The Economics of Solar and Energy Efficiency – How Does it Fit With Your Values? –

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Alternative Energy Trade Fair

Peace Citizens' Recycling Society

Peace River

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Intro: Me! ––

- I am a solar system project developer
- I am not an equipment supplier
- I have no vested interest in any technology

- My interest is that you choose wisely
  - with your eyes wide open
  - based on the facts and whether it is right for you or not.

The Earth provides enough to satisfy every man's need,
…but not every man's greed.

Mohandas Karamchand Gandhi (*Mahatma*) India

Intro: What the Presentation Does…

- Helps you understand how to assess the real values that solar energy technologies bring to you.
- Gives you space to
  ask questions and
  get answers right away

Economics *vs.* benefits…

A quick survey…

- In buying something, what is more important to you?
  - economics
  - personal values

System #1 -- Would you buy this?

- It provides supplementary heat for your house;
- It costs **$6500** installed;
- It **increases** your heating bill and your environmental footprint a small amount;
- There is **less than zero return on your investment**;
- It will likely increase the marketability of your home when you sell it.

- Would you buy this?
  - yes
  - no

System #2 -- Would you buy this?

- It provides supplementary heat for your water;
- It costs **$6500** installed;
- It **reduces** your heating bill by **$200** per year and your emissions footprint by **7200 kg** per year (18% of total heating emissions);
- The return on investment is **~6%**/year (using your own money) (same as **8%** interest from bank);
- It will likely increase the marketability of your home when you sell it.

- Would you buy this?
  - yes
  - no

This is System #1:
a natural gas fireplace

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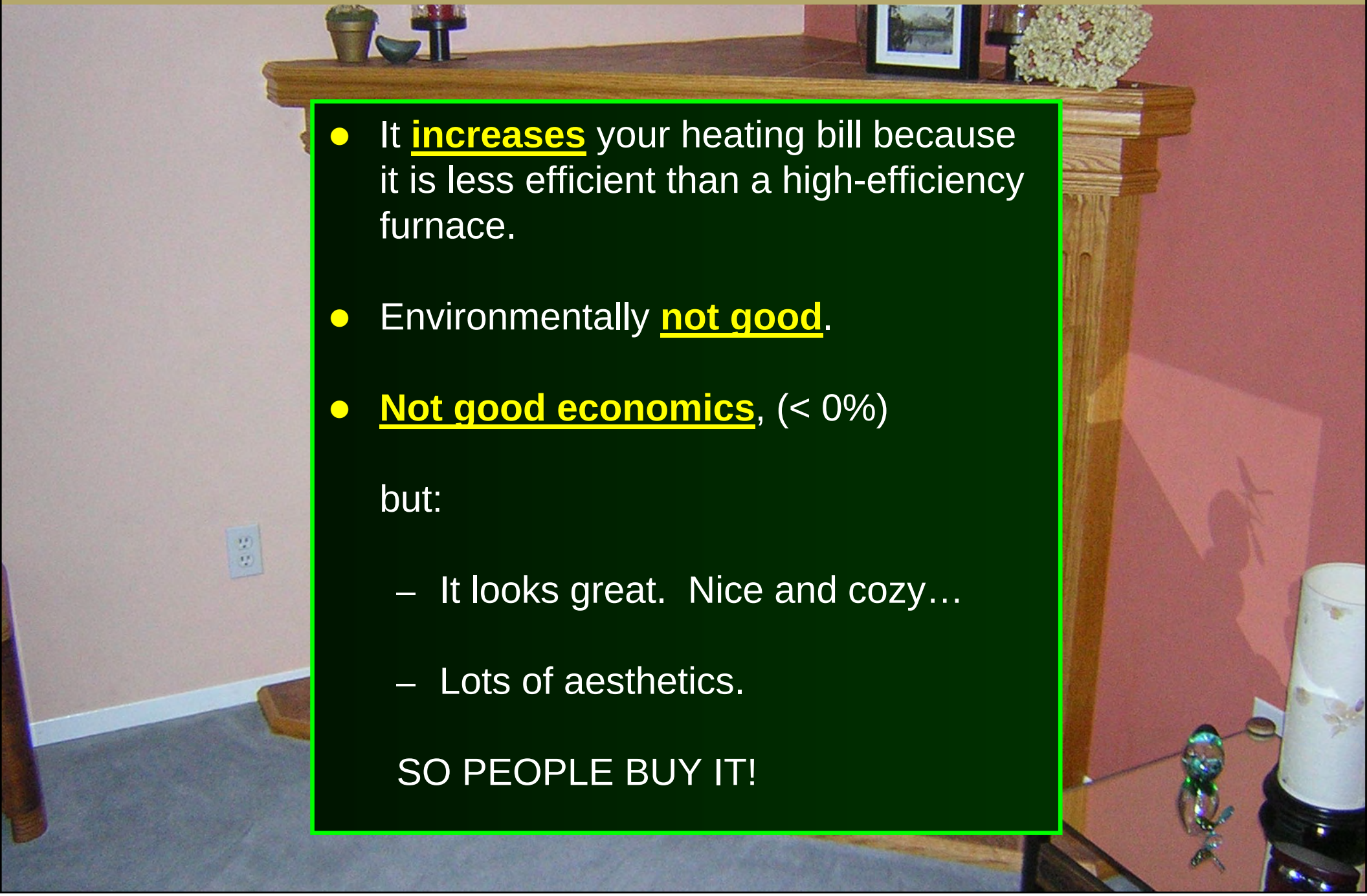
a natural gas fireplace



- It **increases** your heating bill because it is less efficient than a high-efficiency furnace.
- Environmentally **not good**.
- **Not good economics**, (< 0%)

  but:

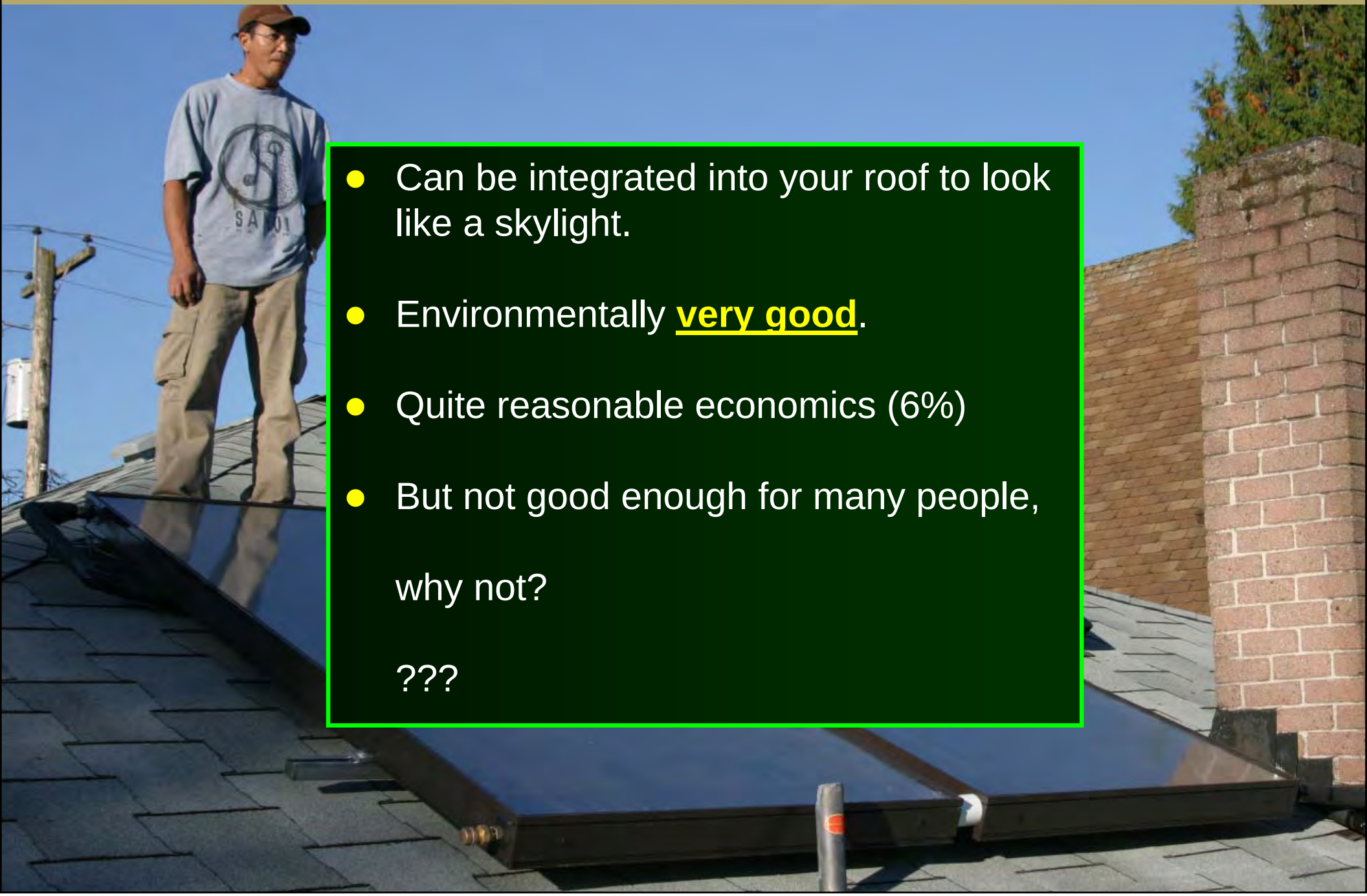
  – It looks great. Nice and cozy…

  – Lots of aesthetics.

  SO PEOPLE BUY IT!

This is System #2:
a solar domestic water heating system

This is System #2:
a solar domestic water heating system



- Can be integrated into your roof to look like a skylight.
- Environmentally **very good**.
- Quite reasonable economics (6%)
- But not good enough for many people,

  why not?

  ???

The Economics of Energy Efficient Furnaces

Cost of natural gas in Edmonton (including delivery and taxes) in 2007. This is 29% of the cost of electricity.	8.73 $/GJ
Cost of furnace energy efficiency – already better than the price of natural gas…! • **high** efficiency gas furnace (92% efficient) • Replacing a standard efficiency (62% efficient)	3.50 $/GJ $449/year savings 14% return on purchase (equivalent to 20% bank interest rate) 7 year cost payback
Reduction in an average household natural gas bill	31%

Natural gas energy efficiency is a secure investment.

Choices to Buy – my observations

- People **buy**
  …what they **want to buy**

  …because they want to buy it…

  regardless of economics and payback

  – Like many types of cars?

    ('cause they're exciting?)

Choices to Not Buy – my observations

- People **don't buy**
  …what they **don't want to buy**

  …because they don't want to buy it…

  regardless of economics and payback

  – Lots of energy efficiency decisions fall into this!

    ('cause its emotionally boring?)

Socialism collapsed because it did not allow the market to tell the economic truth.
Capitalism may collapse because it does not allow the market to tell the ecological truth.

Øystein Dahle
Exxon Norway

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The Consequences of our Spending…

Some consequences from spending a similar amount of money…

Energy efficiency and solar energy	SUVs and other big cars
• $50,000 to $70,000	• $50,000 to $70,000
• Long life: 25-30+ years	• Short life: 5-10 years?
• Appreciates in value	• High levels of depreciation
• Gives a positive return on investment	• Zero return on investment
• Very low environmental footprint	• Huge environmental footprint
• Salutation from your peers	• Increasing disdain from peers
• Good leadership to your peers and the government	• Poor environmental leadership
• Positive role model for your kids	• ???? role model for your kids

Great illustration about the power of marketing and peer pressure

The Challenge when Evaluating the Economics…

The Challenge:

How can we communicate

the real values, and

all the real values,

of solar energy?

… so that ***ALL*** its values are used (instead of being ignored)

in making the decision whether to buy it?

Basis for Decision Making

- **Decisions in life are based on values, not money!**
  - Money is only one of many values used in making decisions.

- A "Values Analysis" monetises our values

  so that it allows

  all our values,

  instead of only just money,

  to be used to help us make our decisions.

Then a payback # is based on a full cost ***and*** a full benefits analysis.

Let Money Talk

- A Values Analysis is based on common phrases that we use to justify decisions:
  - "Money talks."
  - "Let your money do the talking."
  - "Everything has its price."
  - "No such thing as a free lunch."
  - "Perception is reality."
  - "Nothing on the face of the earth is without value."

- Money talks… so let it talk loudly and not hide it!

What we want…

- People ***say*** they want the absolute cheapest commodities regardless of any other detriments associated with them.
  - But what about the detriments of oil, electricity, heating, nuclear power plants, gasoline, freeways, "progress", gambling…

    and their consequences that damage the environment, our health and our community cohesion?

Values and Choices

- We make hundreds of choices every month that have poor economics because:
  - we want to, and
  - there are other benefits in a product that are important to us.
  - …this is just fine.

  But then let's do the same with solar energy…

Economics of Products

- Economics of products depends on the value that we put on ***all*** the benefits.

- If we only value the energy that a solar system produces, then we are ignoring most of the benefits!

Economics of Solar Technologies

- Money talks, so lets let it talk loudly!
- "Payback" is a red herring
  that clouds people's decisions to use solar and energy efficiency!
- Solar energy is:
  - not an affordability issue,
    (after all, we say we can "afford" cars…)
  - definitely not an economics issue,
  - it is largely a ***choice*** issue. OK… there's the problem!

Solar Myth: Solar is not Cost-Effective!

- It all depends on what benefits you place a value on and what detriments you don't place a value on!

- Look at cars…! Which ones are "cost-effective"?
  So why are we applying different principles to solar?

- Solar PV and solar heating

  is economically viable and feasible ***today***

  when more than only its energy benefits are valued…

Values Analysis

Easy steps to follow:

1. Identify all the costs
2. Identify all the benefits
3. Put a value on the benefits
4. Understand whether the benefits will actually happen
5. Calculate the realistic Benefits
6. Calculate Payback and Return on Investment

Full Costs – Residential Grid-Connected Solar PV

Step 1. Add up all the costs of a system.

	Component	Costs
1.	Solar PV array	$ _____
2.	Solar array mounting structure	$ _____
3.	Grid-dependent inverter	$ _____
4.	Switchgear	$ _____
5.	Wiring	$ _____
6.	Installation	$ _____
7.	Utility interconnection approvals	$ _____
8.	**Total Costs**	$ _____

Full Benefits – Residential Solar PV

Step 2. List the benefits will you want to get from it?

for example…

1.	Electricity value, lower electricity bills
2.	Very high PR, green image, sizzle, prestige, status, pride, peer-leadership and influence, bragging rights
3.	Personal satisfaction, fun, conversation piece, curiosity from friends
4.	Emissions-free electricity. Tangible auditable emission reductions, ability to meet your Kyoto target.
5.	Inflation-secure energy, no price shocks
6.	Self generation of power, being your own solar utility
7.	Reduce your community's health care costs
8.	…whatever else is according to your own lifestyle choices.

Value of Benefits – Residential Solar PV

Step 3. What value do you put on each benefit?

1.	Electricity value, lower electricity bills	$ ___ per year
2.	Very high PR, green image, sizzle, prestige, status, pride, peer-leadership and influence, bragging rights	$ ___ per year
3.	Personal satisfaction, fun, conversation piece, curiosity from friends	$ ___ per year
4.	Emissions-free electricity. Tangible auditable emission reductions, ability to meet your Kyoto target.	$ ___ per year
5.	Inflation-secure energy, no price shocks	$ ___ per year
6.	Self generation of power, being your own solar utility	$ ___ per year
7.	Reduce your community's health care costs	$ ___ per year
8.	…whatever other personal choices.	$ ___ per year
9.	**Total Value of Benefits**	$ ___ per year

Likelihood of Benefits – Residential Solar PV

Step 4. How likely will you be to get the benefits?

1.	Electricity value, lower electricity bills	____ %
2.	Very high PR, green image, sizzle, prestige, status, pride, peer-leadership and influence, bragging rights	____ %
3.	Personal satisfaction, fun, conversation piece, curiosity from friends	____ %
4.	Emissions-free electricity. Tangible auditable emission reductions, ability to meet your Kyoto target.	____ %
5.	Inflation-secure energy, no price shocks	____ %
6.	Self generation of power, being your own solar utility	____ %
7.	Reduce your community's health care costs	____ %
8.	…whatever else is according to your own personal lifestyle choices.	____ %

Full Benefit Evaluation

Step 5. Perceived Values x Likelihood of Success = Net Realistic Benefits

	Perceived Values	Likelihood of Success	Net Realistic Benefits
1.	$ ___ per year	____ %	$ ___ per year
2.	$ ___ per year	____ %	$ ___ per year
3.	$ ___ per year	____ %	$ ___ per year
4.	$ ___ per year	____ %	$ ___ per year
5.	$ ___ per year	____ %	$ ___ per year
6.	$ ___ per year	____ %	$ ___ per year
7.	$ ___ per year	____ %	$ ___ per year
8.	$ ___ per year	**Total value of benefits**	$ ___ per year

Full Cost / Benefit Analysis

	Costs	Net Realistic Benefits
1.	$ _____	$ ___ per year
2.	$ _____	$ ___ per year
3.	$ _____	$ ___ per year
4.	$ _____	$ ___ per year
5.	$ _____	$ ___ per year
6.	$ _____	$ ___ per year
7.	$ _____	$ ___ per year
Totals	$ _____	$ ___ per year

Step 6. Simple Payback = Total Costs / Total Benefits

Step 7. Simple Return on Investment = Total Benefits / Total Costs

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Example – Grid-Connected Solar PV Costs

	Component	Costs
1.	Solar PV array	$ 700
2.	Solar array mounting structure	$ 50
3.	Grid-dependent inverter	$ 470
4.	Switchgear	$ 100
5.	Wiring	$ 50
6.	Installation	$ 375
7.	Utility interconnection approvals	$ 250
8.	**Total Costs**	$ 1,995

This is an actual Personal Values Analysis done with the owner of this 100 W grid-connected PV system in Edmonton in 2000.

Example – Full Benefits and Perceived Values

	List of Benefits that the System Owner Perceives	Perceived Values
1.	Save electricity, lower electricity bills	$ 13 per year
2.	Higher esteem from family (who are very green)	$ 2,500
3.	Fun, create curiosity, educate people, be the 1st one on the block with solar power	$ 4,500
4.	Save the environment	$ 2,000
5.	Green image for the owner	$ 500
6.	Spruce up neighbourhood to save it from being run down	$ 1,500
7.	Green the neighbourhood	$ 1,500
8.	Leadership	$ 1,000
9.	Working towards Kyoto GHG reduction goals	$ 200
10.	**Total Value of Benefits**	$ 13,713 in 1st year

Example – Likelihood of Success

	List of Benefits that the System Owner Perceives	Likelihood of Success
1.	Save electricity, lower electricity bills	90 %
2.	Higher esteem from family (who are very green)	50 %
3.	Fun, create curiosity, educate people, be the 1st one on the block with solar power	100 %
4.	Save the environment	70 %
5.	Green image for the owner	95 %
6.	Spruce up neighbourhood to save it from being run down	0 %
7.	Green the neighbourhood	30 %
8.	Leadership	50 %
9.	Working towards meeting Kyoto GHG reduction goals	50 %

Example – Net Realistic Benefits

	Perceived Values	Likelihood of Success	Net Realistic Benefits
1.	$ 13 per year	90 %	$ 12 per year
2.	$ 2,500	50 %	$ 1,250
3.	$ 4,500	100 %	$ 4,500
4.	$ 2,000	70 %	$ 1,400
5.	$ 500	95 %	$ 475
6.	$ 1,500	0 %	$ 0
7.	$ 1,500	30 %	$ 450
8.	$ 1,000	50 %	$ 500
9.	$ 200	50 %	$ 100
10.	$ 13,713 in 1st year	**Total value of benefits**	$ 8,687 in 1st year

Perceived Values x Likelihood of Success = Net Realistic Benefits

Example – Full Cost / Full Benefit Analysis

	Costs	Net Realistic Benefits
1.	$ 700	$ 12 per year
2.	$ 50	$ 1,250
3.	$ 470	$ 4,500
4.	$ 100	$ 1,400
5.	$ 50	$ 475
6.	$ 375	$ 0
7.	$ 250	$ 450
8.		$ 500
9.		$ 100
Totals	$ 1,995	$ 8,687 in 1st year

Simple Payback = 2.3 months

Simple Return on Investment in 1st year = 500%

The Practical Results of a Values Analysis?

1. It shows people where they place their values.
   - We cannot criticize these values because these reflect their own lifestyle choices, not ours!
2. It greatly helps to maximize the return on investment.
3. It gives a credible platform in answering questions from colleagues, peers, neighbours and friends such as "What's the payback?" because it is determining the full-value payback.
4. You can then buy solar and energy efficiency with a clear economic conscience.

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Full cost, Full Benefits – Residential Solar PV

Cost for a 1500 W system, installed	~$14,000
Electricity value, lower electricity bills	~$160 per year
Very high PR, green image, sizzle, prestige, status, pride, peer-leadership and influence, bragging rights	$ ___ per year
Personal satisfaction, fun, conversation piece, curiosity from friends	$ ___ per year
Emissions-free electricity. Tangible auditable emission reductions, ability to meet your Kyoto target.	$ ___ per year
Inflation-secure energy, no price shocks	$ ___ per year
Self generation of power, being your own solar utility	$ ___ per year
Reduce your community's health care costs	$ ___ per year
Total value	$ ___ per year

Full cost, Full Benefits – Solar Water Heater

Cost for a 2-collector system, installed	**~$8,000**
Natural gas value, lower heating bills	~$170 per year
Very high PR, green image, sizzle, prestige, status, pride, peer-leadership and influence, bragging rights	$ ___ per year
Personal satisfaction, fun, conversation piece, curiosity from friends	$ ___ per year
Emissions-free heat. Tangible auditable emission reductions, ability to meet your Kyoto target.	$ ___ per year
Inflation-secure energy, no price shocks	$ ___ per year
Self generation of heat, being your own solar utility	$ ___ per year
Reduce your community's health care costs	$ ___ per year
Total value	$ ___ per year

Example – Lowering the Risk, Increasing the Value

	List of Benefits that Owner Perceives	What would Increase the Benefits?
1.	Save electricity, lower electricity bills	Sunny days, high tilt angle, placement in high sun location
2.	Higher esteem from family	Good communication
3.	Fun	Owner participation in the process…
4.	Be the 1st one on the block with solar power, save the environment	Research to show it…
5.	Create curiosity, educate people, green image for the owner	Communication with stakeholders, high visibility, innovation, artistic flair
6.	Save the neighbourhood from being run down, green the neighbourhood	Communication with neighbours, neighbourhood block party
7.	Leadership	Communication with stakeholders, become a Green Power supplier
8.	Working towards Kyoto GHG goals	EcoLogo certification

Example – the Risk to the Benefits

	List of Benefits that Owner Perceives	Why Might Benefits Not Happen?
1.	Save electricity, lower electricity bills	If electricity prices or solar income changes
2.	Higher esteem from family	If relationship changes!
3.	Fun	If there are technical, people, or regulatory problems
4.	Be the 1st one on the block with solar	If someone beats her to it!
5.	Save the environment	If this is the only small step!
6.	Create curiosity, educate people, green image for the owner	If the system is hidden from view
7.	Spruce up neighbourhood to save it…	Other more important factors!
8.	Green the neighbourhood	If people don't follow the example
9.	Leadership	If people discount its value…
10.	Working towards Kyoto GHG goals	If owner's consumption rises

Example – Actual Benefits?

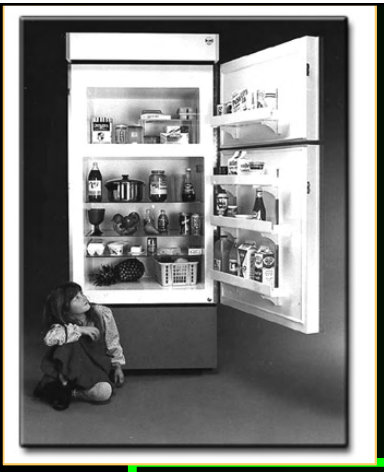
	List of Benefits	Actual	Reason for Actual Benefits
1.	Save electricity, lower electricity bills, save the environment	0%	It is not connected yet – lots of regulatory issues!!!
2.	Higher esteem from family	100%	Working for common goals
3.	Fun	50%	Lots of fun, regulatory hassles too!
4.	1st one on the block with solar!	100%	No-one else has done it!
5.	Create curiosity, green image	100%	High visibility from sidewalk
6.	Educate people		Friends, neighbours, and the Eco-Solar Home Tour
7.	Save n'hood from being run down	0%	…just what we thought!
8.	Green the neighbourhood	5%	This is one small step…
9.	Leadership	1,000% + +	Influencing Alberta and Canada interconnection regulations and Canadian Electrical Code!
10.	Working towards Kyoto goals	1%	Equal to changing 1 light bulb!

The Cost of Energy Efficiency

- Compact Fluorescent Light Bulbs -

Cost of electricity in Edmonton (including delivery and taxes)	11.01 ¢/kWh
Cost of energy efficiency: (already better than grid parity) • 20 W compact fluorescent light bulb (cost $4) • Replacing a 100 W incandescent light bulb • Same amount of light, but 1/5 the electricity and emissions Using 2007 average price data: 100 W cost $12.23/year to run; 20 W cost $2.45/year to run; savings are $9.78 in electricity. Extra gas costs for heating are $2.96/year (for standard efficiency furnace). Emission reductions are 56 kg CO2/year (including increase in furnace GHG) Note: All these economic #s change significantly when the price of electricity and gas changes.	Energy price: 2.4 ¢/kWh $6.45/year savings 237% return on purchase costs 5 month payback in costs!
Savings in average electricity bill for each 100 W light bulb changed!	1.3%
# of 100W to 20W bulb changes to give 1 Tonne of GHGs saved:	18

Concern for man and his fate must always form the chief interest of all technical endeavours....
Never forget this in the midst of your diagrams and equations. Albert Einstein, 1931



The Cost of Energy Efficiency

- Fridges -

Cost of energy efficiency: (already better than grid parity) • New fridge that replaced my 20-year old fridge • Reduced its energy use and emissions to ¼ • Purchase price $1035 Using 2007 average price data: Old fridge cost $189/year to run; new one cost $40/year to run; savings is $149 in electricity. Extra gas costs for heating are $45/year. Emission reductions are 857 kg/year. Note: All these economic #s change significantly when the price of electricity and gas changes.	Energy price: 9.3 ¢/kWh $62/year savings 6.0% return on purchase costs Cost payback: around 10 years
Savings in an average household electricity bill!	20%
Portion of 1-Tonne of GHGs saved:	86%

Electrical energy efficiency is a secure investment.

Insanity is doing the same thing over and over …and expecting different results.

Benjamin Franklin

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