Oil Sands Research

Paper #2

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1 Introduction

1.1 About

Applied math in industry 1) modelisation - we have data, we don't know if this data is useful or not, we need to show that we need to show in our model for achiving results, and data to feed that model. 2) simulation we have a lot of data that depend on real models. identify scenarios. and simulate to show that this configuration is better than the conventional configuration 3) optimization what are the most important factors. which elements take into account. most important variables.

This is not a mere Minimizing/Maximizing optimization problem in which we are trying to minimize the CO2 amount while maximizing profits as simply as that, but it is rather a modern complex optimization problem combining solutions from Discrete, Combinatorial, Stochastic, and Multi-Objetive algorithms.

We discuss the combination of multiple methods to find a better configuration than the conventional configuration, meta-huristic algorithms.

1.2 Supply and Demand

Sure we always talk about demand and supply, but we want to talk about supply more regarding need. The price fluctuates. Your basic need evolves more slowly. Concrete need. Elastic and inelastic demand. Gives an interesting perspective.

We have more supply than demand. That's why the price of oil is down. (Find out why). The keystone XL pipeline got refused.

The highest price for a barrel was above $100 in 2013. This doesn't mean that the oil sands idustries were making their highest profits. Back in 2007, when the price of a barrel of oil was $54, the industries were making four times as much profit was they were making it today [ref]. What changed? As the price of a barrel of oil went up, so did all the supplier costs and 3rd party services. Now, the price is down, but the cost of suppliers and other vendors is not down, but they remain the same. That's what the main issue is right now. What we want to do is reduce supplier costs. They have not reached a technological peak so that the supply of this suppliers is so big that the cost of "fracking" or "steam" becomes affordable.

this are other perspective to add to the paper.

1.3 Math

- Alberta Oil Sands Network
- methods for oil sand development

Problem: Define O the cost of a barrel of oil in the market, E the energy required to develop a barrel of oil, C the cost of producing 1 barrel of oil with a given method, P the profit made by the oil company[1], and X the amount of CO_2[2] released by producing that barrel. First, we want to model the following cost vector v as a multi-objective optimization problem:

$$v = \langle O, E_m, C_m, P_m, X_m \rangle$$

This vector v will serve more and an indicator of performance. Just like different organizations provide university rankings based on different criteria, this vector will also be based on the same observation.

In this paper we want to show that the vector $\langle O, E_w{+}E_s, C_w{+}C_s, P_{w+s}, X_{w+s} \rangle$ yields better EROI while proving to be a good solutions towards a green future for Alberta.

In other words, we want the following linear combination:

$$P = \underbrace{\alpha \times E_w \times C_w}_{\text{EROI Wind Energy}} + \underbrace{\beta \times E_s \times C_s}_{\text{EROI Solar Energy}}$$

In this paper we show that $\beta \times E_s \times C_s \approx 0$ does not prove to be a good EROI, hence $P \approx \alpha \times E_w \times C_w$

2 Modelling

What are we trying to model? What are my variables? What Algorithm do I need?

[1]If different companies have different profits then we talk about another vector of prices

[2]Specify what exactly do we mean by CO_2 here: CO2 produced by oil sands companies

2.1 Model Oil price of $\$/bbl$ in the next 50 years subject to price of last years using time series analysis

2.2 Model A: Current Alberta Oil Sands Network subject to $\$X/bbl$

2.3 Model B: Alternative Network subject to $\$/bbl$

2.4 Make the case that Model B better than Model A

3 Simulation

What are we trying to simulate? What are my simulation environments? What algorithm do I need?

3.1 Model A: Simulation of Current Alberta Oil Sands Network subject to $\$X/bbl$

3.2 Model B: Simulation of Alternative Network subject to $\$/bbl$

4 Optimization

What are we trying to optimize? What are my constrains? What algorithms do I need?

4.1 Discrete Optimization

the network is a discrete network, the choice of putting a turbine or not is also discrete (yes or not).

how many do we place? a bit less a bit more? amortize it.

4.2 Cominatorial Optimization

this a combinatorial optimzation problem. there're many heuristics exist for this. "recherche tabu", "algorithme genetique", in concrete it is a problem with complex structural optimization. For the whole network of turbines, that's a combinatorial problem. meta-huristics there

4.3 Stochastic Optimization

When talking about the functioning of the turbine, there's data problems. there we can talk about machine learning because the turbine needs to learn when to shut down when there is no wind. this is stochastic optimization problem. We have a real system where the wind is random variable, we have the choice of keeping the turbine on or to turn it off, and if we don't do this at the right time, turbine could be non-functioning anymore.

the stochastic problem is at the center of one wind turbine. when to turn it on/off.

4.4 Multi-objective optimization

we want to maximize something and minimize something. Is there a direct relationship? Maybe be not. This what we call multi-objective optimization (profit, co2). When we have conflicting variables, there are artificial trade-offs.

CO2 evaluation methods are highly political. Need to play with this 2 tables (profit, co2)

5 Conclusion

Make the case for Model B better than Model A.

We showed that this configuration is better than the conventional configuration provided the simulation scenarios.