Case Study 1: Alaska Energy

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Abstract

The Alaska Energy Organization (AEO) is looking to invest and develop a new source of clean energy dependency using a windmill farms by the year 2023. In order to generate enough electricity to sustain its community from 3.0 GW to 6.5 GW, the installed capacity in 2023 will be equivalent to the annual electricity consumption of 16 million people. The estimated cost of the project requires an initial capital investment of $5 million by the fourth year the last windmill is installed and operational. Analyzing the present worth of the entirety of the project, it is shown that the project will recover its initial investment by the fourth year as illustrated in Figure 2. Not only will it recover but it will make a total revenue of 30 million dollars.

Introduction

The Alaska energy project is tasked to bring forward a new dependency on renewable energy. A probe of 5 windmills were given a trial period of 24 years. The value of the initial capital investment with in the first four years prior to the turbines becoming operational resulted to a total of $11,879,050 as one may observe from the following formula

Equation 1. Present Worth of Windmills

$$PW= 700K(F/P,10\%,4) + 1.25M(F/P,10\%,3) + 2.5M(F/P,10\%,2) + 5M(F/P,10\%,1)$$

$$=700K(1.4641) + 1.25M(1.331) + 2.5M(1.21) + 5M(1.1)$$

$$= \$11,879,050$$

In order for the Alaska Energy windfarm to recover its capital investment in yearly cashflows, it would need to have a revenue of *$207,883.38* as illustrated through the Sinking fund formula (A/F,I%,N)

Equation 2. Capital Return

$$CR=11,879,050(A/P,10\%,20)$$

$$= \$1,395788.38/ \text{ year}$$

Since windmills are generators that deal with the forces of nature and are out in the environment dealing with all four seasons, a maintenance and Operation cost is mandatory in order to keep the windmills operational. An overhaul is in place to occur within year 10 up to year 15. Overhauling one windmill a year, in order to maintain 5 windmills operational a sixth windmill is funded through a bank/loan in which through yearly investments will be installed by the end of year 9. Through yearly investments of *$129,205.59* as illustrated in the excel spread sheet

YEARS		6th Turbin
-4		
-3		
-2		
-1		
1		129,206
2		258,411
3		387,617
4		516,822
5		646,028
6		775,234
7		904,439
8		1,033,645
9		1,162,850
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		

Figure 1. PMT Table

The PMT formula was used to solve for the annuity that begins at year 0 or in this case year 1.

When all is said and done, the real question for this project is " is this project economical?" the answer to that can be show through the Annual worth of the project as illustrated thought the annual worth formula

Equation 3. Annual Worth

$$AW= R-E-CR$$

Where,

Equation 4. Capital Return

$$CR=I(A/P,I,N)-S(A/F,I,N)$$

Where in our case plug in all the known information we obtain,

$$CR=11,879,050(.3155)+1.2M(.0175)$$

Since we don't have a salvage cost we instead replace it with the disposal cost of the 6 turbines at year 20 in which results with 200k per turbine. There being 6 results in 1.2M dollars.

The annual worth results being

$$AW=30M-5,891,708.70-3,768,840.28$$

$$= \$20,339,481.04$$

The expenses were calculated using excel as the maintenance cost increases slightly by .1% each year after year 5.

YEARS	6th Turbin	Turbine Revenue @ .15$	M/O
-4		0	0
-3		0	0
-2		0	0
-1		0	0
1	129,206	1,500,000.0	250,000.0
2	258,411	3,000,000.0	250,000.0
3	387,617	4,500,000.0	250,000.0
4	516,822	6,000,000.0	250,000.0
5	646,028	7,500,000.0	250,000.0
6	775,234	9,000,000.0	252,500.0
7	904,439	10,500,000.0	255,025.0
8	1,033,645	12,000,000.0	257,575.3
9	1,162,850	13,500,000.0	260,151.0
10		15,000,000.0	262,752.5
11		16,500,000.0	400,000.0
12		18,000,000.0	400,000.0
13		19,500,000.0	400,000.0
14		21,000,000.0	400,000.0
15		22,500,000.0	400,000.0
16		24,000,000.0	265,380.0
17		25,500,000.0	268,033.8
18		27,000,000.0	270,714.2
19		28,500,000.0	273,421.3
20		30,000,000.0	276,155.5
Total			**5,891,708.7**

Figure 2. Total Amount Calculated Using Excell

The cash flow diagram below illustrates the total overlook of the project

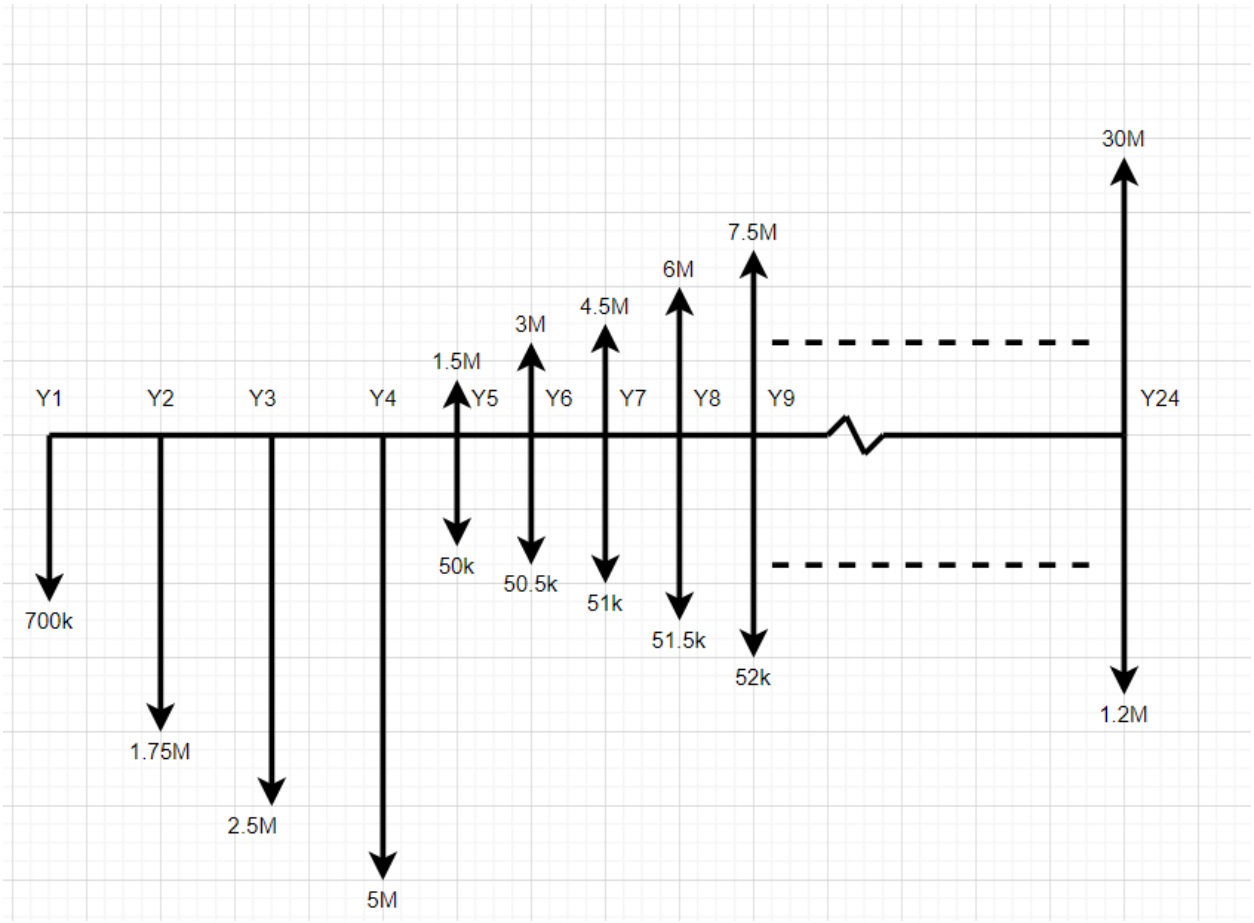

Figure 3. Cash Flow Diagram for Windmill Project

Conclusion

Overall, the project shows promise of returning a revenue of *$20,339,481.04* a year with the five turbines running non-stop. In a real world situation, this wouldn't always be the case since wind is unpredictable and unreliable. But for the sake of this scenario, the project is economical and will provide a profit much larger than the initial capital investment of 5M dollars.