A CRITICAL ASSESSMENT:

DEFINING ZERO ENERGY BUILDINGS

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The concept of ZERO ENERGY BUILDINGS…

…is based on a building that uses very little energy and the energy it does use,

is supplied by renewable resources.

The concept of ZERO ENERGY BUILDINGS…

A low energy building can still consume non-renewable energy and not be sustainable

A low energy + nZEB consumes less non-renewable energy than it produces using renewable resources….and is sustainable

Why is Clearly Defining a Zero Energy Building Important?

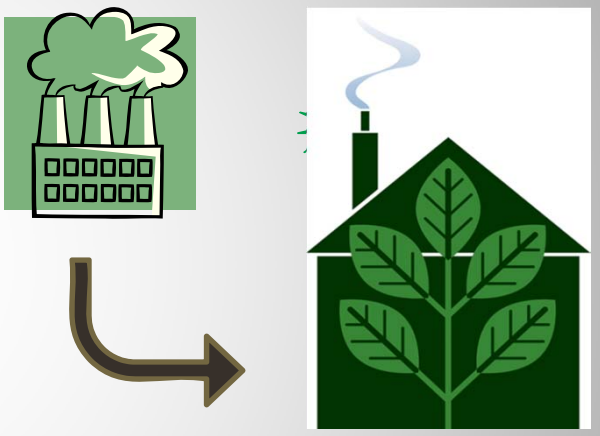
Because, the definition leads to the design

Common Abbreviations:

- ZEB = Zero Energy Buildings
- NEB = Net Zero Energy Buildings
- nZEB = Net Zero Energy Buildings
- ZØNE = Zero Net Energy
- NZE = Net Zero Energy

All Zero Energy Buildings must first be built to be energy efficient –as compared to an agreed upon standard or "reference"

Using Less Energy Than a Reference* Building:



* Reference Building

This is important !!

nZEB takes us from designing buildings that uses less energy than a "standard" …

… to one that is energy efficient and uses less non-renewable energy than it produces from sustainable sources.

Who is working on the standardizing the definition?

- U. S. Department of Energy
- National Renewable Energy Laboratory
- Energy Performance of Buildings Directive Recast
- ASHRAE
- International Energy Agency
- International Living Future Institute
- Alliance to Save Energy

What do you think constitutes a nZEB?

- Off the grid
- "0" non-renewable energy consumed?
- "0" net energy consumed over a year?
- Energy generated on-site is equal to that used by the building?
- "0" cost of energy over time?

Depending on the definition-

- –The design may be too expensive
- –It may mislead us
- –It have unintended environmental or sustainability consequences

A “ranking” of nZEB options has been proposed by NREL

nZEB Renewable Source Energy Hierarchy

- **Option 0: Reduce site energy use through low-energy building technologies**

We don’t want this -

Option 0: Low Energy examples

High efficiency HVAC

Efficient water heater

Super R Insulation

High efficiency windows

Tight envelope

Efficient appliances

Optimum orientation

CF or LED lighting

Programmable thermostat

ZEB Renewable Energy Hierarchy

- Option 0: Reduce site energy use through low-energy building technologies
- **Option 1: Use renewable energy sources within the building footprint**

Option 1: Bldg footprint sources

Photovoltaics

Solar Hot Water

Wind generators on building

> Building Footprint <

ZEB Renewable Energy Hierarchy

- Option 0: Reduce site energy use through low-energy building technologies
- Option 1: Use renewable energy sources within the building footprint
- **Option 2: Renewable energy sources from on-site**

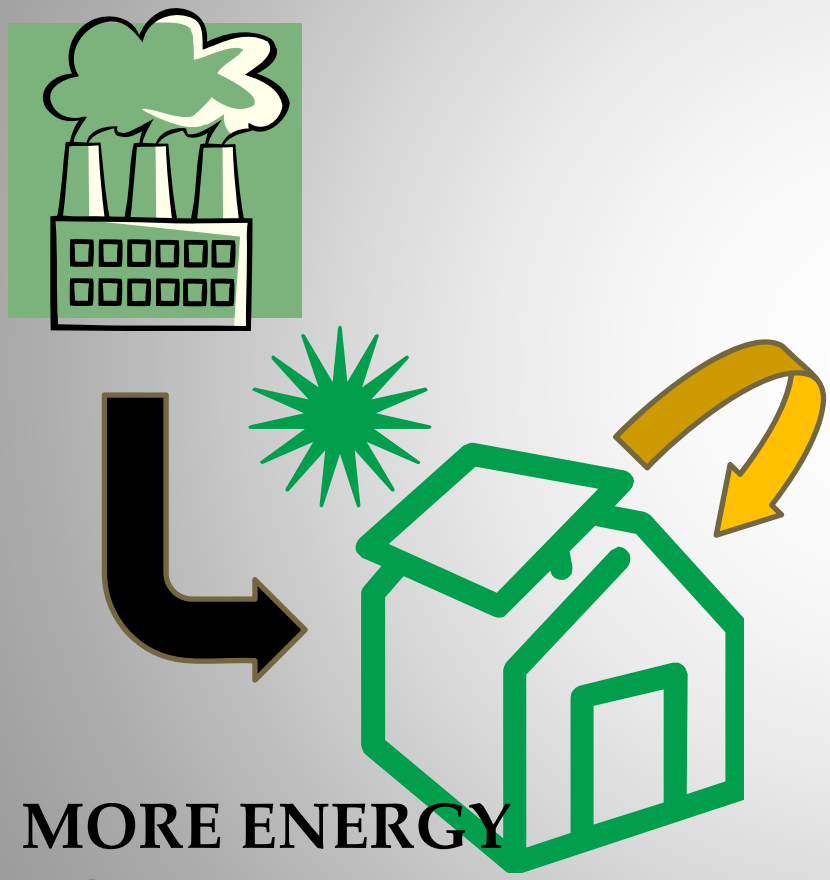
Option 2: On-site sources example

Photovoltaics

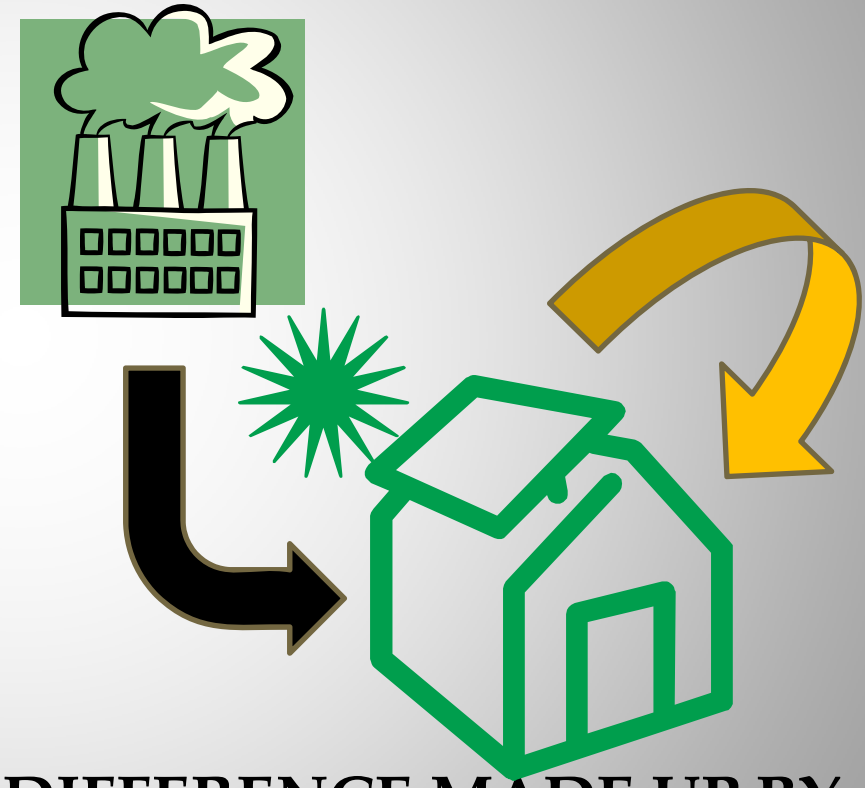
Solar Hot Water

Wind generators on-site

On Site Energy to Achieve nZEB example



MORE ENERGY USED THAN GENERATED



DIFFERENCE MADE UP BY MORE PV CAPACITY

nZEB Renewable Energy Hierarchy

- Option 0: Reduce site energy use through low-energy building technologies
- Option 1: Use renewable energy sources within the building footprint
- Option 2: Renewable energy sources from on-site
- **Option 3: Off-site renewable energy sources for use on-site**

Option 3: Off-site energy sources

Biodiesel

Biomass

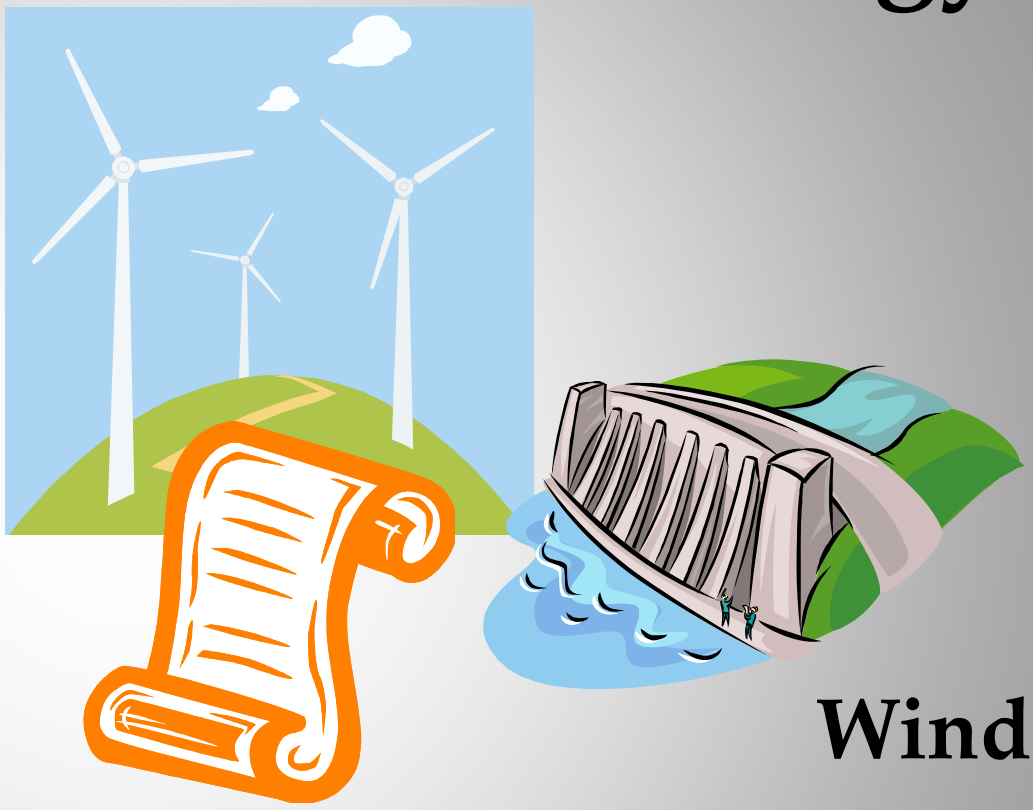
Waste

Convert to electricity and heat

ZEB Renewable Energy Hierarchy

- Option 0: Reduce site energy use through low-energy building technologies
- Option 1: Use renewable energy sources within the building footprint
- Option 2: Renewable energy sources from on-site
- Option 3: Off-site renewable energy sources for use on-site
- **Option 4: Purchase off-site renewable energy**

Option 4: Purchase off-site energy

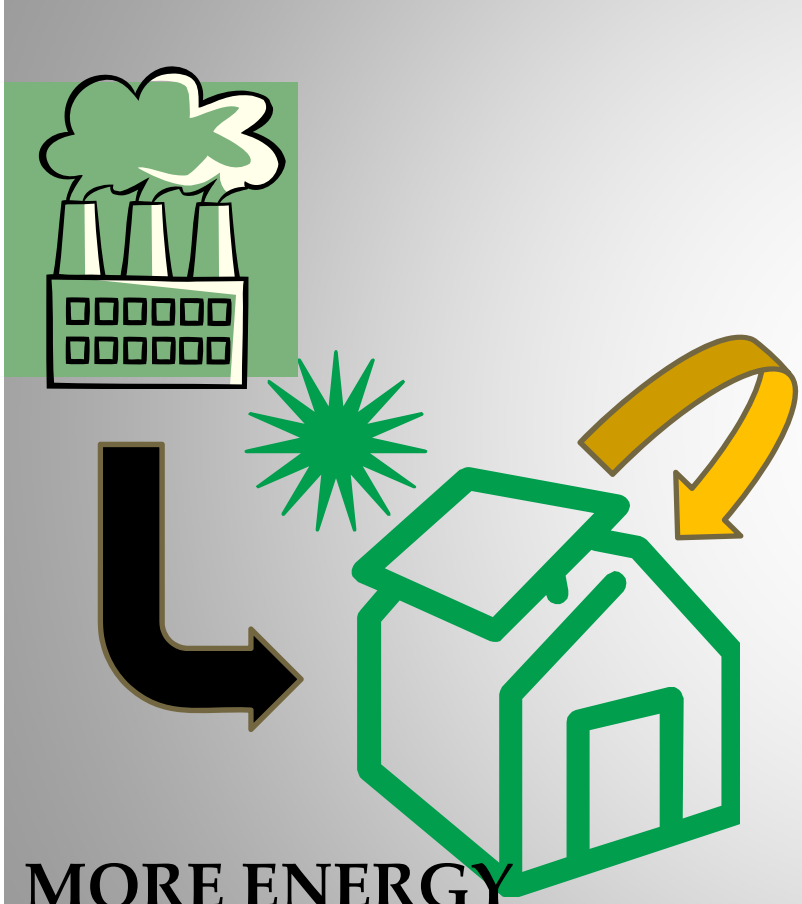


Wind

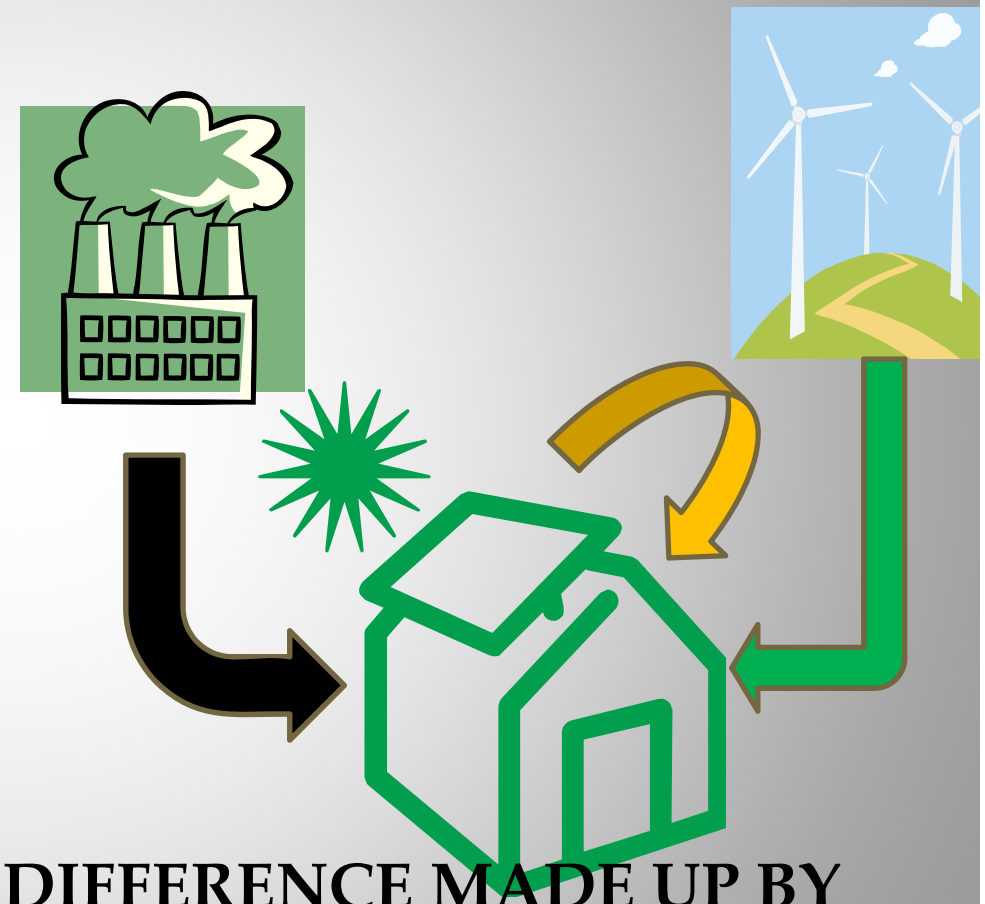
Hydroelectric

Green purchase credits

On & Off Site Energy to Achieve nZEB



MORE ENERGY USED THAN GENERATED

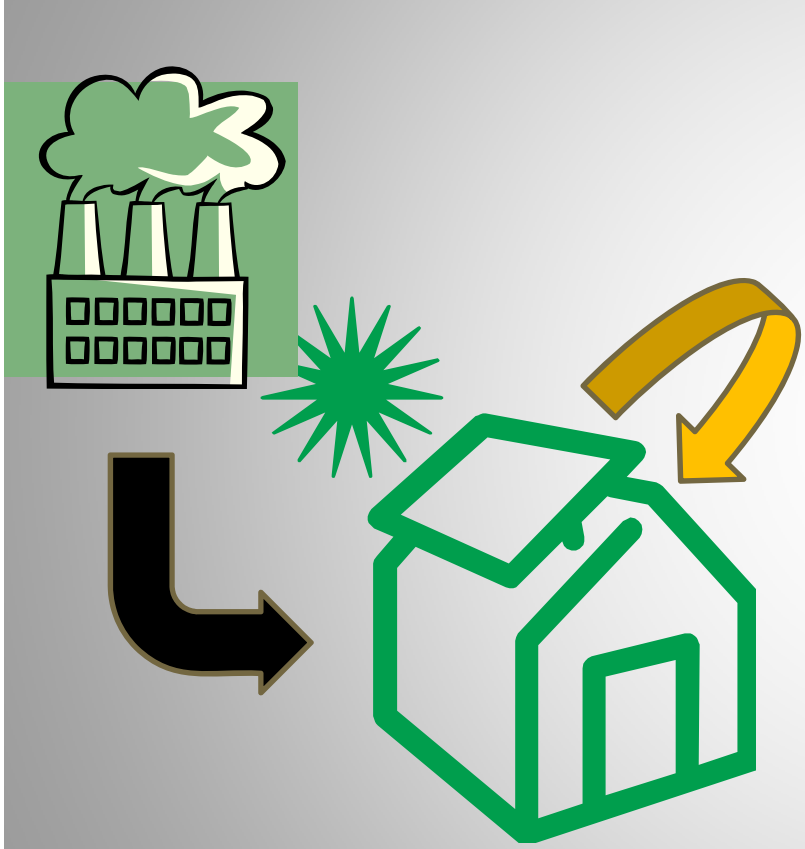


DIFFERENCE MADE UP BY PURCHASE OF RENEWABLE ENERGY

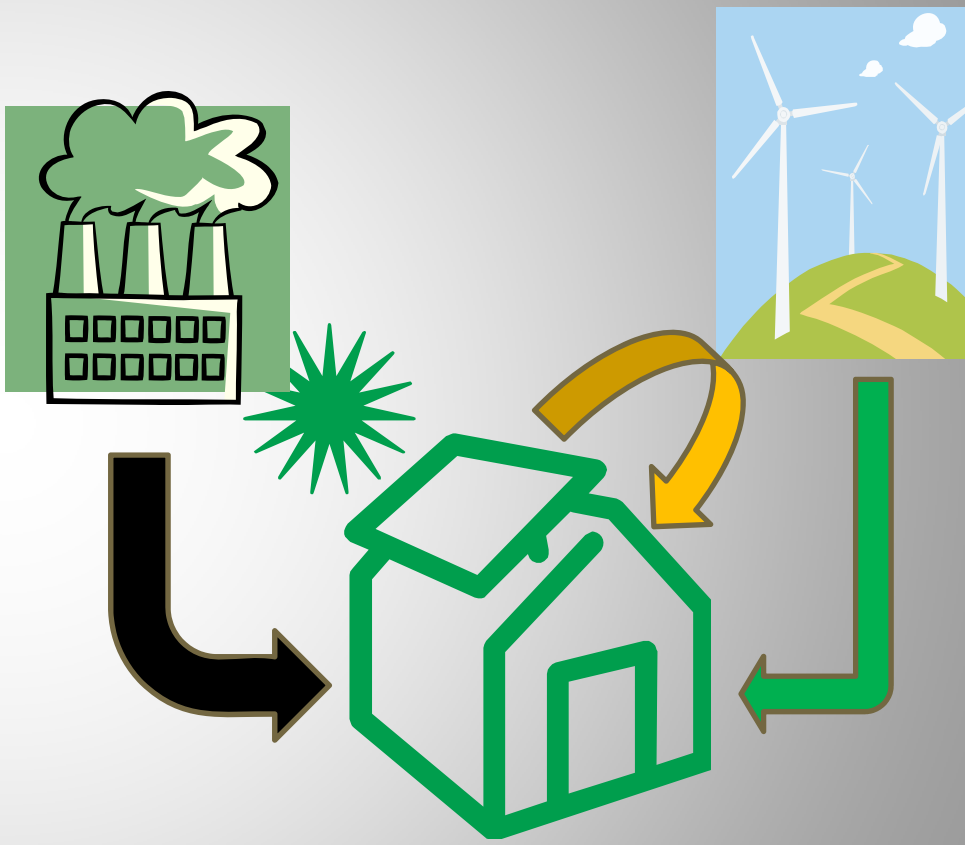
nZEB Renewable from Cost and Emissions Criteria

- **Option 5: Net cost of renewable vs. non-renewable energy**

Option 5: Energy Costs Balance to Achieve nZEB



MORE ENERGY COST THAN RECOVERED



DIFFERENCE MADE UP BY PURCHASE OF RENEWABLE ENERGY

Cost Criteria for nZEB - Positives

- Easy to measure – verifiable from utility billings
- Uses market to choose lowest cost fuel

Cost Criteria for nZEB

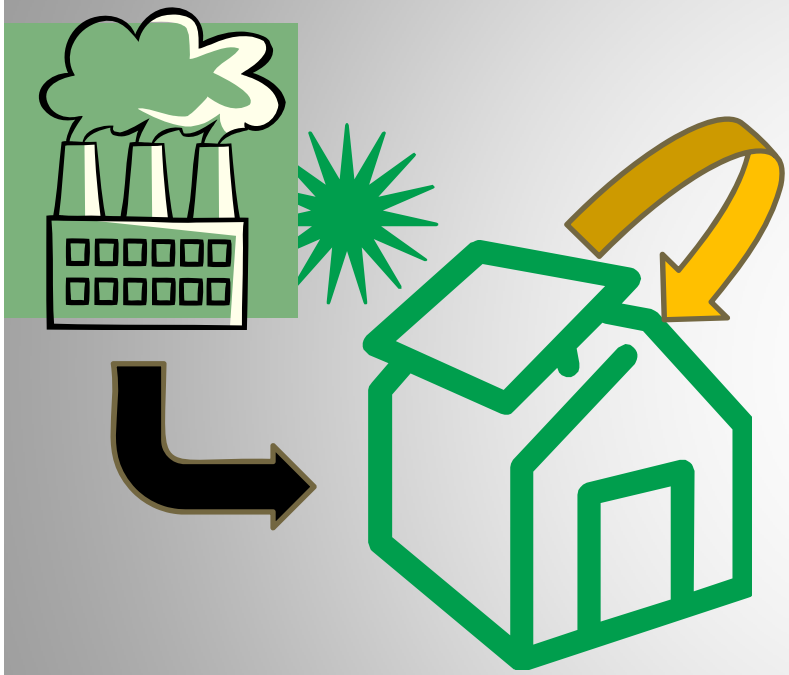
Negatives -

- Requires equitable net-metering agreements
- Highly volatile energy rates make for difficult tracking over time
- May not impact energy grid

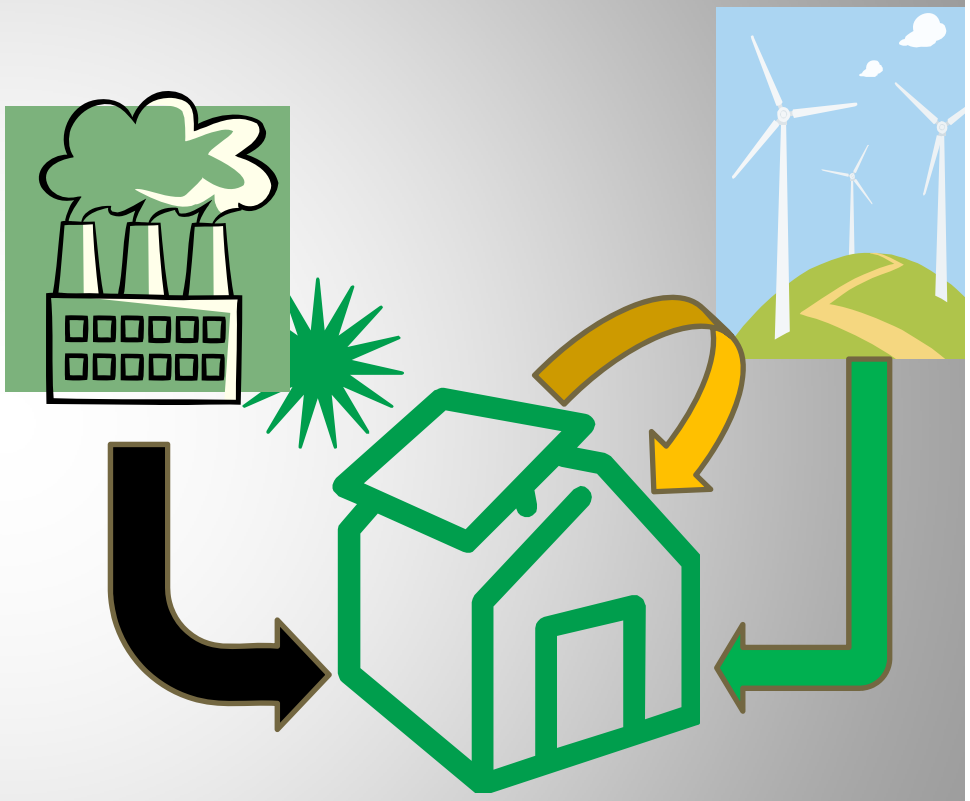
nZEB Renewable from Cost and Emissions Criteria

- Option 5: Net cost of renewable vs. non-renewable energy
- **Option 6: Net emissions off-set between renewable and non-renewable energy sources**

Option 6: Energy Emissions Balance to Achieve nZEB



MORE EMISSIONS FROM ENERGY SOURCES THAN THOSE FROM EMISSIONS FREE SOURCES



DIFFERENCE MADE UP BY PURCHASE OF EMISSIONS FREE RENEWABLE ENERGY

Emissions Criteria for nNEB - Positives

- Good model for Green Power
- Accounts for GHG's
- Easier to reach nZEB

Emissions Criteria for nNEB - Negatives

- Does not focus on energy use
- Requires appropriate emissions factors

"Take away"

- Several definitions of Zero Energy Building
- Make sure that everyone involved in the communication understands what Zero Energy Building concept is being referenced