# Electrifying the Oil Sands

## An alternative to steam with the potential to reduce Alberta's emissions


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## INTRODUCTION

SAGD has high GHG emissions. Alternative technologies that use electricity have the potential to reduce emissions. ET-DSP is one example that will be modelled to explore this.

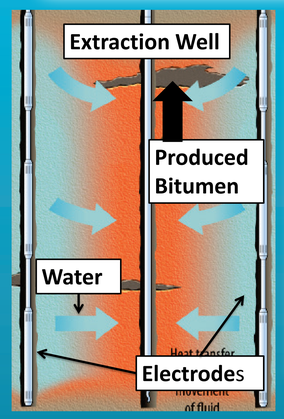


Figure 1: Electro Thermal Dynamic Stripping Process [2]

**How ET-DSP Works:**

- A tight grid of electrodes is inserted into a reservoir (Fig 1).
- Electricity passes through water to heat bitumen.
- Water is produced and re-injected through the electrodes [1].

## METHODS

- Reference scenario (SAGD) from CanESS [3].
- Modelled 2 different power sources (Fig 2): Combined Cycle Gas Turbines (CCGT) and best case of low carbon sources (i.e. wind, hydro, nuclear).
- ET-DSP is modelled as having the same production trend as SAGD does in [3]; barrels of ET-DSP offset barrels of SAGD (Fig 2) starting in 2025.

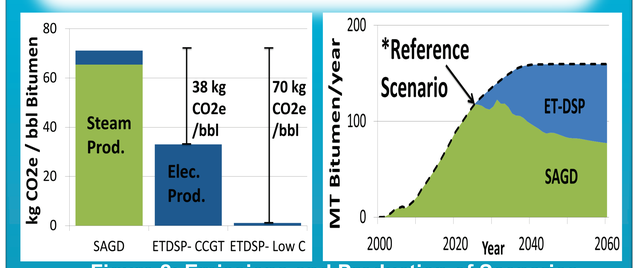


Figure 2: Emissions and Production of Scenarios

**Assumptions**

- Only extraction and recovery considered.
- Theoretical electricity consumption (70kWhr / bbl) [1] used for the ET-DSP process.
- ET-DSP is commercialized and adopted by 2025.
- Although ET-DSP and SAGD target different reserves [2] , ET-DSP will be chosen over new SAGD projects & produce "stranded" reserves .

## RESULTS

### A. Power Consumption

ET-DSP uses a lot of electricity. Current pilots use the AB grid. Existing AB grid capacity is 15 GW or 54 TWhr / year at 100% capacity [4]. Therefore, it may not be possible to continue using the grid if ET-DSP is widely adopted.

Fig 3: Projected demand in 2060
- 32 TWhr greater than the reference scenario
- On-site generation may be better

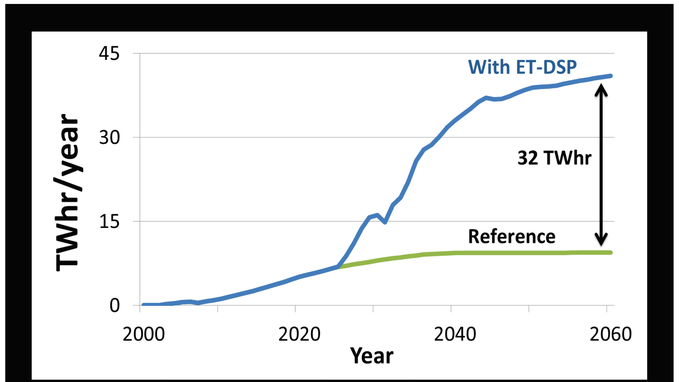


Figure 3: Power Demand Projections

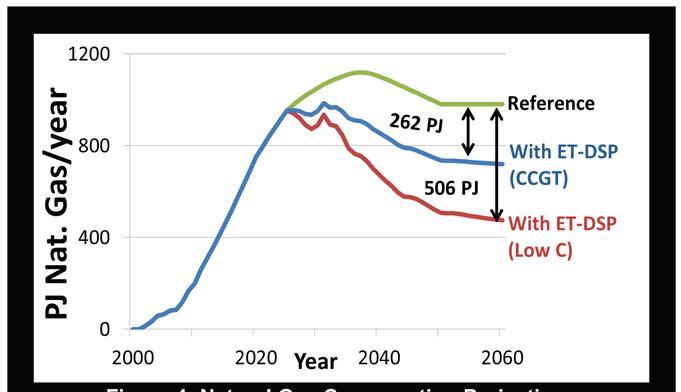


Figure 4: Natural Gas Consumption Projections

### B. Natural Gas Usage

Despite large power consumption, ET-DSP has increased energy in vs energy out efficiency compared to reference:
- With CCGT it's nearly 3 x more efficient
- With Low C it's nearly 4 x more efficient

Fig 4: As a result, ET-DSP scenario requires less natural gas than reference scenario:
- 27% less with CCGT
- 52% less with Low Carbon

### C. Greenhouse Gas Emissions

GHG emissions produced from ET-DSP depend on the electricity source (Fig 2):
- SAGD – 71 kg CO2e / bbl of bitumen
- ET-DSP with CCGT – 33 kg CO2e / bbl
- ET-DSP with Low Carbon – 1 kg CO2e / bbl

Fig 5: ET-DSP scenario reduces GHGs in 2060 by
- 18% with CCGT
- 50% with Low Carbon

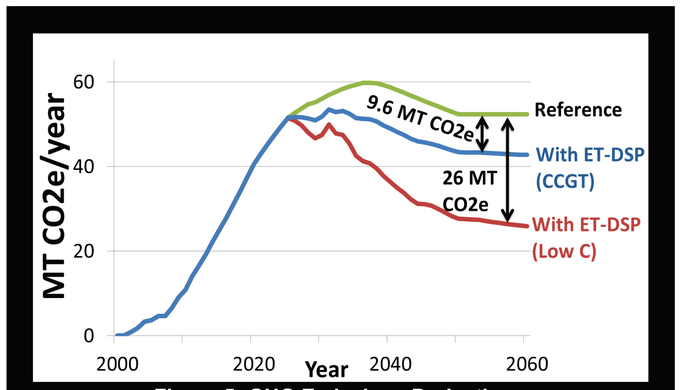


Figure 5: GHG Emissions Projections

## DISCUSSION

**Government Influence**
- As seen from the results, using low carbon power would have significant GHG reductions.
- Large-scale "green" electricity would likely require government support and funding.

**Land Usage**
- Due to the grid structure of the electrodes, upwards of 400 wells are required to obtain analogous production to one SAGD well pair [1].
- This large amount of land must be clear cut which would have adverse environmental effects.
- However, it is claimed full restoration is possible in less than 10 years [2].

**Study Limitations**
- While the results show promising potential, it should be emphasized that the values used in this study assumed the theoretical values .
- This assumption was necessary as recent pilot tests have experienced problems with electrode reliability and water zones [5] that resulted in a very large, and unusable, kwh/bbl number.

## CONCLUSION

ET-DSP is an example of a technology that uses electricity to heat bitumen. By offsetting new SAGD projects, there is the potential for Alberta's emissions to be reduced by 26 MT in 2060; this requires low carbon electricity, so policy that influences renewable energy would be very beneficial. However, ET-DSP has some limitations including large land and power use.

## REFERENCES


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[4] Alberta Energy System Operator (AESO). Available: http://www.energy.alberta.ca/electricity/682.asp [Accessed 16 Nov 2014].
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