



ModelOff 2013 Questions and Answers

Energy Operations

Question Appeared in: ModelOff 2013 Round 1

Time Allocated: 35 minutes

INTRODUCTION

You've been asked to prepare a model to forecast the performance of a Solar PV (photo-voltaic) business. The business buys rooftop solar panels from overseas and installs them on the rooftops of people's houses in Australia. The business then sells the electricity generated at an agreed price schedule to either the owner of the house or the main electrical grid.

You will need to calculate forecasts of:

- i) kW of installed capacity
- ii) Generation of electricity (in kWh)
- iii) Purchasing and installation costs
- iv) Revenues from generation.

Note on Energy Industry Terminology:

"kW" stands for kilowatt, and is a measure of electrical power.

"kWh" stands for kilowatt-hour, and is a measure of energy, equal to the work done by a power of 1 kW for one hour.

For example, a small electric heater might operate at a power of 2,000 watts or 2kW. In three hours of operation, it would consume $2\text{kW} \times 3 \text{ hours} = 6\text{kWh}$ of electricity (energy).

As the business is based in Australia, the costs and revenue forecasts need to be prepared in Australian Dollars (AUD).

You are to prepare a monthly forecast model that includes the dates from 1 July 2013 to 30 June 2023.

To assist you in your task, the assumptions page has already been set out for you in the included workbook, but with the operational assumptions missing. You will need to fill in the assumptions, and then model the necessary calculations.

OPERATIONAL DETAILS

Purchasing and installation costs

The solar panels are purchased in US Dollars (USD) either as small or large systems.

The small systems cost US\$5,000 and have a rated capacity of 3kW.

The large systems cost US\$8,000 and have a rated capacity of 5kW.

In addition to the purchase cost, each system also costs 500 Australian Dollars (AU\$500) to install on a rooftop.

Assume that costs do not escalate with time.



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Performance of panels

When they are new, the panels are forecast to generate 4 kWh of electricity per day per kW of rated capacity. So for example, a new 3kW system would, in the month of May, generate $4\text{kWh/kW/day} * 3\text{kW} * 31\text{ days} = 372\text{ kWh}$ of electricity in the month of May.

The panels degrade over time. When they are brand new (that is, in the month of installation) they operate at 100% efficiency. They then decline in efficiency on a diminishing value basis by a constant percentage amount every month, so that on any given day, the efficiency in 12 months' time of a panel will be exactly 99% of its current efficiency.

Assume that the degradation of each panel occurs monthly, instantaneously on the first day of each month, beginning in the month after installation of that panel. You will need to determine the appropriate monthly degradation rate.

Revenues

Some of the electricity generated by the panels will be purchased by the house at a price equal to **Tariff A**. The remainder of the electricity generated will be sold to the main electrical grid at a price equal to **Tariff B**.

Houses with a small system will purchase 10 kWh of electricity per day from the company at a price equal to Tariff A.

Houses with a large system will purchase 15 kWh of electricity per day from the company at a price equal to Tariff A.

Prices

Tariff A: Initial price is AUD \$0.2500 per kWh. Each 1 July, beginning on 1 July 2014, the price of Tariff A will escalate by 2%.

Tariff B: Initial price is AUD \$0.08 per kWh. This tariff does not escalate.

Installation Details

The installation period lasts from July 2013 to June 2015. The number of small and large systems installed each month has been provided for you in the included workbook.

Assume that all systems are installed on the first day of the month and begin generation instantly. Assume that the purchasing and installation costs are incurred in the month of installation.

Exchange Rate Details

The AUD to USD exchange rate for each month during the installation period has also been provided in the included workbook.