4 ECONOMICS OF RENEWABLE ENERGY COOLING AND ICE MAKING

Life time costing is the basis for the economic analysis that supports the decision for the energy source (renewable/conventional) ice making or cooling. In this chapter, the cases for renewable energy and ice making will be discussed and compared with the conventional options.

4.1 SOLAR THERMAL ICE-MAKING

A dedicated product for renewable energy ice making that is commercially available is the ISAAC thermal solar icemaker.

- Not yet series produced
- Prototype cost approx US$12-15,000
- Price at series production (local production in developing country): est US$4-5,000
- Other products: PV ice plants and wind/ diesel hybrid powered plants (not fully renewable)

4.1.1 COMPARISON ISAAC WITH DIESEL POWERED PLANT

A comparison has been made between the investment and fuel cost of a diesel and solar ice plant (18, locally series produced, ISAAC systems) over a 20 year running period. Investments in other equipment as well as other running cost such as labour and maintenance are not taken into account (assumed equal for both systems).

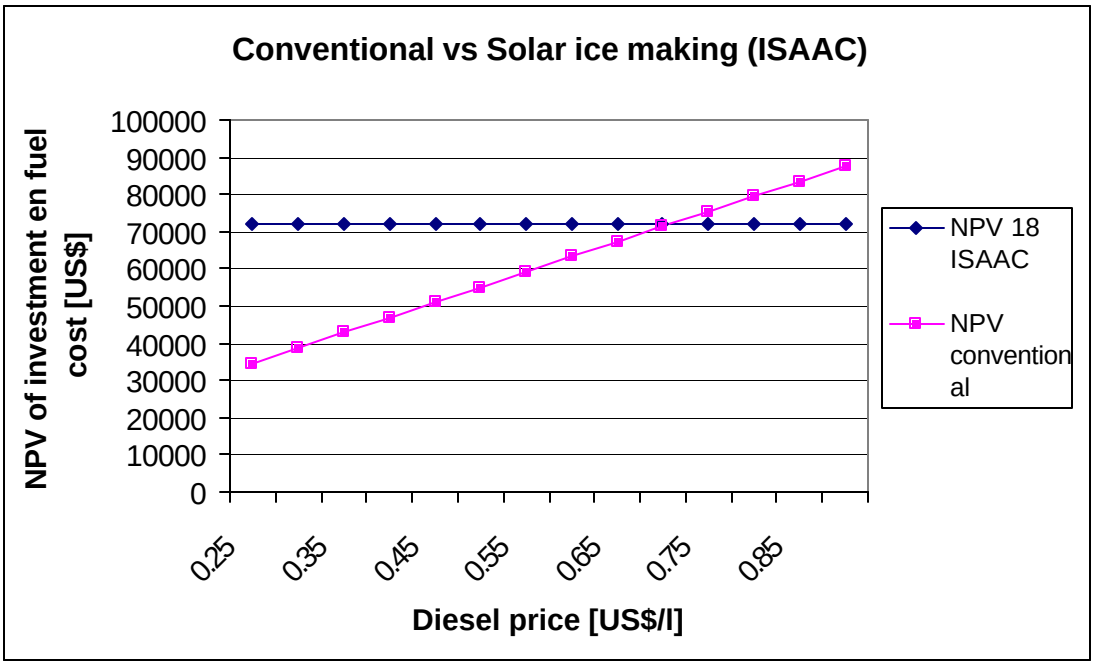

Figure 5: Life cycle cost analysis of a diesel operated icemaker (investment US$15,000) compared to 18 ISAAC solar icemakers (investment US$72,000), both producing 0.9 Tons of ice per 24hrs. Discount rate is 15%, economic life is 20 years, scrap value is US$0,00 and at year 10 a new Diesel generator will be purchased at a cost of US$5,000. It is assumed that local assembly will make the ISAACs available at US$4,000 each. Because of the country specific cost for transportation, import tax, maintenance and labour costs, these cost are assumed equal for both operations and therefore not taken into account in this cost comparison. Assumed energy use is 90kWh/ton of ice and the efficiency of the generator is assumed at 3kWh/liter of Diesel.

As can be seen in the figure above, the solar ice making plant is more expensive than the diesel powered plant up to a fuel cost of around US$0,7/ litre. Detailed study is needed to find what cost reductions and efficiency improvements can be made when scaling up the ISAAC technology to compete with a diesel powered ice making plant.

4.2 RE COOLING

PV solar refrigerators are commercially available. In the off-grid setting, they compete with kerosene and gas powered refrigerators which are less expensive to buy but use considerable amounts of fuel. Gas (propane or butane) refrigerators also require the infrastructure to fill and exchange the bottles. A cost comparison will be made in this section.

4.2.1 COST COMPARISON OF GAS, GRID AND SOLAR REFRIGERATOR FOR MILK COOLING

As an example, a comparison has been made between the investment and fuel cost of a propane and solar fridge over a 10 year running period as a function of the price of propane and electricity.

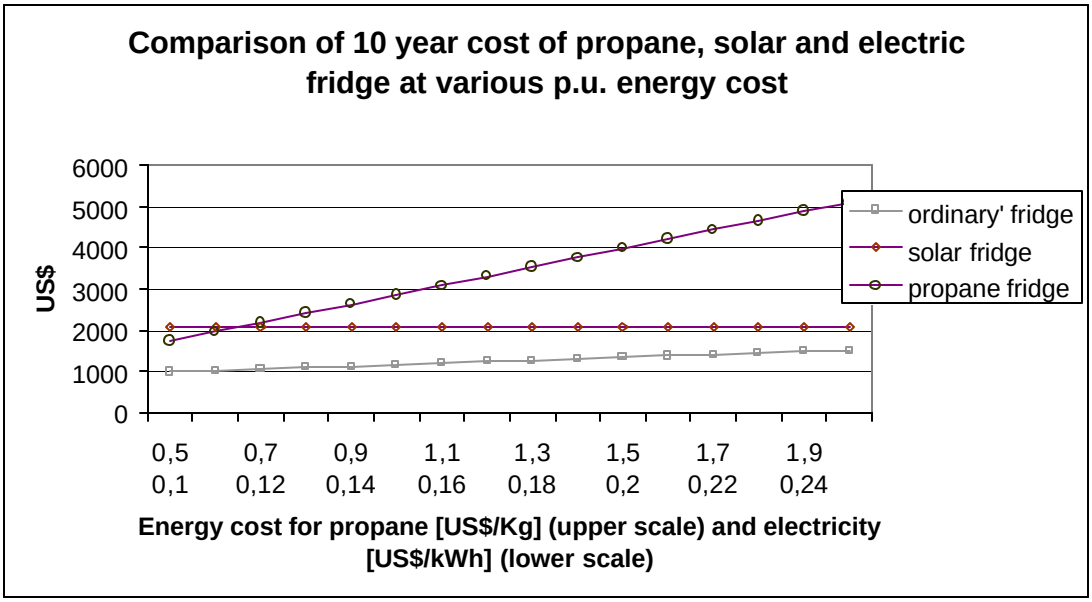

Figure 6: Indication of simple 10 year cost of a propane, solar and 'ordinary' (grid) refrigerator, perceived by a private person (no inflation, no discount rate used). The assumed energy cost are: gas US$0,71/day (a new bottle @US$15,- every 3 weeks), grid electricity: 0,96kWh (@US$0,15) /day, solar US$0,1/ day (battery replacement every 3 years incl.). The assumed purchase prices for the refrigerators are: solar (incl. PV): US$1750,- , gas: US$610,- and grid US$640,- (energy efficient 0,96kWh/day fridge).

In rural areas or areas with unreliable grid (long power cuts or power rationing), lifetime costing will reveal the most economic option. If commercially available, a solar refrigerator may well work out cheaper than a gas or kerosene refrigerator.

4.3 DECIDING FOR RENEWABLE OR CONVENTIONAL ENERGY

The decision for a local entrepreneur to opt for renewable energy or for a conventional energy source depends on many factors. Rational decision making can be helped by the following questions:

1- What is the added value for cooling?
- What is the economic damage of no cooling?
- Will cooled products have a higher yield (how much)?
- What occupancy rate will justify the investment ? Is that realistic?

2- Are there other factors that require cooling:
- Does the market/client require it?
- Government regulations/laws
- Competition?

3- What would be the renewable energy options and what would be the conventional options?
    - What resources are available (wind speed, solar irradiation), does the seasonal trend match the demand?
    - What are the investment and operational cost of each option and what are the risks?
    - What margins and occupancy rate is needed for the RE option to compete with the conventional option? Is that a realistic one?
    - What are the other requirements (skilled labour, space, etc) for both options?