COST ANALYSIS OF GENERATING ROI

ABSTRACT

In this document, we explore the formula which generates ROI (return of investment). The paper is not a detailed financial analysis of project economics. However, they do provide simple, clear metrics based on the reliable information which can be used to evaluate the cost and performance of different renewable power generation technologies. This report helps to inform the current renewable power generation and assist potential investor make informed decisions on investment.

This report consists of main factors which affect ROI and the main formula.

DISCUSSION

Discussion part consists of main factor which affects overall ROI and discussion of cost for wind power, solar power as well as the pumped hydro storage energy.

MAIN FACTOR

CIVIL WORKS AND CONSTRUCTION FEE

The construction costs include installation and transportation fee of wind turbine, the wind turbine foundation (tower), and the construction of access roads and other related infrastructure required for the wind farm.

For the turbine, the largest costs components are the rotor blades, the tower and the gearbox. Together, these three items account for around 50% to 60% of the turbine cost. The generator, transformer and power converter account for about 13% of the turbine costs, with the balance of “other” costs being made up miscellaneous costs associated with the tower, such as the rotor hub, cabling and rotor shaft. Overall, the turbine accounts for between 64% to as much as 84% of the total installed costs, with the grid connection, civil works and other costs accounting for the rest.

For the solar panel, the largest costs come with the inverter. All solar systems come with an inverter that converts DC to AC and because it is the working part of the system it is the component most likely to break. For this reason, Solara only supplies the top handful of brands from companies like Fronius, Enphase and SolarEdge. A cheap inverter from China may cost $500 compared to $2000 for a European Made equivalent.

Operations and maintenance costs (O&M)

The Operation and Maintenance (O&M) cost of a Component is the cost associated with operating and maintaining that Component. The total O&M cost of the system is the sum of the O&M costs of each system Component.

Supply chain cost, sales tax on equipment and other cost

Total supply chain management cost is the sum of the costs associated with the processes to Plan, Source, Deliver, and Return and is calculated as Sales - Profits - Cost to Serve (e.g., marketing, selling, administrative).

Formula for generating ROI

ROI = Net Profit / Total Investment * 100

Investment = installation cost

(Note: if possible, please take other costs in consideration, like inspection fee, technology renew fee, the price of conducted material and labour cost)

Gross Profit = ((energy power * electricity price) - maintenance fee) * number of year

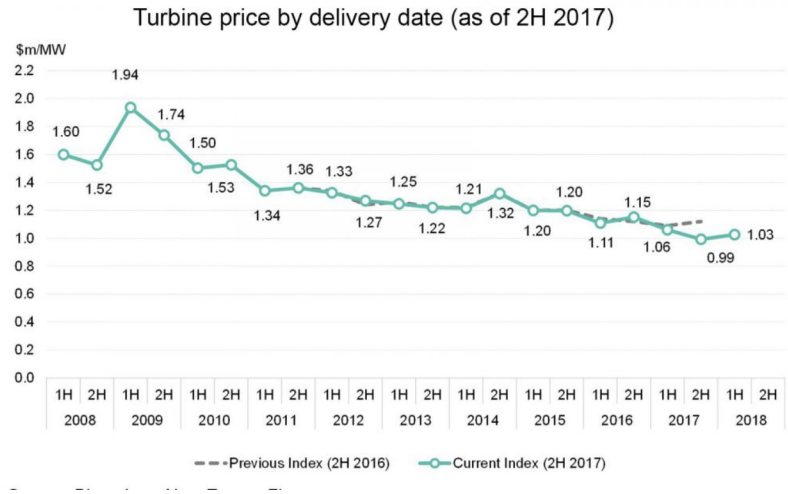
Net Profit = Gross Profit - Total Investment

Wind energy

Installation Cost

Based on the installation cost in 2018, the price for the wind turbine is 1.03USD million/MW.

The below diagram shows global average price for turbine by delivery date, it clearly demonstrates a continuous decreasing trend from 2009 onwards (Bloomberg NEF, 2018). Therefore, 1 million USD is selected as the average global installation cost for wind turbine in 2019 over area size. By assuming there is only one wind mill within the 100 m^2, the installation cost per 1 meter square is around $10,000.



Operation and Maintenance Cost

The median operations and maintenance (O&M) cost for utility-scale wind farm with a full wrap guarantee was just over $48,000/MW in 2016. Since the optimal wind farms are sized among three ranges, which are between 0 MW and 10MW, 10MW and 20MW as well as 20MW and 30MW. And most of the wind farms are between 20 MW to 30MW (Cetinay, Kuipers and Guven, 2017). Thus, 20 MW is used to calculate the maintenance cost per farm, which is $48000/MW * 20MW, equals to $960,000 per farm. This means the maintenance cost rate = 960,000 / area input.

ROI

Annual Earning from power generated = energy input (kWh/m^2) * area input * 0.23 dollar/kWh * 24h/day * 365 day/year

Net profit = (Annual earning - maintenance cost rate * area input) * number of year - (installation cost * area input)

ROI = Net profit / (installation cost * area input) * 100

SOLAR ENERGY

Installation Cost

In 2019, the average solar panel cost is $3.05/watt. The average solar panel system size in the U.S is approximately 6 kilowatts (kW), therefore an average solar panel system would cost $12,810 after tax credits. That's more than two percent lower than it was just a year ago, and solar panel system costs are continuing to fall (Matasci, 2019). Therefore, the installation cost = $3.05/watt * energy input (kWh/m^2) * 1000 * area input (m^2).

Maintenance cost:

The average cost of an annual inspection for a household rooftop solar PV system is approximately $150.00. The average cost of having panels cleaned by a reputable solar installation company ranges from $10.00 – $20.00 per panel.

From the research, cost per KWh for the annual maintenance of each system is:

- For the 3KW system, the cost is around $0.12 per KWh.
- For the 8KW system, the cost is around $0.09 per KWh.

With the above information of average 6KW system, $0.11 per kWh is used. Therefore, the annual maintenance cost = $0.11/kWh * energy input (kWh/m^2) * area input (m^2) (Blanch, 2013).

ROI

Annual Earning from power generated = energy input (kWh/m^2) * area input * 0.23 dollar/kWh * 365 day/year
Net profit = (Annual earning - maintenance cost) * number of year - installation cost
ROI = Net profit / Installation cost * 100

PUMPED HYDRO

Installation Cost

According to the Lazard's Levelized Cost Of Storage report, capital costs for pumped storage projects around the world range from about $1.5 million to $2.5 million per MW installed (Vaughan and West, 2017).
So the **installation fee** is $2 million per MW.

Maintenance cost

(For here, we only consider the fixed operation and maintenance fee)
(using 1 Australian Dollar equals 0.69 United States Dollar)

Pumped Hydro	
Cost and Performance Data for Power Generation Technologies, prepared for the National Renewable Energy Laboratory Black & Veatch 2012	45,288
DOE/EPRI Electricity Storage Handbook in Collaboration with NRECA Sandia National Laboratories 2015	9,182
2018 Integrated System Plan modelling assumptions Australian Energy Market Operator 2018	5,000

Maintenance fee =$31375/MW/year +$6361.29/MW/year+ 3464/MW/year = 41200 MW/year (Aemo.com.au, 2018).

ROI

Annual Earning = energy input (kWh/m^2) * area input * 0.23 dollar/kWh * 365 day/year
Net profit = (Annual earning - (maintenance cost * energy input (kWh/m^2) * area input)/1000) * number of year -(installation cost * energy input (kWh/m^2) * area input)/1000
ROI = Net profit / (installation cost * energy input (kWh/m^2) * area input) * 100

CONCLUSION

Overall, through the formula we compute, we could determine the ROI for different energy types including pumped hydro storage energy, solar energy and wind energy.

Reference:

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