System Level Benefits of SAGD Cogeneration


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INTRODUCTION

Most oil sands facilities that use steam-assisted gravity drainage (SAGD) employ once through steam generators (OTSGs) and produce about three times the greenhouse gas (GHG) emissions associated with conventional oil recovery.

This poster summarizes the findings of a recent report (Fig. 1, [1]) that assesses the system level implications of replacing OTSGs with gas turbines & heat recovery steam generators (HRSG) with duct burning (DB) to produce both steam for SAGD and electrical power for SAGD and the Alberta grid.

Fig. 1. CESAR Scenario report available at www.cesarnet.ca [1]

METHODS

Two case studies (Fig. 2) were carried out to compare the techno-economic and environmental implications associated with running a 33,000 bbl/day SAGD facility with a steam: oil ratio (SOR) of 2-4.

While the base case drew power from the grid, the Cogen case had two 85 MW gas turbines to met the heat and power needs of SAGD and put power on the grid at 390 kg CO_2/MWh.

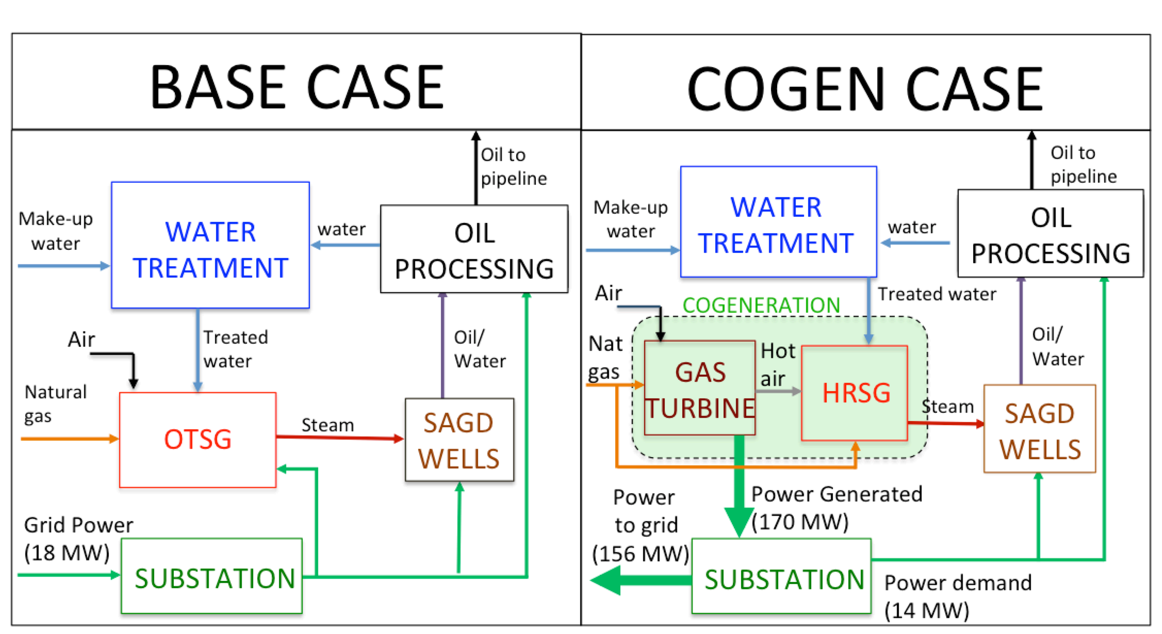


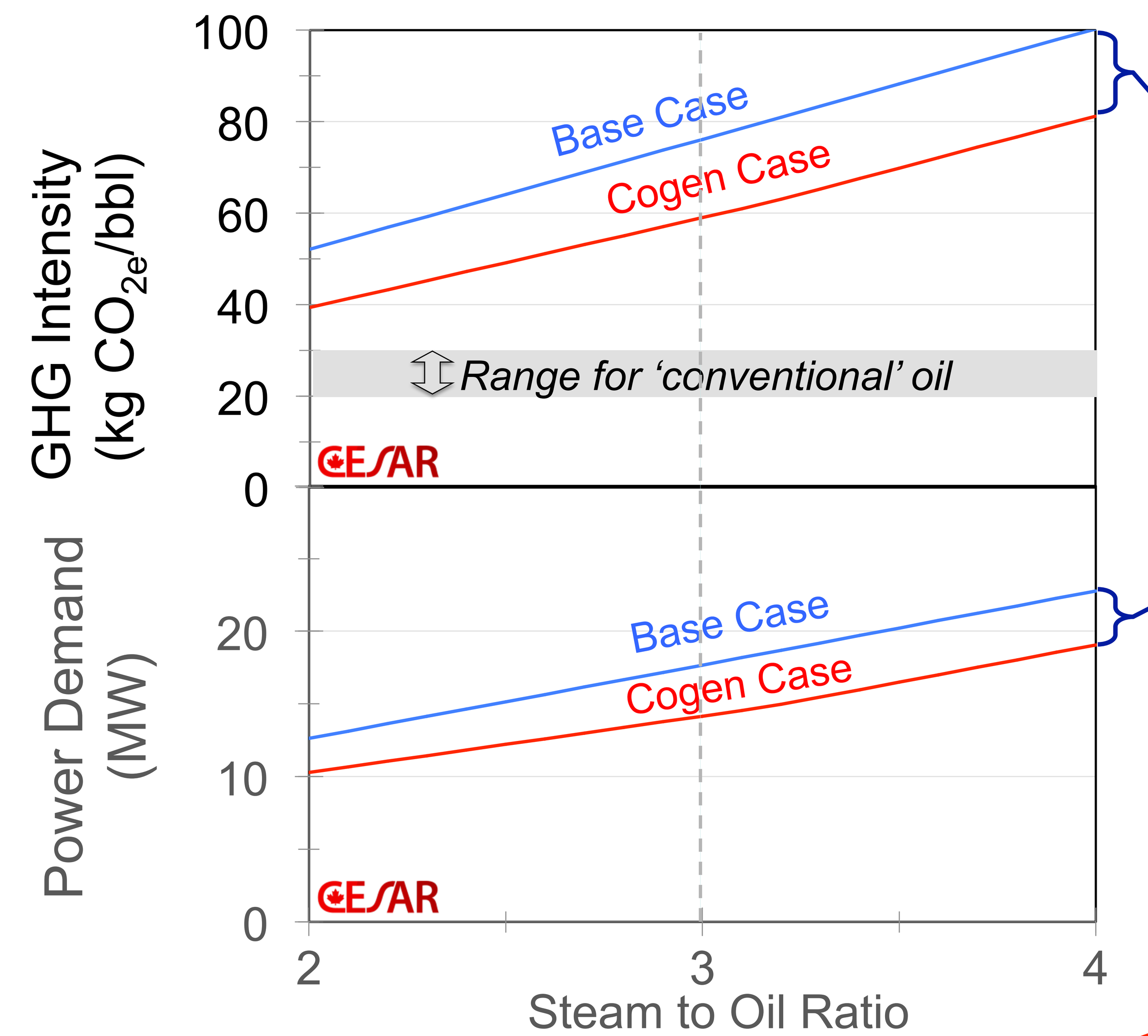
Fig. 2. Process flow diagrams for the two case studies

RESULTS

Fig. 3. GHG Intensity of Oil Sands Crude

- *Includes emissions associated with steam + electricity needs for SAGD*

Fig. 4. Power Demand for SAGD Operations



NOTE:

- With cogen, the GHG intensity of oil production was ~20% lower.
- In the Base Case, fans needed for OTSG increase the power requirements
- Both cases produce same amount of oil and power.
- Total Energy input is 16.5% lower with Cogen
- Total GHG emissions (SAGD +power) are by 2,000 t/d lower with Cogen
- Conversion losses are 28.6% lower in the Cogen Case

Fig. 5. Comparison: Cogen Case vs. Base Case

Two 85 MW_e GT (100% Load) on 33kb/d SAGD Facility

Equivalent Crude & Grid Power Output without Cogeneration

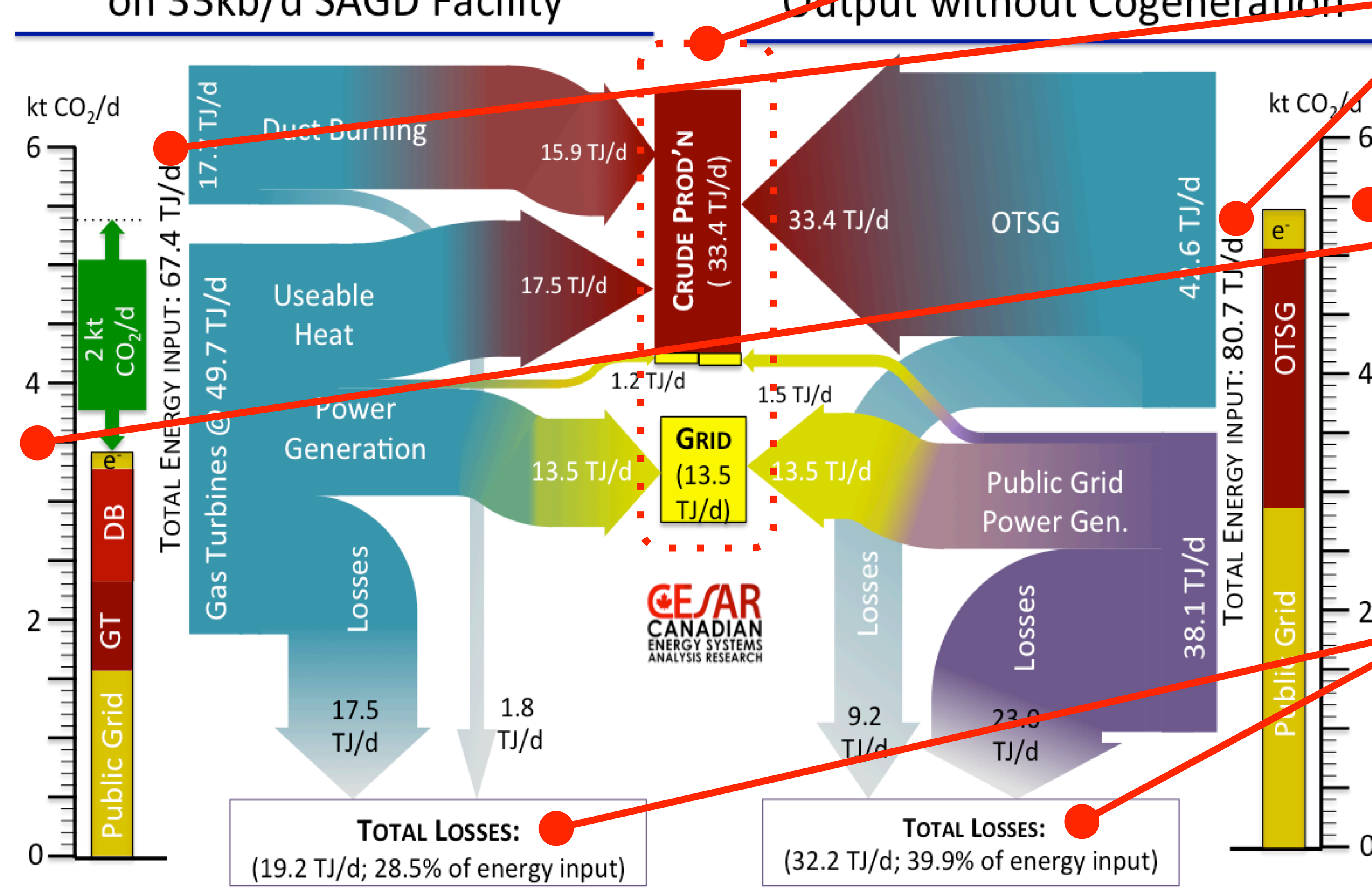
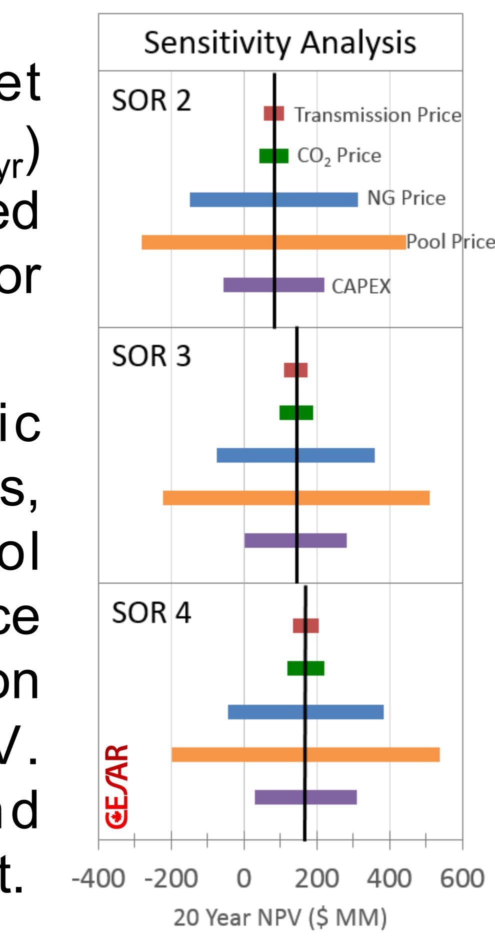


Fig. 6. Economic Sensitivity Analysis

Cogen's incremental net present value ($NPV_{10\%,\ 20\ yr}$) over the Base Case ranged from \$82MM - \$170MM for SORs from 2 to 4.

Of five major economic parameters, the capital costs, (CAPEX), electricity pool price and natural gas price had the greatest impact on the incremental NPV. Transmission price and carbon price had less impact.



CONCLUSION

Cogeneration is a commercial technology with multiple equipment suppliers and engineering service companies. If deployed on SAGD facilities at the scale described here, it could provide all the heat and power needs for SAGD plus export ~150 MW to the electrical grid.

In the process, SAGD Cogeneration would reduce GHG emissions by ~2,000 t CO_2/d for a typical 33,000 bbl/day facility, and potentially generate a positive return on investment (@ SOR of 3, NPV is \$140M).

This technology has the potential to contribute to Alberta' and Canada's climate change policies. To explore this opportunity further, these case study models were incorporated into province-wide scenario models as reported elsewhere (Ref [2]).

REFERENCES

[1] Layzell DB, Shewchuk E, Sit SP, Klein, M. 2016. Cogeneration options for a 33,000 BPD SAGD facility: Greenhouse gas and economic implications. CESAR Scenarios Vol. 1, Issue 3: 1-54.

[2] Layzell DB, Narendran M, Shewchuk E, Sit SP. 2016. SAGD Cogeneration: Reducing the carbon footprint of oilsands production and the Alberta grid. CESAR Scenarios Vol. 1, Issue 4: 1-36

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