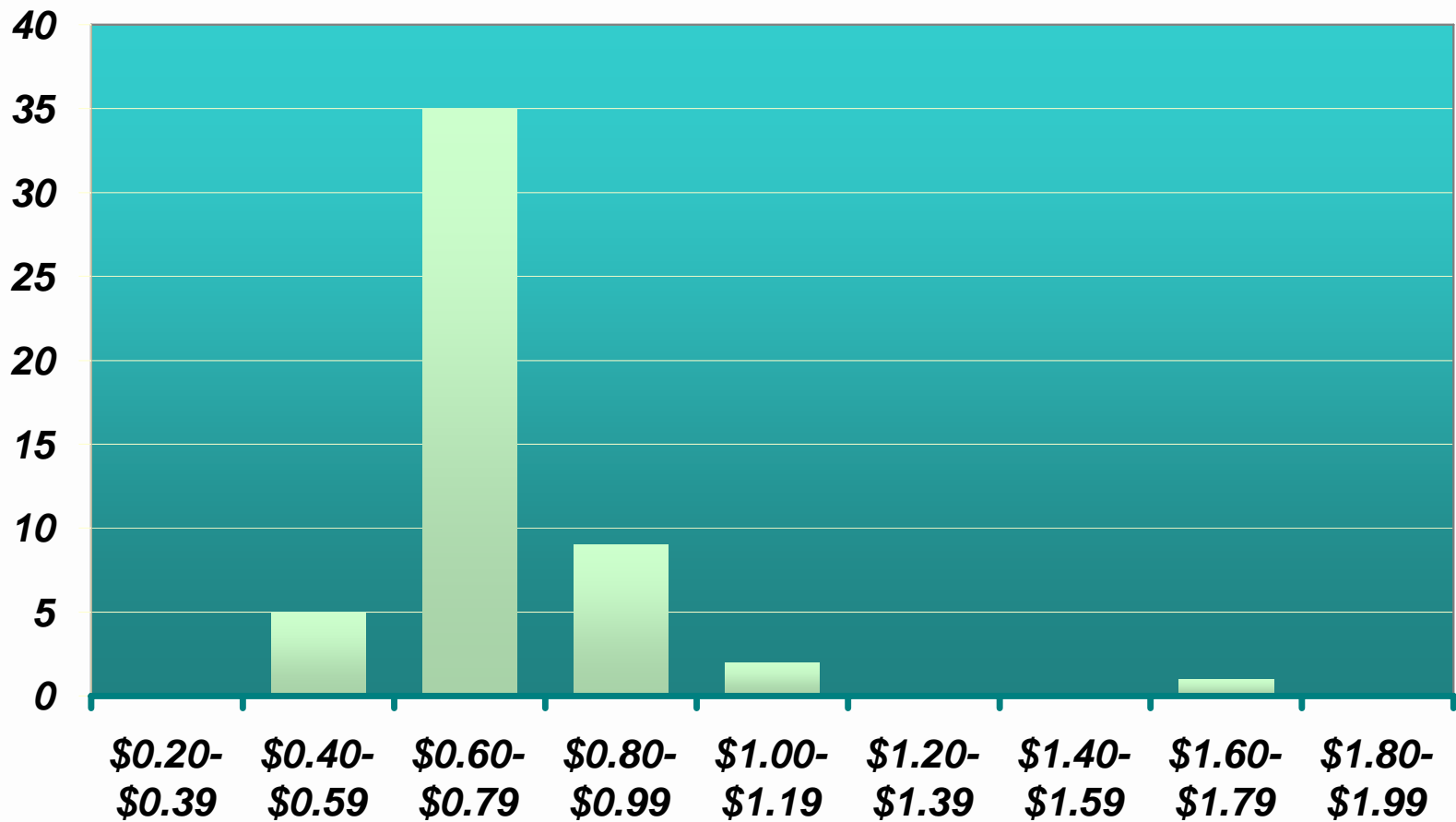


# Equipment - Inverters

- The Go Solar California list of eligible equipment includes inverters
- Researched on the Web to find pricing for some of the modules on that list
- All of the modules on the list were UL 1741 certified
- Most were also certified to IEEE 1547 or IEEE 929

# Equipment - Inverters

## *Histogram of Inverter Price/Watt Data*



# Sizing

- You get the most for your money if you generate exactly what you use.
  - Utility pays back at cost
  - Retail rate is \$0.08 - \$0.09. Buy back is less than \$0.032<sup>1</sup>
  - Some of the costs are independent of size (design, inspections, installation, equipment pricing has an offset)
- Our usage last year was 7,732 kWh
- The average generation in Colorado is about (1900 kWh) / (kW rating) per year<sup>2</sup>
- Therefore, the optimal size is
$$(7,732 \text{ kWh} / \text{yr}) / (1900 \text{ kWh} / \text{kW-yr}) = \mathbf{4 \text{ kW}}$$

<sup>1</sup> [http://www.xcelenergy.com/docs/psco\\_elec\\_entire\\_tariff.pdf](http://www.xcelenergy.com/docs/psco_elec_entire_tariff.pdf)

<sup>2</sup> "A Consumer's Guide to Buying a Solar Electric System", Produced for the US Department of Energy by the National Renewable Energy Laboratory, September 1999.

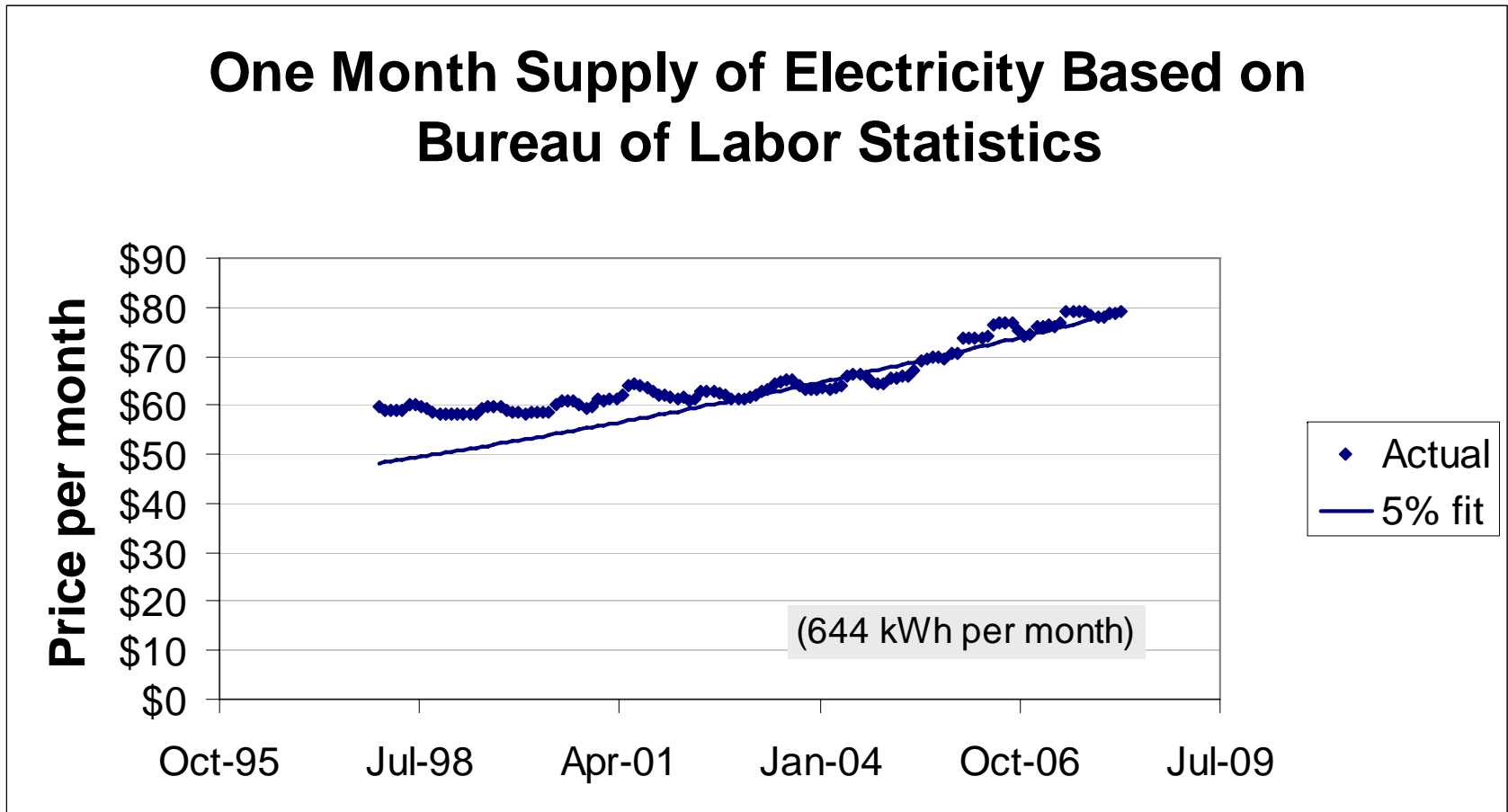
# Cost Estimate

## My Estimate for a 4kW Grid Parallel System

Assuming I cut down three trees and received the full rebate

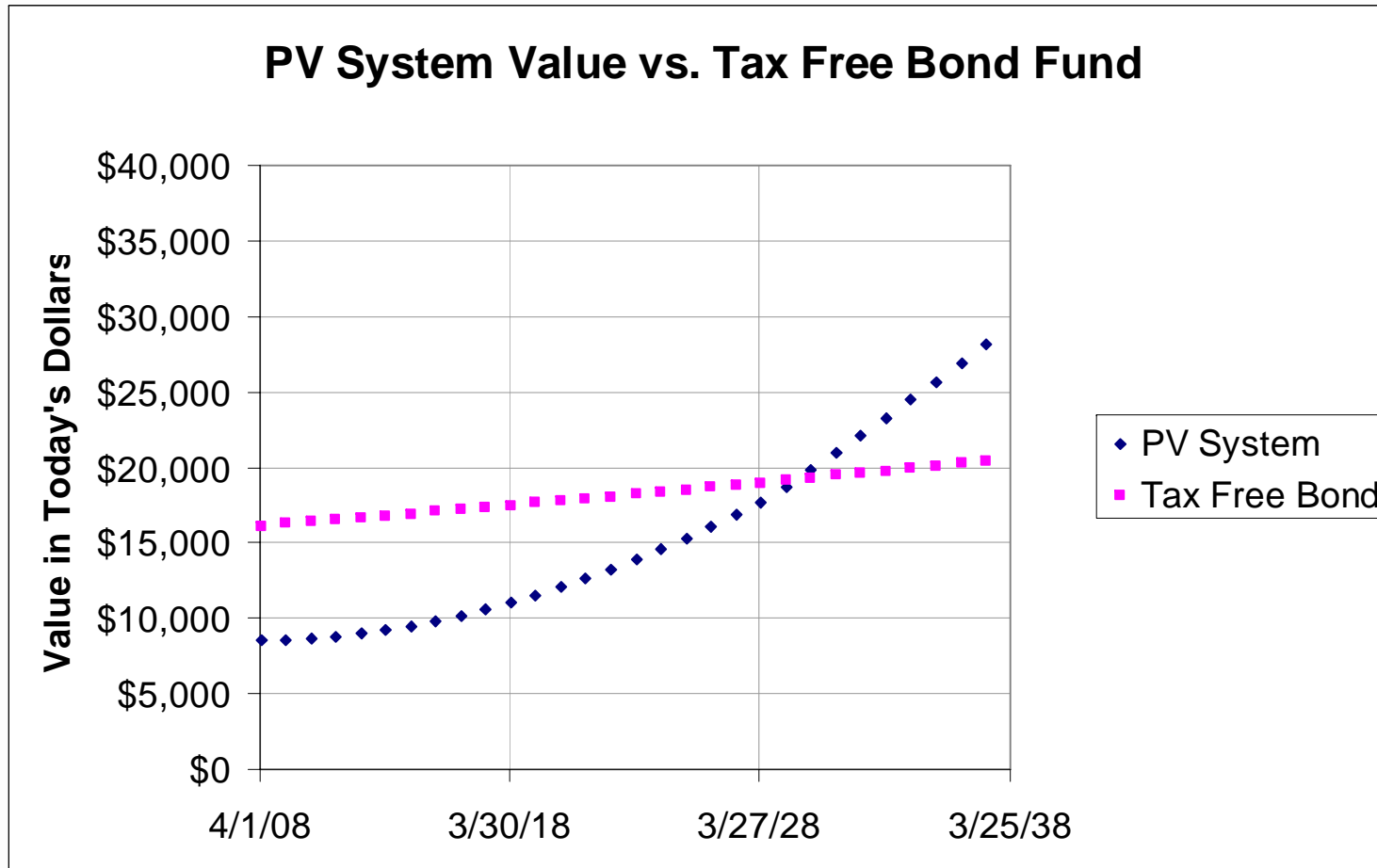
		<b>Notes</b>
PV Modules	\$19,880	4 kW * \$4.97 / W Based on pricing research
Inverter	\$2,920	4 kW * \$0.73 / W Based on pricing research
Engineer Check	\$750	Personal communication with Pat Osborn of Great Plains Power, 4/11/2008
Other Equipment	\$2,355	My guess
Installation	\$7,000	Dan Ramsey, David Hughes, "The Complete Idiot's Guide to Solar Power for Your Home", Alpha Books, 2007, page 173
Inspections	\$200	\$100 / hour <a href="http://www.co.jefferson.co.us/building/building_T45_R55.htm">http://www.co.jefferson.co.us/building/building_T45_R55.htm</a>
Permit	\$1,002	\$69 for first \$2,000 + \$3 / \$100 <a href="http://www.co.jefferson.co.us/building/building_T45_R55.htm">http://www.co.jefferson.co.us/building/building_T45_R55.htm</a>
<b>Total</b>	<b>\$34,107</b>	
<b>Total / W</b>	<b>\$8.53</b>	
Rebate	-\$18,000	\$4.50 Per Watt
<b>Net Cost</b>	<b>\$16,107</b>	
<b>Net Cost / W</b>	<b>\$4.03</b>	

# Merits as an Investment – Inflation<sup>1</sup>



<sup>1</sup><http://data.bls.gov/PDQ/outside.jsp?survey=cu>

# Merits as an Investment

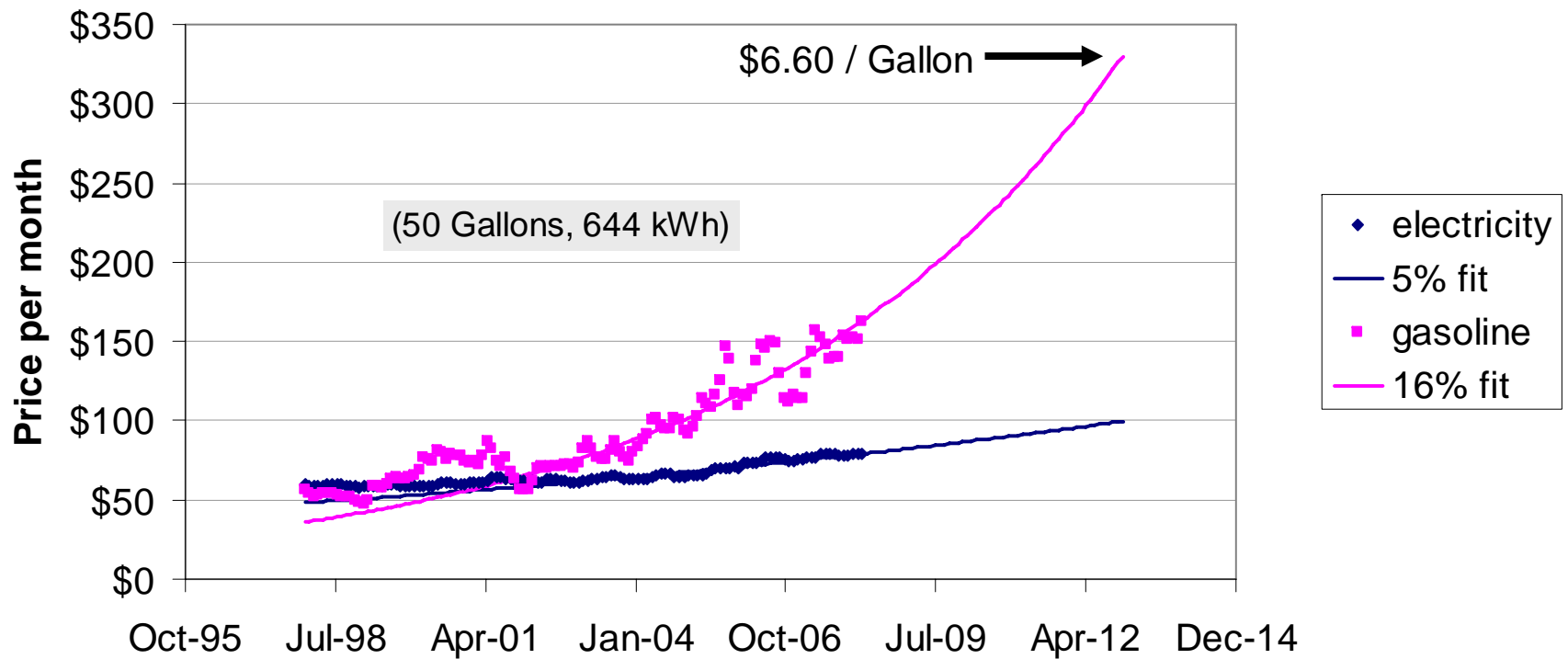


<sup>1</sup><https://personal.vanguard.com/us/FundsSnapshot?FundId=0044&FundIntExt=INT>



# Gasoline Prices Are Going Nuts

One Month Supply of Electricity and Gasoline Based on Bureau of Labor Statistics and My Fit

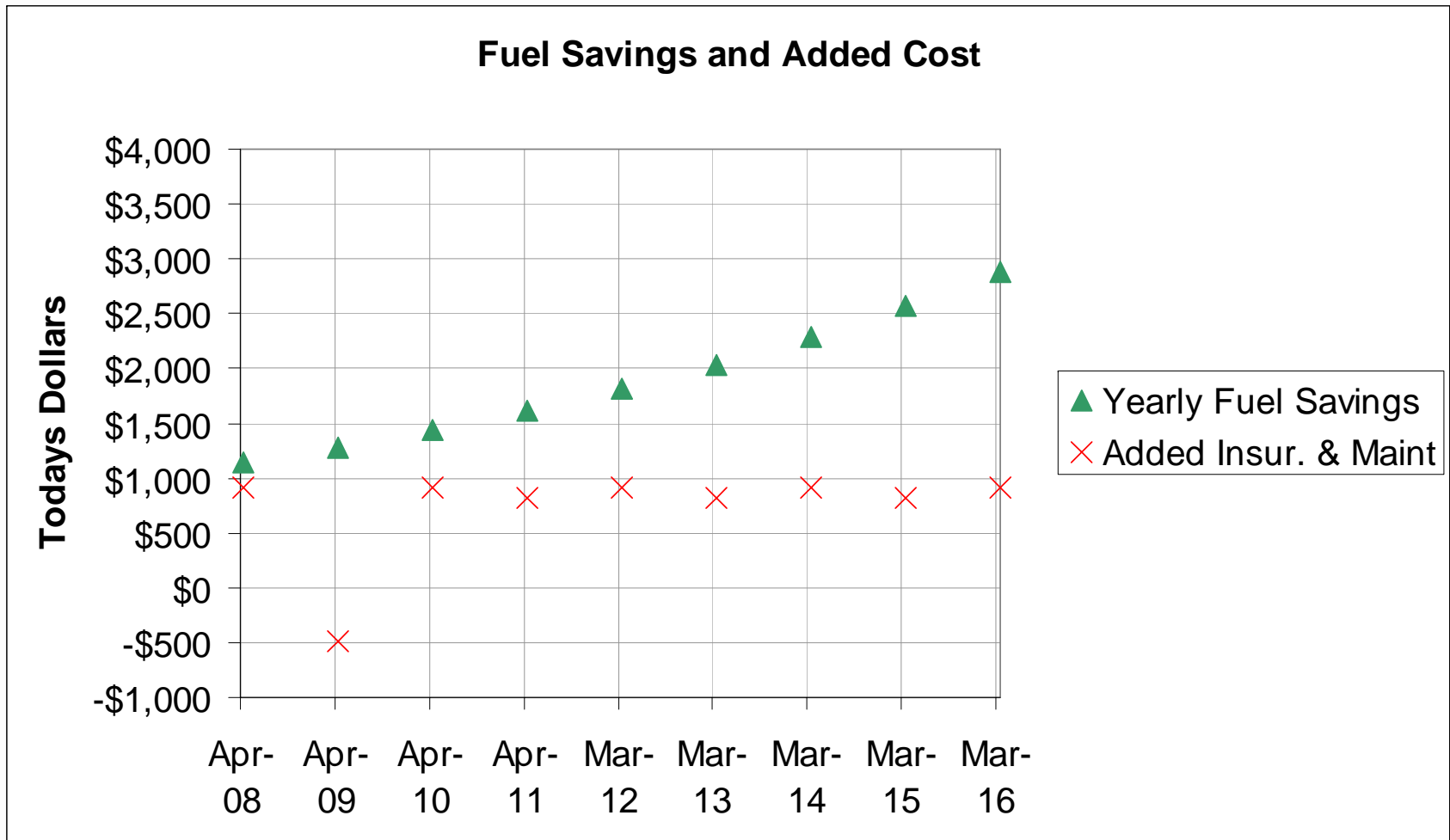


<sup>1</sup><http://data.bls.gov/PDQ/outside.jsp?survey=cu>

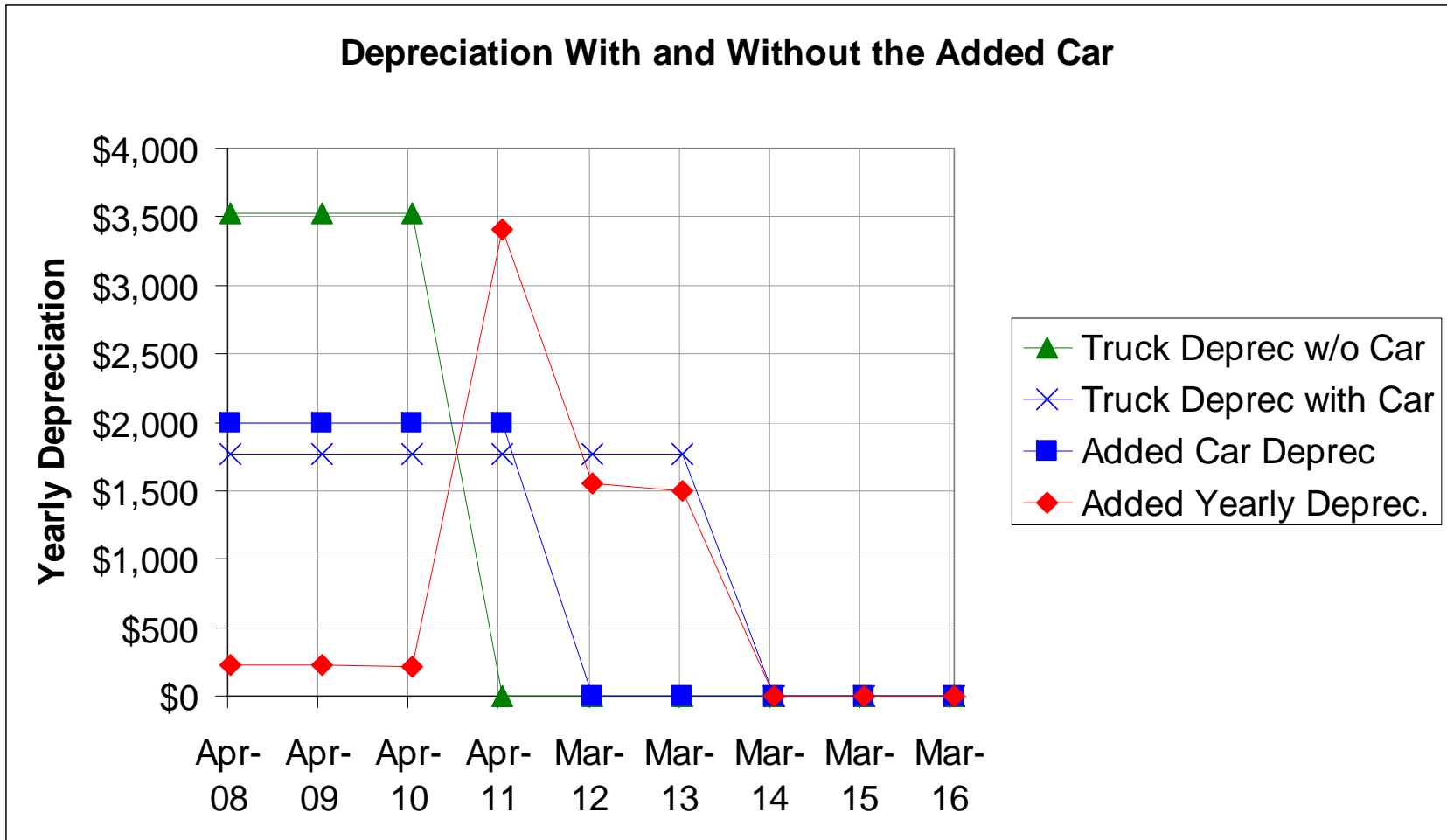
# Merits of adding a fuel efficient vehicle for commuting

- I presently commute 20 miles a day in a Ford F150
- I need to keep our truck for towing our boat
- How does buying a 2004 Ford Focus with 50,000 miles compare to the status quo?

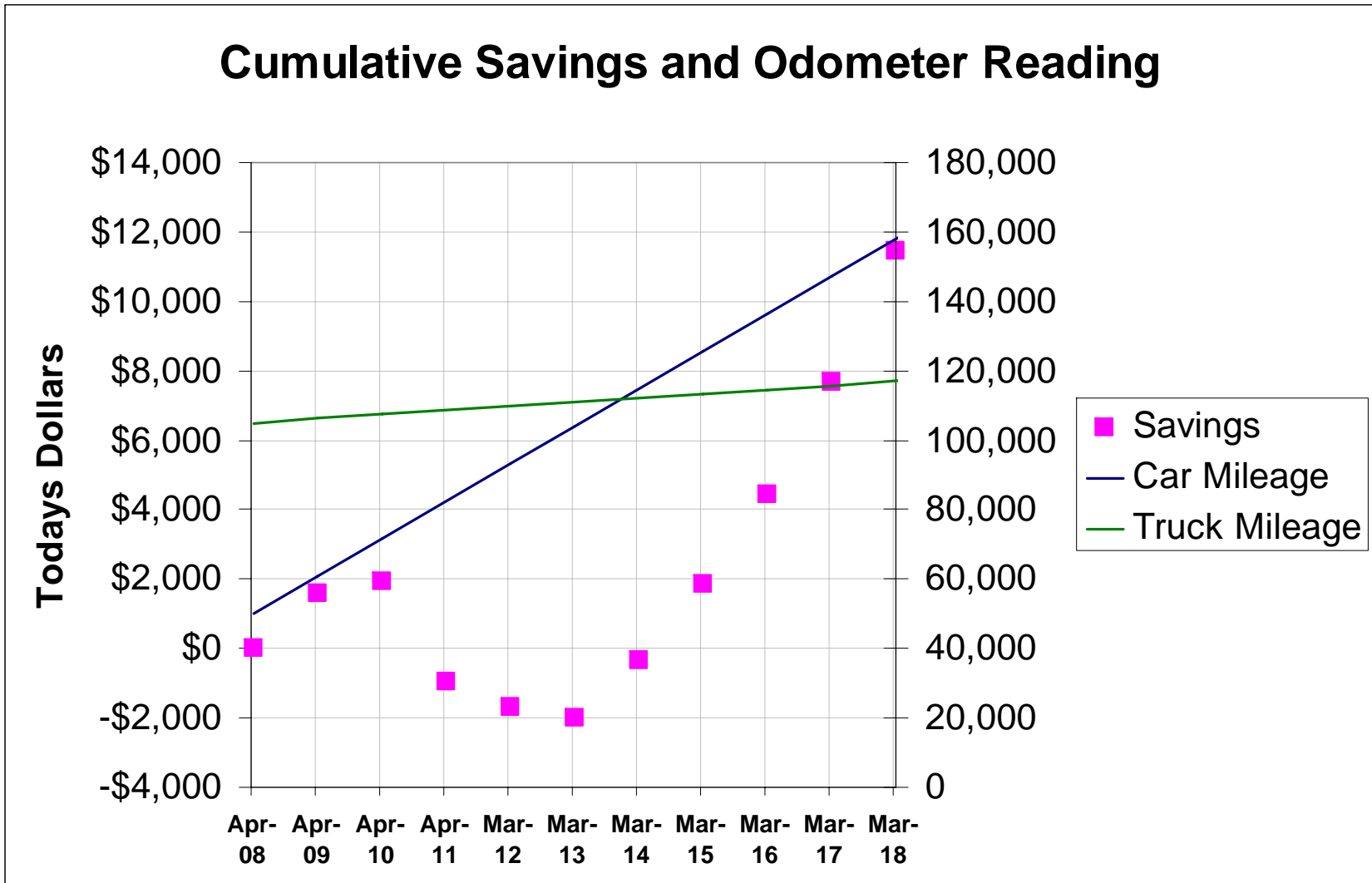
# Added Car Investment Merits



# Added Car Investment Merits



# Added Car Investment Merits



# Equipment References Used

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<http://www.beyondoilsolar.com/inverters.htm>

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