## New High Efficiency Industrial Gas Boiler

**SOLUTION DESCRIPTION:**
New steam generator technologies to replace existing steam generators in the existing process configuration

**CREATED:** October 8, 2014
All projects are evaluated and actioned as they are received.

**CHALLENGE SPONSOR:**
COSIA’s GHG EPA is sponsoring this challenge.
Our aspiration is to **produce our oil with lower greenhouse gas emissions than other sources of oil.**

COSIA has four Environmental Priority Areas (EPAs): Water, Land, Tailings, and Greenhouse Gases (GHGs).

For more information on this COSIA Challenge please visit [www.cosia.ca](http://www.cosia.ca)

---

Canada’s Oil Sands Innovation Alliance (COSIA) accelerates the pace of environmental performance improvement in Canada’s oil sands through collaborative action and innovation. COSIA Members represent more than 90 per cent of oil sands production. We bring together innovators and leading thinkers from industry, government, academia and the wider public to identify and advance new transformative technologies. Challenges are one way we articulate an actionable innovation need, bringing global innovation capacity to bear on global environmental challenges.
WHAT TO SUBMIT TO COSIA
COSIA requires sufficient non-confidential, non-proprietary information to properly evaluate the technology.

Some items that will be especially important to present in your submission are:

• Concept and basic unit operations
• Technical justification for the approach (e.g. laboratory batch or continuous experiments; pilot or demo plants; process modeling; literature precedent)
• Describe quantities and qualities of utilities and consumables that are required
• Energy inputs – quantity and type(s)
• Capital and operating cost estimates if available based on described capacity targets
• 3rd party verified comparison of your proposed technology against an MEA baseline. 3rd party verifiers should be reputable, independent engineering companies if possible
• Basis of cost estimation, including estimation scope, contingency, etc.
• IP status of your proposed technology
• What operating environment restrictions might your technology face:
  – Explosive atmospheres
  – Severe weather
  – Power fluctuations

FUNDING, FINANCIALS, AND INTELLECTUAL PROPERTY
COSIA Members are committed to identifying emerging technologies and funding the development of the technologies to the point of commercialization, while protecting the Intellectual Property (IP) rights of the owner of the technology.

Successful proposals can receive funding from COSIA members to develop and demonstrate the technology in an oil sands application. Multiple technologies may be funded, at the discretion of the Members.

HOW TO SUBMIT TO COSIA

Please note: ETAP is a staged submission process. The initial submission requires only a brief description and limited technical information. Upon review by COSIA, additional information may be requested. Instructions for submission are provided on the ETAP site.

All information provided is non-confidential. COSIA will respond to all submissions.
#0007: New High Efficiency Industrial Gas Boiler

**DETAILED SOLUTION DESCRIPTION**

The COSIA GHG Environmental Priority Area Steering Committee has identified new high efficiency (above ground) industrial gas boilers as a technology which could improve the GHG performance of the oil sands. The GHG EPA SC is interested in new steam generator technologies to replace existing steam generators in the existing process configuration. Proposals based on work that is a proven concept are desired.

The ideal technology(ies) will:

- Dramatically increase the efficiency of a boiler (e.g. >93% on HHV basis)
- Either be commercially available today or deployable in the next 5 years
- Increase efficiency using current levels of water quality (SiO2 < 50 mg/L (minimum, < 25 mg/L desired), Ca/Mg <0.5mg/L, 1,000-8,000 mg/L TDS, >25 mg/L TOC)
- Potentially integrate boilers with waste heat utilization for electricity production or other purposes
- Novel configurations could also be considered, including steam generation in the well.
- NOx emissions comparable or lower than existing boilers/burners
- Steam quality and pressure is comparable to existing Once Thru Steam Generators used by Oil Sands producers

**BACKGROUND**

The current boiler technology applied in an oil sands operation for in-situ Steam Assisted Gravity Drainage (SAGD) or Cyclic Steam Stimulation facility is a once-through steam generator (OTSG). A typical 33,000 barrel per day SAGD facility would operate six steam boilers requiring 1600 GJ/hr (LHV) of combined heat input with radiation losses of 32 GJ/hr and stack losses of 100 GJ/hr. Approximately 95% of the GHG emissions associated with an in-situ facility are from the combustion of natural gas for the production of steam.

Because of the high solids content of the boiler feed water, once thru steam generators (OTSG’s) are preferred over drum boilers.

Note that some COSIA members are already investigating or advancing the following:

- Boilers in Series
- Rifle Tubes
- Direct Contact Steam Generation

Current water treatment technology leaves boilers vulnerable to fouling and scaling, which leads loss of efficiency, tube failures and downtime for cleaning and repairing.

**APPROACHES NOT OF INTEREST**

**ADDITIONAL INFORMATION**
**Glycol Air Cooler**

125 GJ/h

**Diluent**

**Total Air Cooler Heat Released to Atmosphere**

Glycol Return 50 °C 5.8 °C

71 °C 40 °C Produced Gas Cooler

(Received to ambient air)

**Emulsion / BFW Exchanger Sales Oil Coolers**

Emulsion 137 GJ/h 43.9 GJ/h

**Dilbit**

**PADS**

175 °C 133 °C Oil Treating 131 °C 50 °C Process to Process

106 °C Hot Glycol

144 °C Produced Water Cooler Cold Glycol

**Reservoir**

**Make-up Water Heater Exchangers Duty**

22 GJ/h GJ/h

**Make-up Water**

Emulsion / BFW 136.9

**Blowdown Glycol Cooler**

84.5

**De-Oiling / Water Treatment PW / MU water exchanger**

Produced Gas Air Cooler (s) 3.5

Air Glycol Heater 2

Diluent Glcyol Heater 4.4

BFW 82 °C 13 GJ/h Sales Oil Coolers 43.9

55 °C Make-up Water Glycol Heater 21.8

PW / MU water exchanger 18.1

Blowdown Cooler

Air 20 °C Fan 33 °C

**Glycol Air Cooler**

124.7 (based on 5°C Ground Temp) 79.3 GJ/h 5 °C

**Stack Losses**

BFW Preheaters 86.7

32.1 GJ/hr

**OTSG Air Glycol Heaters (two services)** 22.7

BD Water to Disposal

80 °C Air Glycol Preheater 195 °C (LHV basis) OTSG Air Preheater (Flue Gas) N/A

Water Heat to Earth

80 °C 9.16 GJ/h

**FORCED DRAFT FAN UTILITY COOLERS**

20 GJ/hr

**Blowdown Cooler**

**Glycol System 0.4 2.5**

**Total 17.9 117.3 220 °C**

**Direct CO2 Generation**

MT/day 417.6 kg/m3 Bitumen

**Indirect CO2 Generation** MT/day 62.5 kg/m3 Bitumen

**Total CO2 Emissions** MT/day kg/m3 Bitumen

Assumes electricity grid CO2 emissivity of 763 kg CO2eq / MW-hr

**Electrical Loads**

<table>
<thead>
<tr>
<th>Power (MW)</th>
<th>Equivalent Heat (GJ/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>170 kW</td>
<td>1.8</td>
</tr>
<tr>
<td>860 kW</td>
<td>11.4</td>
</tr>
</tbody>
</table>

**Inputs Energy**

HP BFW Pump

Natural Gas 1538

Electrical Power 117.3

Produced Gas 51.1 °C

40 °C 63 GJ/h (LHV)

Total 1655

30 GJ/hr (LHV)
This is a generic and hypothetical mine and extraction facility developed by COSIA. While representative, it is not based on any one facility. Recovery and solvent loss is based on Alberta Energy Regulator requirements.
This is a generic and hypothetical mine and extraction facility developed by COSIA. While representative, it is not based on any one facility. Recovery and solvent loss is based on Alberta Energy Regulator requirements.
This is a generic and hypothetical mine and extraction facility developed by COSIA. While representative, it is not based on any one facility. Recovery and solvent loss is based on Alberta Energy Regulator requirements.
This is a generic and hypothetical mine and extraction facility developed by COSIA. While representative, it is not based on any one facility. Recovery and solvent loss is based on Alberta Energy Regulator requirements.