Pathway to Stewardship & Kinship

Objective:

- To compare and contrast the environmental impacts of different home building technologies

Method:

- Students will choose technologies to create a paper depiction of a house then consider its financial cost and environmental impact

Procedure Summary

1. **Preparation**
   a. Students may participate individually or in a group. If you choose groups, determine them ahead of time.
   b. Print and cut out required items
2. **Distribute Money**
   a. Each student or group of students will need a sum of money to use to purchase their house parts.
3. **Purchasing**
   a. Students or groups of students examine the information cards about each technology and purchase their choices using their dollar tokens.
4. **Recording and Calculating**
   a. The cost and Impact Score for each part of their house is recorded and totals are calculated.
5. **Discussion**
   a. Some suggested questions for classroom discussion.

Pathway to Stewardship & Kinship

Preparation

1	Print and cut enough **Money Available** cards for each student or group of students to get one.	See Appendix A1 and A2	1 card per group
2	Print and cut out **Dollar Tokens** to make change when students buy house technology. One page should be enough for two groups. The teacher keeps these until they need to make change.	See Appendix B	10 tokens per group
3	Print and cut out enough **Technology Cards** for a set for each group.	See Appendix C	1 set per group
4	Print enough **Impact Charts** for each group to have a set.	See Appendix D	1 set per group
5	Print one **Worksheet** per group	See Appendix E	1 page per group
6	Print and cut out **House Parts**. Print one of each page. As students will be choosing which items to purchase, the exact amounts needed of each item cannot be predicted.	See Appendix F	1 of each page

Distribute Money

To begin the activity, students will need an amount of money.

1. Fold the Available Money cards in half and place in a bowl.
2. Have each group send up a representative to draw a card. This is how much money the group has available to spend.
3. This is an opportunity to discuss how different incomes affect the choices that can be made by home buyers.

Pathway to Stewardship & Kinship

Purchasing

1. Pass out sets of cards to students. The students study the cards to learn about the different technologies.
    a. Each card includes a brief description, a dollar token cost and icons indicating environmental impacts or advantages.
    b. Key to icon meanings.
2. Students choose one of each technology (roof, electricity, insulation, appliances and heating).
3. Groups must be able to afford all the items using their Available Money.
    a. Rather than trying to estimate an actual cost which would quickly become out of date, each technology is assigned a number of dollar tokens to indicate its comparative cost.
4. When students have made their choices, they purchase their desired technologies from the teacher using their dollar tokens.
    a. For their first purchase, students hand in their Money Available card. The teacher makes change using the individual dollar token.
    b. The teacher gives the group their paper cut-outs of each house part purchased.
5. Students assemble their house on their worksheet.
6. Collect the technology cards.

Early Finishers
Students can draw in furniture and landscaping for their house.

Technologies Info Cards

Roof
- shingles new material
- shingles recycled material
- Steel
- Green

Electricity
- Off grid solar
- Grid tied solar
- Grid renewable
- Grid regular

Insulation
- Fiberglass
- Recycled denim
- Cellulose
- Straw bale

Appliances
- Conventional
- Energy Star
- Super Efficient
- Propane

Heating
- Wood
- Electric Furnace
- Natural Gas / Propane
- Heat Pump

Recording and Calculating

1. Distribute charts that show the **Impact Scores** for each technology.
2. Students complete the tracking chart on their house worksheet.
3. Students add up the impact score of their house.
    a. A lower score indicates a lower environmental impact.

Technology Impact Charts

Roof

Electricity

Insulation

Appliances

Heating

Discussion

- Which technologies had the greatest effect in lowering a house's environmental impact?
- What is the relationship between cost and environmental impact?
- What technologies were not included that you think should have been?
- How has the information you learned changed your thoughts about your possible future home?

Appendix A1: Available Money Cards.

Your available money 15 $	Your available money 14 $	Your available money 13 $
Your available money 12 $	Your available money 11 $	Your available money 10 $
Your available money 7 $	Your available money 6 $	Your available money 5 $

Appendix A2: Available Money Cards.

Your available money 12 $	Your available money 11 $	Your available money 10 $
Your available money 12 $	Your available money 11 $	Your available money 10 $
Your available money 9 $	Your available money 8 $	Your available money 7 $

Appendix B: Dollar Token Cards

Appendix C: Technology Cards

Biodegradable	Low GHG	Low Energy	Renewable
Non-Biodegradable	**High GHG**	**High Energy**	**Non-Renewable**

Roof

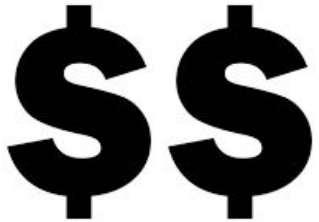
Shingles (new material)

- Regular shingles are made from non-renewable materials
- They cannot be recycled and they are non-biodegradable
- Low initial cost

Roof

Steel

- Steel roofs may be made of a mixture of recycled and new metal
- They can be infinitely recycled at the end of their life
- High initial cost



Roof

Shingles (recycled)

- Recycled shingles are made from tires and other waste materials
- They have limited ability to be recycled at the end of their life and are not biodegradable

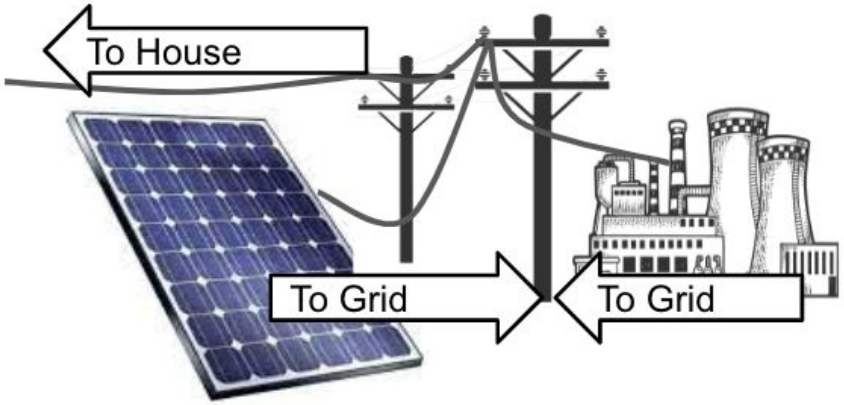
Roof

Green

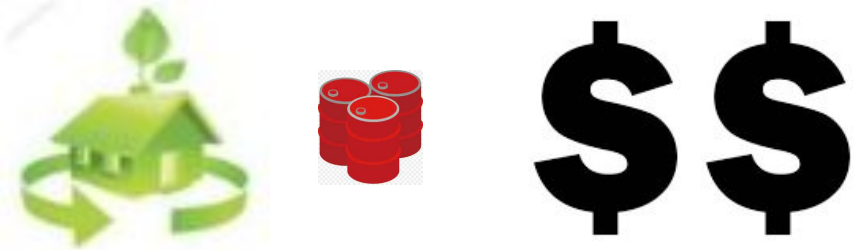
- A green roof has a layer of soil and plants growing on the top
- This roof provides excellent insulation in the winter and cooling in the summer
- It is very heavy and buildings must be specially designed to carry the weight

Electricity

Grid Connected Solar

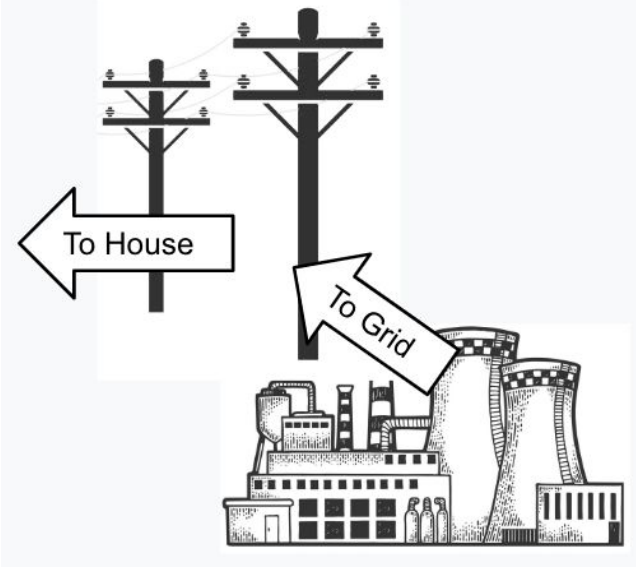


- The solar panels on the property feed into the general grid and the owner gets paid for that energy.
- The house then draws on the grid and the owner pays for that.
- A mixture of solar power produced on property and provincially generated power which uses mostly non-renewable sources.

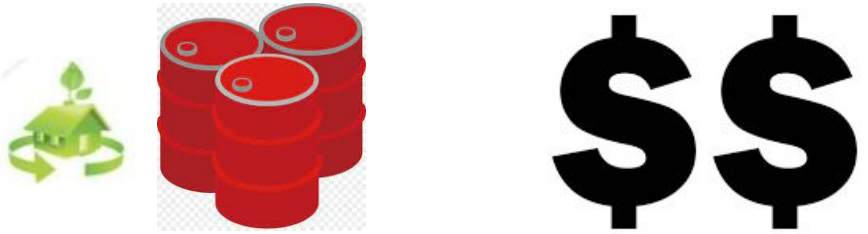


Electricity

Grid Regular



- Electricity available on the grid is produced by a mixture of renewable and non-renewable sources.
- A large portion of Ontario's energy is sourced from Nuclear. There is not yet a long-term plan for storage of nuclear waste.
- The second largest portion is from the renewable source of hydro dams.
- A number of private companies still operate natural gas powered generating plants.



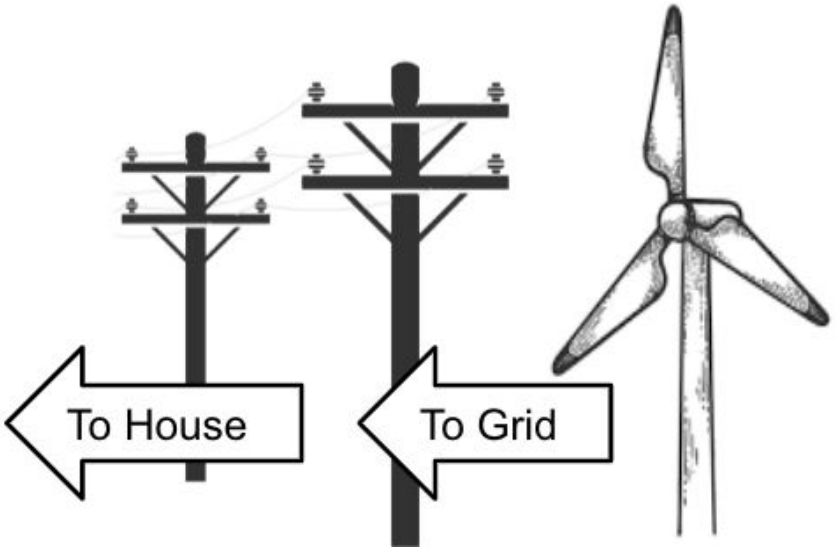
Electricity

Off Grid Solar

- The home's only source of electricity is the solar panels on the property.
- High upfront cost, but energy is free.
- Requires flexibility to manage the changing levels of power available.
- Building the panels uses some non-renewable materials and right now, the panels cannot be recycled.

Electricity

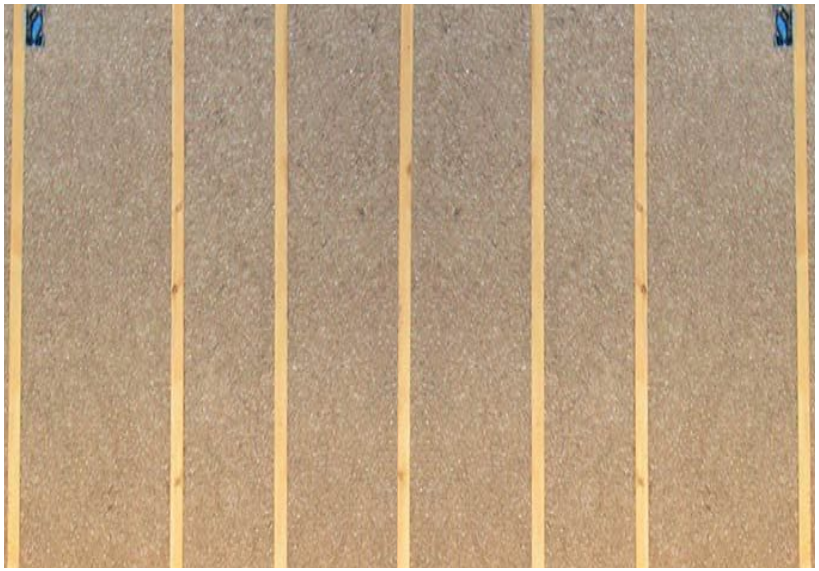
Grid Renewable



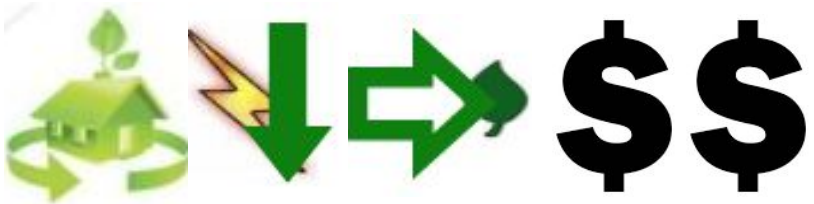
- Ontario home owners can buy their electricity from a number of different companies.
- Some companies offer electricity that has been sourced from renewable sources such as wind and solar.
- The prices are usually slightly higher than sources that may include non-renewables.

Insulation

Cellulose



- Cellulose insulation is made from recycled newspapers.
- It is an effective form of home insulation comparable to denim and fiberglass.
- It is biodegradable at the end of its life



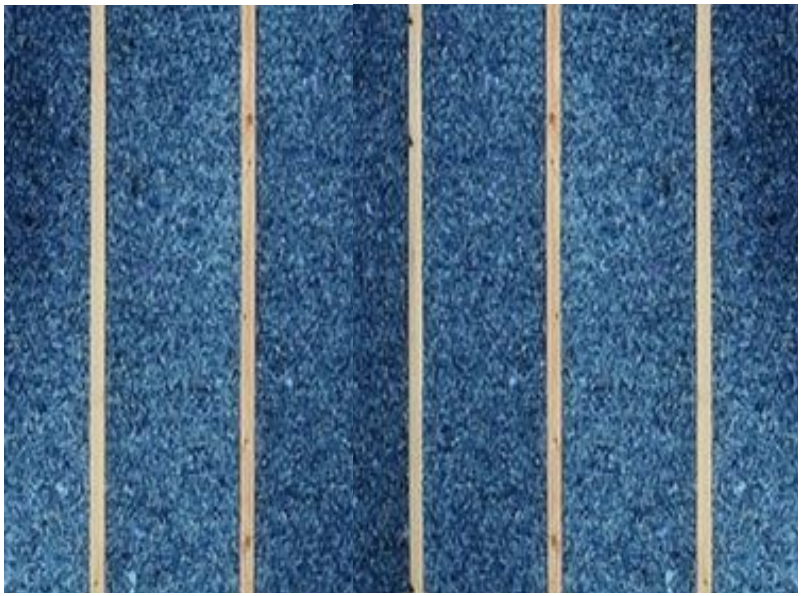
Insulation

Straw Bale

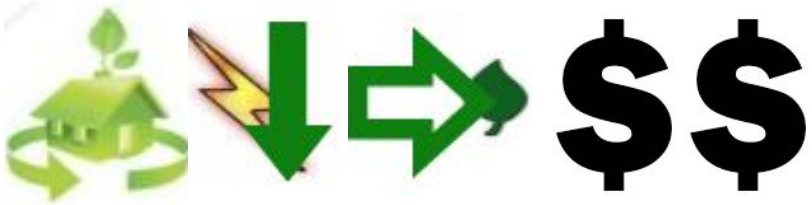
- Straw bale insulation is a renewable resource.
- It is an excellent home insulation and outperforms fiberglass, cellulose and denim.
- It is biodegradable at the end of its life.
- House walls will be much thicker than conventional walls.

Insulation

Recycled Denim



- Denim insulation is made from recycled waste from the clothing industry.
- It is an effective home insulation comparable with fiberglass and cellulose.
- It is biodegradable at the end of its life.



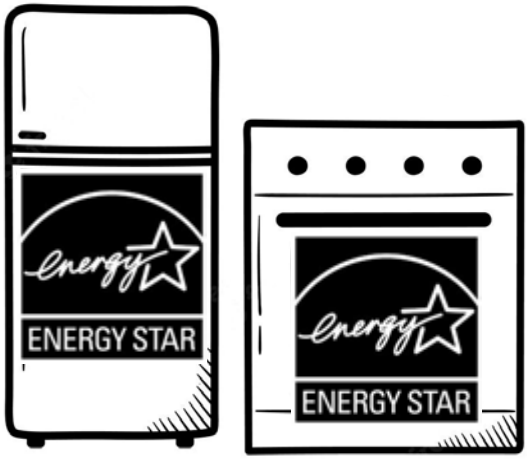
Insulation

Fiberglass

- Fiberglass insulation is made using extreme heat which consumes large amounts of energy.
- It is sourced from non-renewable materials and cannot be recycled and is non-biodegradable.
- It is an effective and popular choice for home insulation.

Appliances

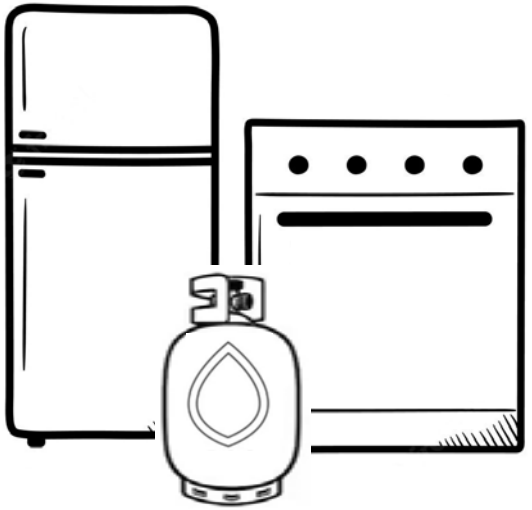
Energy Star



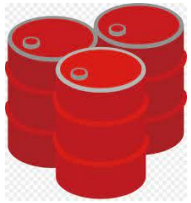
- have a moderate initial cost.
- meet government standards for high energy efficiency.

Appliances

Propane

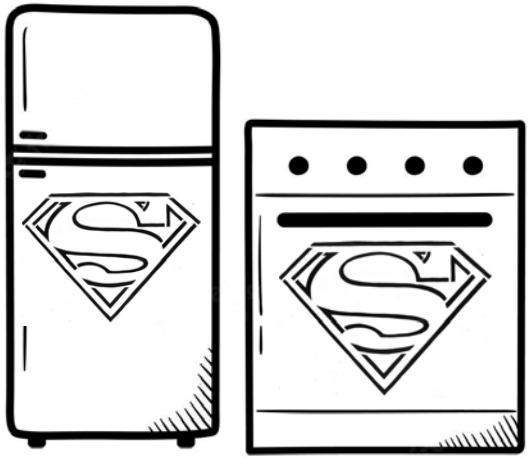


- do not need electricity as they take their energy from canisters of propane
- can be operated off-grid
- may be cheaper than ultra efficient electric appliances and are not affected by periods of low light
- Propane is non-renewable and produces GHGs when burned

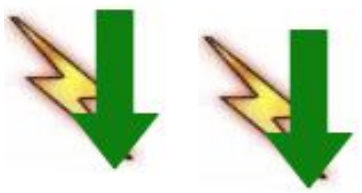


Appliances

Super Efficiency

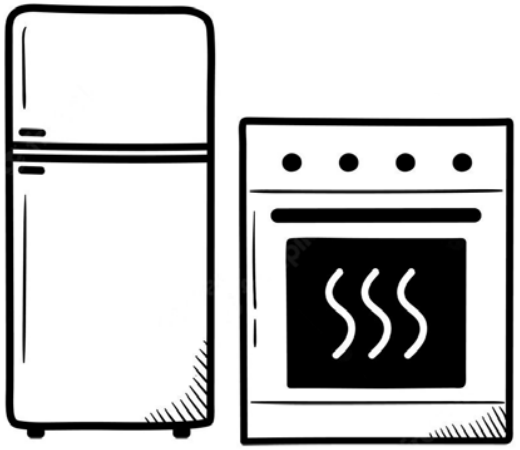


- have been specially designed to use very low amounts of electricity.
- often smaller and more insulated than conventional appliances.
- have a high initial cost.
- some are specifically designed to work well with an off-grid solar electric system by using direct current.



Appliances

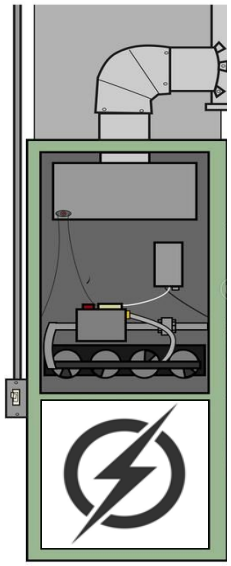
Regular



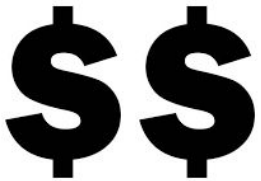
- have a lower initial cost.
- consume more electricity than Energy Star certified or Super Efficient appliances.

Heating

Electricity

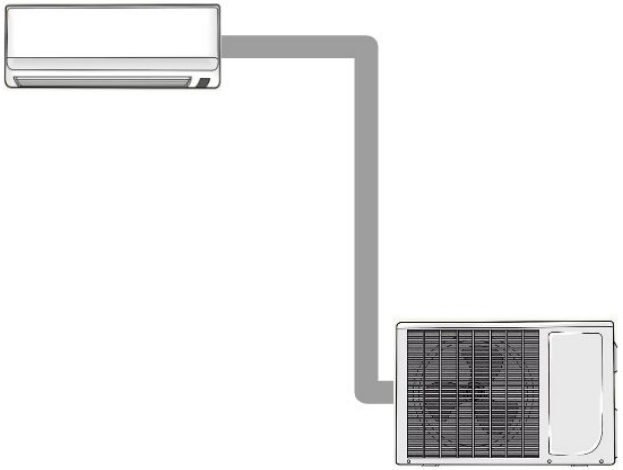


- High efficiency electric furnaces are moderate consumers of energy
- Baseboards and other radiant heat sources are high consumers of energy
- No GHGs are produced at the home, but the source of the electricity generation must be considered.



Heating

Heat Pump



- A unit collects and concentrates heat from the air or ground and puts it into the house
- Uses electricity to operate, but is more efficient than electric furnaces or electric radiant heat.
- High initial cost

Heating

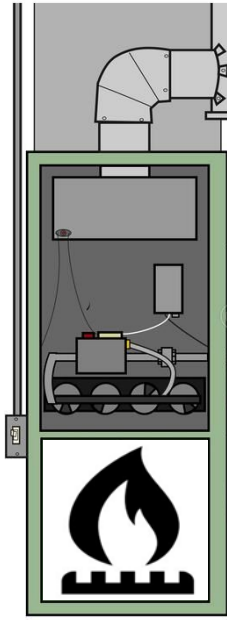
Wood

- Low initial cost
- Wood burned in a stove produces heat
- Is GHG neutral
- Is a practical option for off-grid homes
- Requires additional labour from the homeowner to manage wood supply and feeding of the stove
- Finding and storing firewood in cities and towns is very challenging

$$

Heating

Propane



- Both are non-renewable and produce GHGs when burned
- Propane heat can be used off-grid
- Natural Gas is only available in highly populated areas such as towns and cities

$$

Appendix D: Impact Charts

Roof						
	makes garbage	GHG emissions	energy use	source materials	Impact Score	cost
shingle new	yes	high	no effect	non-renewable	**5**	$
shingle recycled	some	moderate	no effect	recycled	**3**	$
steel	recycled	moderate	no effect	recycled	**2**	$$
green	compost	low	reduces	mostly renewable	**1**	$$$$

Appendix D: Impact Charts

Electricity						
	makes garbage	GHG emissions	energy use	source materials	Impact Score	cost
PV off grid	No	very low	no effect	No difference between sources	**1**	$$$$
PV grid tied	No	very low	no effect	No difference between sources	**2**	$$$
Grid - renewable	No	moderate	no effect	No difference between sources	**3**	$$
Grid - regular	No	high	no effect	No difference between sources	**5**	$

Appendix D: Impact Charts

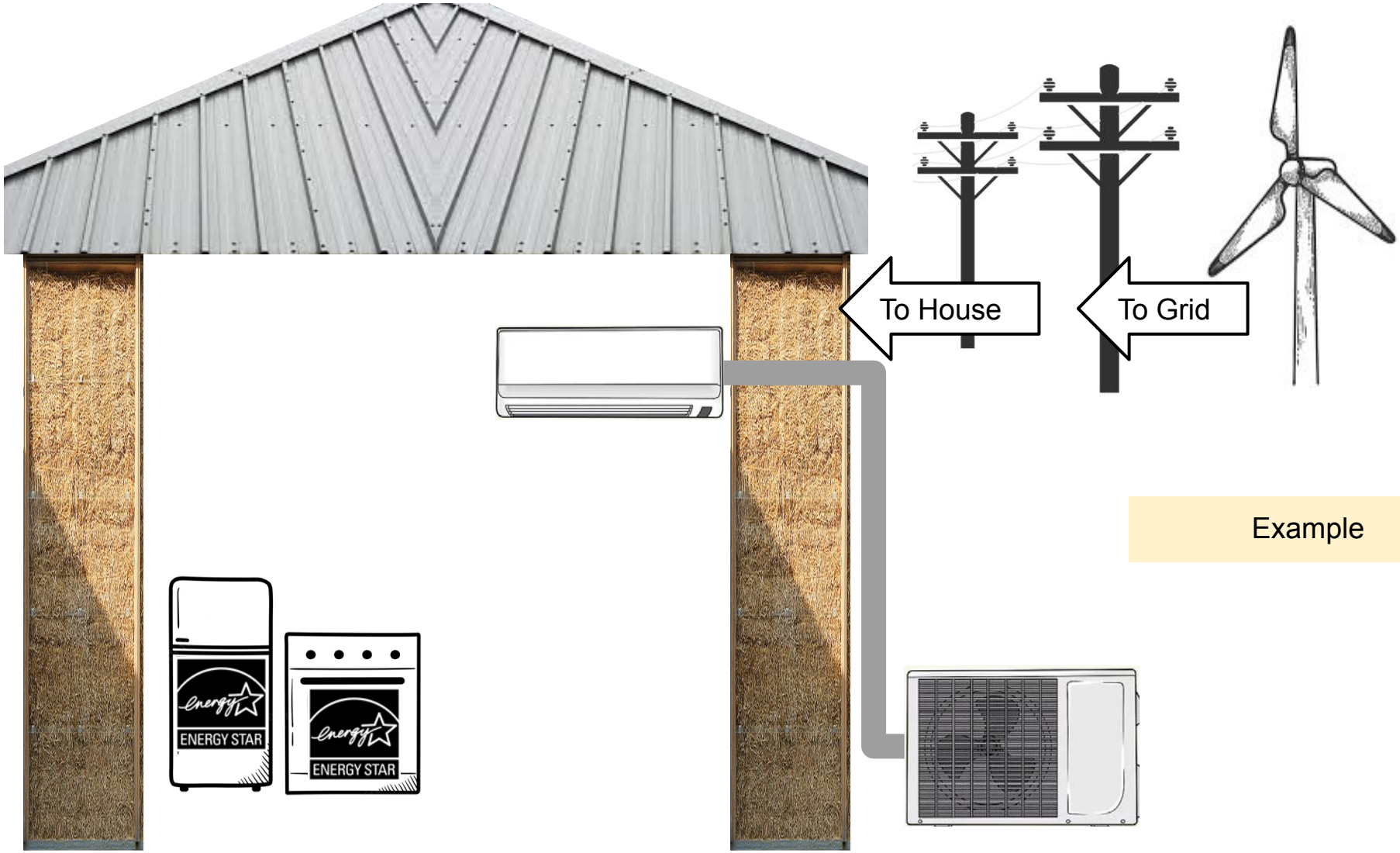
Insulation						
	makes garbage	GHG emissions	energy use	source materials		cost
fiberglass	high	high	reduces	non-renewable	**5**	$
celulose	no	low	reduces	recycled	**3**	$$
recycled denim	no	low	reduces	recycled	**3**	$$
straw bale	no	none	strongly reduces	renewable	**1**	$$

Appendix D: Impact Charts

Appliances						
	makes garbage	GHG emissions	energy use	source materials	Impact Score	cost
regular	no difference between appliances	high	high	no difference between appliances	**4**	$
energy star	no difference between appliances	moderate	moderate	no difference between appliances	**2**	$$
very high efficiency	no difference between appliances	low	low	no difference between appliances	**1**	$$$
propane	no difference between appliances	moderate	moderate	Energy source is non-renewable	**3**	$$

Appendix D: Impact Charts

Heating						
	makes garbage	GHG emissions	energy use	source materials	Impact Score	cost
wood	no	very low	no effect	renewable	**2**	$
electricity	no	moderate	no effect	some renewable some non-renewable	**4**	$
natural gas or propane	no	high	no effect	non-renewable	**5**	$
heat pump	no	low	no effect	some renewable some non-renewable	**3**	$$$



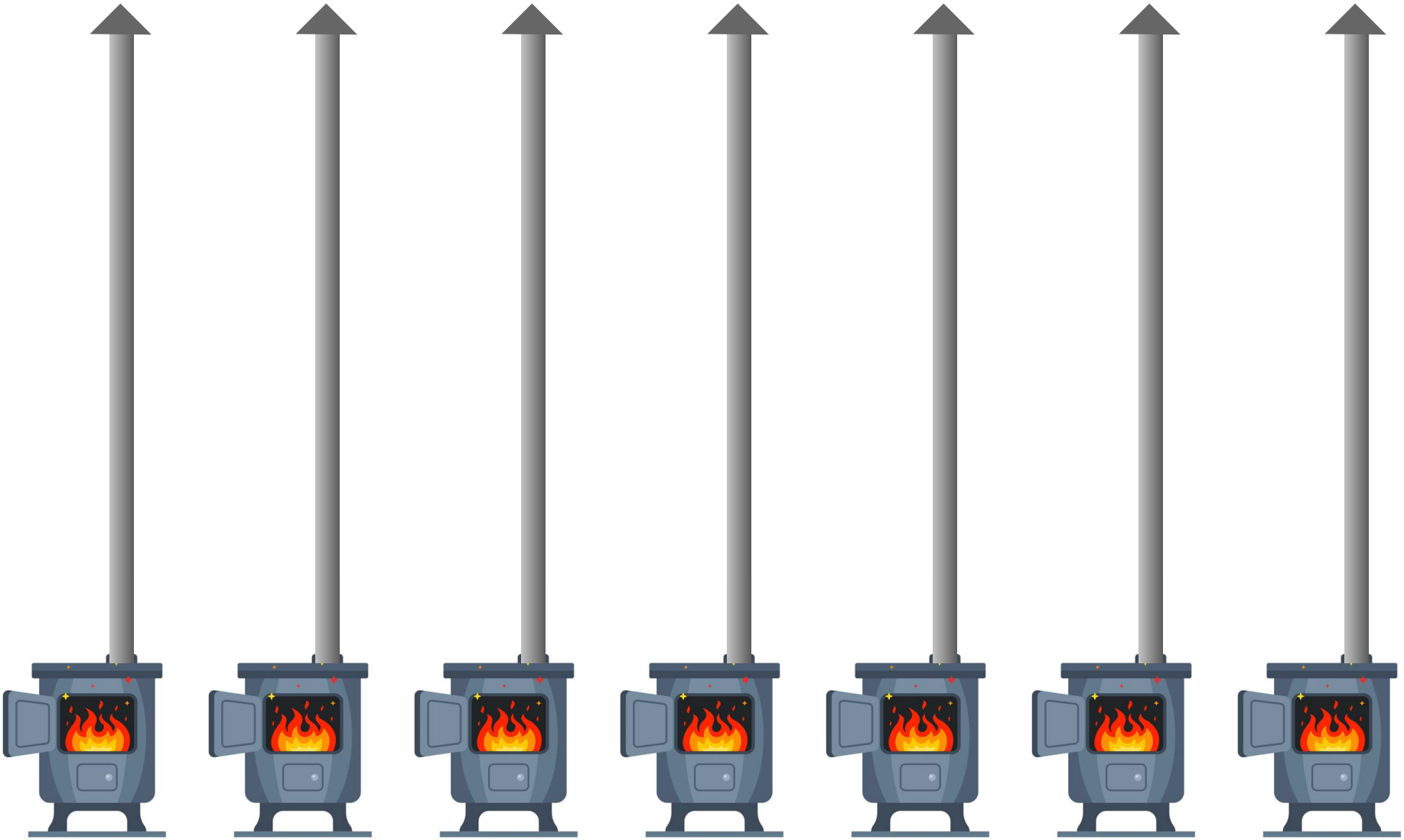
Example

	Roof	Insulation	Heat	Electricity	Appliances	Totals
Type	Steel	Strawbale	Heat Pump	Grid-Renewable	Energy Star	
Cost	$$	$$	$$$	$$	$$	11x$
Score	2	1	3	3	2	11

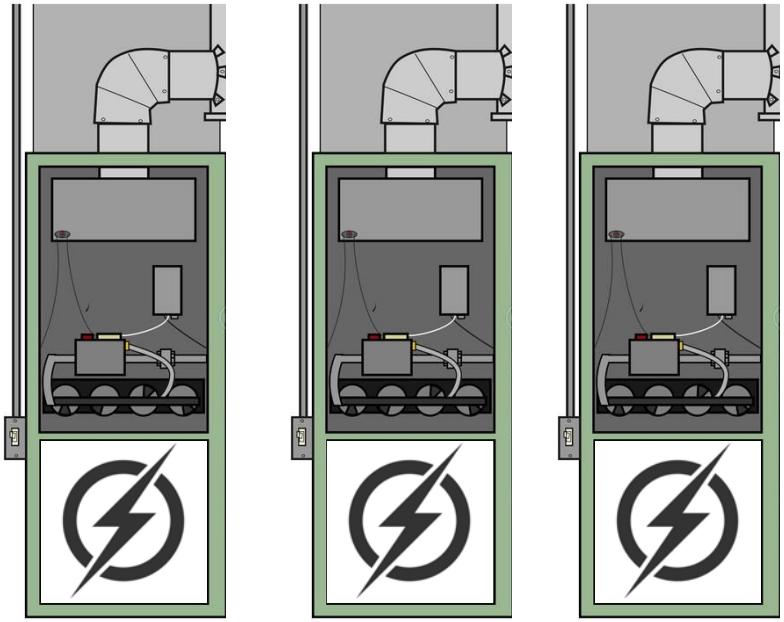
Appendix E: Worksheet

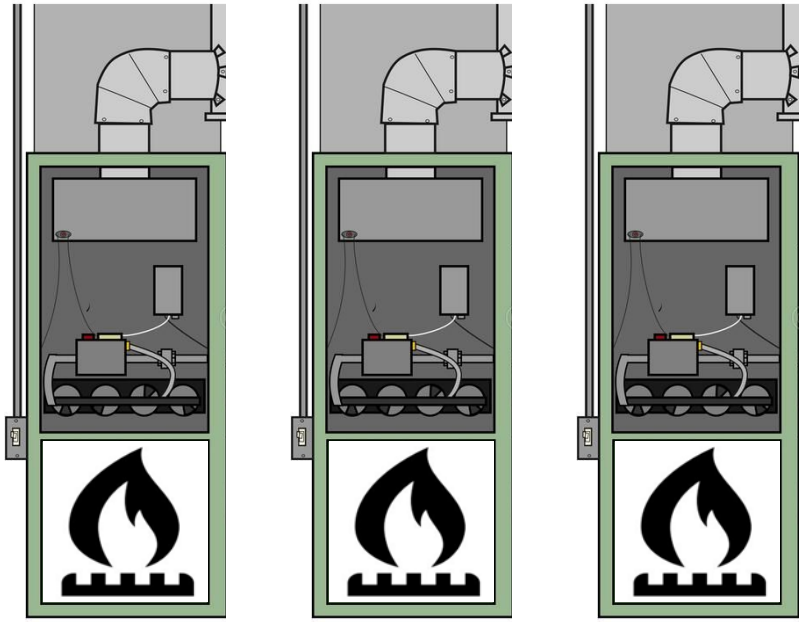
Feature	Roof	Insulation	Heat	Electricity	Appliances	Totals
Cost						
Score						

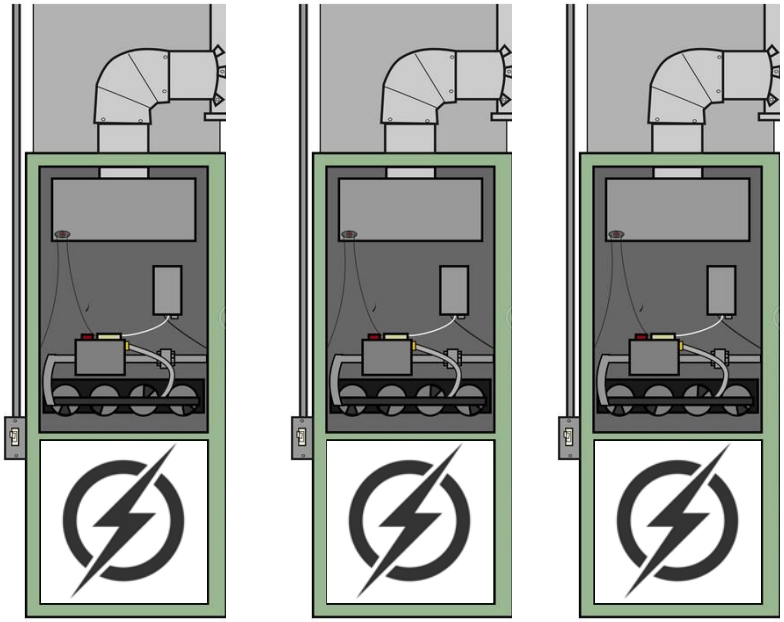
Appendix F: House Parts

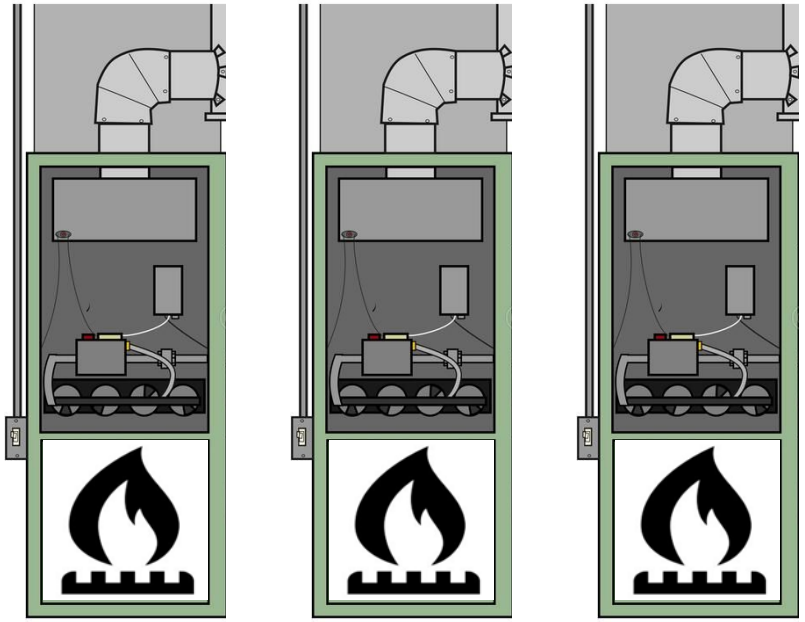


Appendix F: House Parts

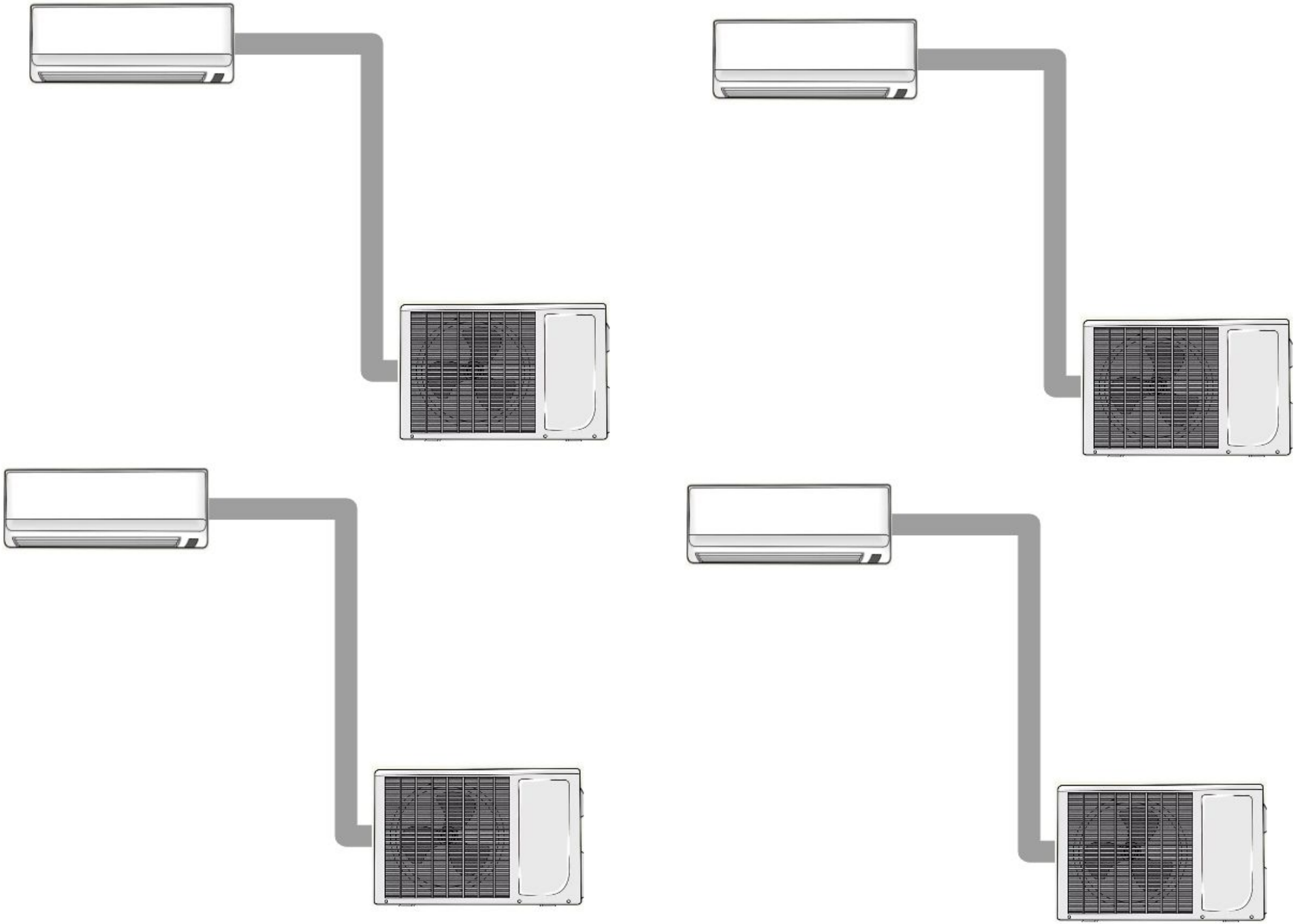




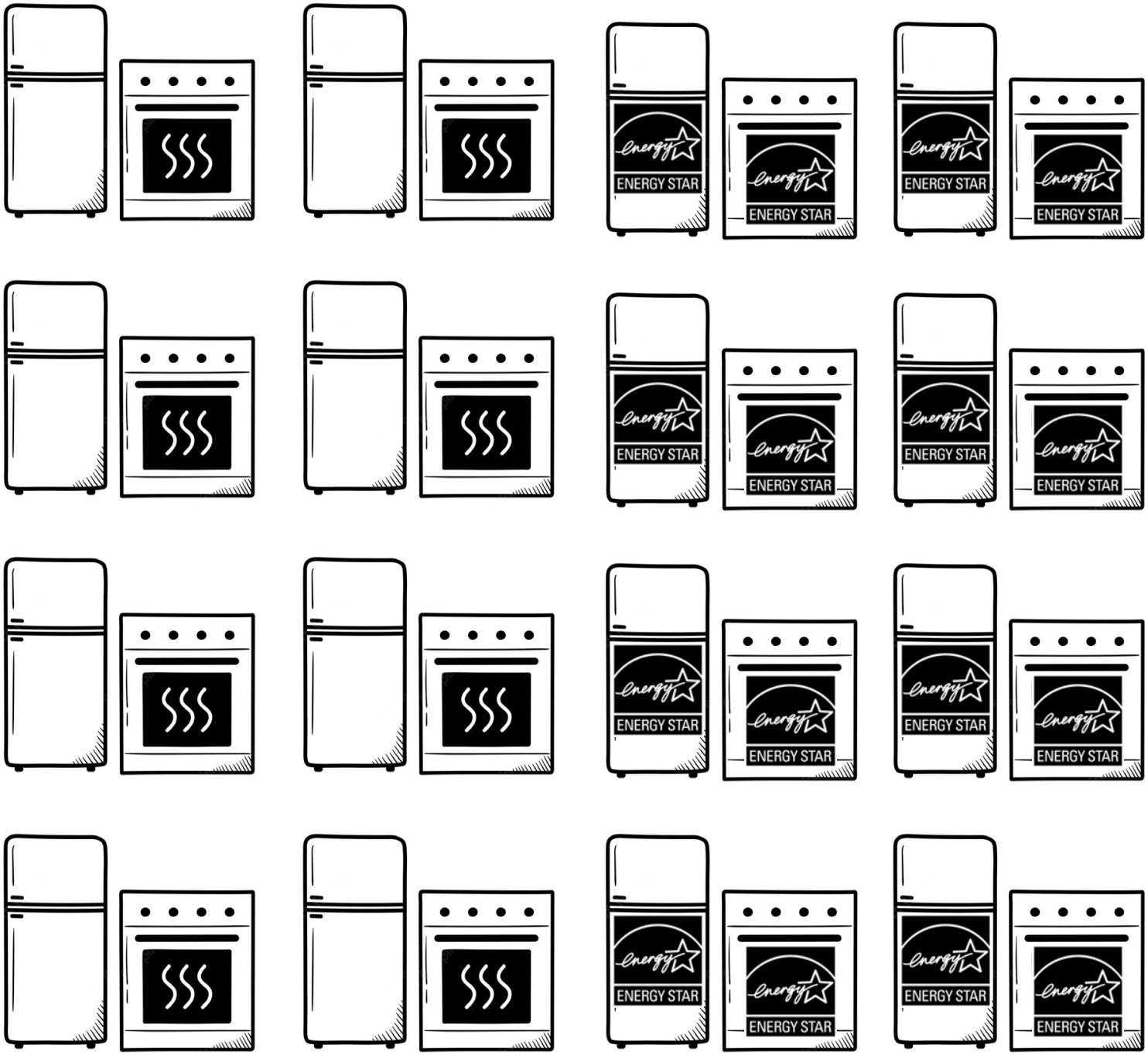




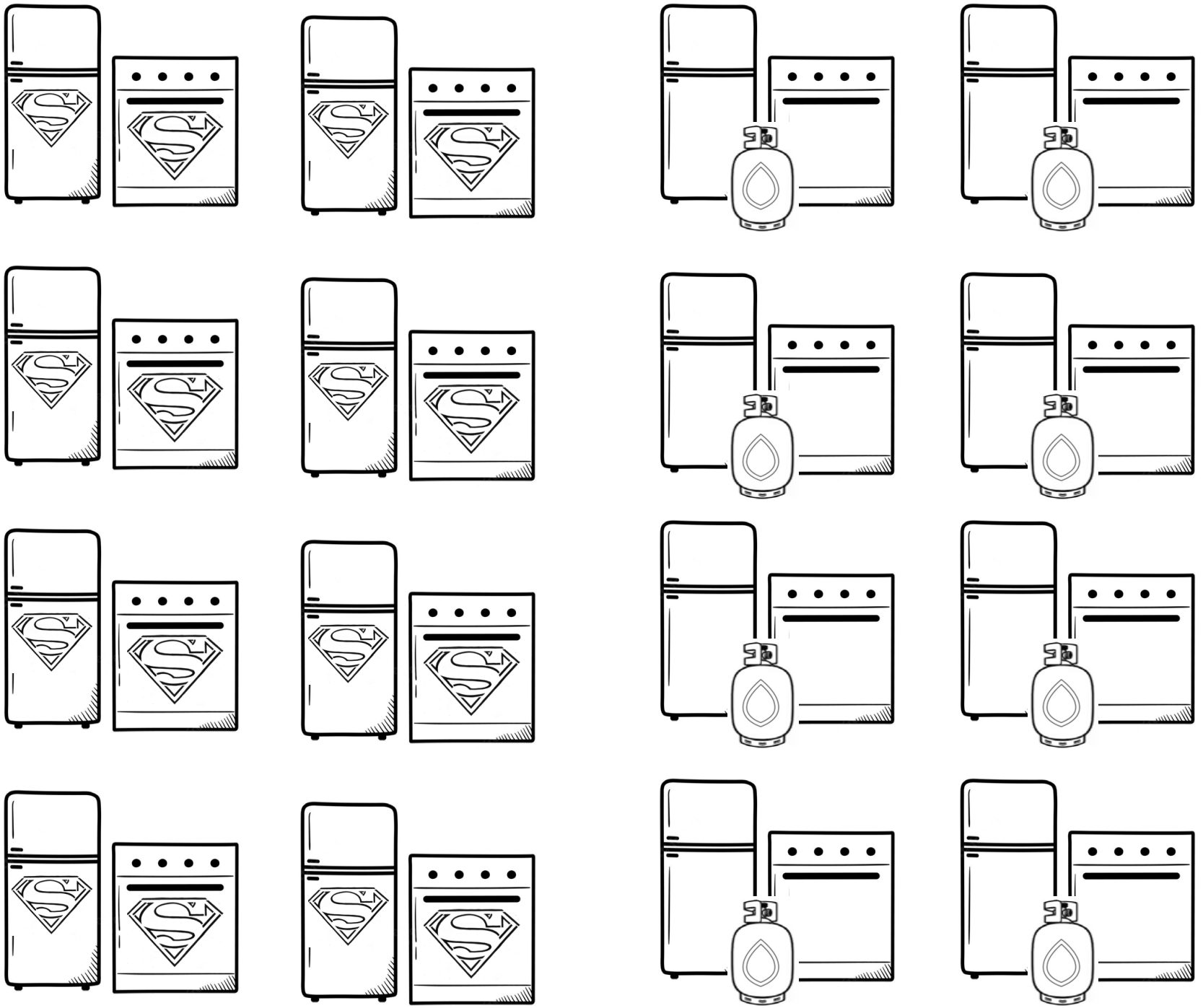
Appendix F: House Parts



Appendix F: House Parts

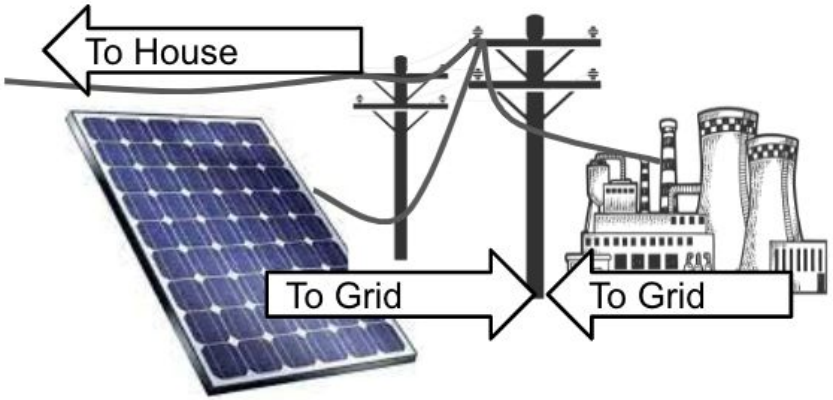


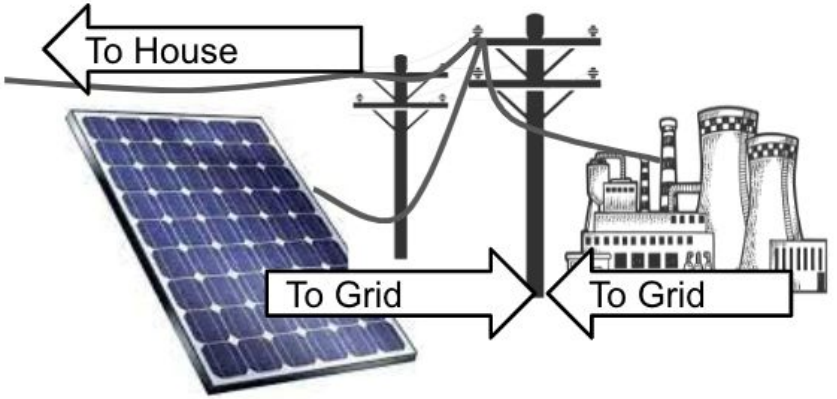
Appendix F: House Parts

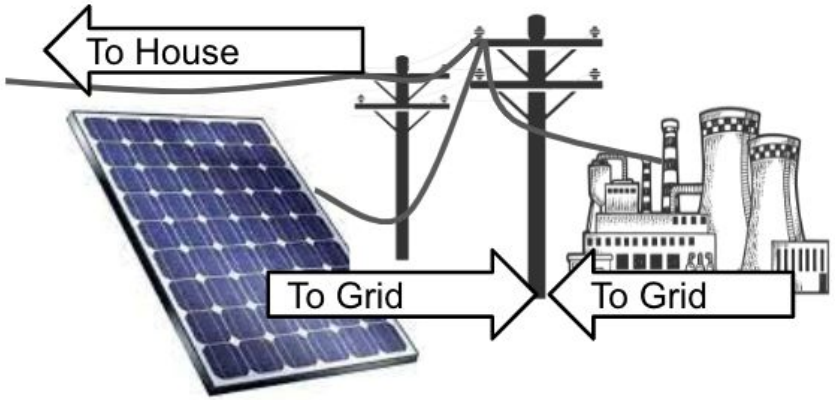


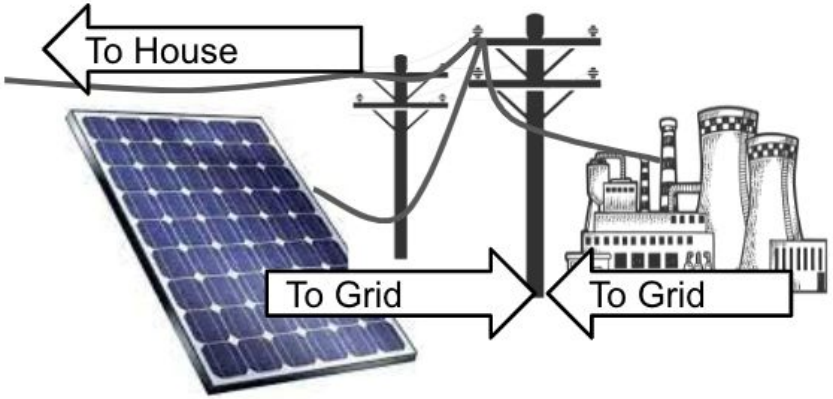
Appendix F: House Parts

Appendix F: House Parts

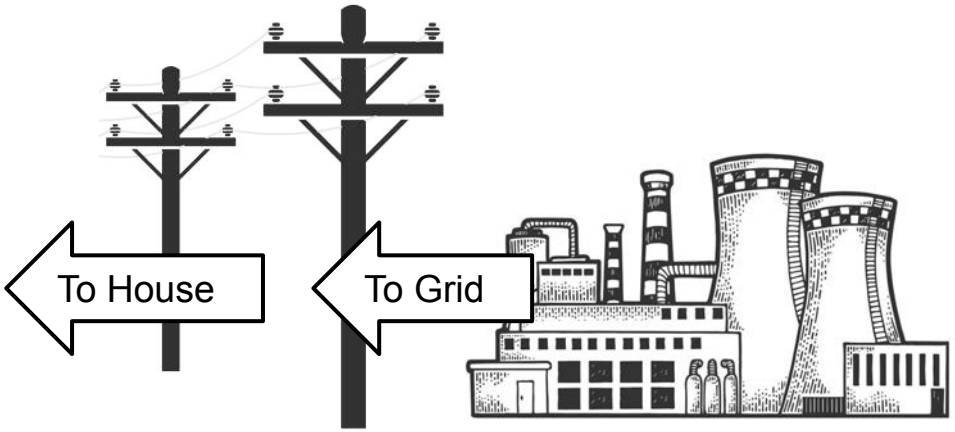


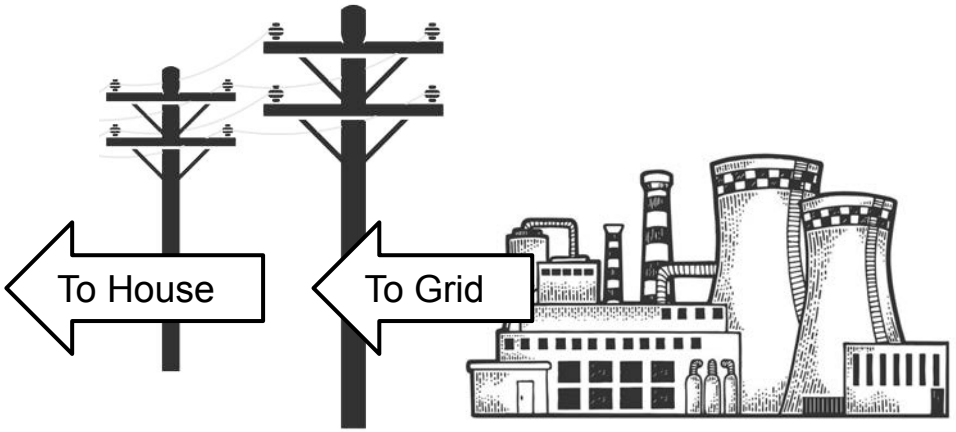


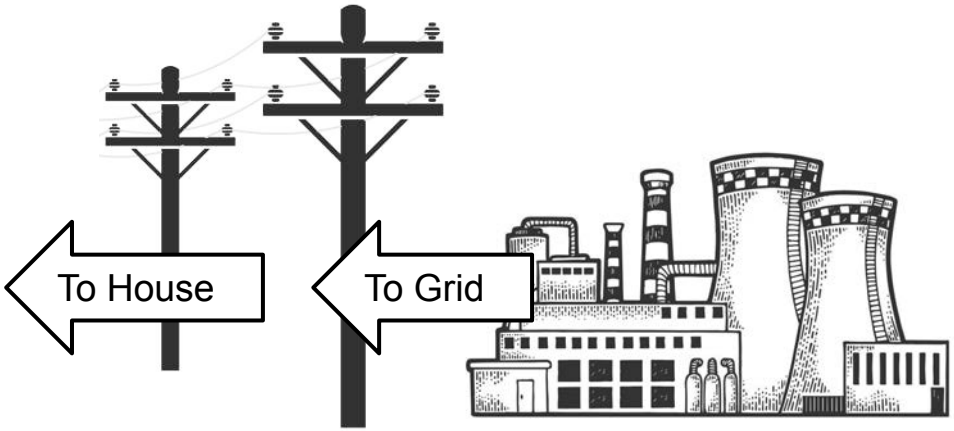


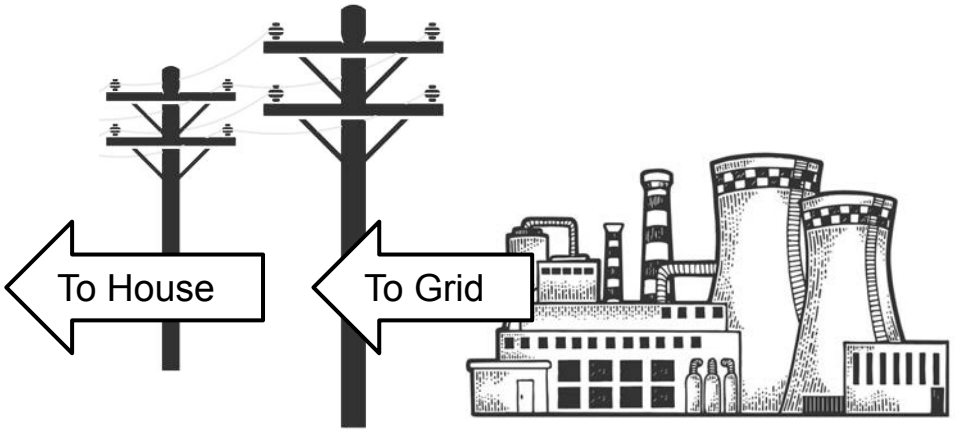


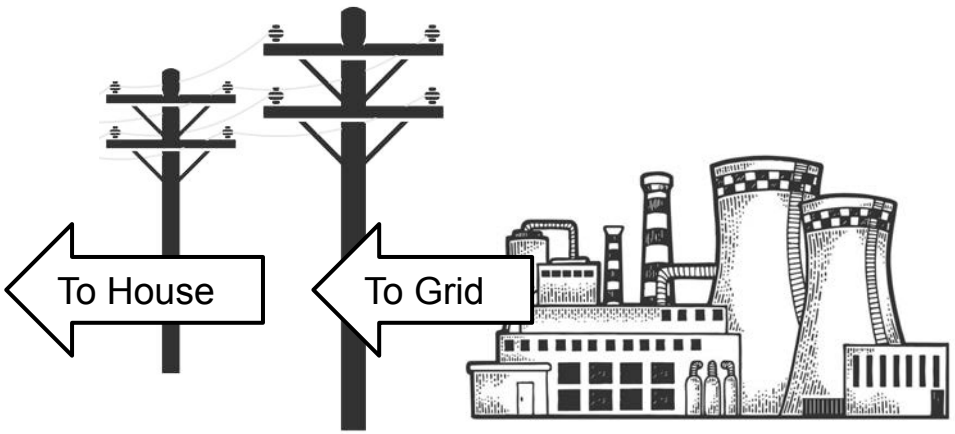
Appendix F: House Parts

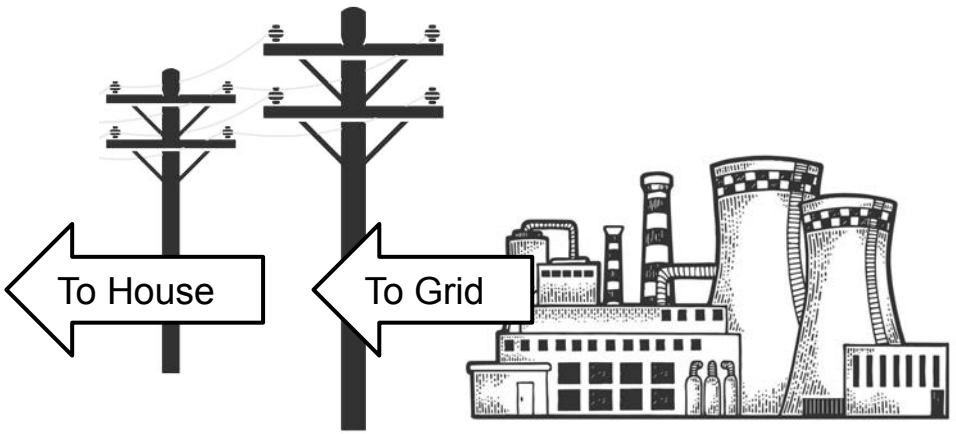












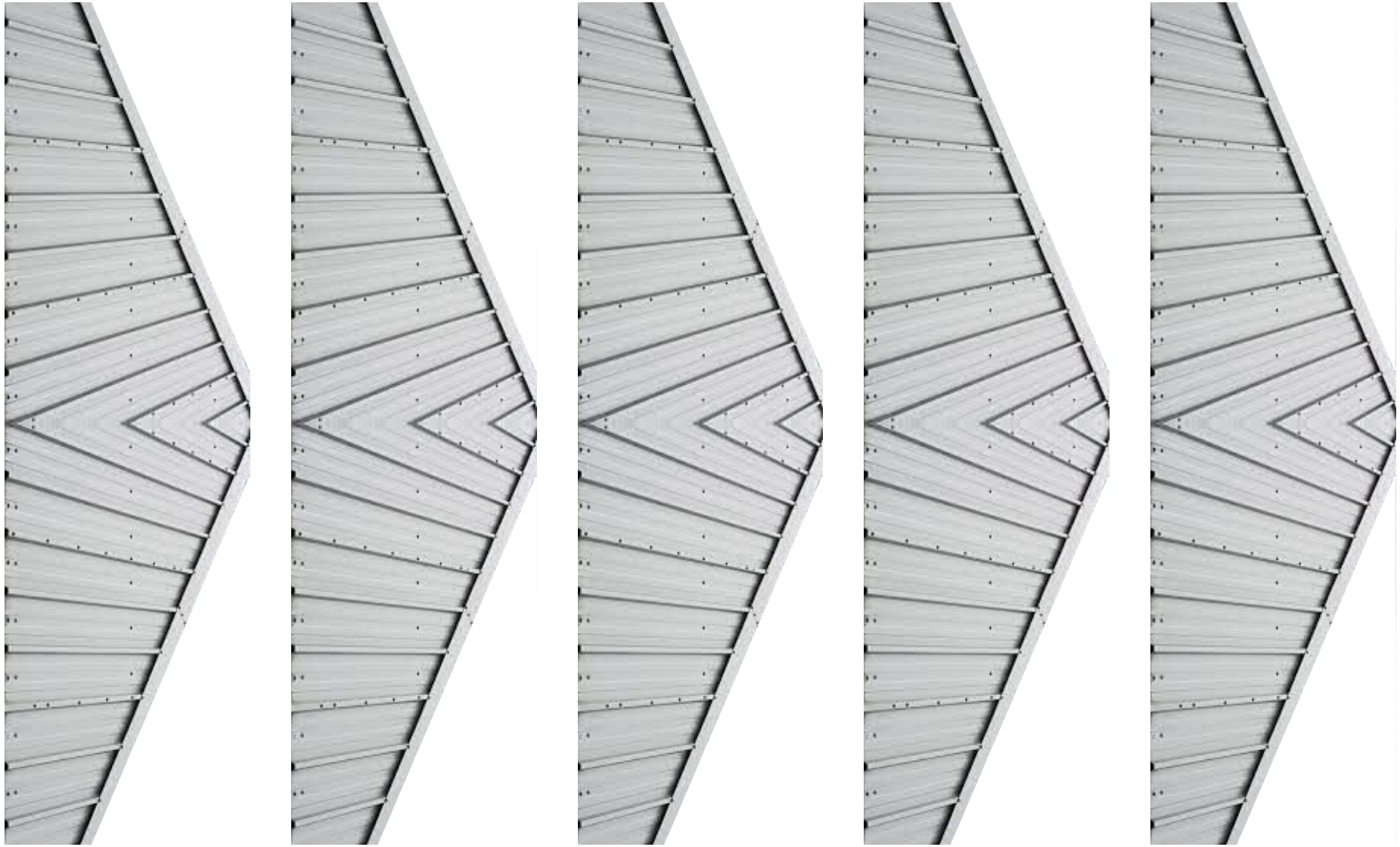
Appendix F: House Parts

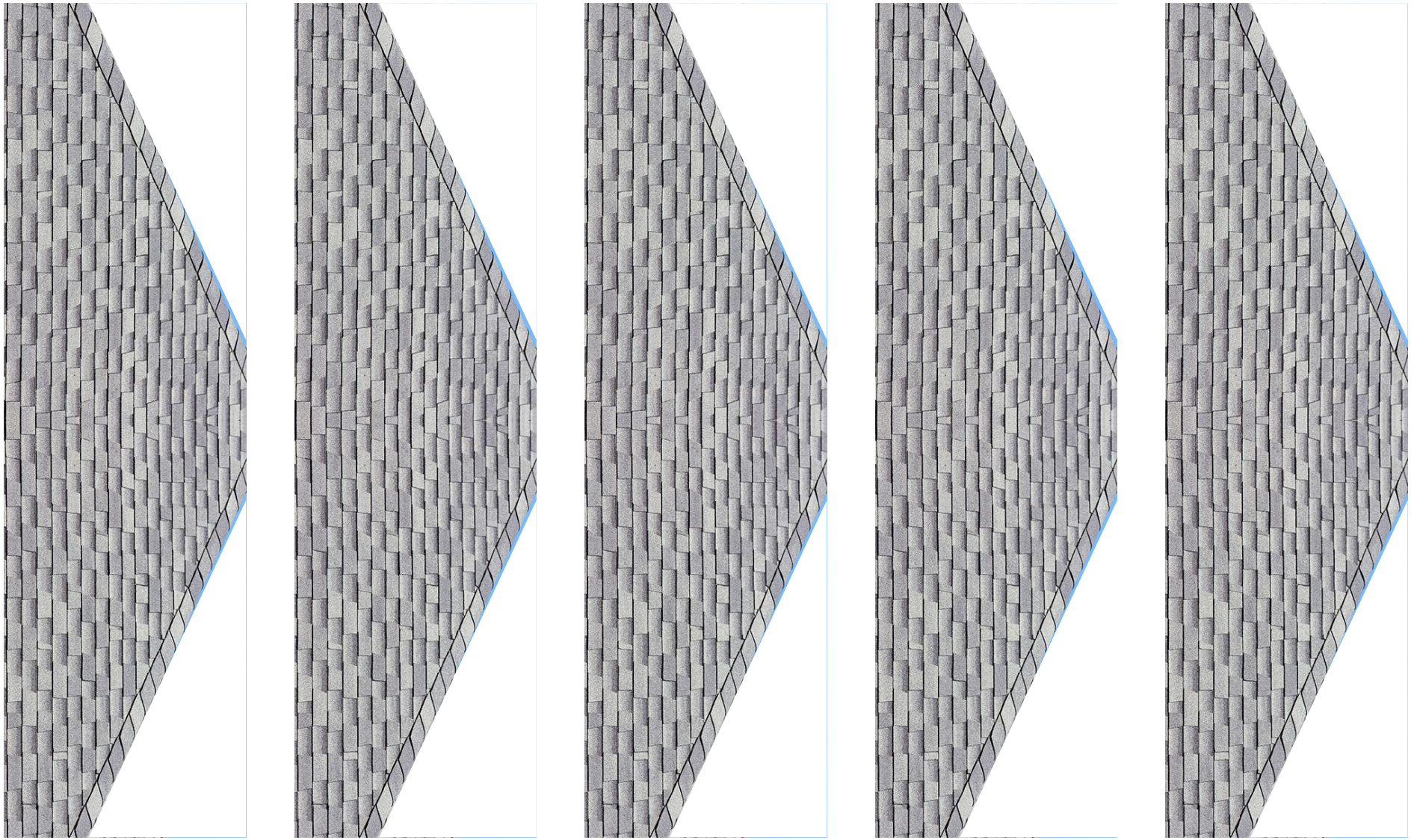
Appendix F: House Parts - Insulation: Strawbale

Appendix F: House Parts - Insulation: Cellulose

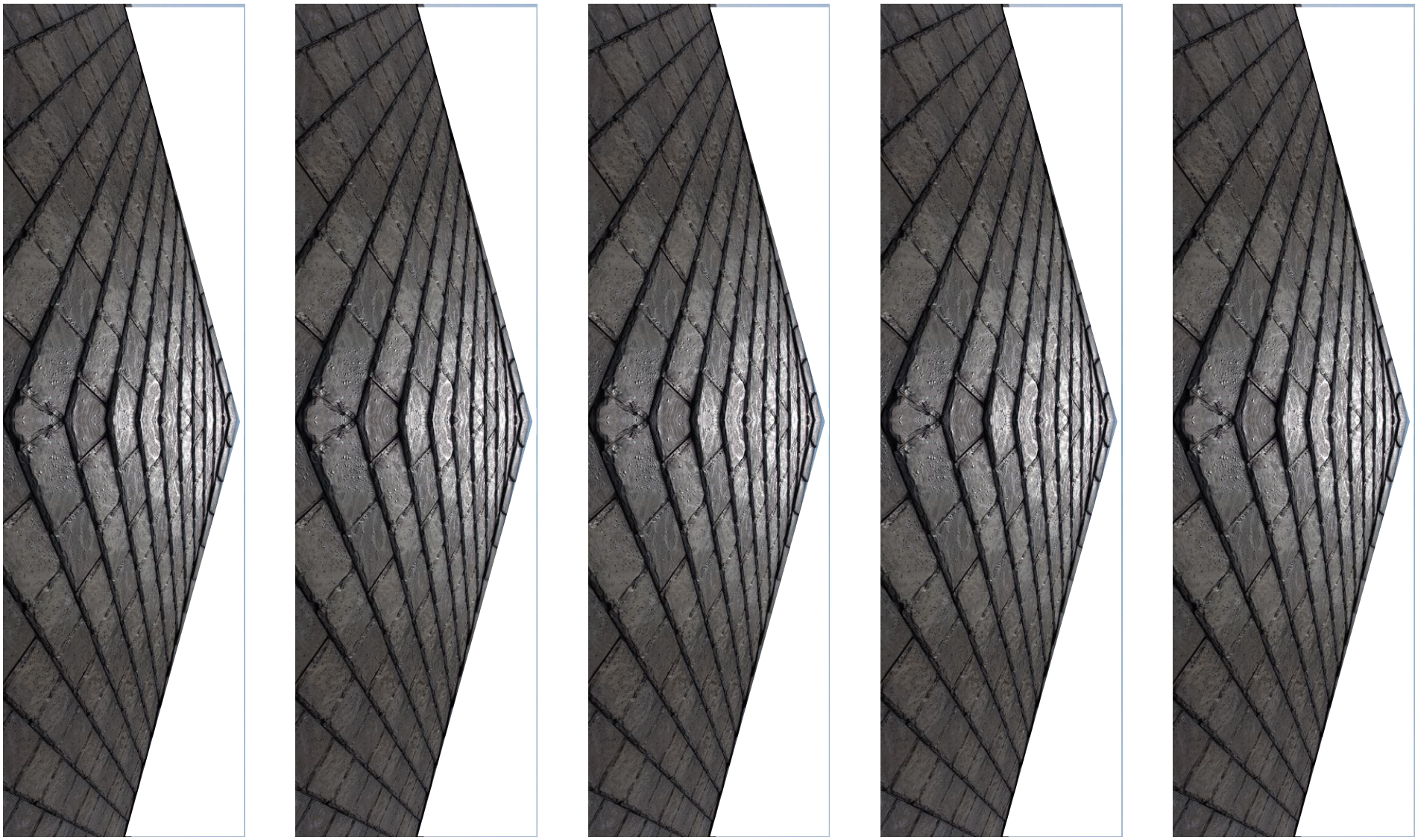
Appendix F: House Parts - Insulation: denim

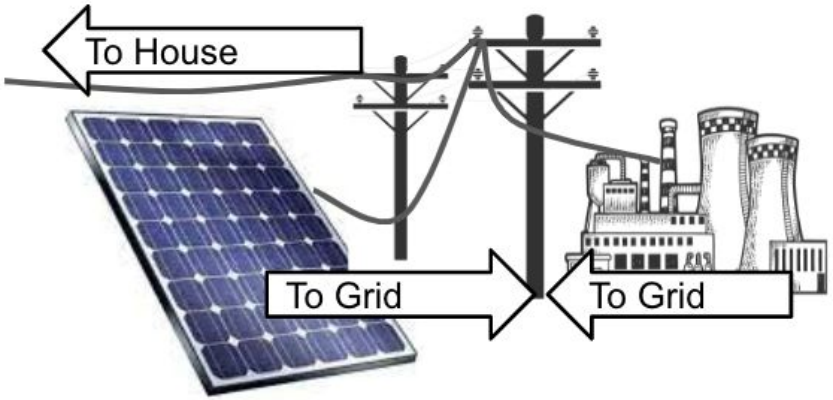
Appendix F: House Parts - Insulation: Fiberglass



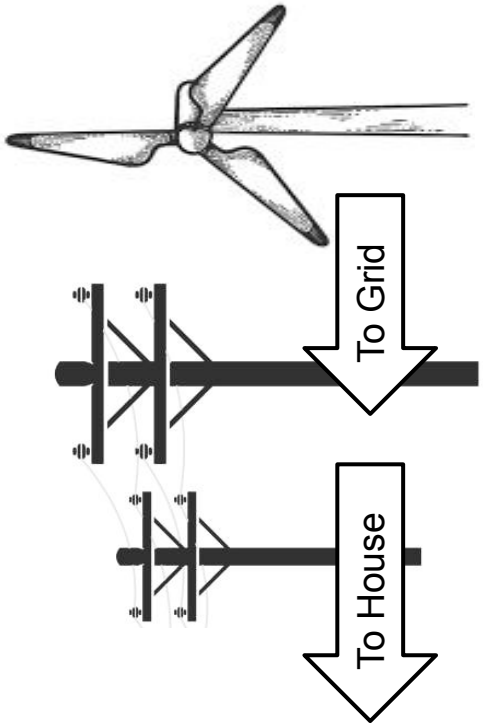


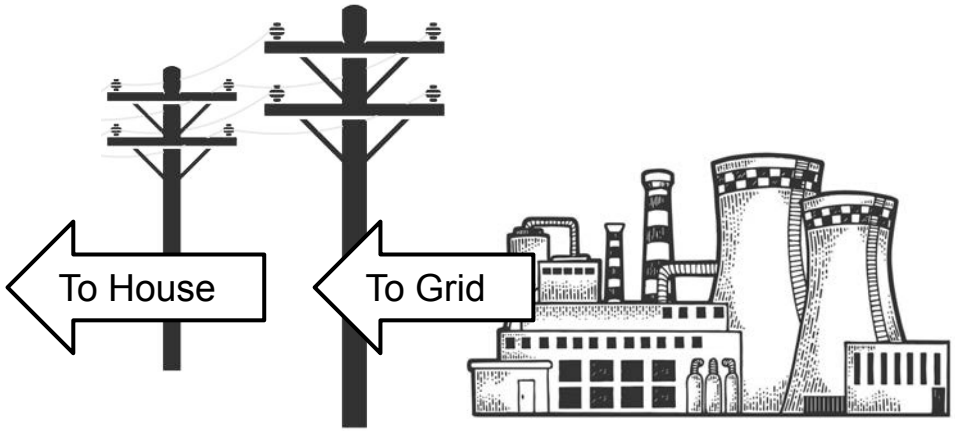
Appendix F: House Parts - Roof: Green




To House
To Grid
To Grid

To House

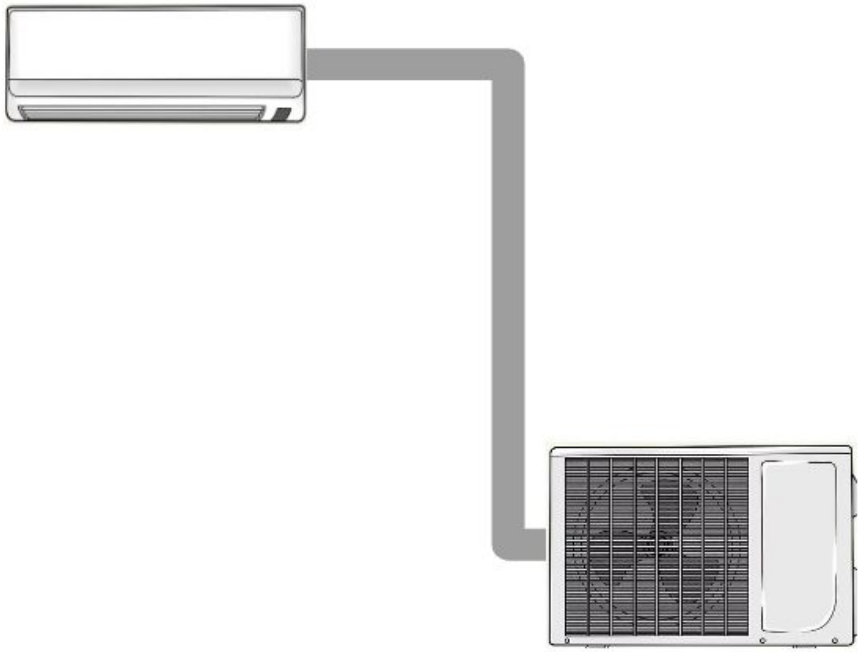

To Grid
To House

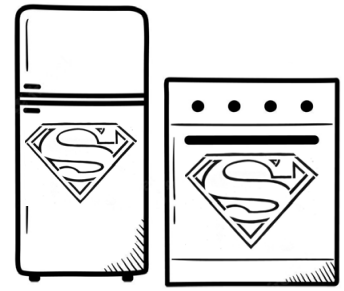

To House
To Grid

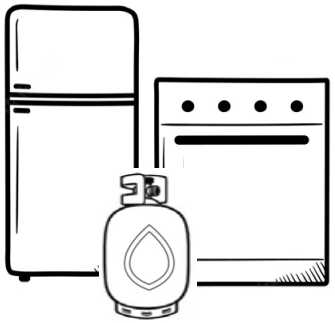
Appendix F: House Parts - Roof: Asphalt Recycled Materials

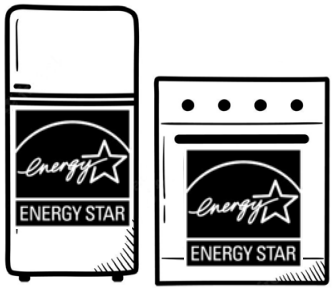
Appendix F: House Parts - Insulation: Fiberglass

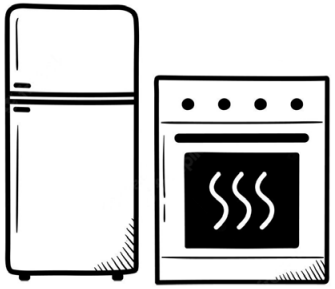
Appendix F: House Parts

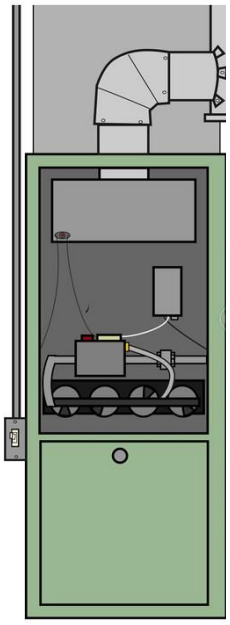


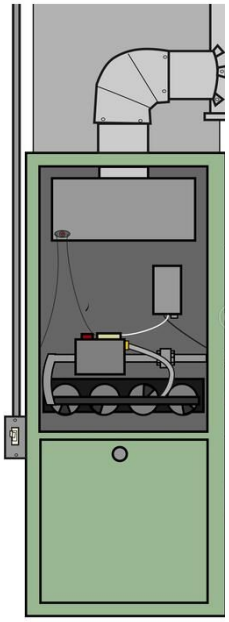


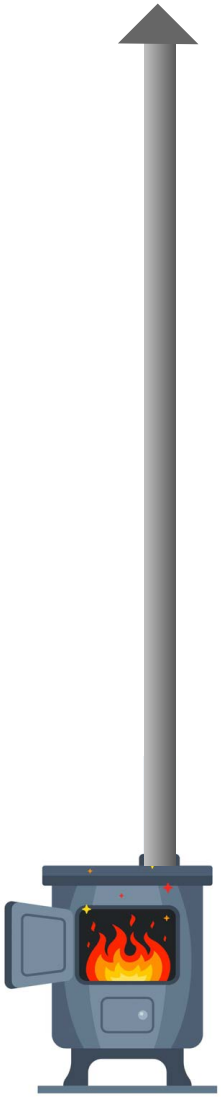












Pathway
to Stewardship & Kinship

Skills Competition
Create 5 competitions. For each competition, students will receive between 1 and 3 dollar tokens depending on their performance.

Suggested competitions:
- Bean bag toss with targets
- Timed dribbling through pylons
- Number of hits keeping a birdie in the air using a badminton racket
- Lowest limbo
- Highest playing card tower
- Check out Minute to Win It ideas

Random
Choose a method
1. Print Money Available cards and have students draw them from a container randomly.
2. Students within each group pair up and compete with Rock, Paper Scissors or Coin Flip to determine the order they get to choose the money cards.
    a. Place students in groups of four.
    b. Winners play winners, losers play losers.
        i. First Choice: win - win
        ii. Second Choice: win - lose
        iii. Third Choice: lose - win
        iv. Last Choice: lose - lose

Guess That Wattage Competition
Students guess the energy used by appliances measured in watts. Requires a plug-in watt meter, (available to buy or at the Peterborough Library).
1. Show students an appliance.
2. Students guess how many watts an appliance uses.
3. Plug the appliance into the watt meter and turn it on.
4. Students who are closest, without going over, are awarded the most dollar tokens.
    a. The top ⅓ get 3 tokens
    b. The middle ⅓ get 2 tokens
    c. The bottom ⅓ get 1 token.
5. Repeat for 5 rounds.

Roof

Shingles (recycled)

- Recycled shingles are made from tires and other waste materials
- They have limited ability to be recycled at the end of their life and are not biodegradable

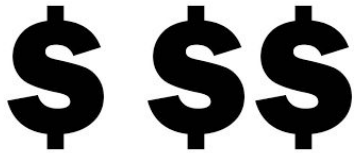
Roof

Shingles (recycled)
Price here

Roof

Green

- A green roof has a layer of soil and plants growing on the top
- This roof provides excellent insulation in the winter and cooling in the summer
- It is very heavy and buildings must be specially designed to carry the weight



Roof

Green
Price here

Roof

Shingles (new material)

- Regular shingles are made from non-renewable materials
- They cannot be recycled and they are non-biodegradable
- Low initial cost

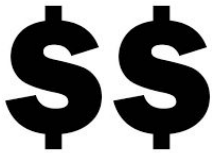
Roof

Shingles (new material)
Price here

Roof

Steel

- Steel roofs may be made of a mixture of recycled and new metal
- They can be infinitely recycled at the end of their life
- High initial cost



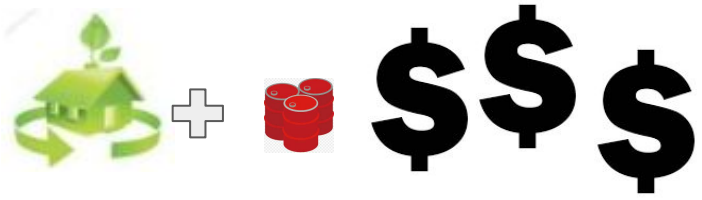
Roof

Steel
Price here

Electricity

Solar - grid tied

- The solar panels on the property feed into the general grid and the owner gets paid for that energy.
- The house then draws on the grid and the owner pays for that.
- A mixture of solar power produced on property and provincially generated power which uses mostly non-renewable sources.



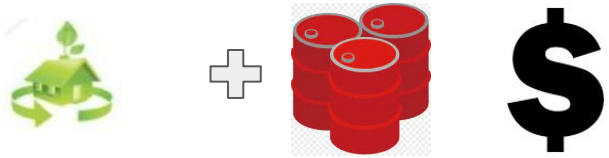
Electricity

Solar - off grid

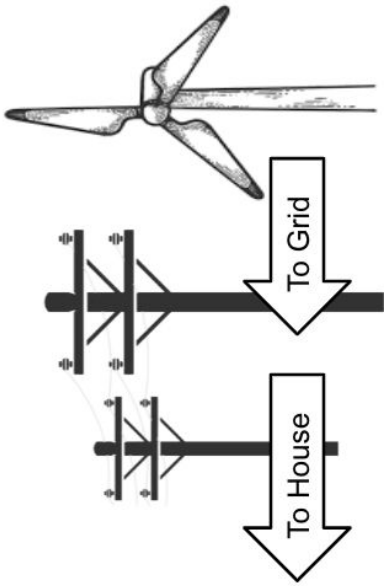
Electricity

Grid - regular

- Electricity available on the grid is produced by a mixture of government and privately owned companies using renewable and non-renewable.
- A large portion of Ontario's energy is sourced from Nuclear. There is not yet a long-term plan for storage of nuclear waste.
- The second largest portion is from the renewable source of hydro dams.
- A number of private companies still operate natural gas powered generating plants.



Electricity



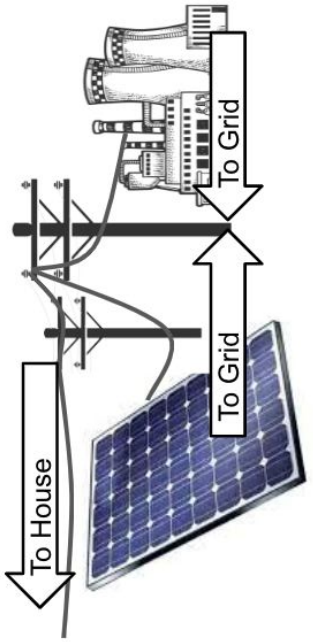
Grid - renewables

Electricity

Solar - off grid

- The home's only source of electricity is the solar panels on the property.
- High upfront cost, but energy is free.
- Requires flexibility to manage the changing levels of power available.
- Building the panels uses some non-renewable materials and right now, the panels cannot be recycled.

Electricity



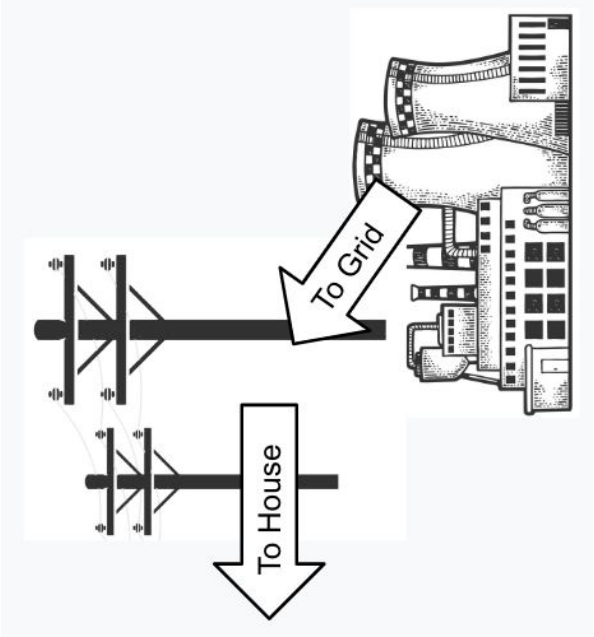
Solar - grid tied

Electricity

Grid - renewables

- Ontario home owners can buy their electricity from a number of different companies.
- Some companies offer electricity that has been sourced from renewable sources such as wind and solar.
- The prices are usually slightly higher than sources that may include non-renewables.

Electricity



Grid - regular

Insulation

Fiberglass

- Fiberglass insulation is made using extreme heat which consumes large amounts of energy.
- It is sourced from non-renewable materials and cannot be recycled and is non-biodegradable.
- It is an effective and popular choice for home insulation.

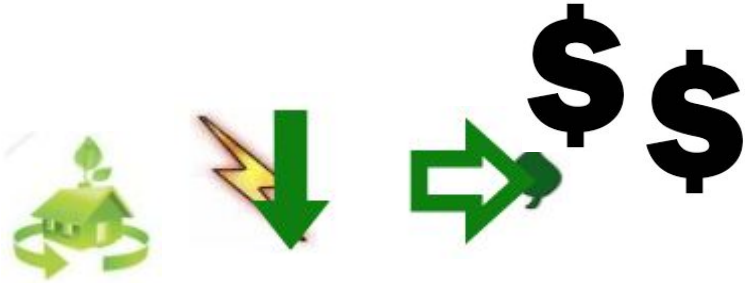
Insulation

Fiberglass

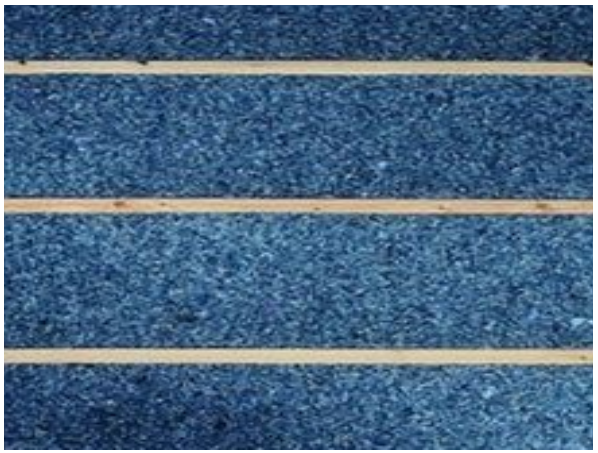
Insulation

Recycled Denim

- Denim insulation is made from recycled waste from the clothing industry.
- It is an effective home insulation comparable with fiberglass and cellulose.
- It is biodegradable at the end of its life.



Insulation

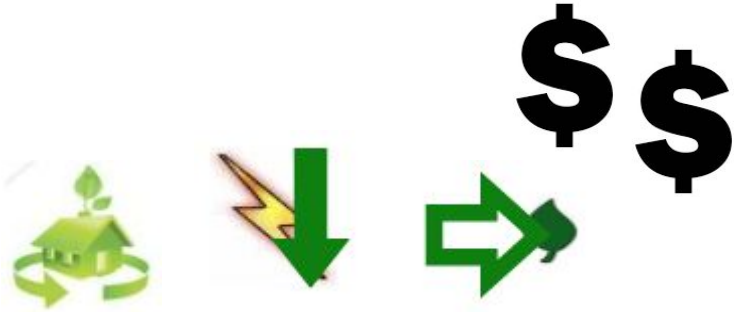


Recycled Denim

Insulation

Cellulose

- Cellulose insulation is made from recycled newspapers.
- It is an effective form of home insulation comparable to denim and fiberglass.
- It is biodegradable at the end of its life



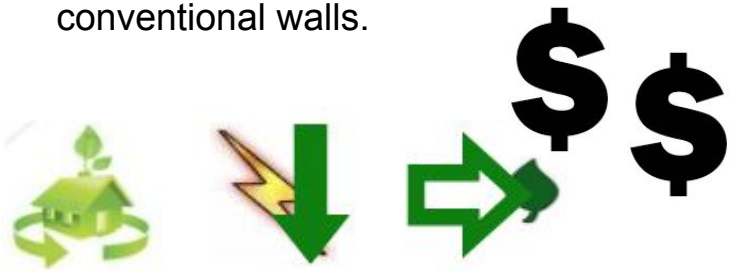
Insulation

Cellulose

Insulation

Straw Bale

- Straw bale insulation is a renewable resource.
- It is an excellent home insulation and outperforms fiberglass, cellulose and denim.
- It is biodegradable at the end of its life.
- House walls will be much thicker than conventional walls.



Insulation

Straw Bale

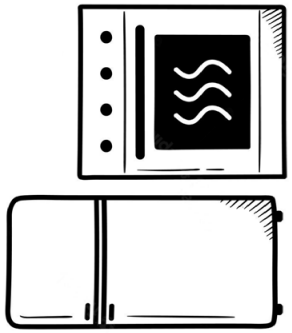
Appliances

Regular

- have a lower initial cost.
- consume more electricity than Energy Star certified or Super Efficient appliances.

$

Appliances



Regular

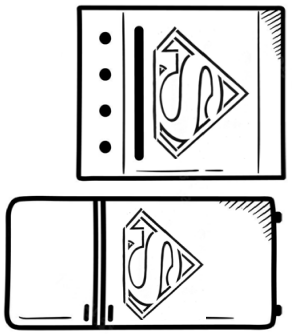
Appliances

Super Efficiency

- have been specially designed to use very low amounts of electricity.
- often smaller and more insulated than conventional appliances.
- have a high initial cost.
- some are specifically designed to work well with an off-grid solar electric system by using direct current.

$$$

Appliances



Super Efficiency

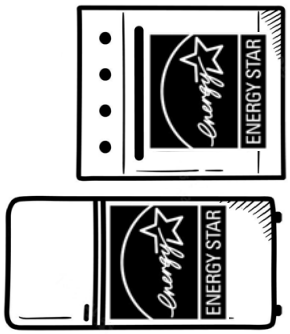
Appliances

Energy Star

- have a moderate initial cost.
- meet government standards for high energy efficiency.

$$

Appliances



Energy Star

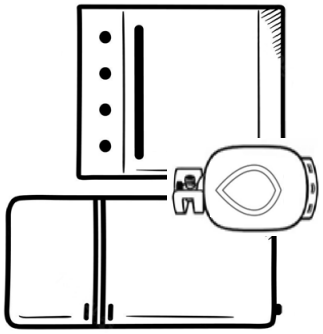
Appliances

Propane

- do not need electricity as they take their energy from canisters of propane
- can be operated off-grid
- may be cheaper than ultra efficient electric appliances and are not affected by periods of low light
- Propane is non-renewable and produces GHGs when burned

$$

Appliances



Propane

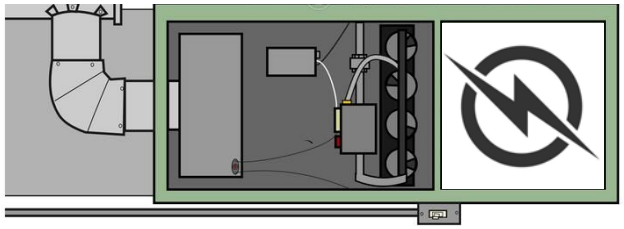
Heating

Electricity

- High efficiency electric furnaces are moderate consumers of energy
- Baseboards and other radiant heat sources are high consumers of energy
- No GHGs are produced at the home, but the source of the electricity generation must be considered.

$$

Heating



Electricity

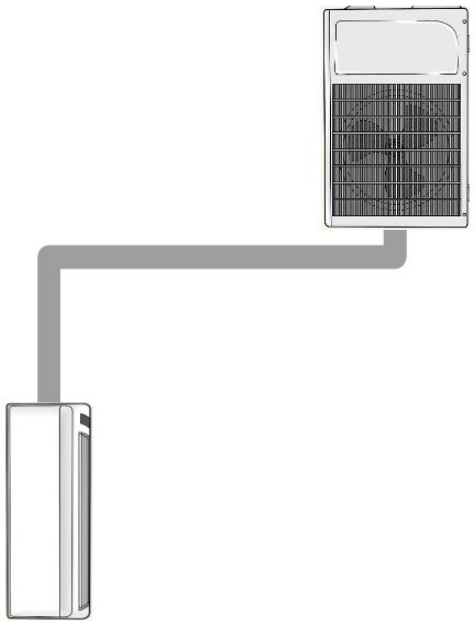
Heating

Heat Pump

- A unit collects and concentrates heat from the air or ground and puts it into the house
- Uses electricity to operate, but is more efficient than electric furnaces or electric radiant heat.
- High initial cost

$$$

Heating



Heat Pump

Heating

Wood

- Low initial cost
- Wood burned in a stove produces heat
- Is GHG neutral
- Is a practical option for off-grid homes
- Requires additional labour from the homeowner to manage wood supply and feeding of the stove
- Finding and storing firewood in cities and towns is very challenging

$

Heating

Wood

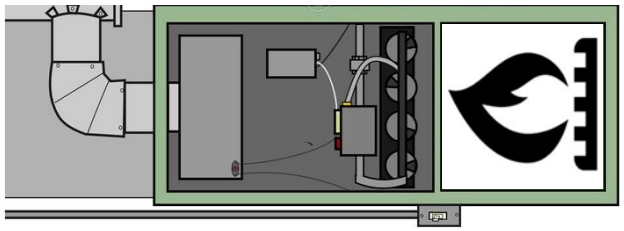
Heating

Natural Gas or Propane

- Both are non-renewable and produce GHGs when burned
- Propane heat can be used off-grid
- Natural Gas is only available in highly populated areas such as towns and cities

$$

Heating



Natural Gas or Propane