

Net-Zero House Study

Engineering 333 Class Project

Senior Mechanical Engineering Students

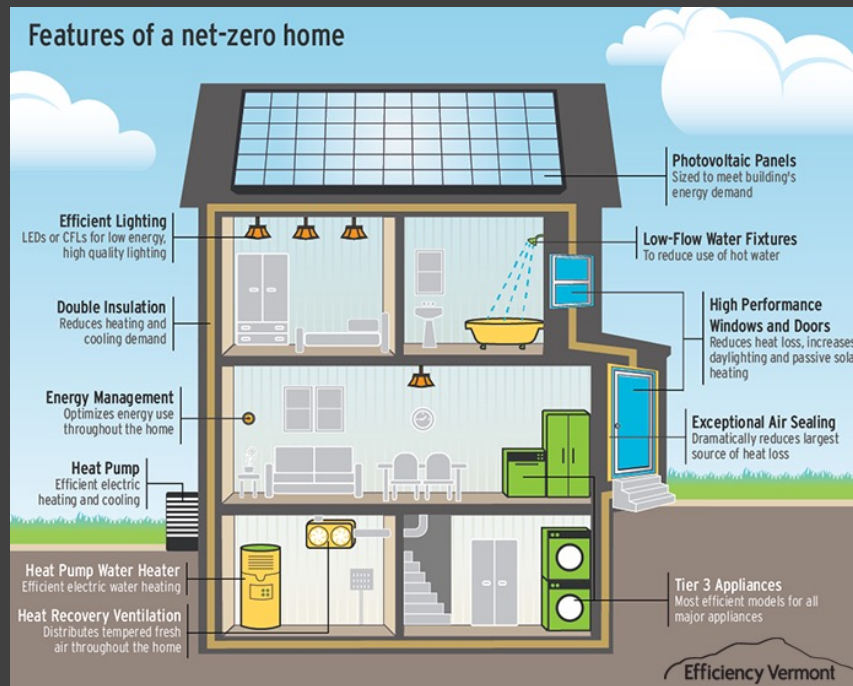
12/02/2014



What would it take to make a home in Grand Rapids Net-Zero?



What is Net-Zero?



https://www.encyvermont.com/sf-images/default-source/bbd/residential/netzero_graphic_final_cs5_largetext-01DAC6DAB02C1A.png?sfvrsn=2

Historical US Energy Consumption Percentage by Sector

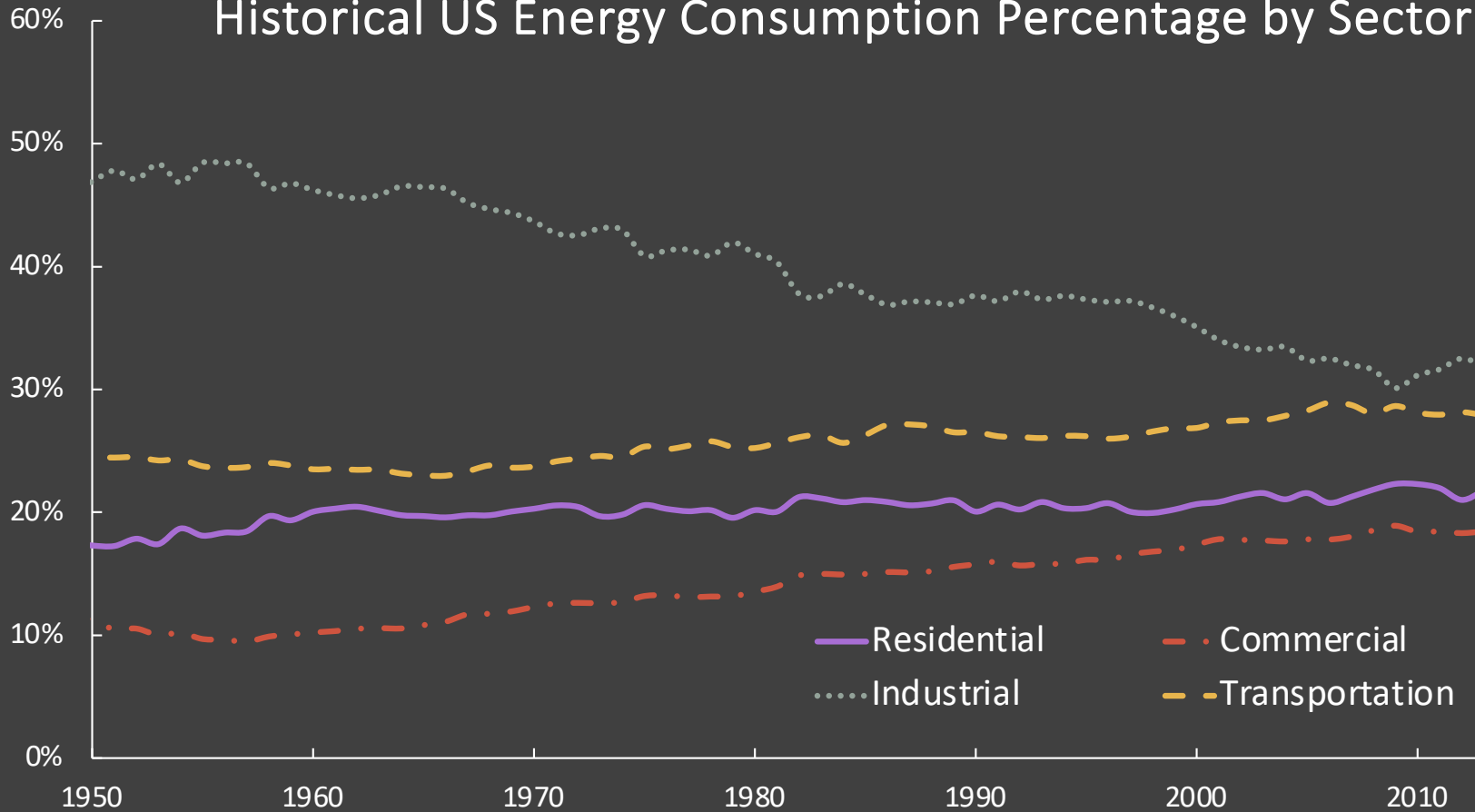


Figure 1. Historical US Energy Consumption Percentage by Sector.

<http://www.eia.gov/totalenergy/data/annual/showtext.cfm?t=ptb0201a>

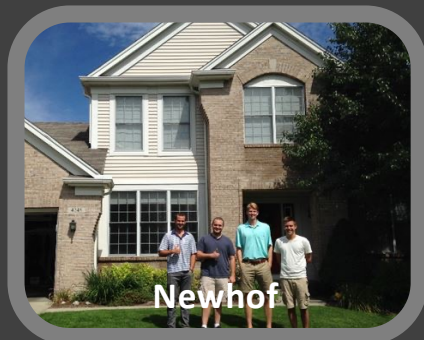


Why investigate this?

God spoke: “Let us make human beings in our image, make them reflecting our nature so they can be responsible for the fish in the sea, the birds in the air, the cattle, and yes, Earth itself, and every animal that moves on the face of Earth.”

- Genesis 1:26





Background

Assess

Reduce

Generate

Offset

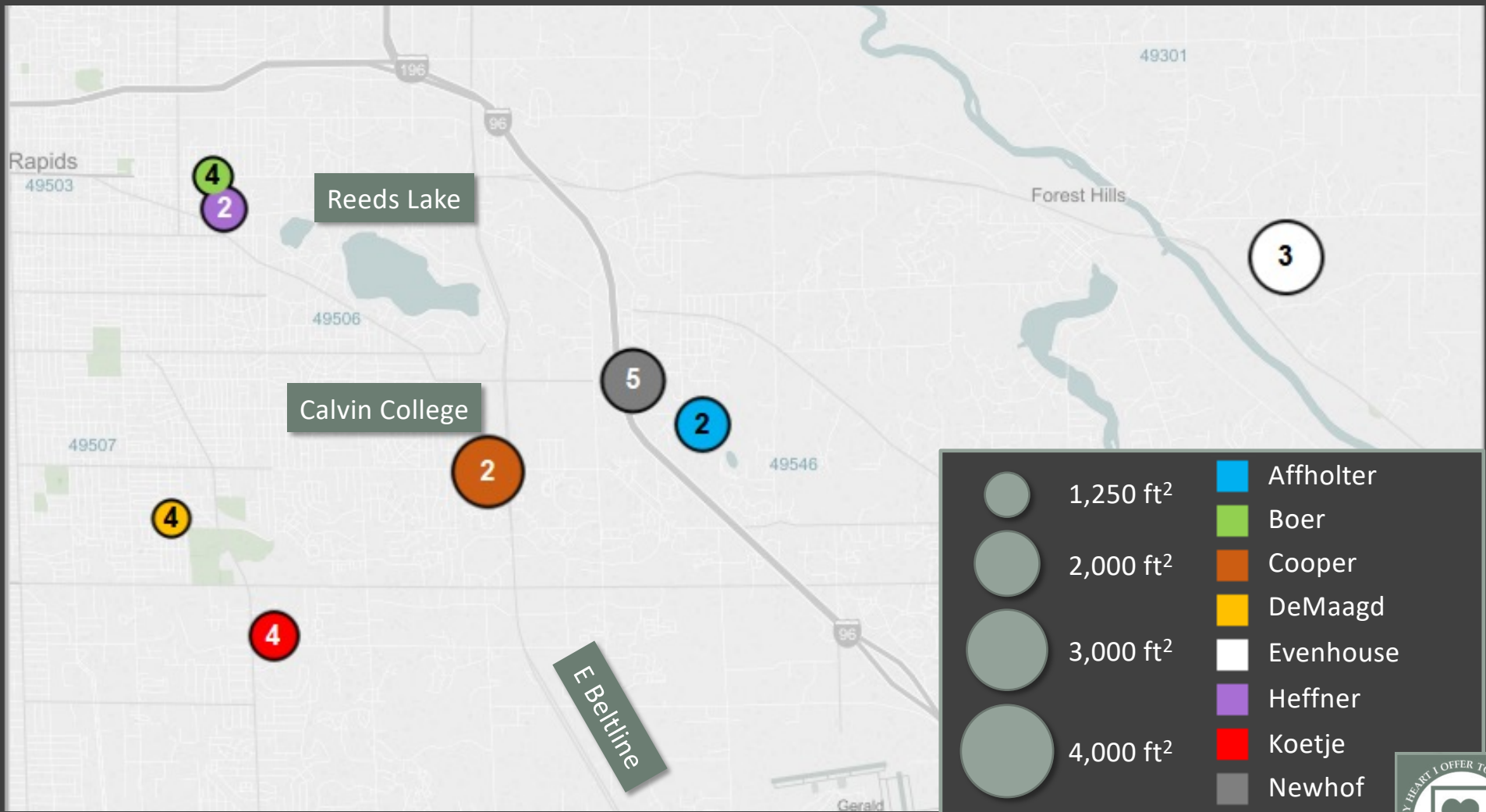
Results

Net Zero Homes Project

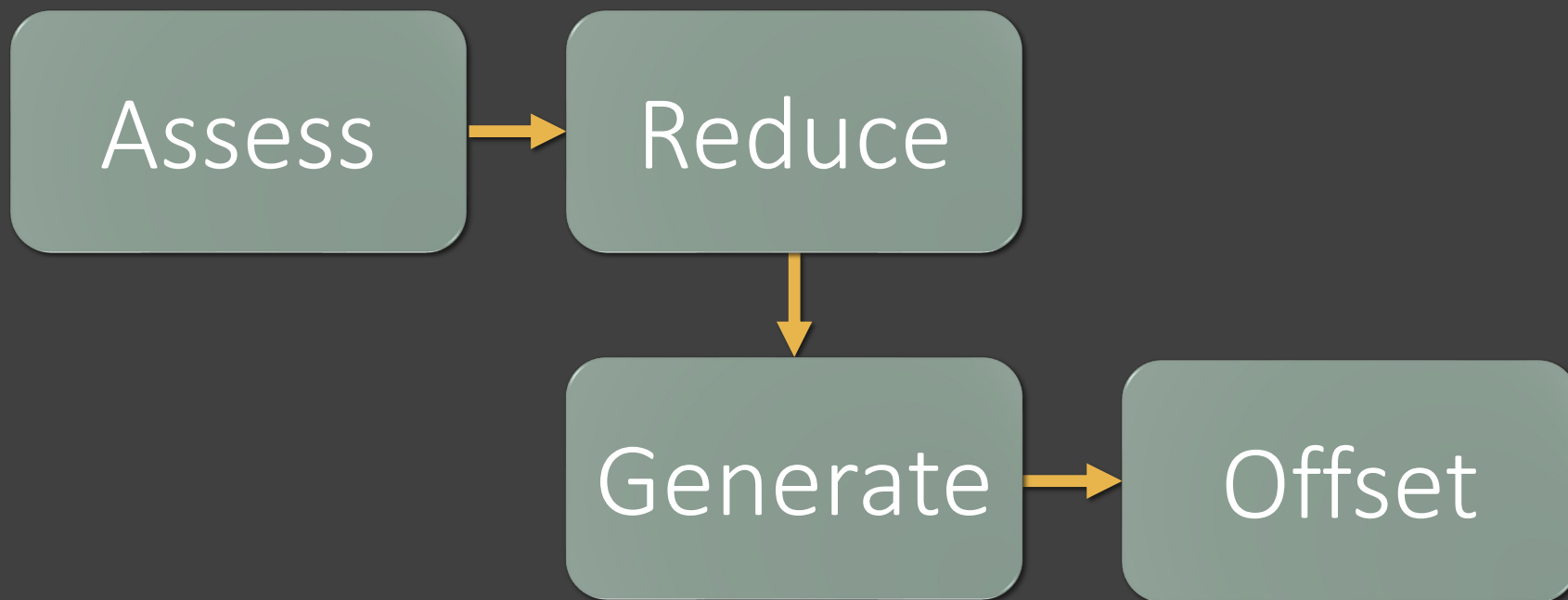
10/7/23

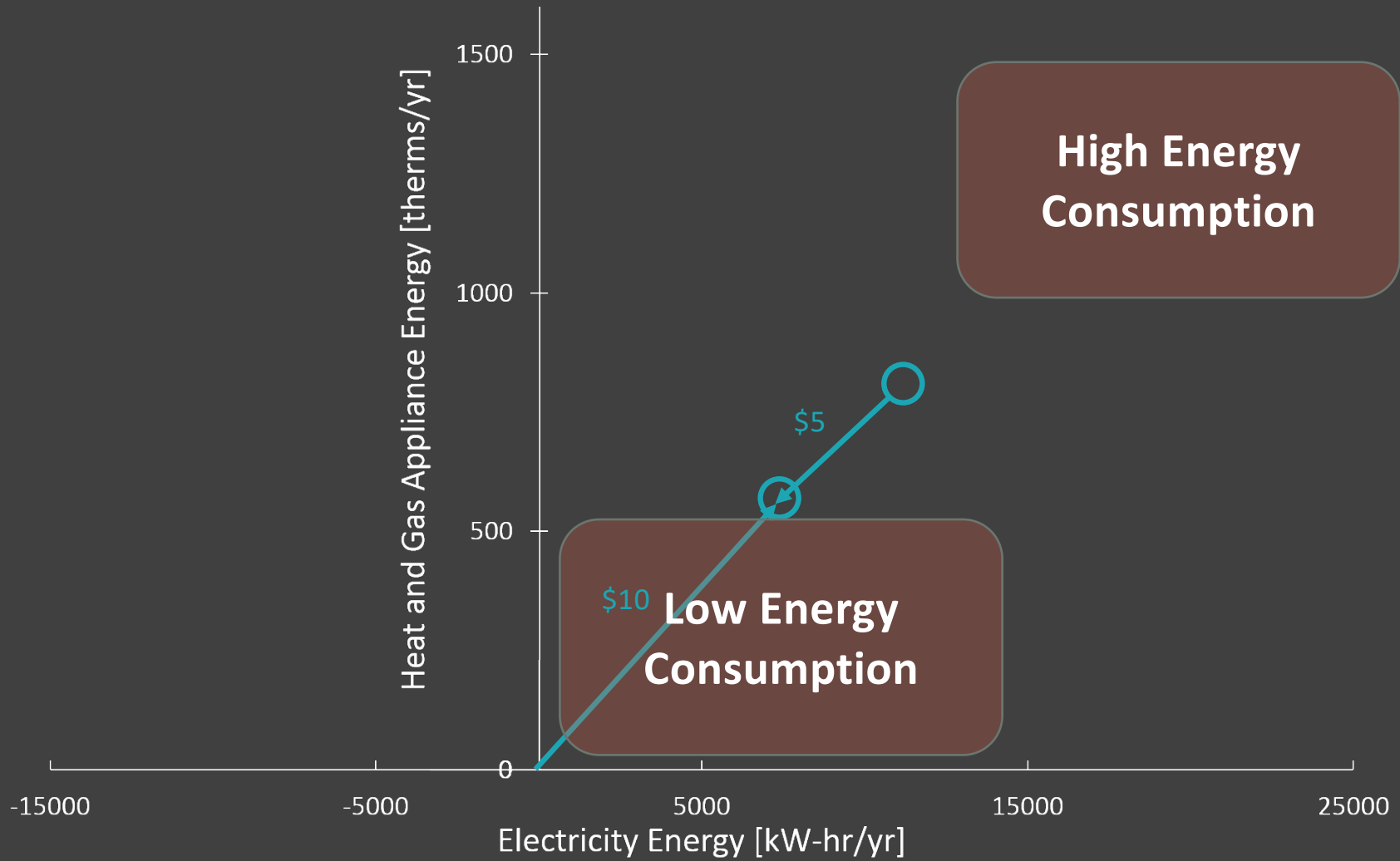
6



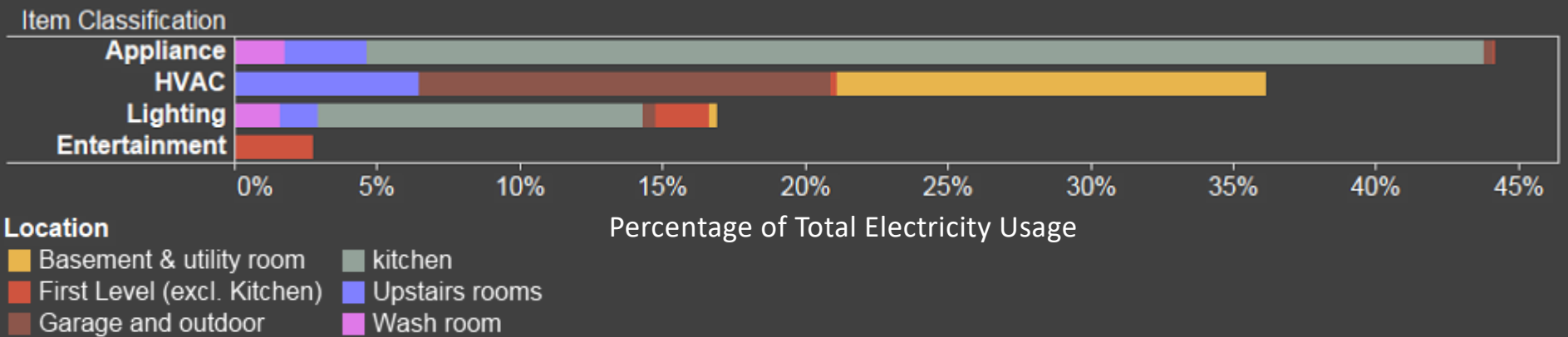


Net-Zero Implementation Process

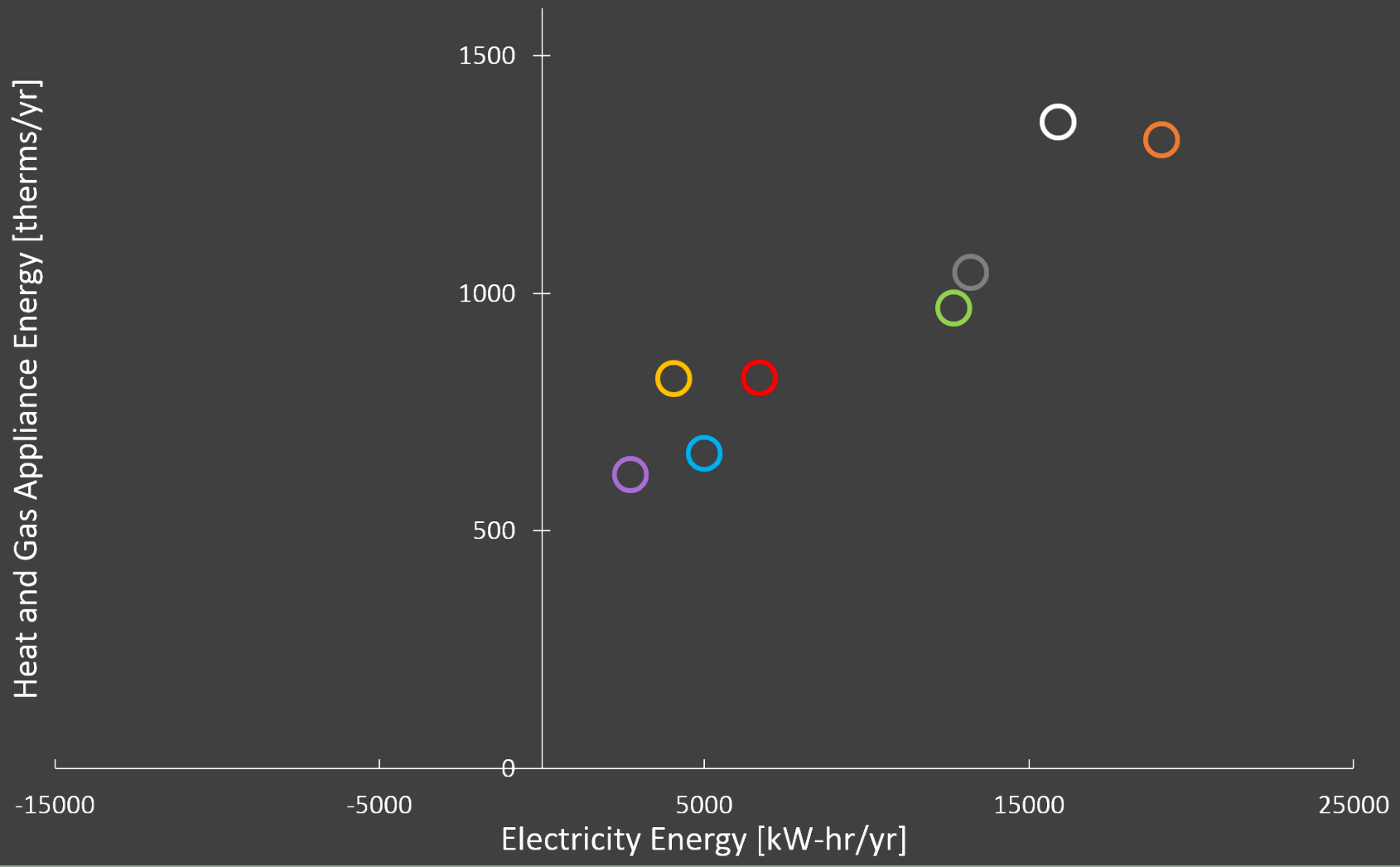




Assess: Energy Audits



Heat and Gas Appliance Energy [therms/yr]



Energy Reduction

Lighting



<http://s.hswstatic.com/gif/led-light-bulb-1.jpg>

Appliances



<http://dakselfstorage.com/wp-content/uploads/2014/10/kitchen-appliance-storage.jpg>

Insulation



<http://nesbuildingsolutions.com/wp-content/uploads/2013/01/spray-foam-wall-insulation-1.gif>

Lifestyle Changes



<http://compass.xbox.com/assets/3a/17/3a17ef9b-e017-4282-9f25-6b7e35b0c27a.jpg?n=ui-xbox-360-cle-video-xbox-video-1000x487.jpg>

Background

Assess

Reduce

Generate

Offset

Results

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LED Lighting – Cooper House

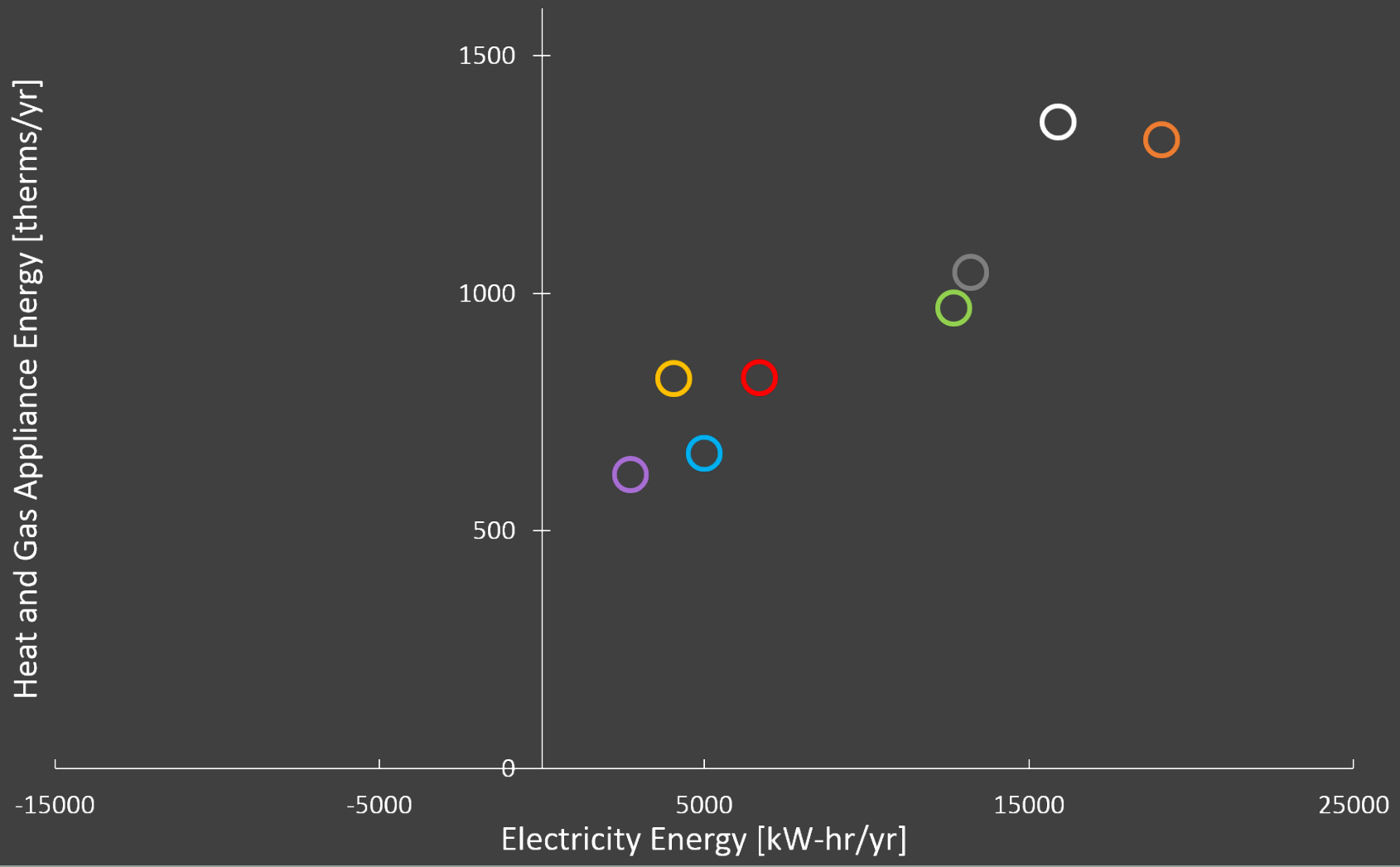


<http://www.marco.org/media/2013/09/cree-led-flaw.jpg>

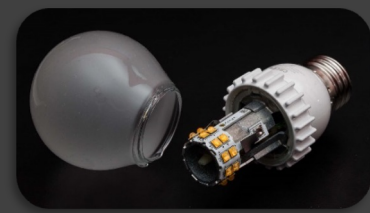
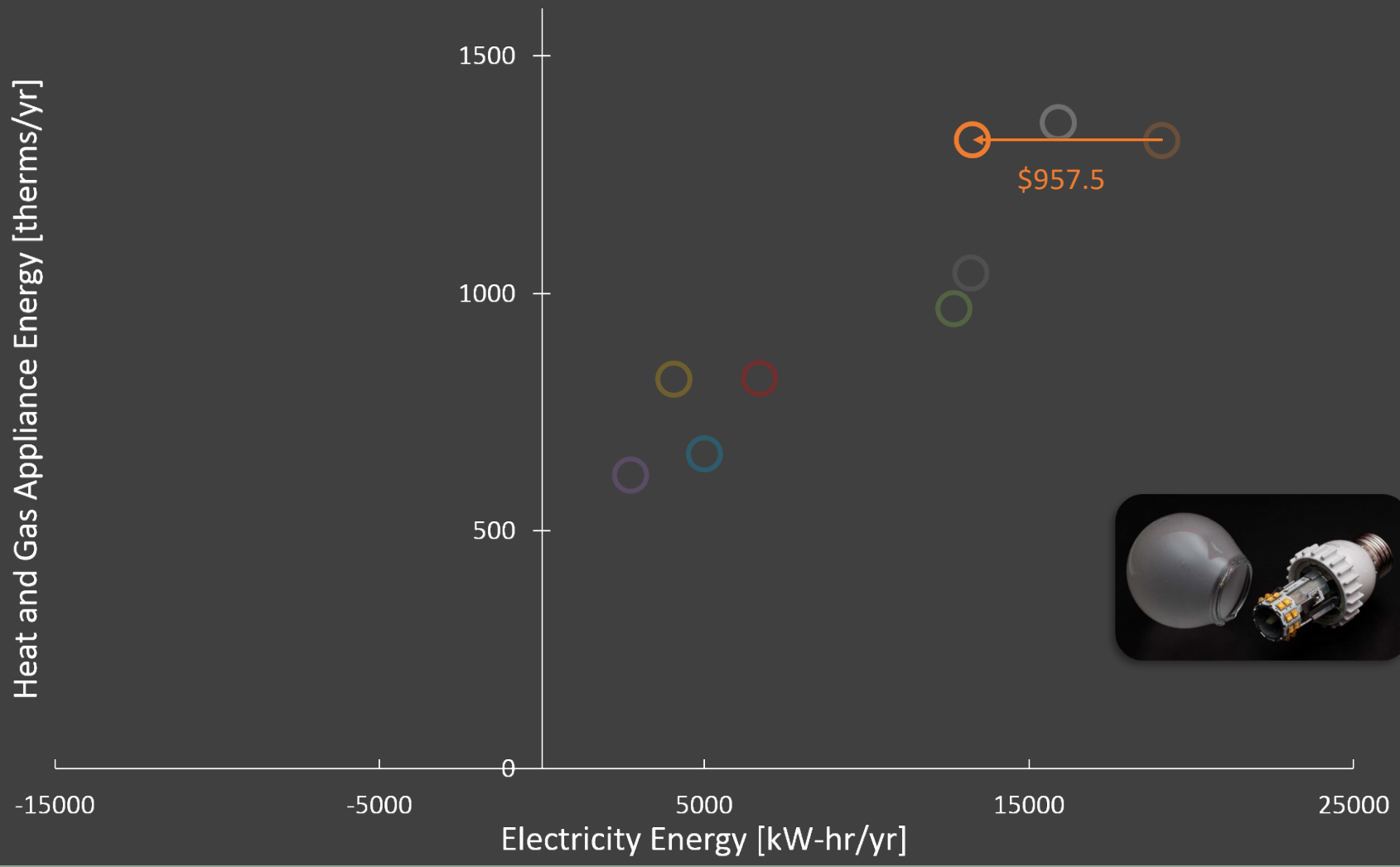
<http://assets.inhabitat.com/wp-content/blogs.dir/1/files/2011/08/Zimba-bwe-CLF-bulb-exchange-3-537x402.jpg>



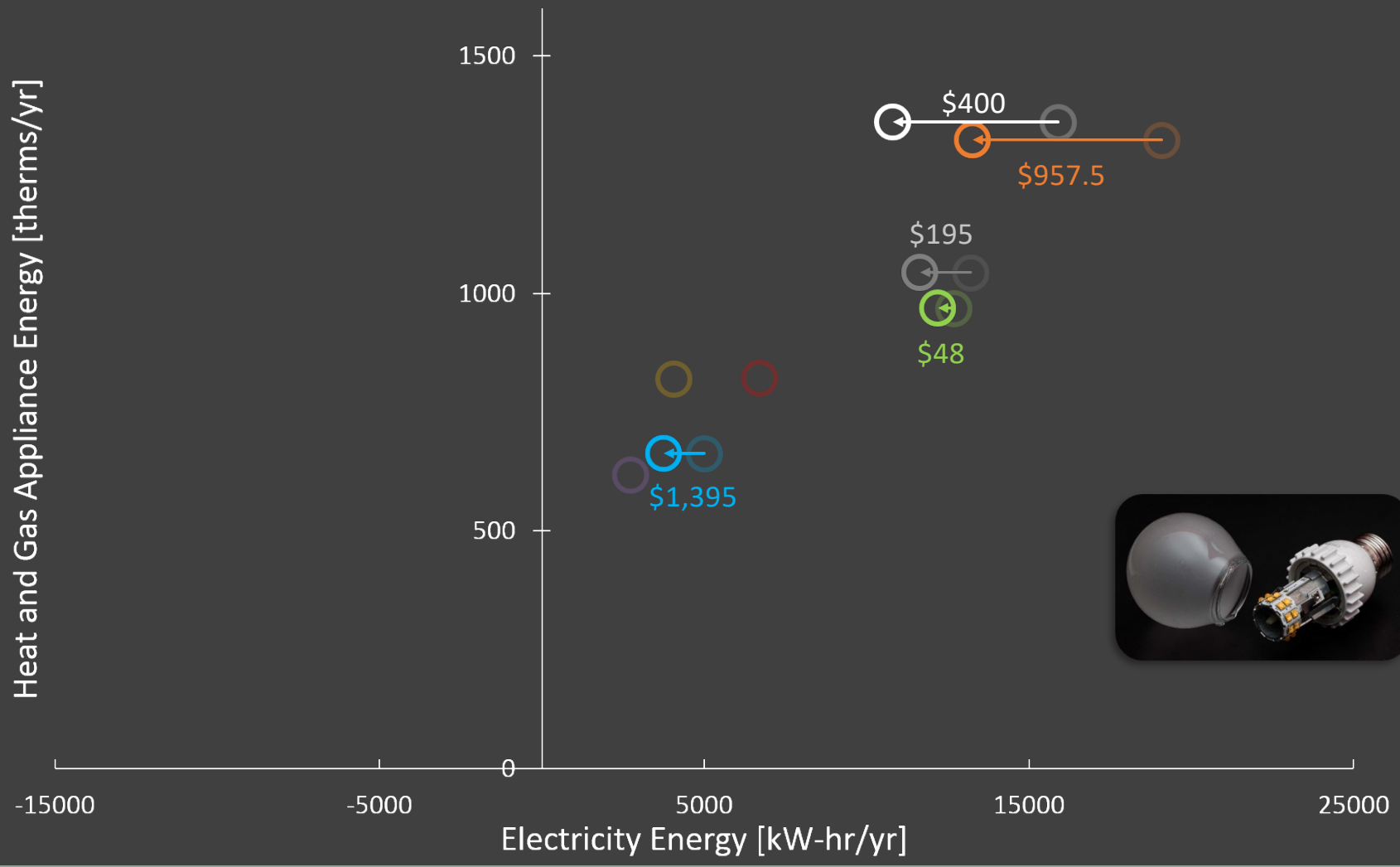
Heat and Gas Appliance Energy [therms/yr]



Heat and Gas Appliance Energy [therms/yr]



Heat and Gas Appliance Energy [therms/yr]



Appliances – DeMaagd House



<http://www.homeenergytune-ups.com/wp-content/uploads/2013/11/energyefficient.jpg>

Background

Assess

Reduce

Generate

Offset

Results

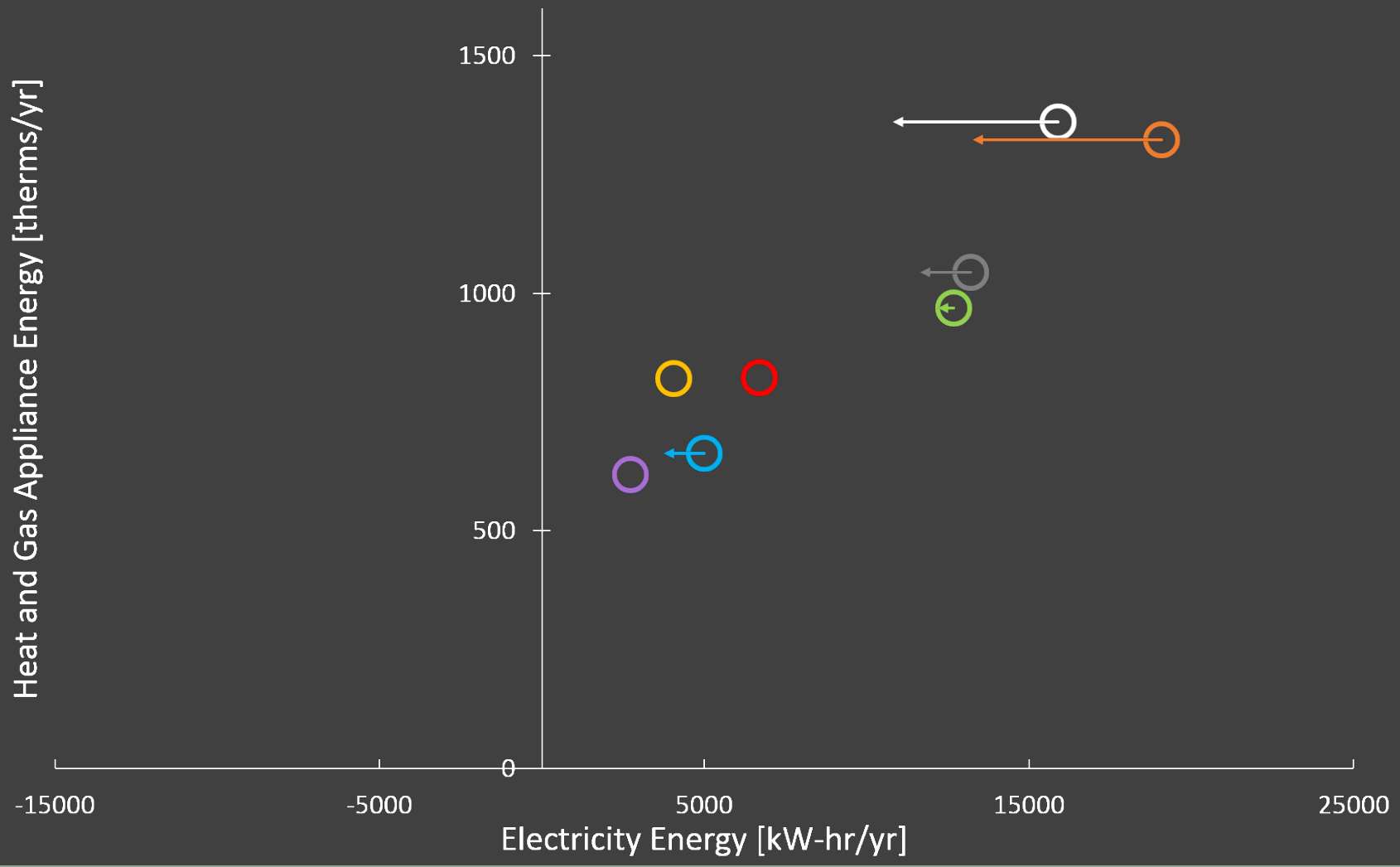
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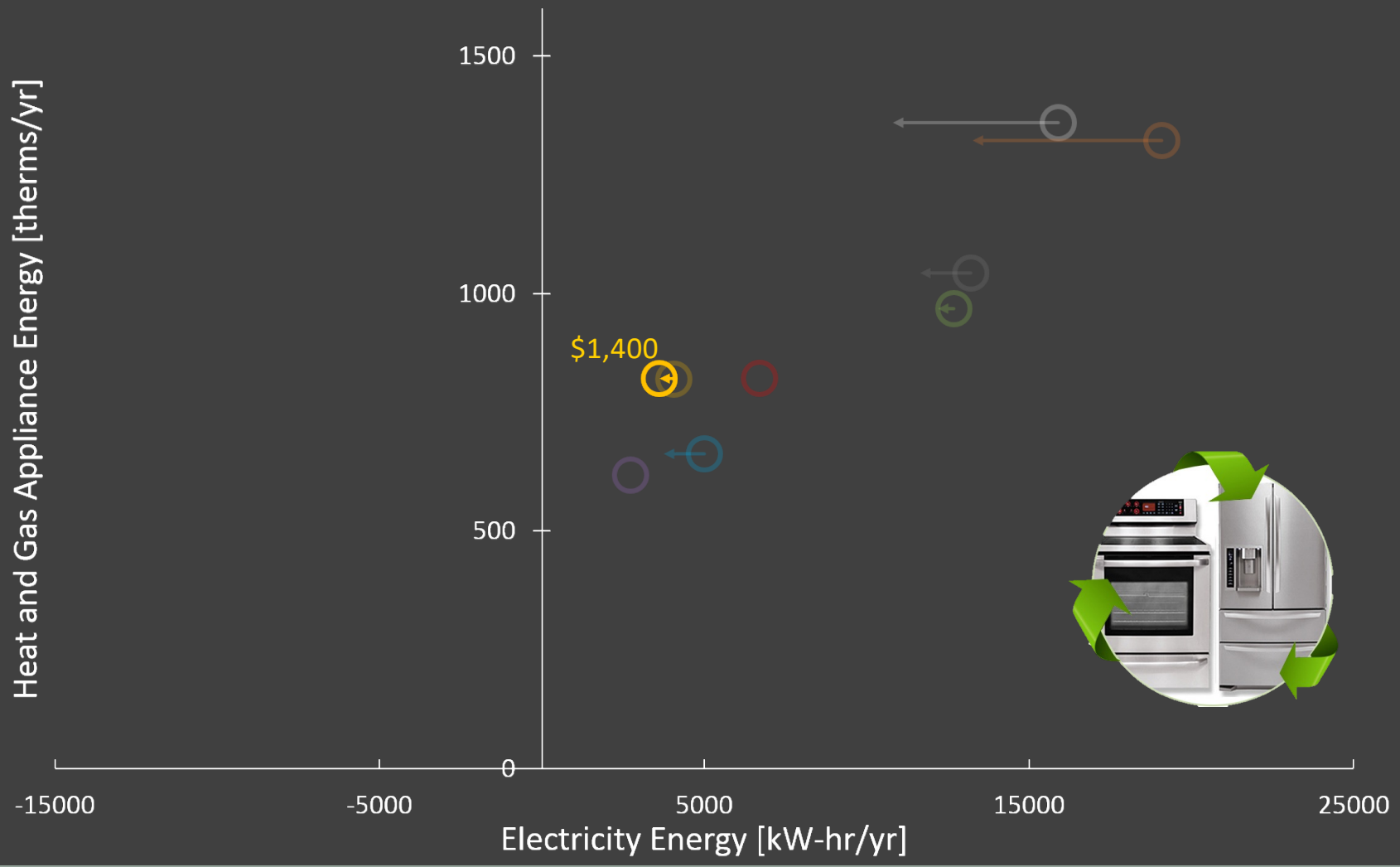
17



Heat and Gas Appliance Energy [therms/yr]



Heat and Gas Appliance Energy [therms/yr]



Background

Assess

Reduce

Generate

Offset

Results

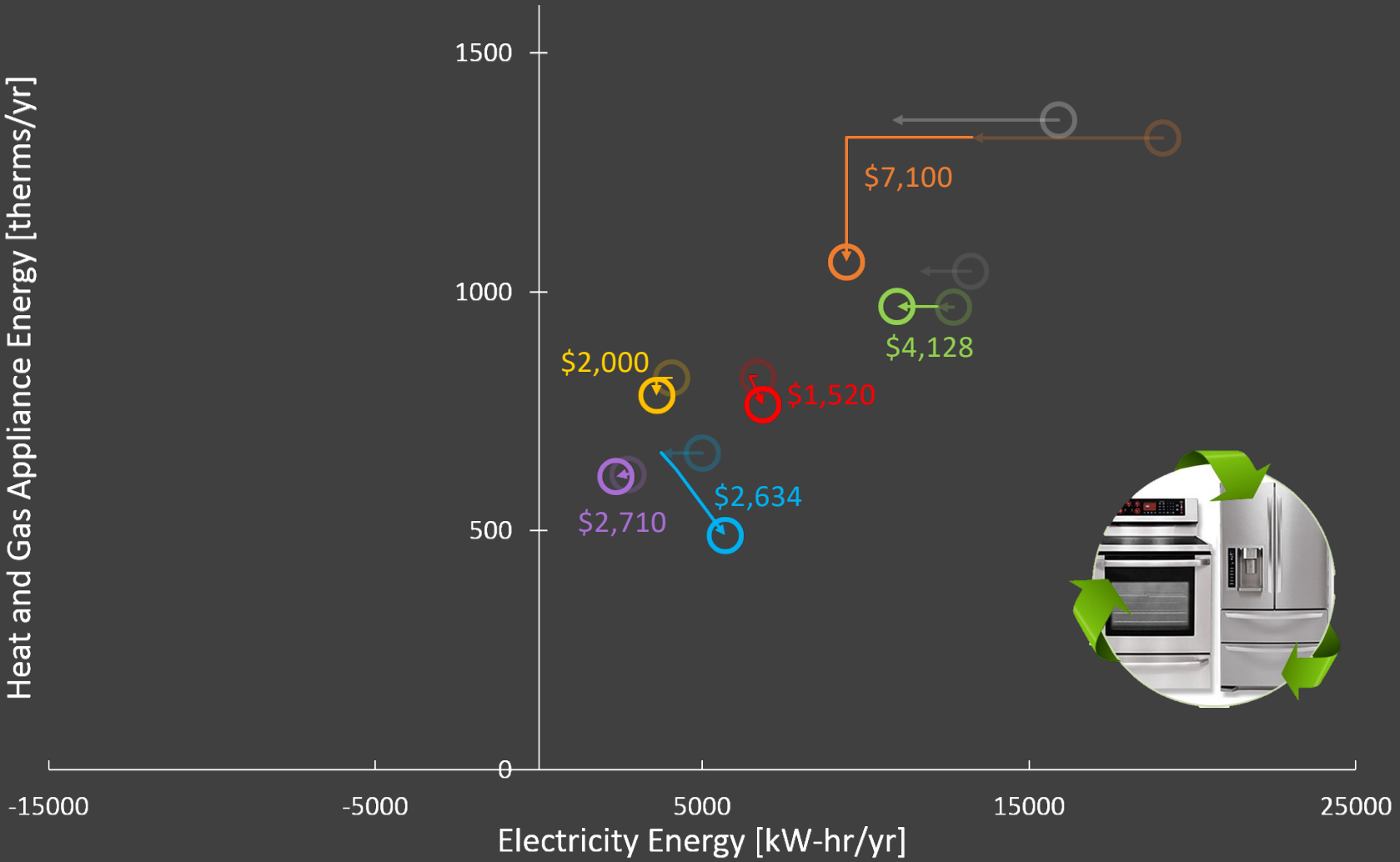
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Heat and Gas Appliance Energy [therms/yr]



Background

Assess

Reduce

Generate

Offset

Results

Net Zero Homes Project

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20



Insulation – Koetje House



<http://iandsinsulation.com/images/TomSpraying.jpg>

Background

Assess

Reduce

Generate

Offset

Results

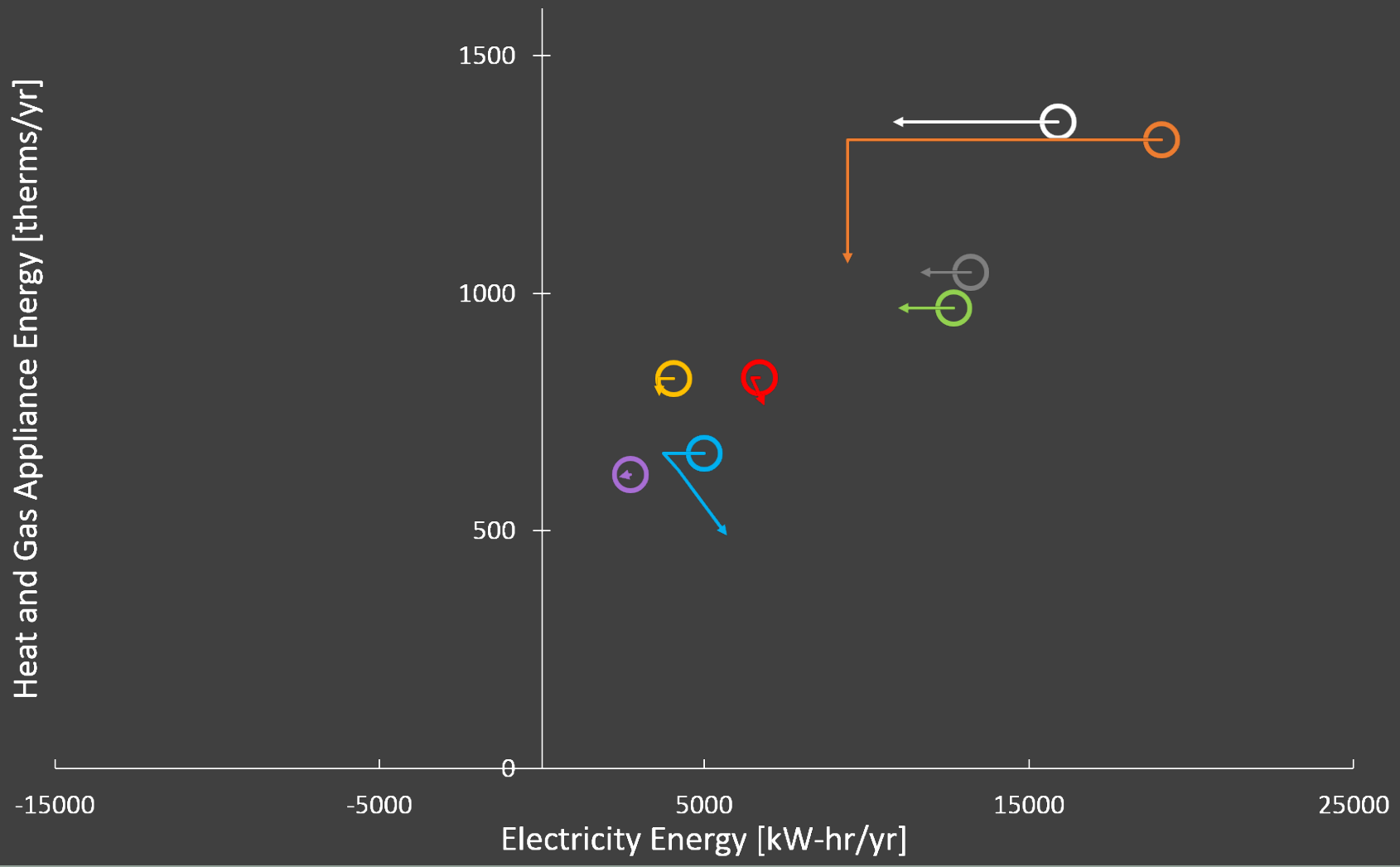
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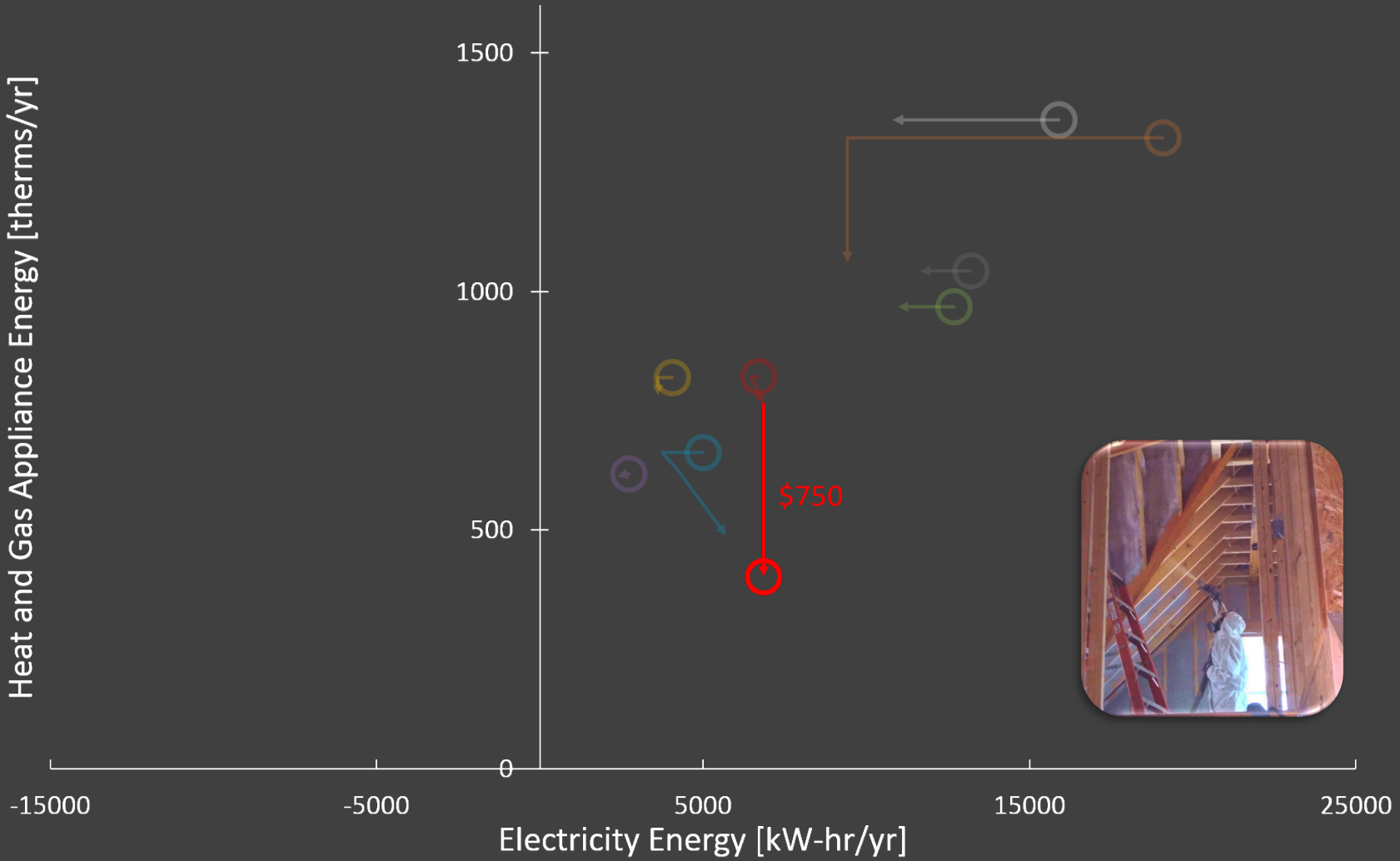
21



Heat and Gas Appliance Energy [therms/yr]



Heat and Gas Appliance Energy [therms/yr]



Background

Assess

Reduce

Generate

Offset

Results

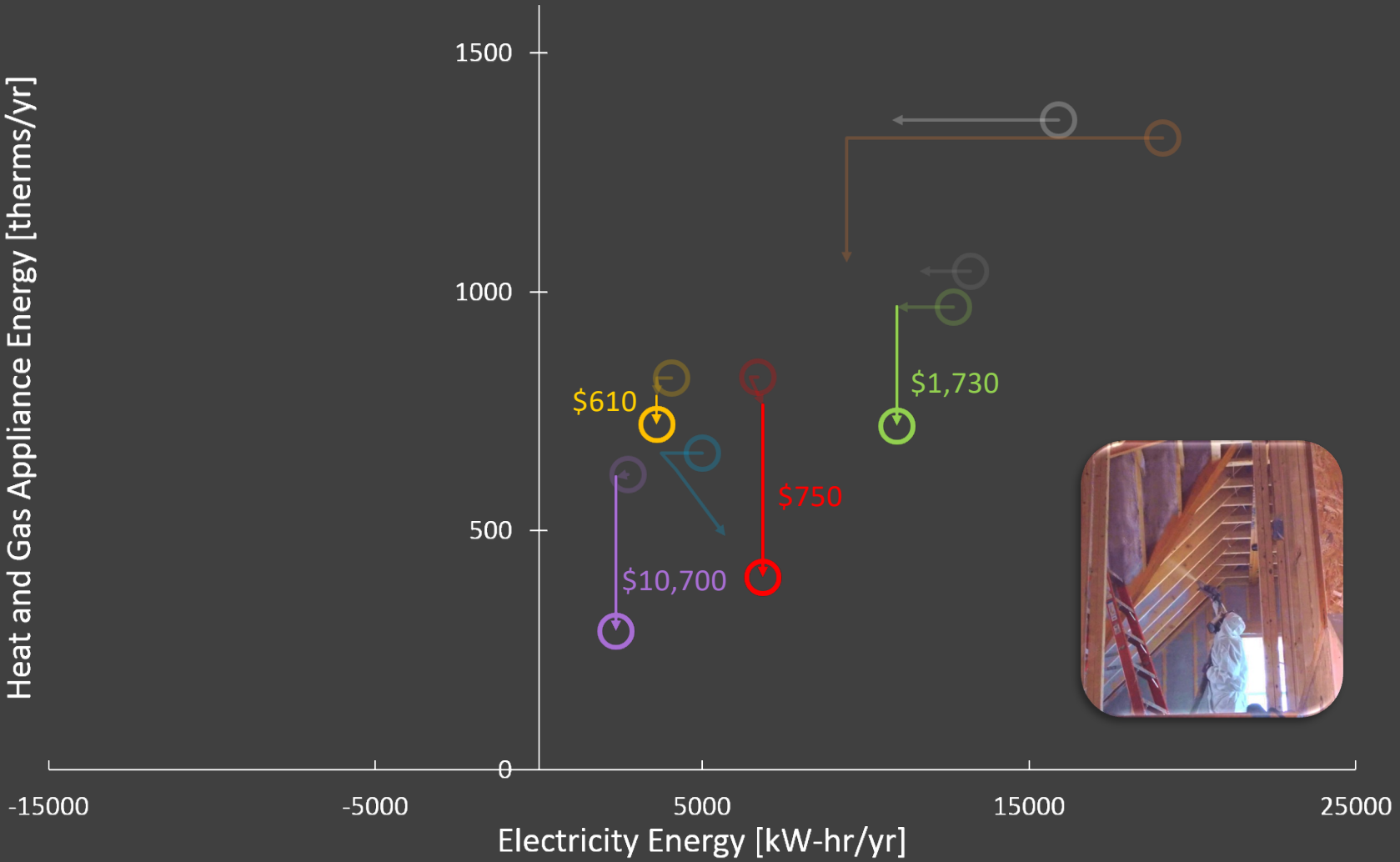
Net Zero Homes Project

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23



Heat and Gas Appliance Energy [therms/yr]



Background

Assess

Reduce

Generate

Offset

Results

Net Zero Homes Project

10/7/23

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Lifestyle Changes - Boer House



http://www.bose.com.hk/upload/products/videowave/videowave_bl_lg.jpg

Background

Assess

Reduce

Generate

Offset

Results

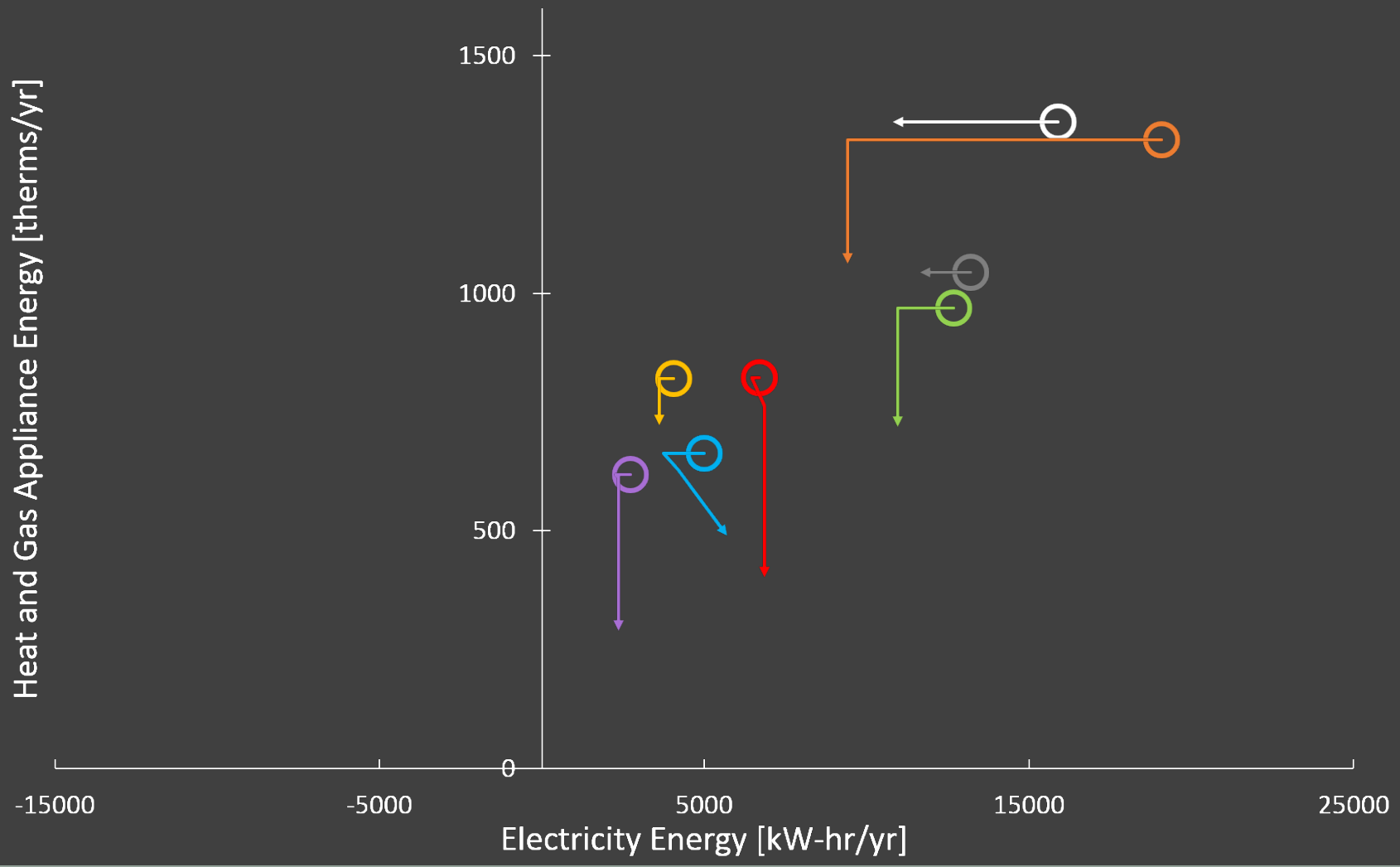
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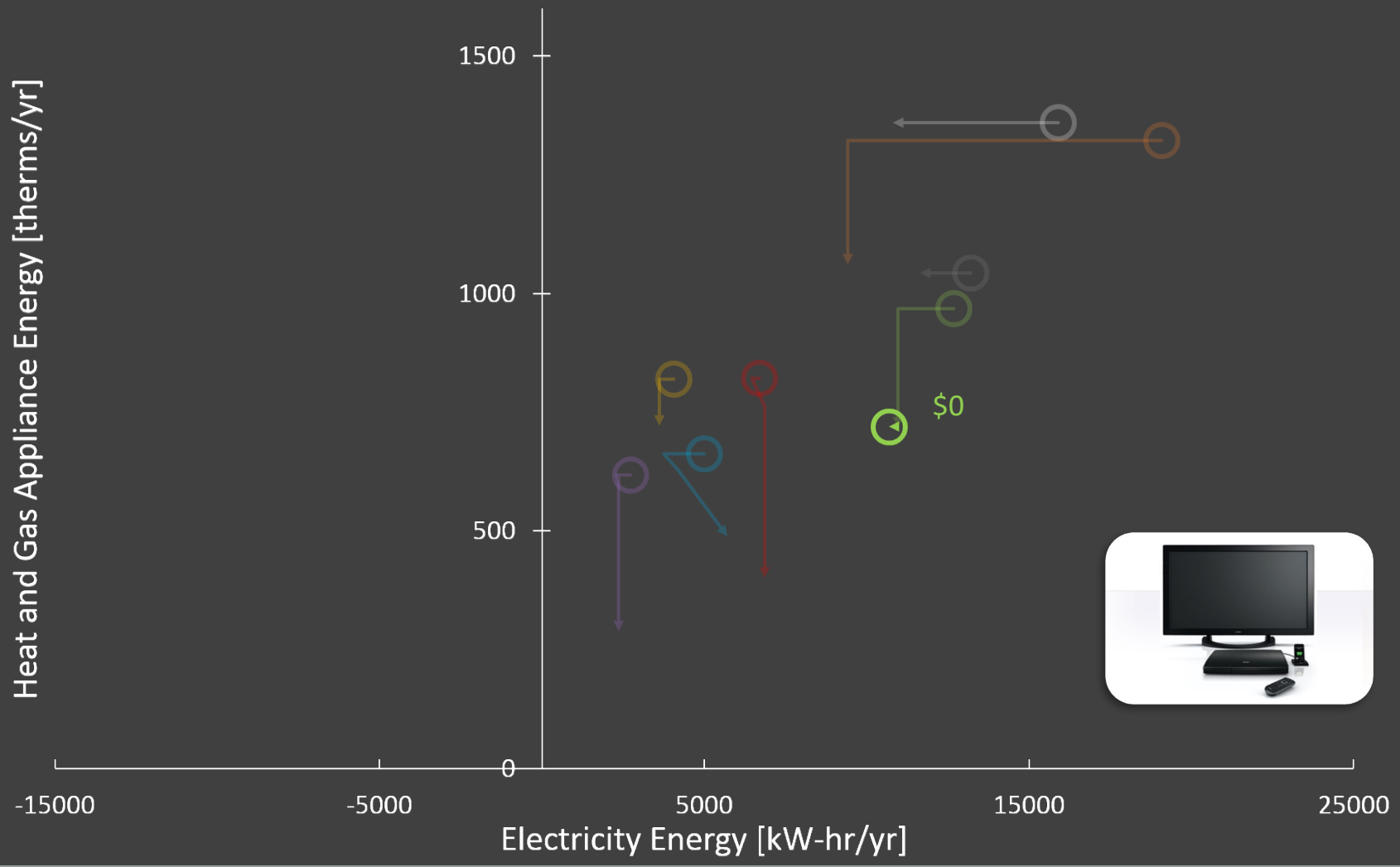
25



Heat and Gas Appliance Energy [therms/yr]



Heat and Gas Appliance Energy [therms/yr]



Background

Assess

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Offset

Results

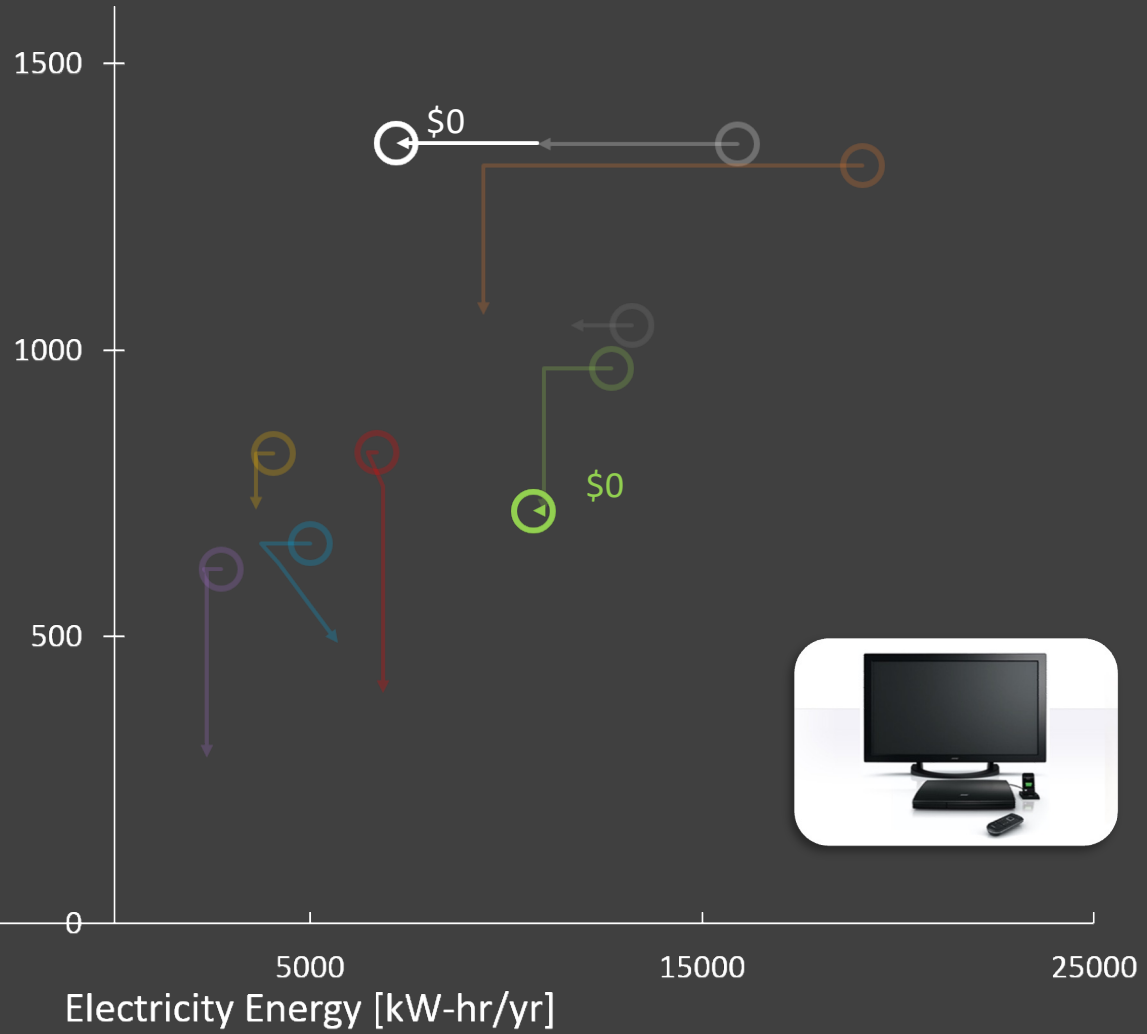
Net Zero Homes Project

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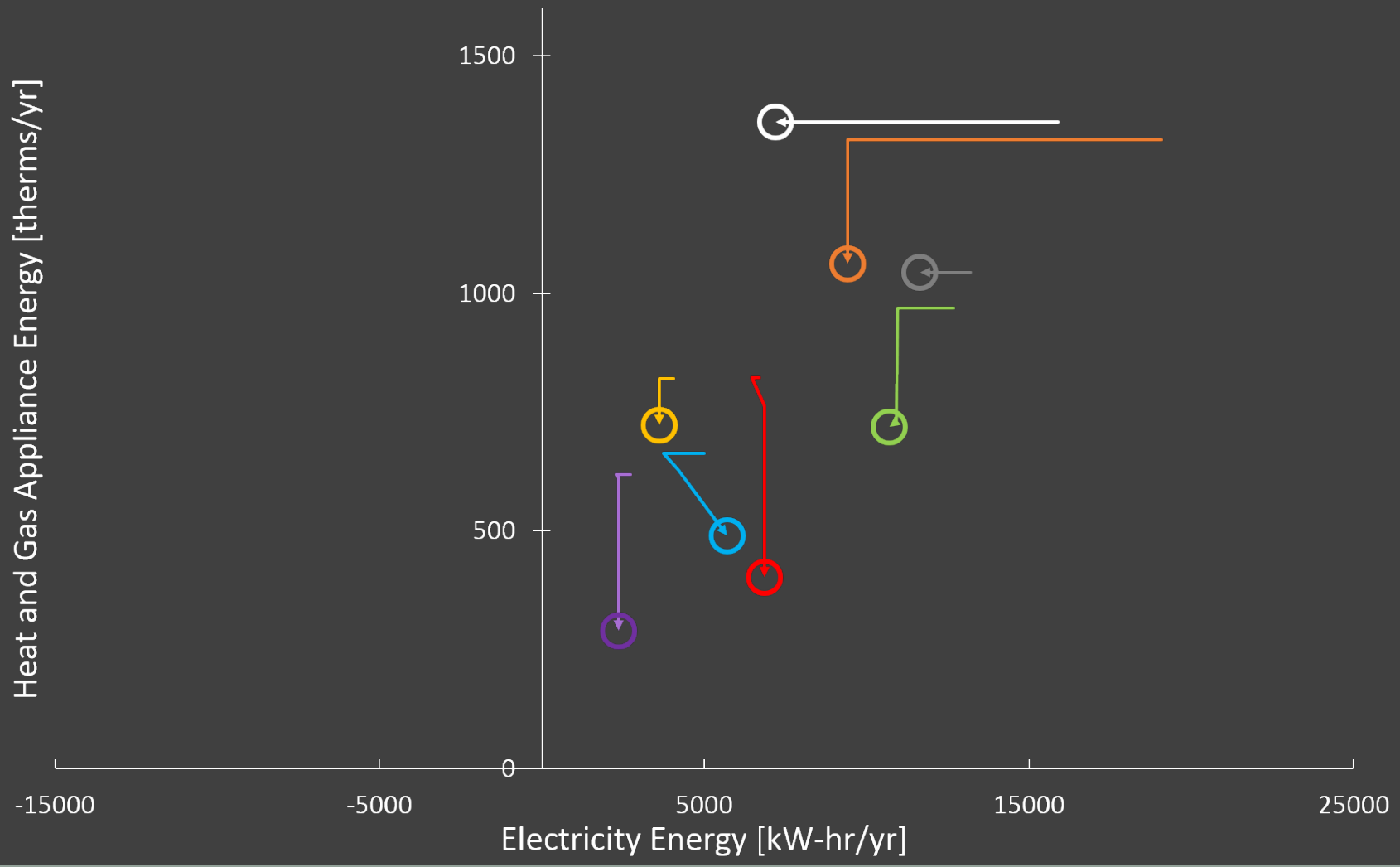
27



Heat and Gas Appliance Energy [therms/yr]



Heat and Gas Appliance Energy [therms/yr]



Energy Generation



<http://www.windpower.com/2011/09/15/energy-generation-from-renewables/>
<http://www.maketsolar.com/solar-energy-information/02-solar-energy.htm>
<http://www.nerg.co.uk/NerG/biomass-heating/>

Background

Assess

Reduce

Generate

Offset

Results

Net Zero Homes Project

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30



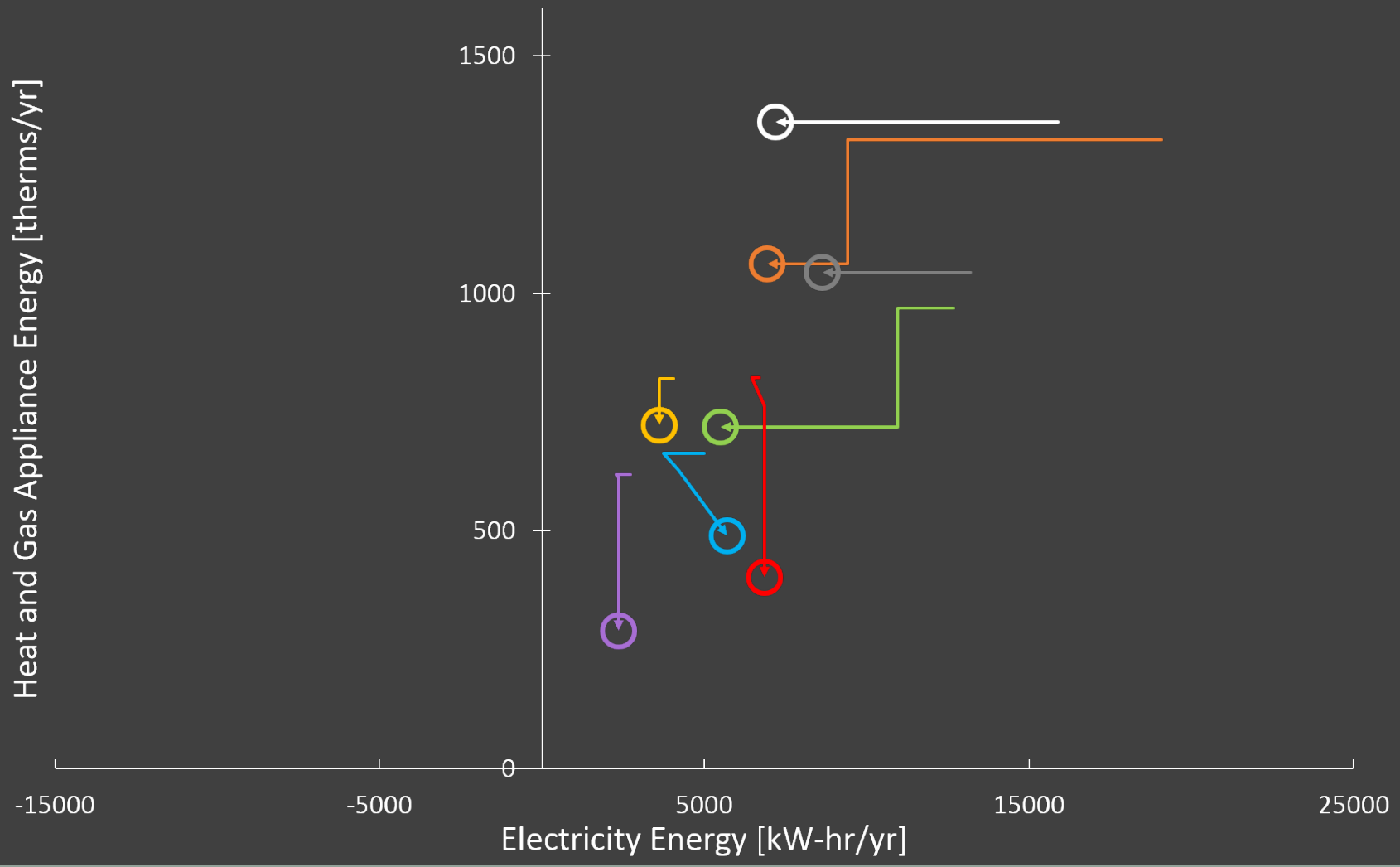
Geothermal - Affholter House



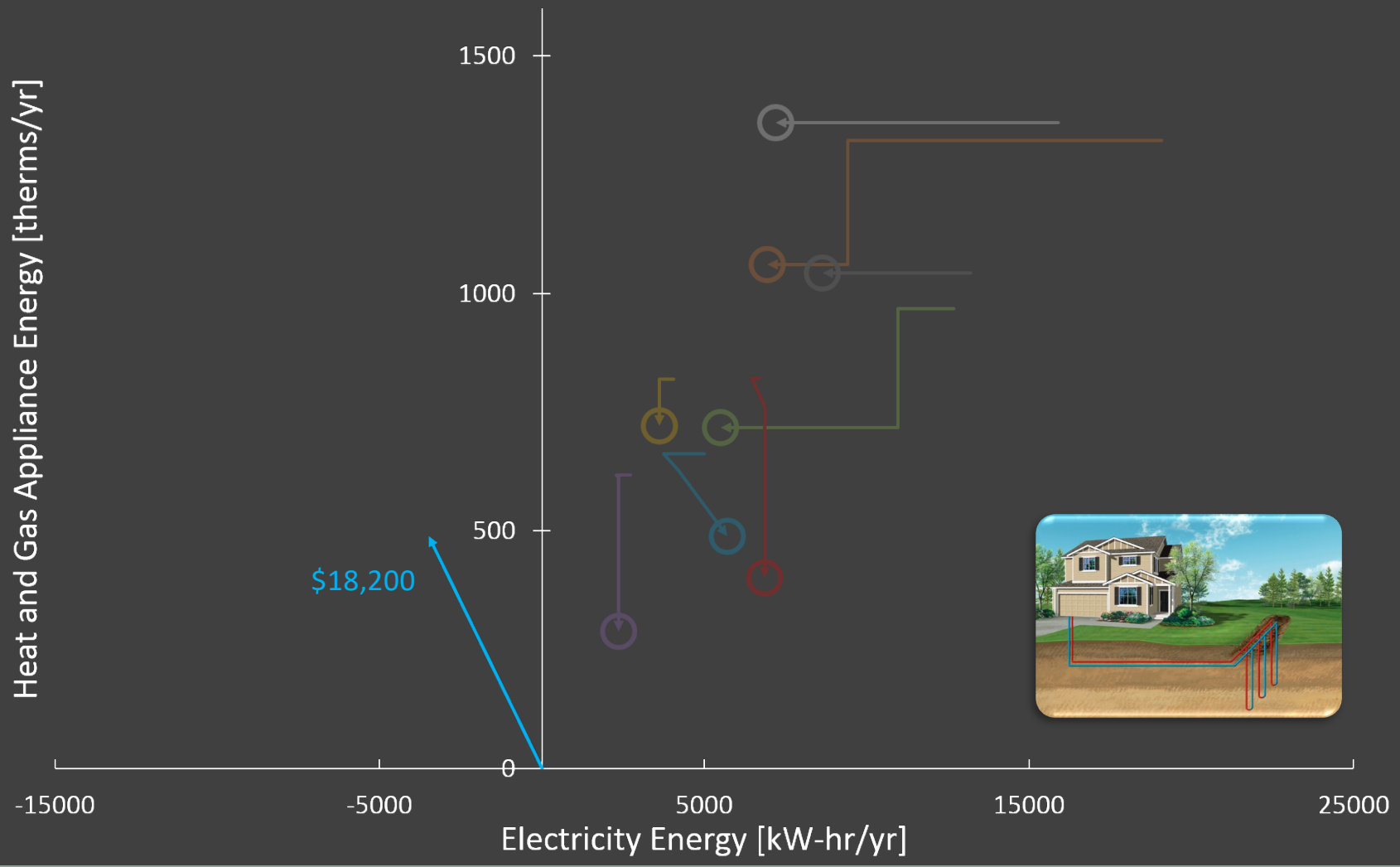
http://www.esipowercorp.com/Portals/139609/images/Vertical_Loop.jpg



Heat and Gas Appliance Energy [therms/yr]



Heat and Gas Appliance Energy [therms/yr]



Background

Assess

Reduce

Generate

Offset

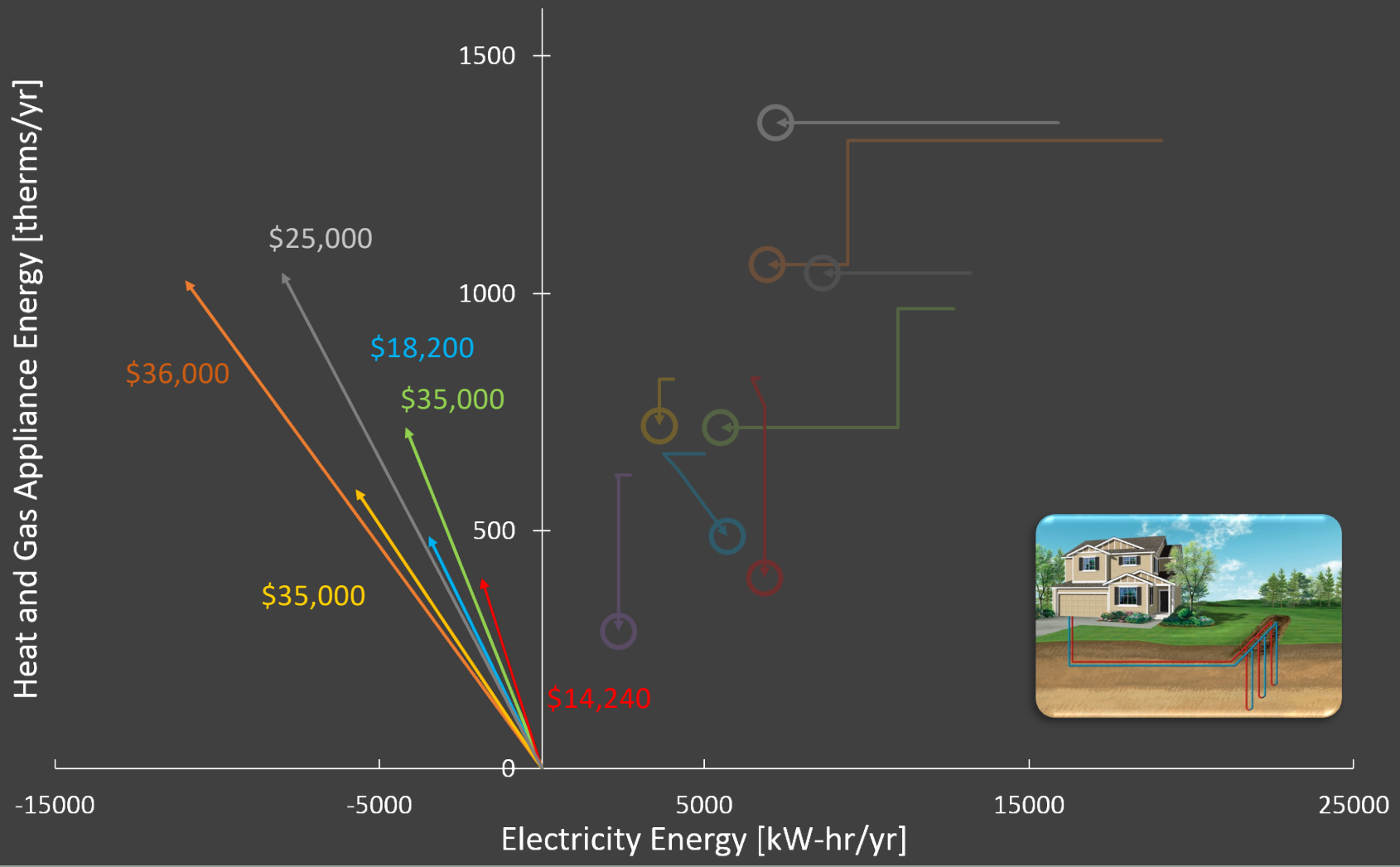
Results

Net Zero Homes Project

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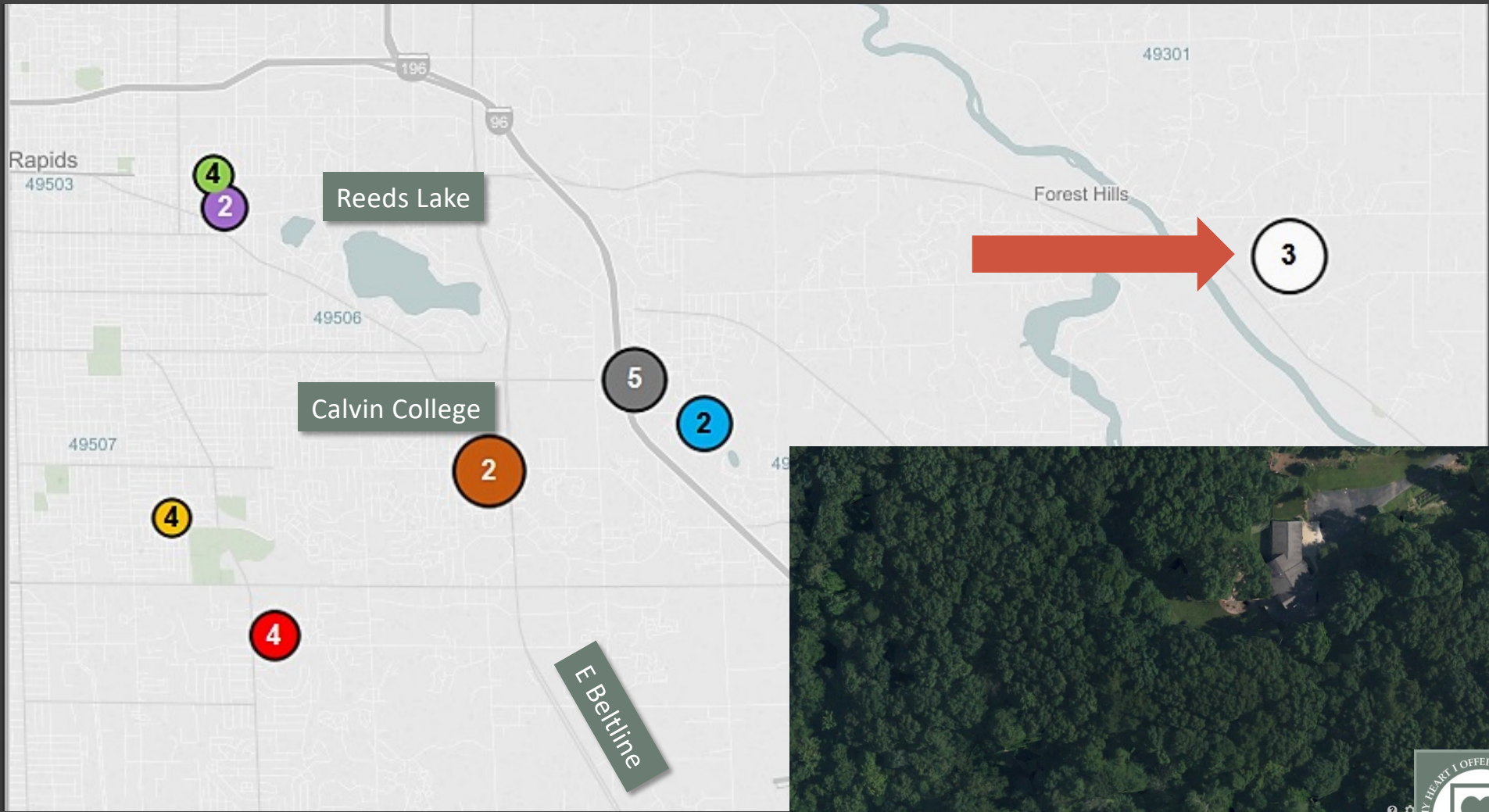
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Biomass - Evenhouse





Biomass



Evenhouse

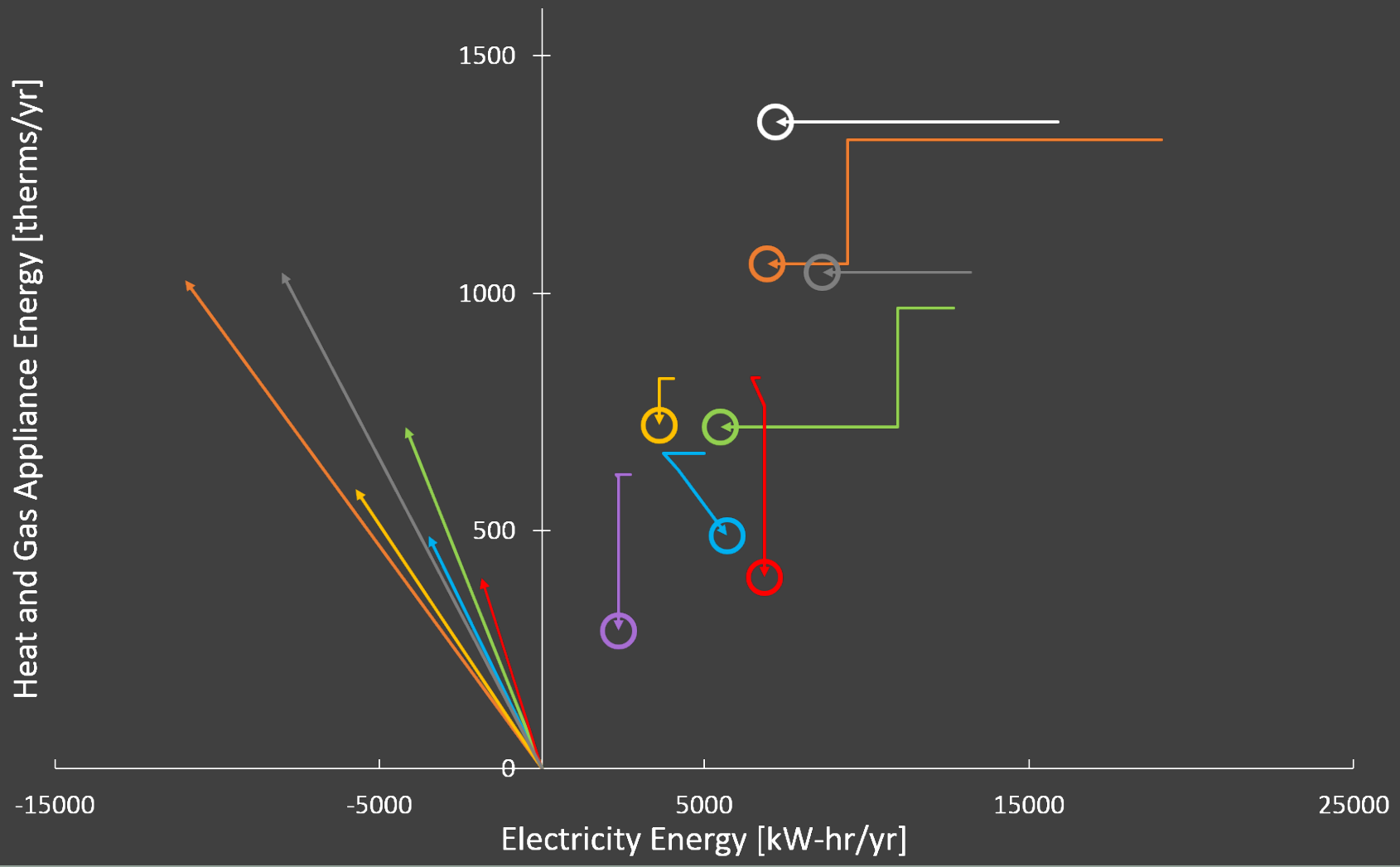


http://www.woodmaster.com/woodfurnaces_4400.php

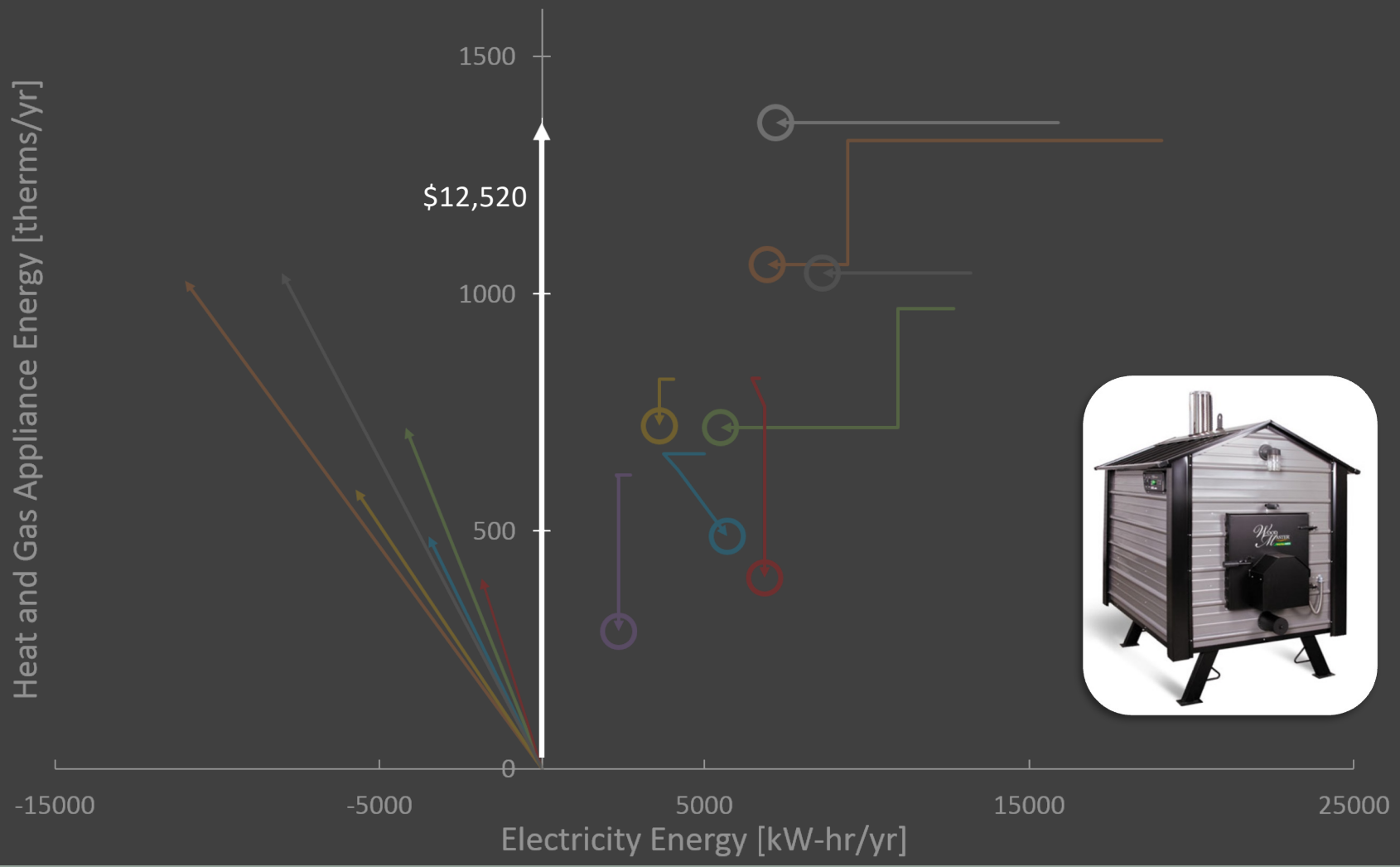


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Photo by: V. Jedlicka
Visit <http://lancaster.unl.edu>





Heat and Gas Appliance Energy [therms/yr]



Background

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Net Zero Homes Project

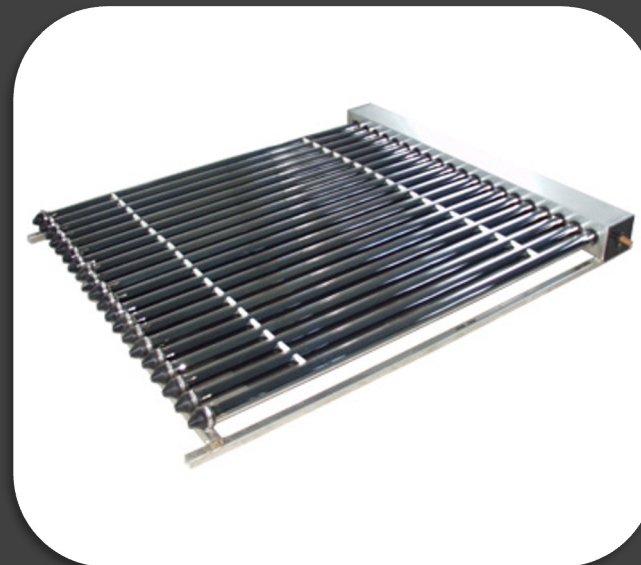
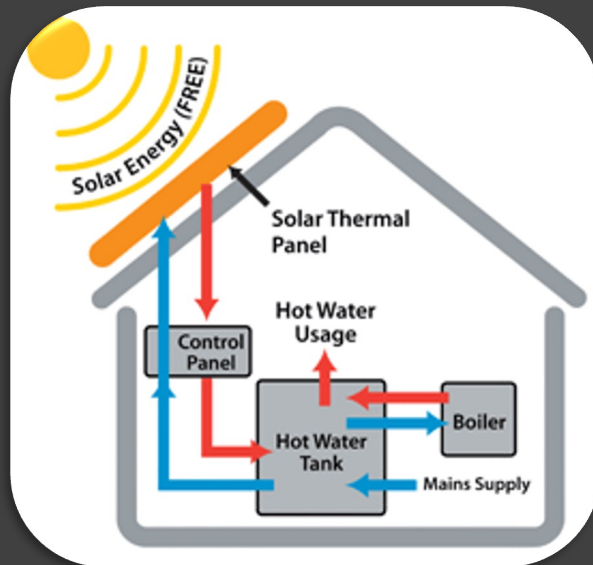
10/7/23

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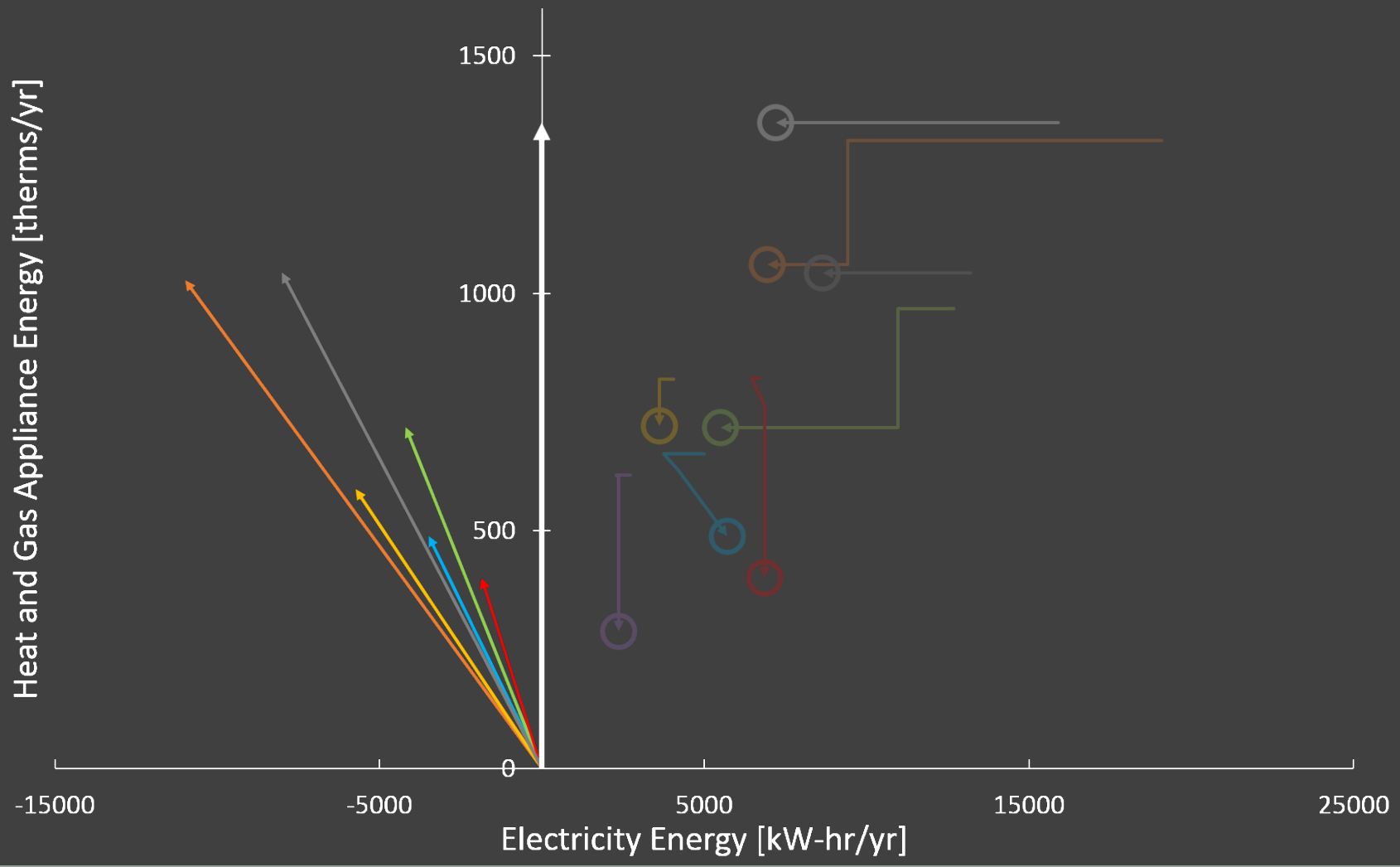
Solar Heat - Heffner

57 Therms / year-panel

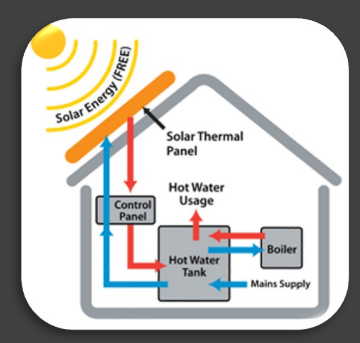
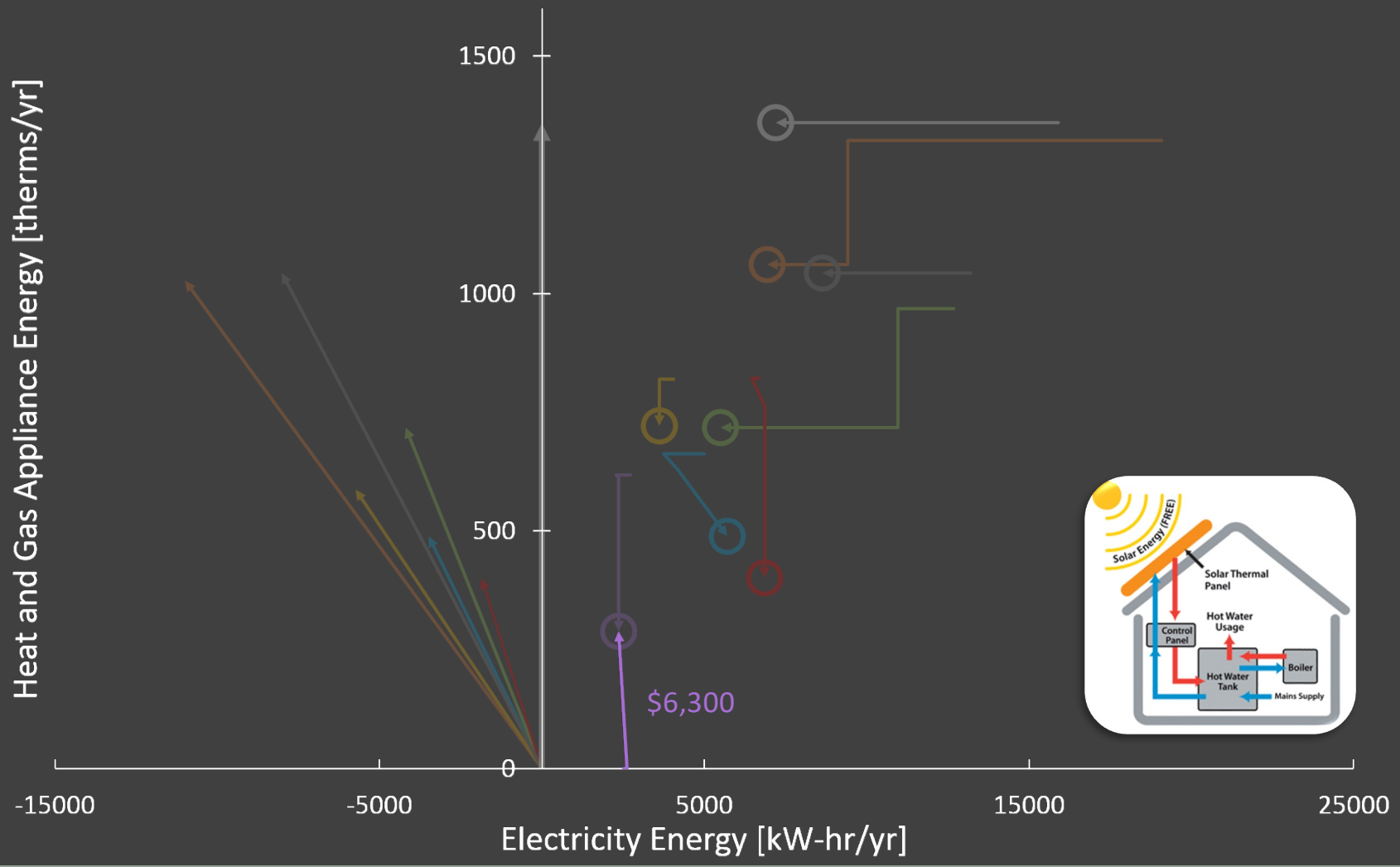


<http://genesisennergysolutions.com/energy-solutions/solar-thermal>
<http://www.climatetechwiki.org/technology/solar-heating>

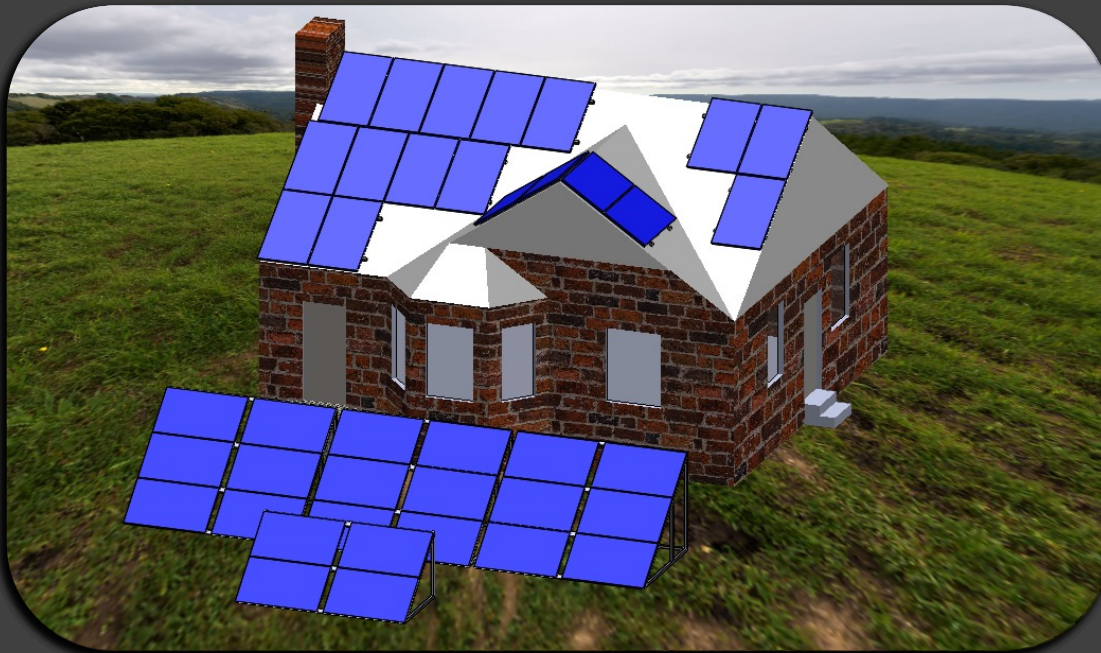




Heat and Gas Appliance Energy [therms/yr]



Solar PV



315 SOLAR PANEL

EXCEPTIONAL EFFICIENCY AND PERFORMANCE



The planet's most powerful solar panel.

The SunPower™ 315 Solar Panel provides today's highest efficiency and performance. Utilizing 96 back-contact solar cells, the SunPower 315 delivers a total panel conversion efficiency of 19.3%. The 315 panel's reduced voltage-temperature coefficient, anti-reflective glass and exceptional low-light performance attributes provide outstanding energy delivery per peak power watt.

Background

Assess

Reduce

Generate

Offset

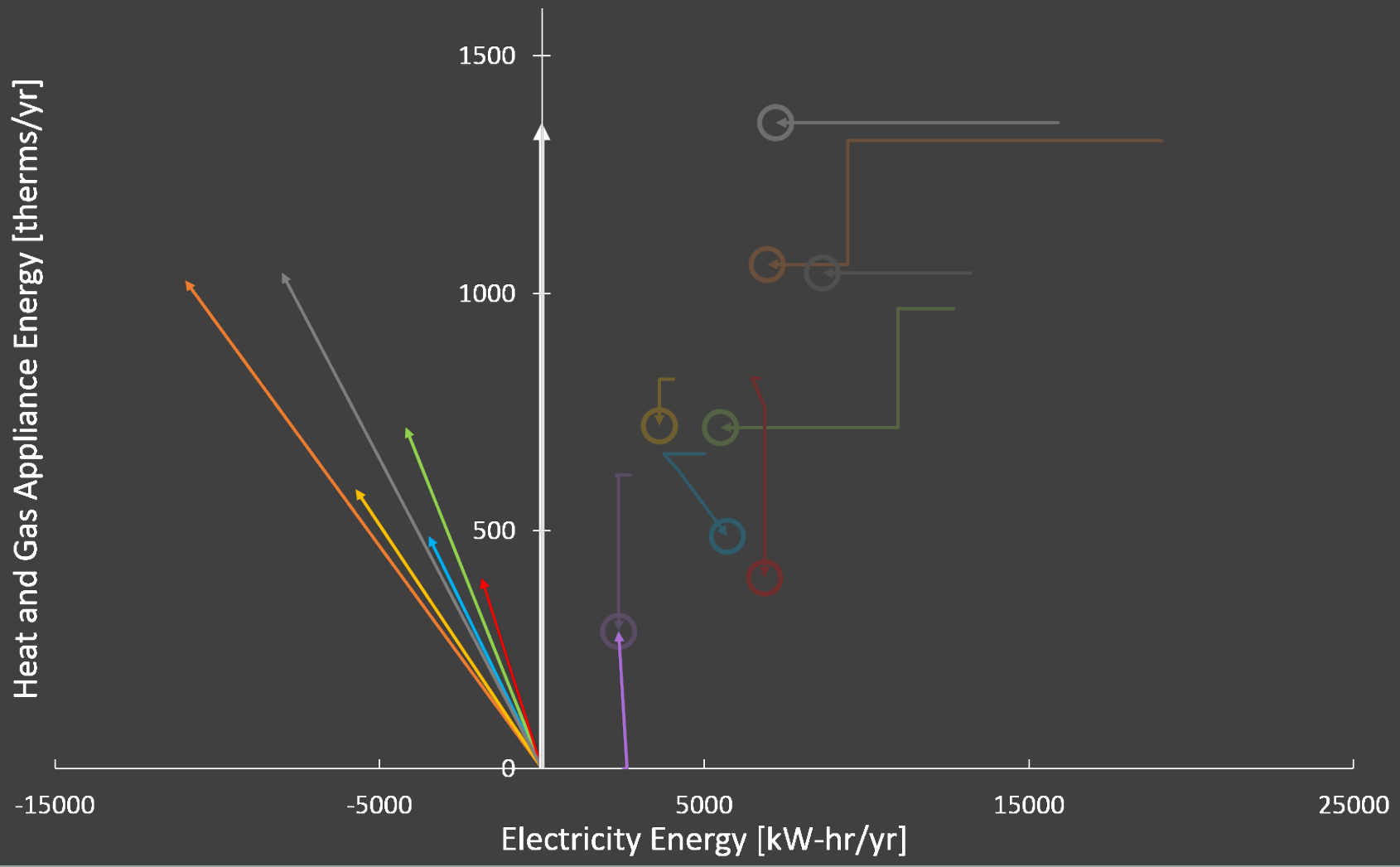
Results

Net Zero Homes Project

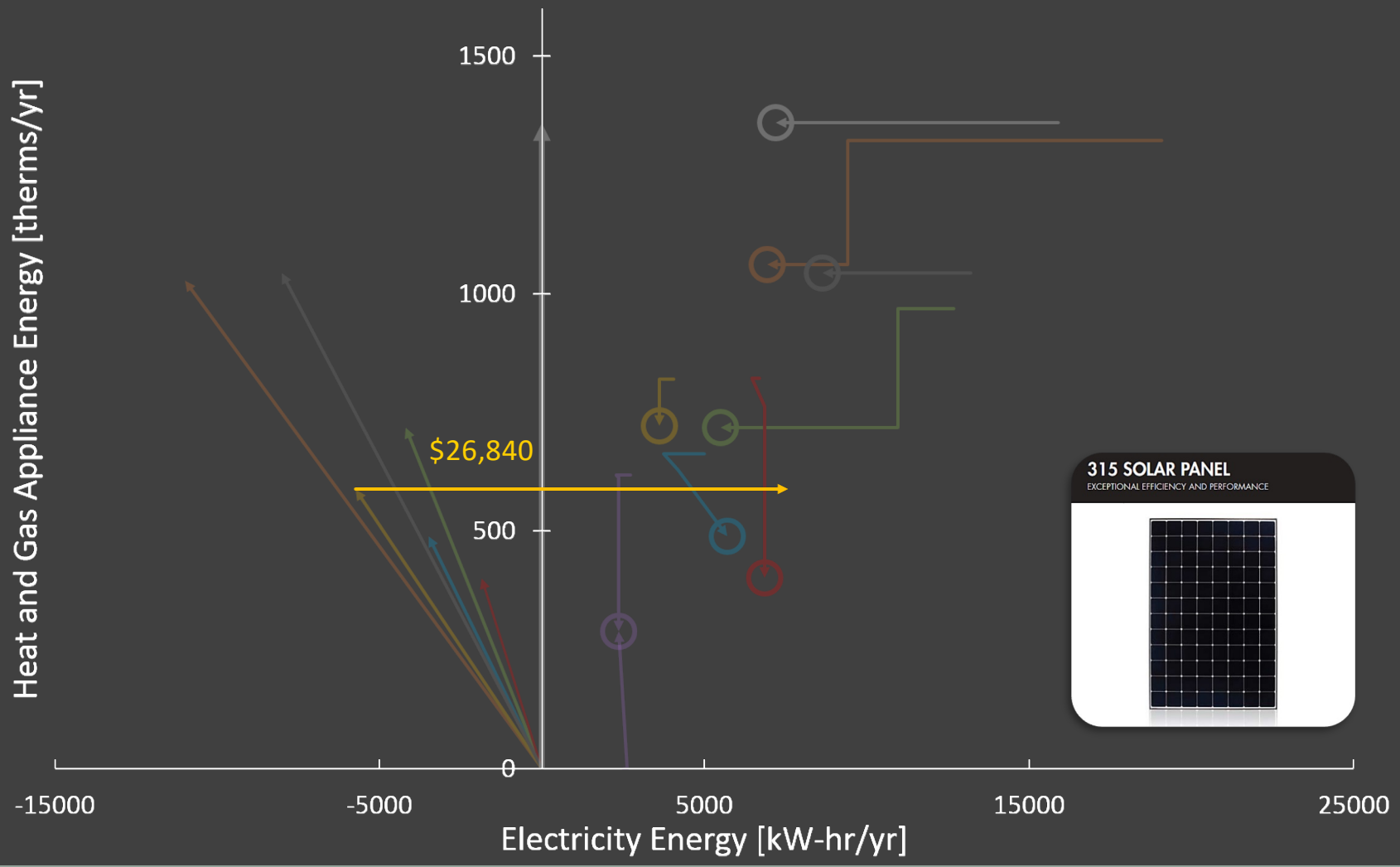
10/7/23

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Heat and Gas Appliance Energy [therms/yr]



Background

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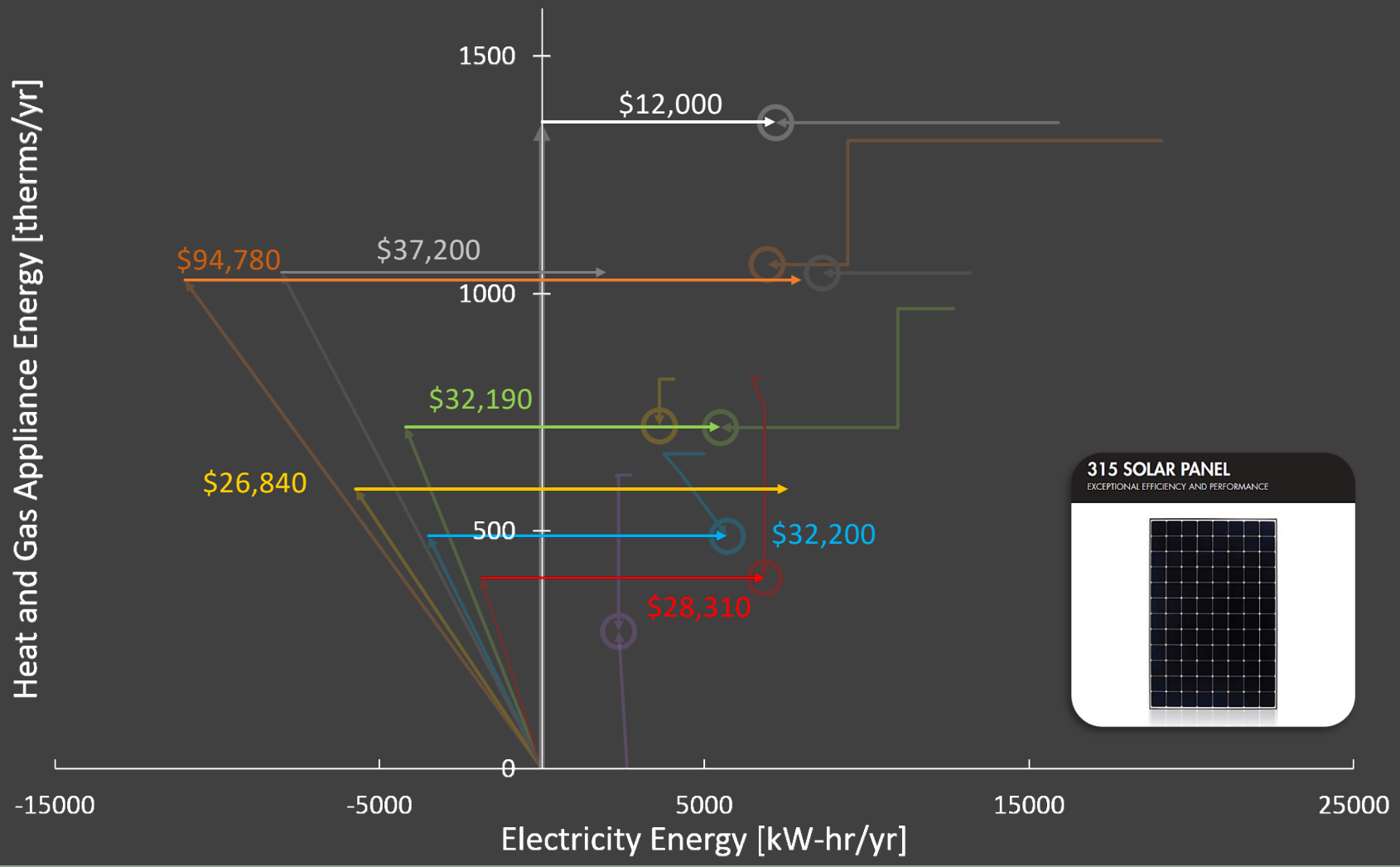
Net Zero Homes Project

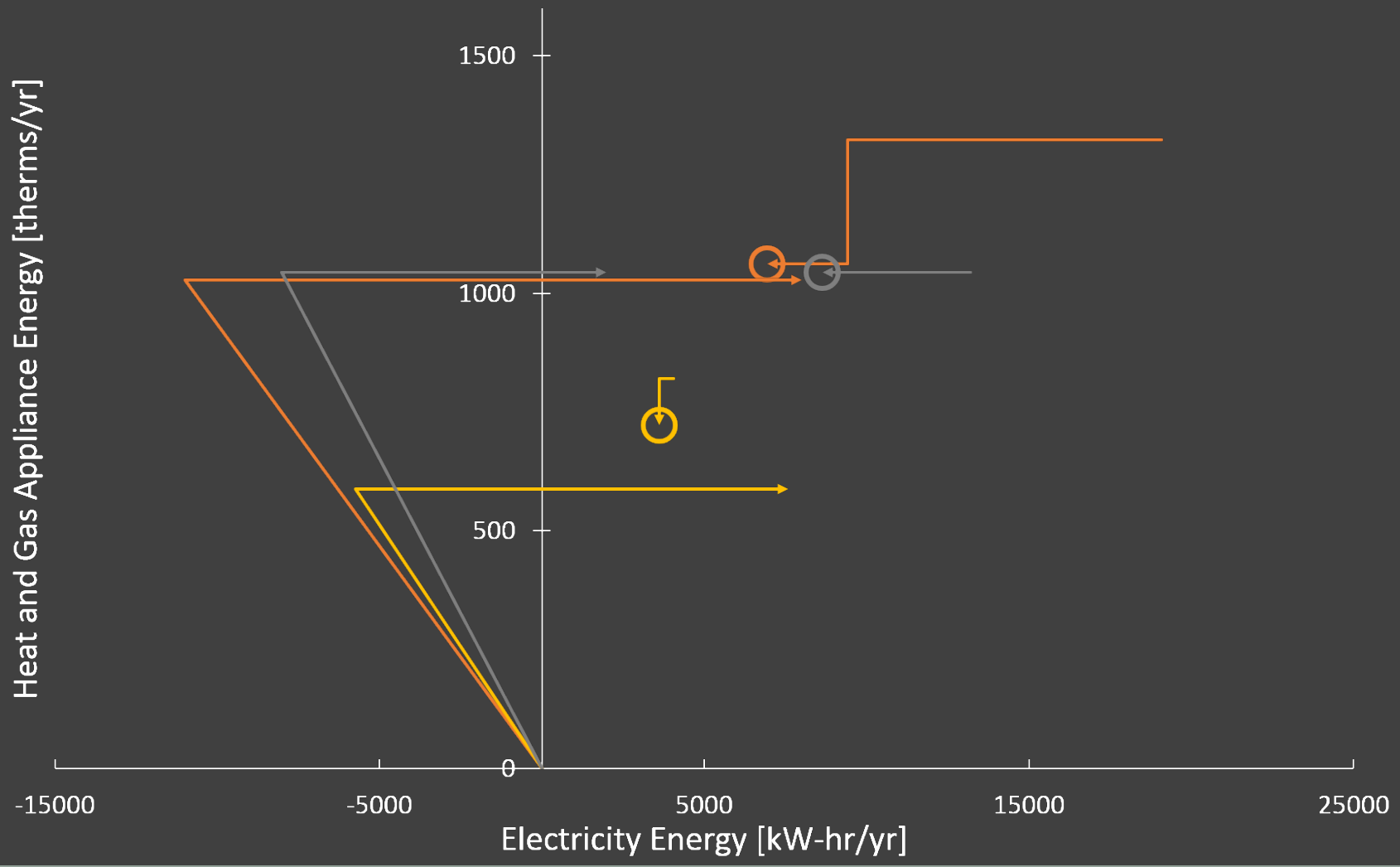
10/7/23

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Heat and Gas Appliance Energy [therms/yr]





Wind



<http://windturbineshome.net/>



<http://cleantechnica.com/2014/04/21/real-innovation-wind-energy/>

Background

Assess

Reduce

Generate

Offset

Results

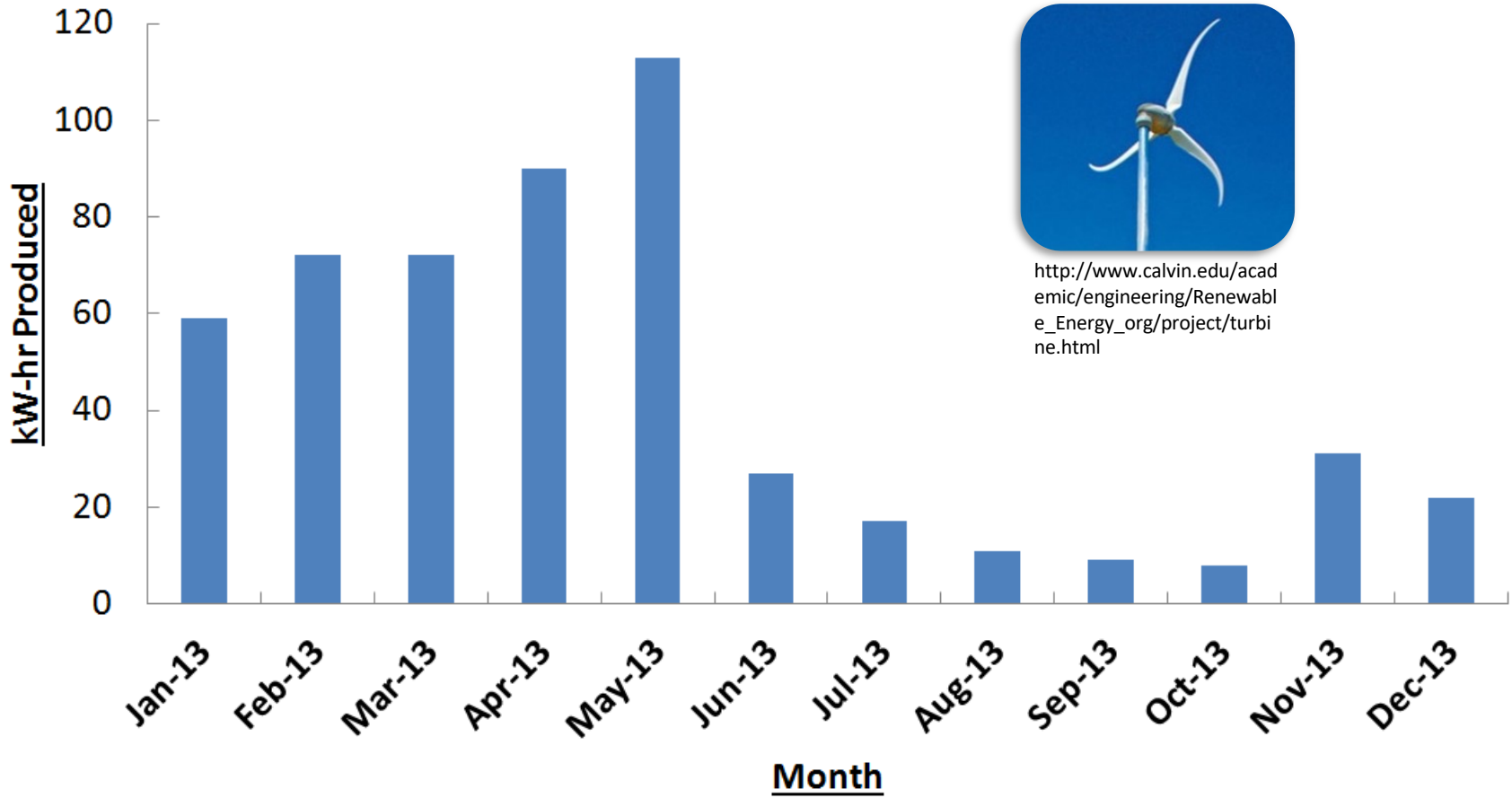
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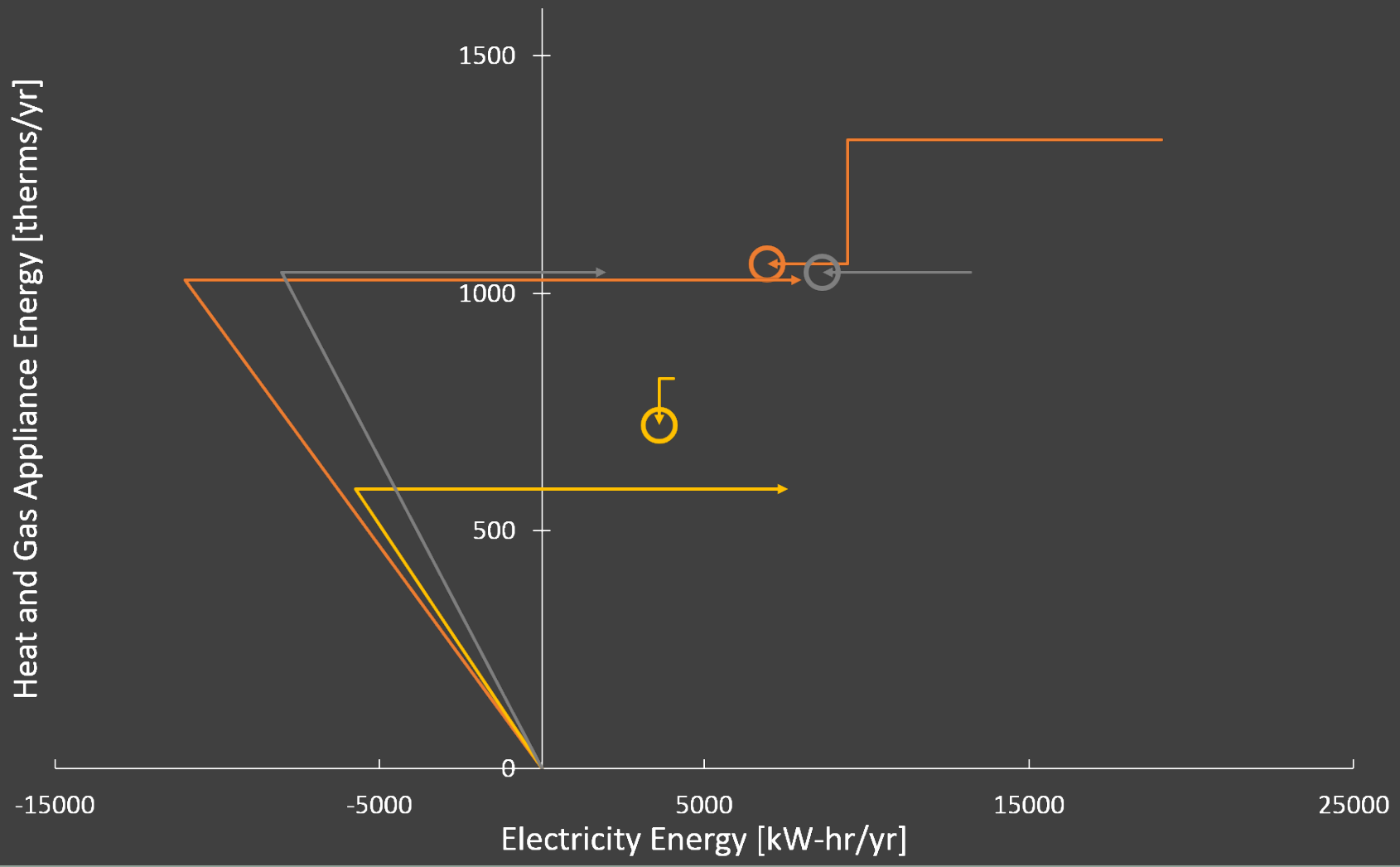


Calvin Wind Turbine Production 2013

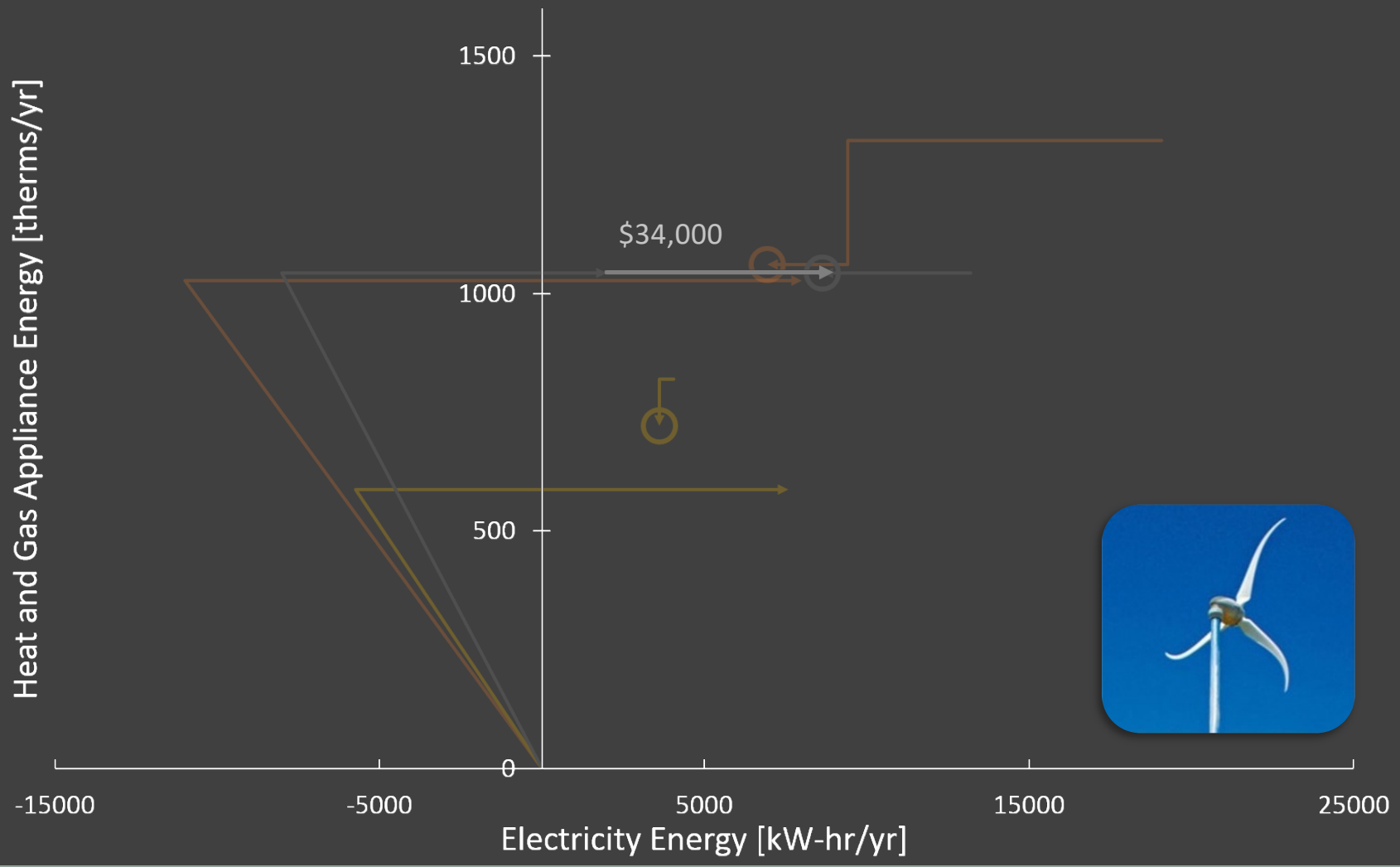


http://www.calvin.edu/academic/engineering/Renewable_Energy_org/project/turbine.html





Heat and Gas Appliance Energy [therms/yr]



Background

Assess

Reduce

Generate

Offset

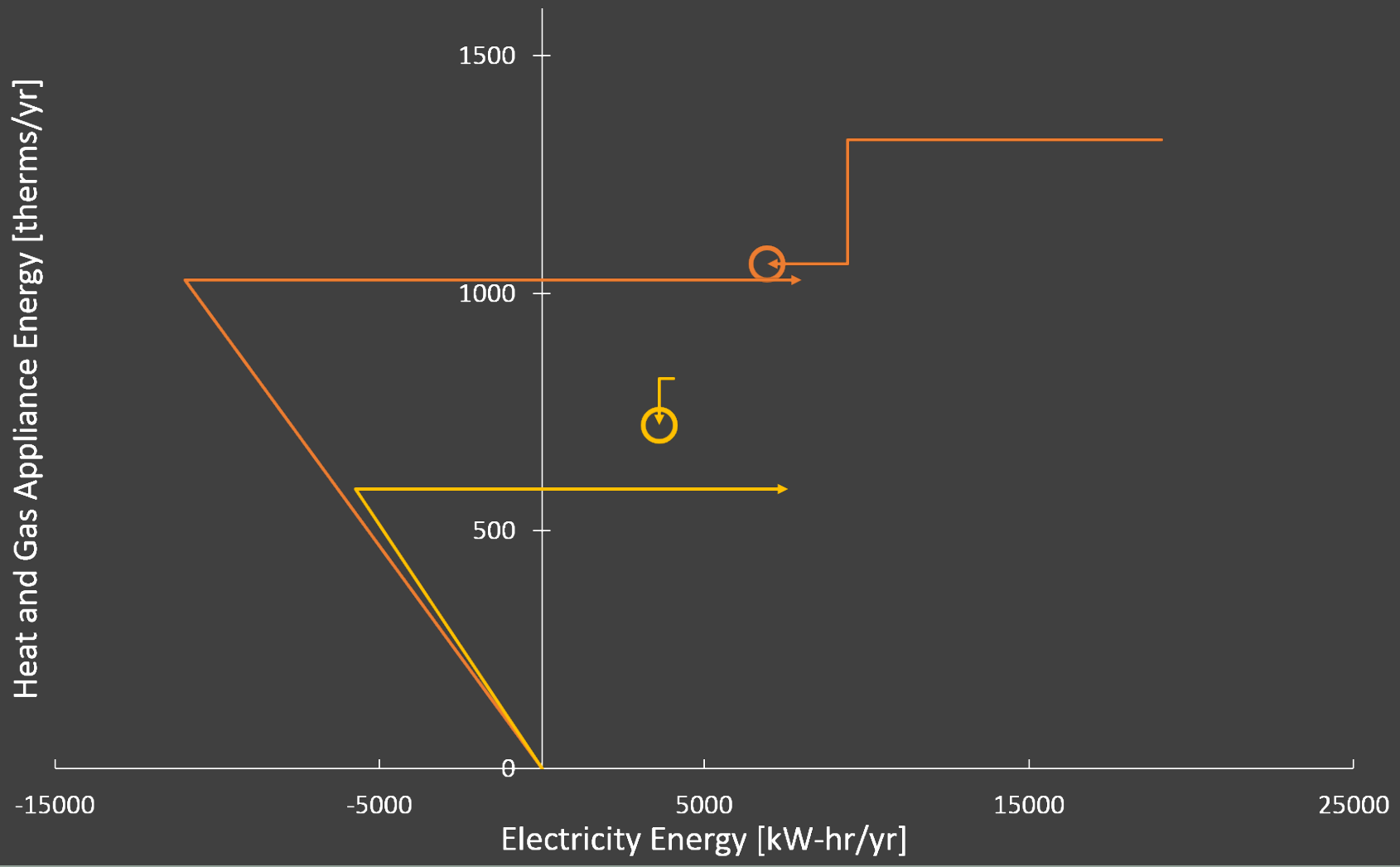
Results

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Offset

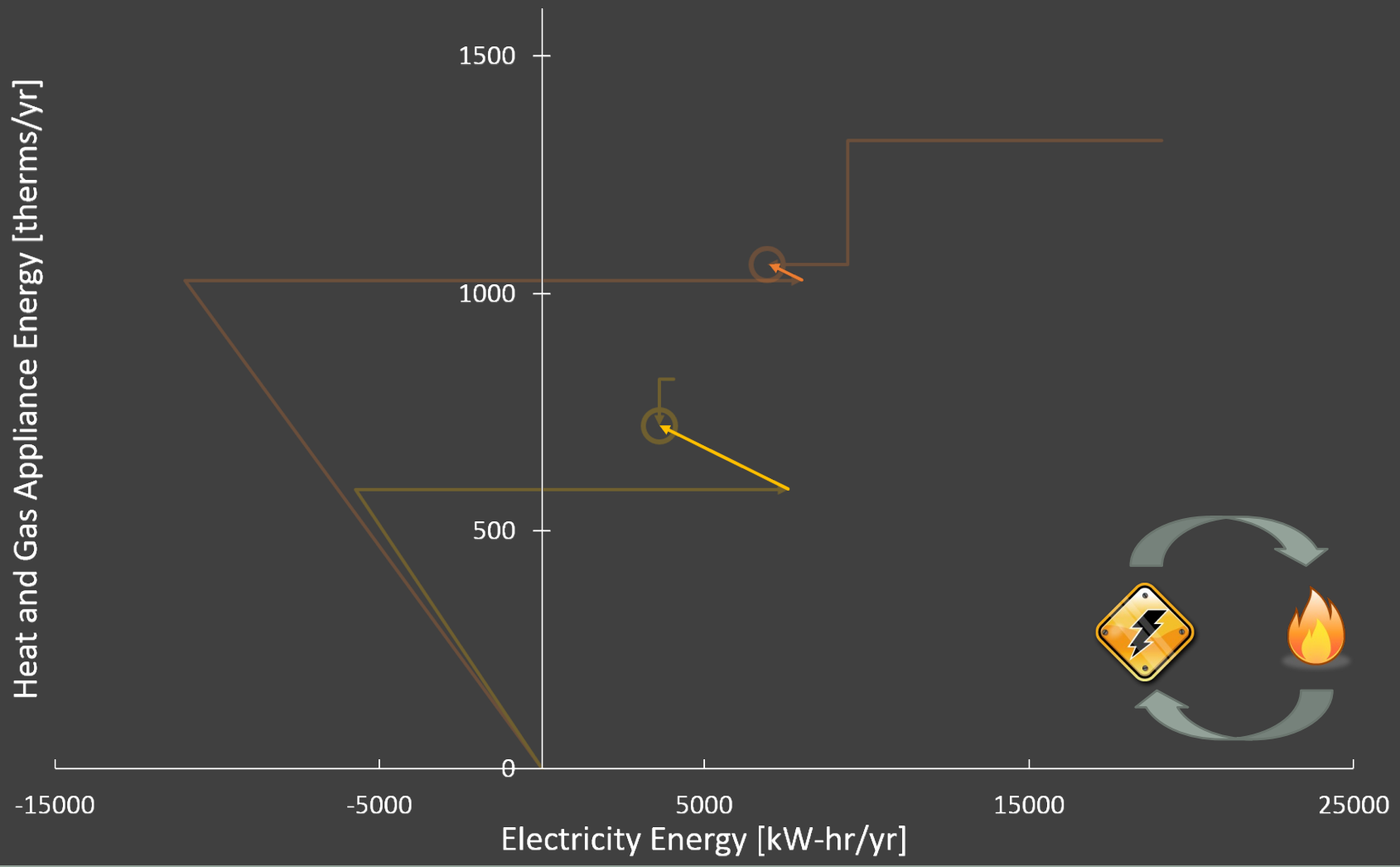


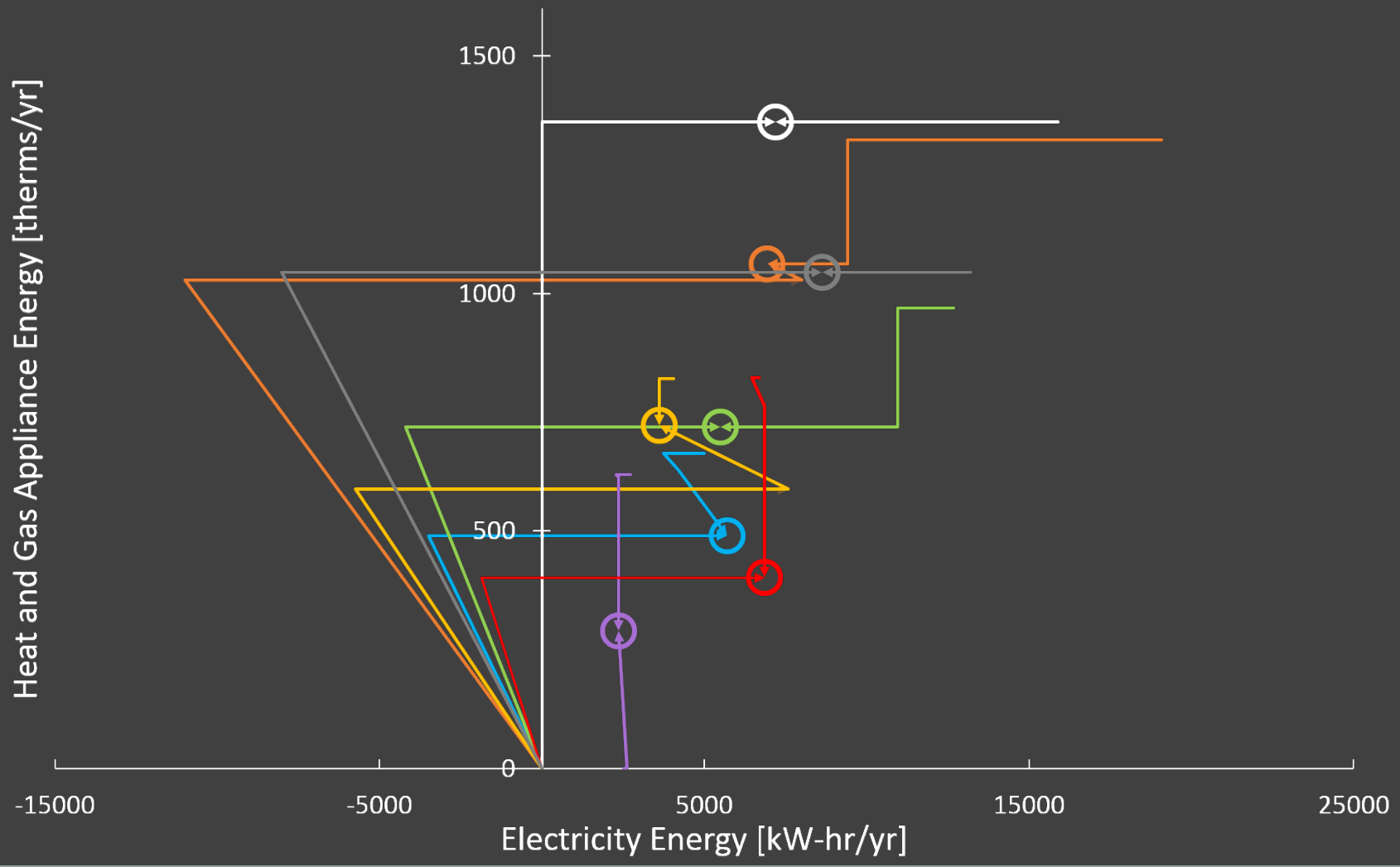
**Renewable
Energy
Credits
(RECs)**



www.better-world-energy.com







What did we learn?



What Worked?



<http://inhabitat.com/new-bio-solar-panels-are-made-with-cotton-and-castor-beans/>

Background

Assess

Reduce

Generate

Offset

Results

Net Zero Homes Project

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What Did Not Work?



<http://inhabitat.com/bladeless-wind-turbine-design-is-for-the-birds-literally/>

Background

Assess

Reduce

Generate

Offset

Results

Net Zero Homes Project

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Challenges



<http://news.nationalgeographic.com/news/energy/2012/02/pictures/120228-spain-solar-energy/>



<http://www.brainright.com/ourhouse/Construction/SolarElectric/>

Background

Assess

Reduce

Generate

Offset

Results

Net Zero Homes Project

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Challenges



<http://www.mercuryrefrigeration.ca/index.php?page=geothermal>



Takeaways



<http://10-most.com/the-top-ten-most-expensive-things-in-the-world/>

Background

Assess

Reduce

Generate

Offset

Results

Net Zero Homes Project

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Take Home Message

Take small steps toward energy efficiency



<http://superfastlinkbuilding.com/wp-content/uploads/2012/04/How-Green-Affiliate-Marketing-Can-Grow-Your-Sustainable-Business-1.jpg>

Take Home Message

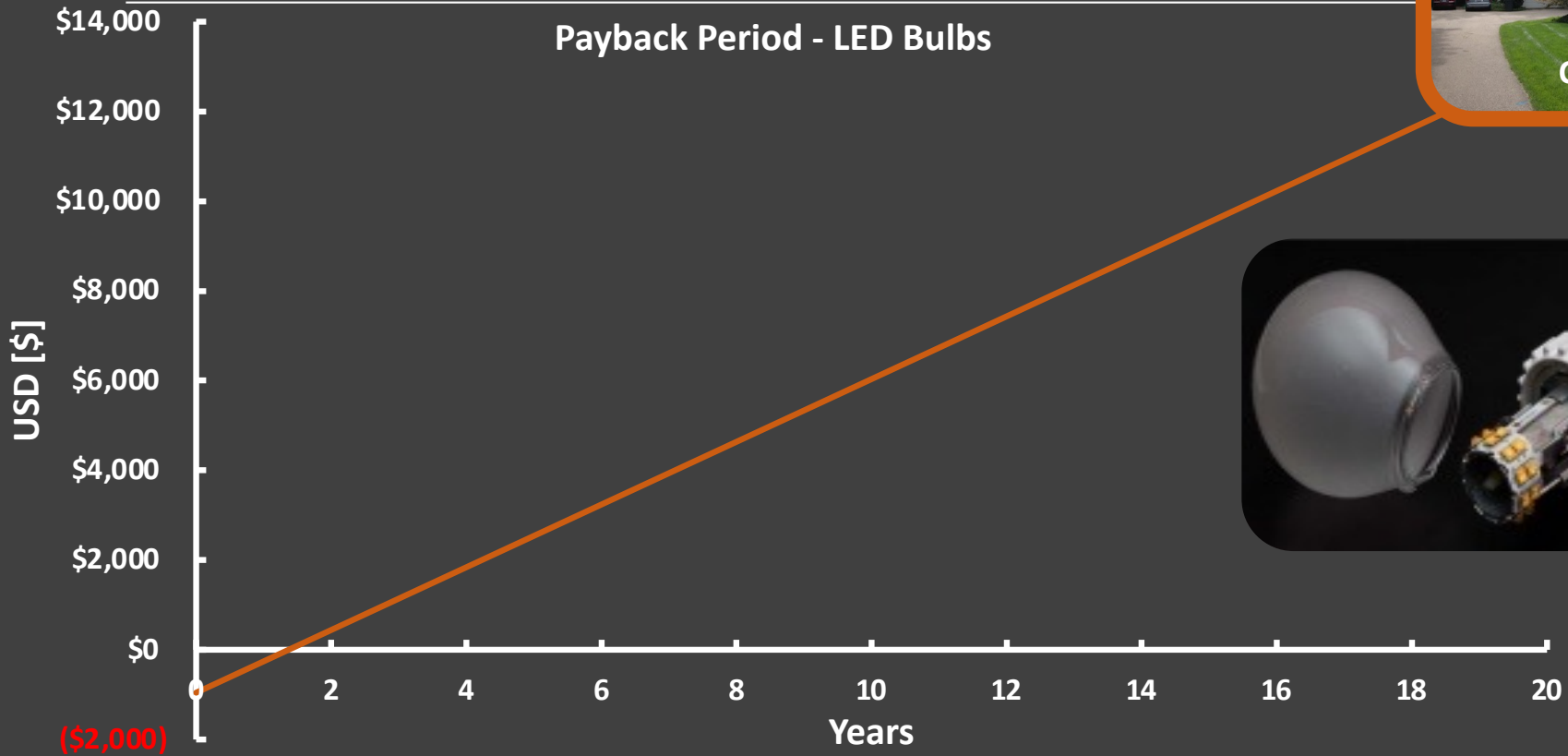


<http://assets.inhabitat.com/wp-content/blogs.dir/1/files/2011/08/Zimbabwe-CLF-bulb-exchange-3-537x402.jpg>



Take Home Message

Payback Period - LED Bulbs



Take Home Message



<http://www.ci.bellaire.tx.us/index.aspx?NID=917>

Background

Assess

Reduce

Generate

Offset

Results

Net Zero Homes Project

10/7/23

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Take Home Message



<http://www.realestate.com.au/blog/a-household-history-of-the-fridge-2/>



<http://www.geappliances.com/appliances/refrigerators/cafe-hot-water-french-door-refrigerator/>



Background

Assess

Reduce

Generate

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Results

Net Zero Homes Project

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Take Home Message



http://2.bp.blogspot.com/-WQcK_tUJq2M/UR49huX812I/AAAAAAAAAFoo/oDNyAeYhV5A/s1600/Sustainable-Home.png

“The choice you make that will have the biggest impact on your environmental footprint is what kind of house you live in.”

- Professor Heun

Net-Zero House Study

Engineering 333 Class Project

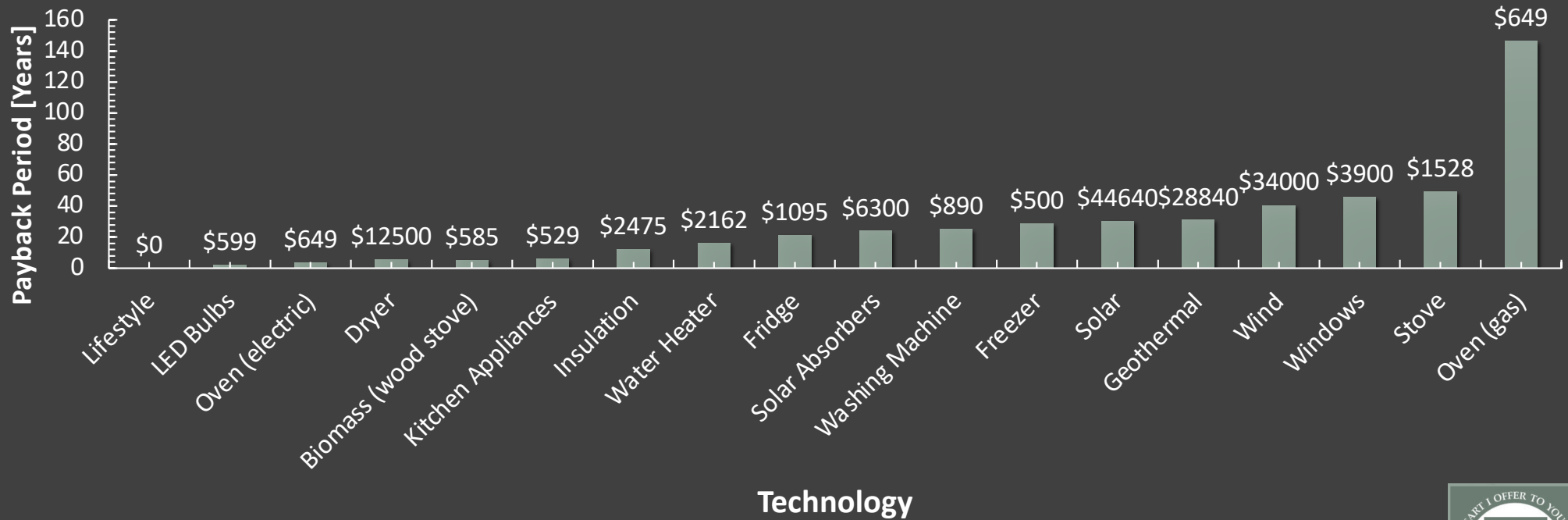
Senior Mechanical Engineering Students

12/02/2014



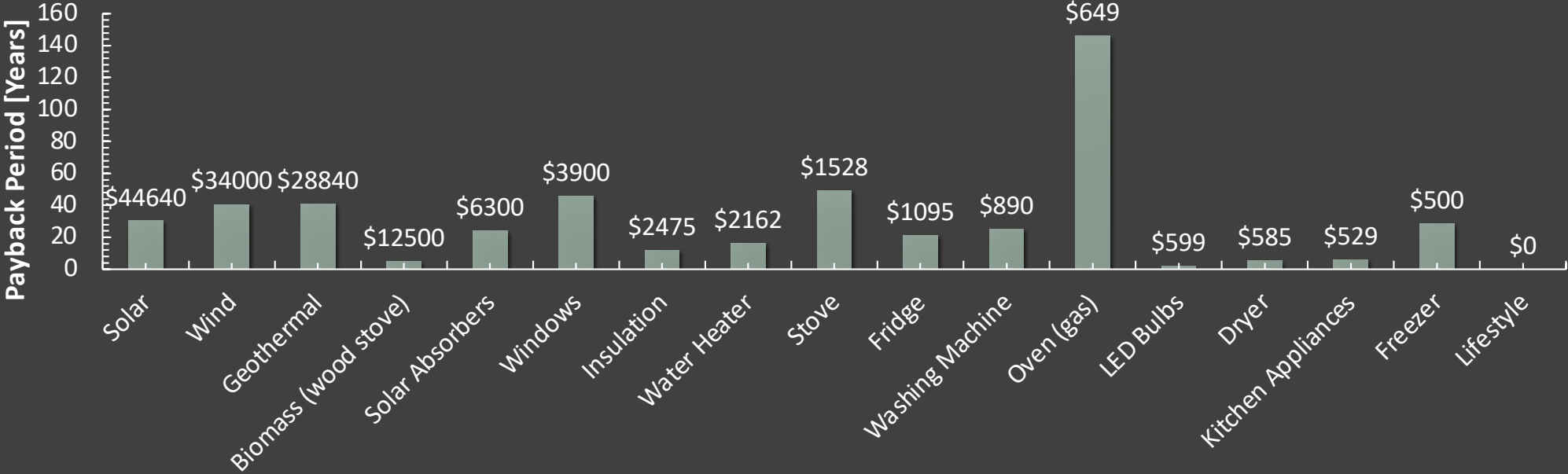
Compiled Technology Payback

Low to High Payback Period



Compiled Technology Payback

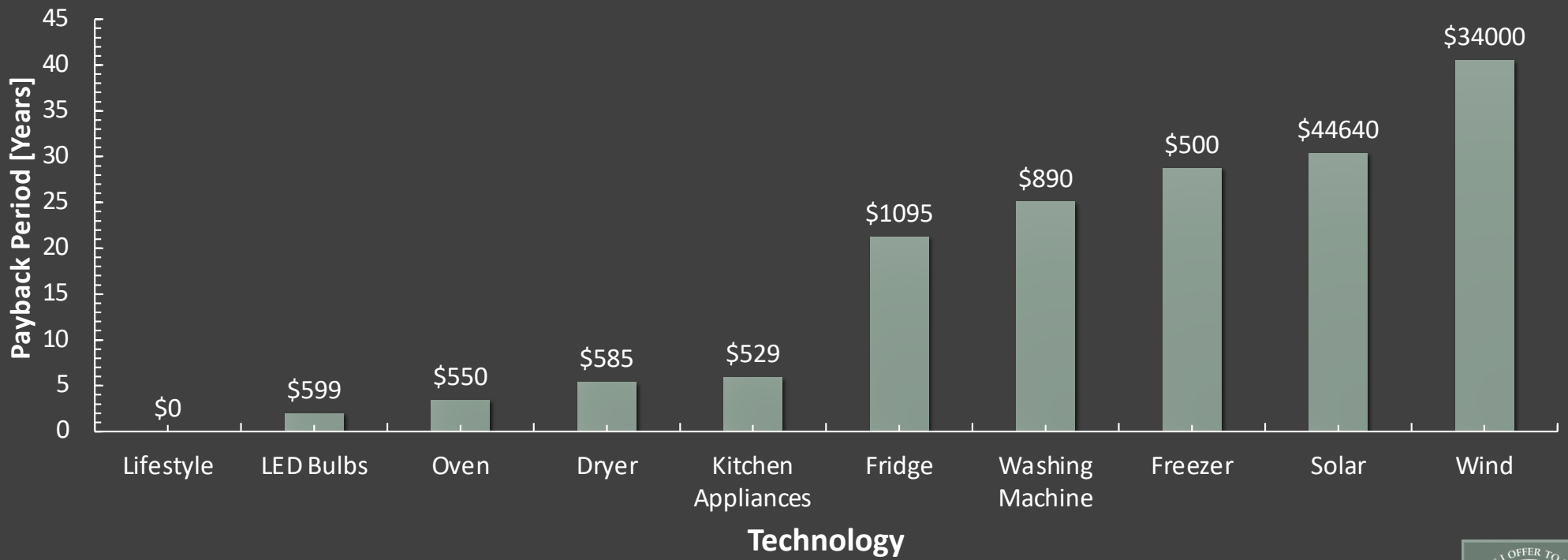
High to Low Investment Cost



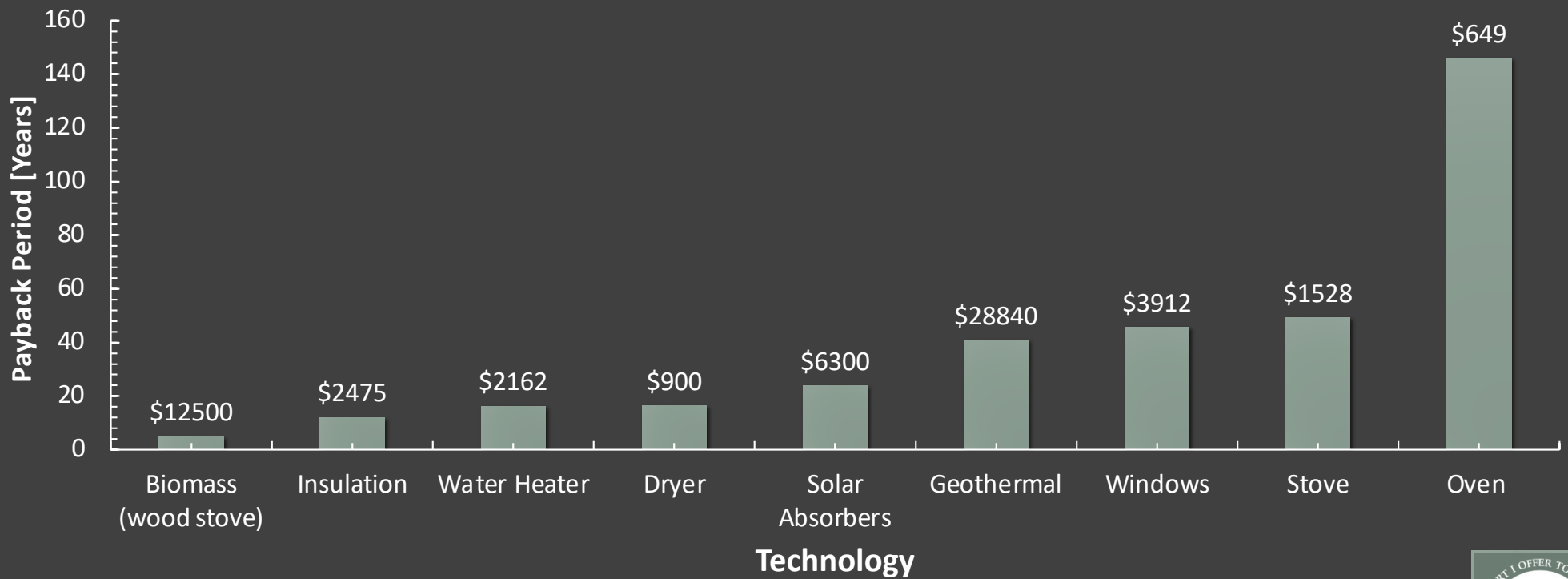
Technology Implementation



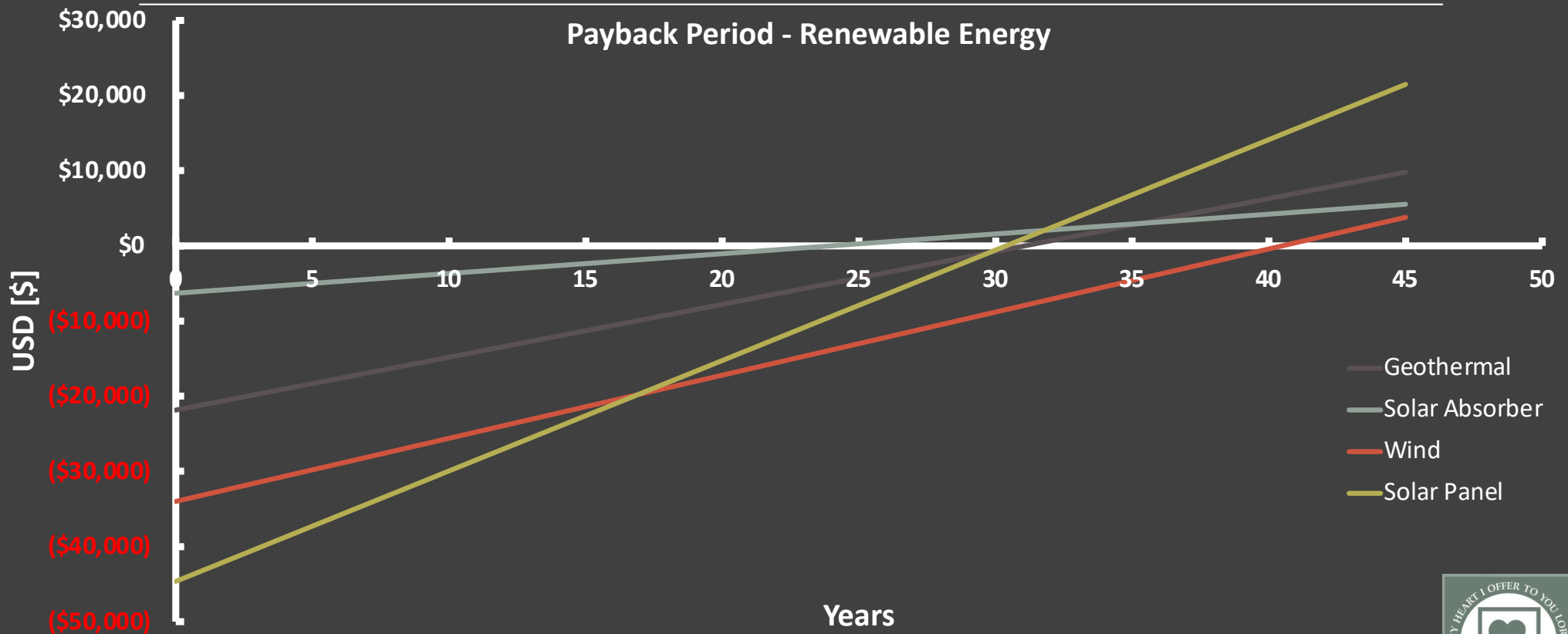
Payback Period – Electricity



Payback Period – Gas



Payback Period – Renewable Energy



Payback Period – Renewable Energy

