Greenhouse Gas Fact Sheet – Renewable Energy Technologies

What is EROEI?

Energy Returned on Energy Invested is the ratio of the total energy produced by a fuel or technology compared to the energy to extract, manufacture and operate the fuel or technology. In other words, it takes energy to make energy.

For example, the total energy to extract and refine materials, manufacture a technology, as well as transport, install and operate the product must be less than the total energy it will produce in its useful life.

What is the EROEI for a 2 MW Vestas Wind Turbine?

Main Turbine Components:

- Steel = 240,000 kg
- Concrete = 1,000,000 kg
- Copper = 3,000 kg
- Carbon Fibre Reinforced Plastic = 15,000 kg
- Plastics = 10,000 kg
- Aluminum = 4,000 kg

Using the GHG Emissions Worksheet, multiply masses by the related embodied energy:

- Steel = 240,000 kg x 37 MJ/kg
- Concrete = 1,000,000 kg x 1 MJ/kg
- Copper = 3,000 kg x 70 MJ/kg
- CFRP = 15,000 kg x 480 MJ/kg
- Plastics = 10,000 x 90 MJ/kg
- Aluminum = 4,000 x 215 MJ/kg

Total = 20,000 GJ (add 20% for transportation and installation = 24,000 GJ)

Energy made per year
= 2,000 kW x 24 h/d x 365 d/y x 20% capacity factor
= 3,500,000 kWh/year
= 12,600 GJ/y of electricity or 30,000 GJ/y of primary energy (the equivalent energy needed to produce the electricity using 40% efficiency).

EROEI = 30,000 GJ/y x 20 y / 24,000 GJ = 25

This means that the wind turbine will produce 25 times more energy than it took to manufacture over its useful life.

* It should be noted that energy systems (like Alberta's electricity grid) require more complex analysis (base load, backup generation due to intermittency of renewables, etc.). Control technologies, storage, and demand management technologies are advancing the ability for renewables to replace fossil fuel generation on Alberta's grid.

EROEI for Electricity Generation

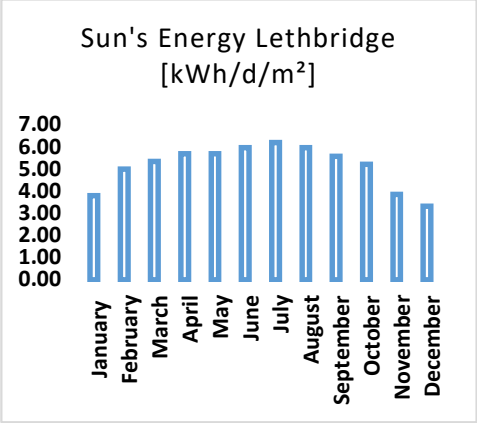
Coal (no CSS)	12 to 20
Coal (with CSS)	4 to 7
Natural Gas	7 to 15
Nuclear	5 to 15
PV	5 to 8
Wind	20 to 25

What is the EROEI for a Photovoltaic (PV) Solar Panel

The energy required to make a PV solar panel can vary widely depending on the manufacturer, the region it was manufactured and the technology.

A typical value for a PV array manufactured today is 1150 kWh/m^2

The energy produced by a solar panel depends on the amount of sunlight. Lethbridge is a sunny place.



The energy produced for 1 kW_p (7 m^2 of panels) is 1580 kWh each year or 225 kWh/m^2. Given a useful life of 25 years:

EROEI = 225 kWh/m^2/y x 25 y / 1150 kWh/m^2 = 5

The PV solar panel will produce 5 times more energy than it took to manufacture over its useful life.

SAGE
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