Association of Professional Engineers, Geologists and Geophysicists of Alberta
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Coal Gasification and CO_2 Capture

How feasible? How soon?

Dr. David Lewin
EPCOR Senior Vice President, IGCC Development
Chair, Canadian Clean Power Coalition

- Investments in Canada and the United States
- Responsible for operating power generation with gross capacity of > 3,400 MW
- Owns 30.6 per cent of EPCOR Power L.P., Canada's largest power income fund
- 35% of EPCOR-operated facilities generate power from renewable sources – wind, small hydro, biomass, landfill gas; and waste heat recovery / recycled energy

Canada's abundant coal supply

Alberta's supply of coal contains twice the energy of its conventional crude, natural gas, and bitumen combined.

- Coal is, by far, the most abundant fossil fuel in Canada representing 66% of energy reserves.
- This vast reserve, used at current rates, will last for many centuries.
- Approximately one-fifth of Canada's electricity is generated from coal – more than any other fossil fuel.
- Alberta, Saskatchewan and Nova Scotia all depend on coal for 70% of their energy needs; coal supplies 23% of Ontario's net generation
- In power generation, the quality, characteristics, and performance of coal varies considerably from region to region. There is no one size fits all.

Coal Gasification: *Why?*

Public policy directions are making the paradigm shift to IGCC and CO_2 capture technologies imperative.

Canada

- Federal Regulatory Framework for Air Emissions mandates greenhouse gas reductions – 20% by 2020, and 50% by 2050.
- Proposed GHG regulations to be published later this year; finalized in 2009 for implementation January 1, 2010.

Alberta

- Provincial regulation on air emissions of NOx, SOx, PM and now HG have tightened over the past few years.
- Alberta's CO_2 reduction targets begin with 2% per year reduction in 2010 to a total of 12% by 2015.

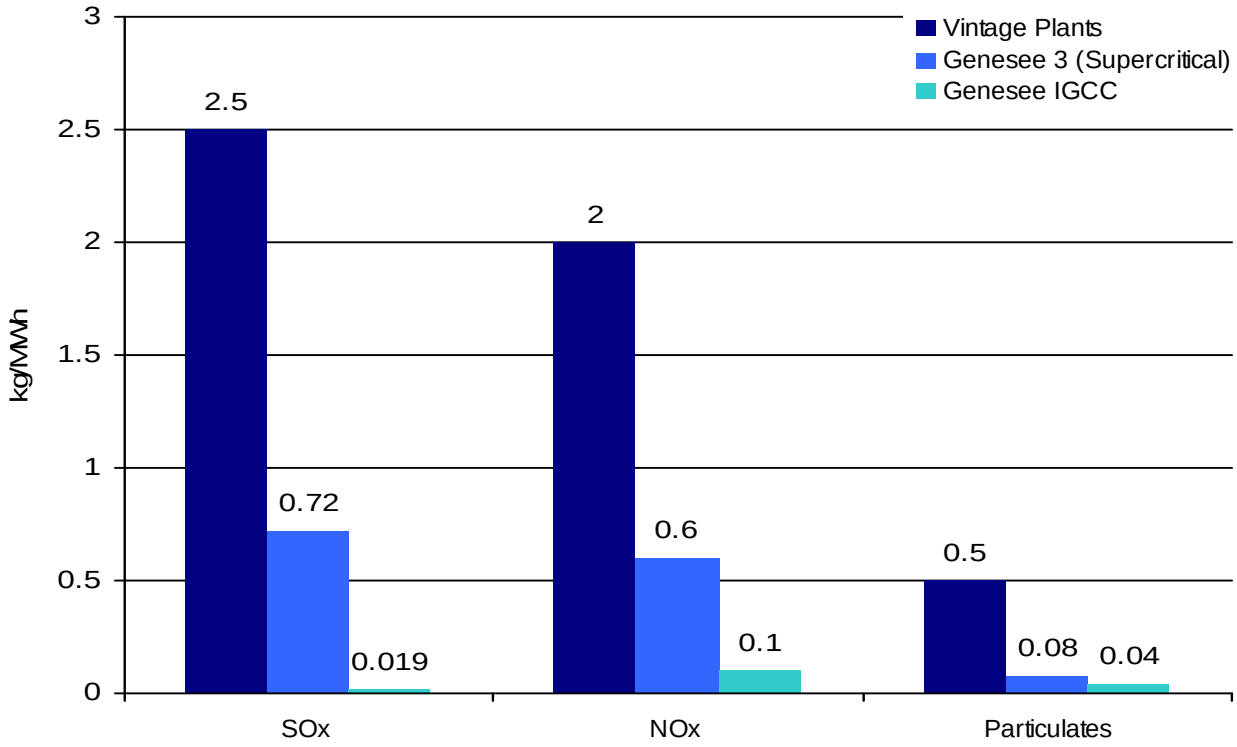
Coal Gasification: *Why?*

An IGCC plant would be many times cleaner than vintage coal-fired plants and the best natural gas facility operating today.

- The gasification process virtually eliminates smog-related air emissions, and captures carbon dioxide – a greenhouse gas.
- Compared to supercritical coal-fired facilities, IGCC technology has the potential to further lower NO_x, particulate matter, and SO_2 by 99.25%.
- The IGCC process requires about one-third less water than a pulverized coal plant.
- An IGCC plant could allow for a relatively pure CO_2 stream available for Enhanced Oil Recovery, perhaps in Alberta's Pembina Oil Fields.
- The gasfication process also creates hydrogen – a potential fuel for the future – and other chemical products such as ethanol, fertilizers, and substitutes for natural gas.

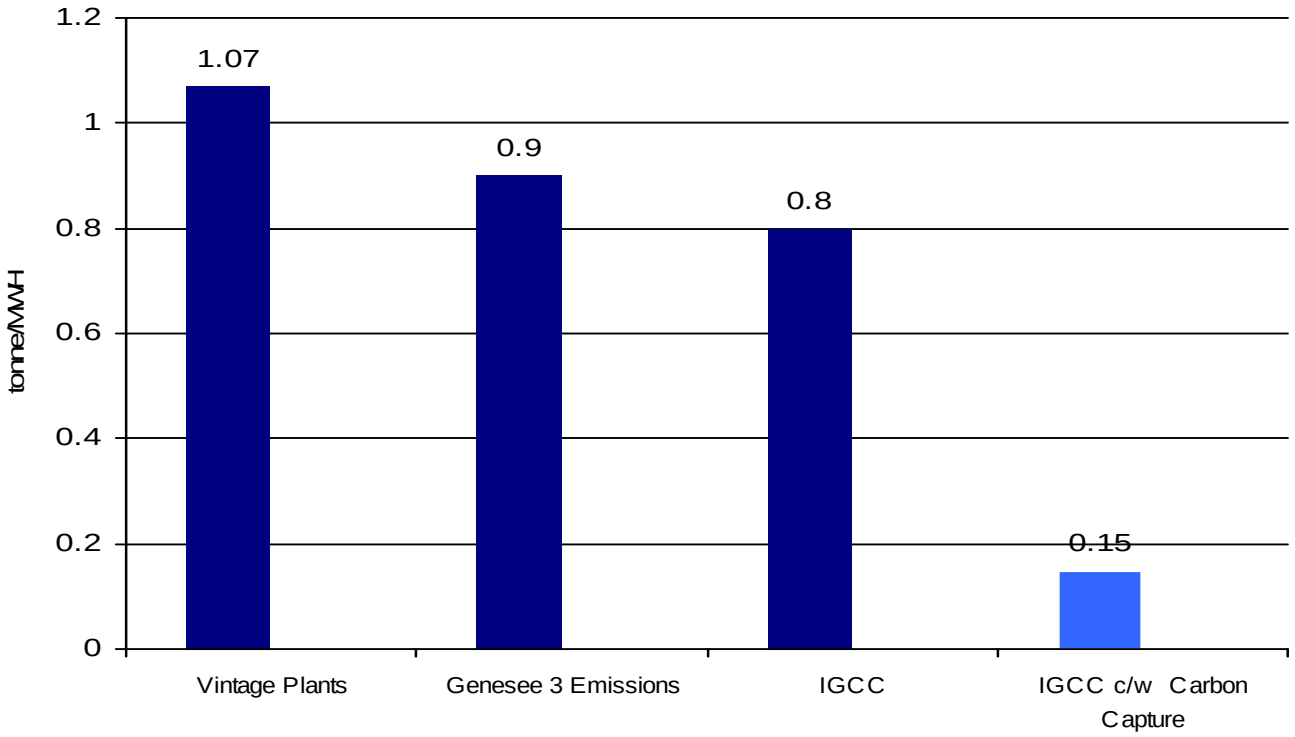
Create step-change improvements in emissions

Clean coal technology leads to real air quality improvement by reducing smog-related emissions.



Reducing Canada's greenhouse gas emissions

Through supercritical technology and offsets, CO_2 emissions from new coal are already being reduced.



Coal Gasification: *What?*

IGCC faces several challenges that could impact broad commercialization of the technology in the mid-term.

- **Cost.** Capital costs are projected to be substantially higher than conventional pulverized coal plants, and up to $6,000 per kilowatt (not including CO_2 capture).
- **Technology performance**. A number of technological considerations and challenges remain. Most research, demonstration based on bituminous coal.
- **Carbon capture and storage (CCS).** The ability to capture CO_2 is the largest underlying driver of IGCC technology. Final overall cost of any IGCC project cannot be determined without resolution of transportation and sequestration issues.
- **Carbon policy.** Additional clarity concerning the development of new carbon emissions policy is required.

Coal Gasification: *What?*

Costs for an IGCC plant cannot be determined without resolving critical CO_2 transportation and sequestration issues.

- Carbon capture and storage (CCS) represents a range of technologies that reduce emissions and / or enable CO_2 to be captured and effectively stored rather than released into the atmosphere.
- It is made-up of three distinct steps – capture, transportation, storage.
- Central limitation is that there is no full-scale power plant in operation anywhere in the world that captures and stores CO_2.
- Development of CCS technology is dependent upon availability of sites for sequestration and supporting infrastructure, in addition to well defined legal and regulatory frameworks. This is in its very early stages.

Coal Gasification: *How?*

Genesee IGCC Project

Commercialization of a 270 (net) MW facility expected to take place over three phases with a total requirement of $33 million, following which a consortium of investors would be in a position to make a decision on building a utility-scale pilot plant.

To facilitate the timeline, in 2006, EPCOR and the Alberta Energy Research Institute committed $11 million each to the project so it could proceed expeditiously. Natural Resources Canada provided the remaining $11 million in October 2007.

CANADIAN CLEAN POWER COALITION

EPCOR, Sherritt International, Nova Scotia Power, SaskPower, TransAlta, Alberta Energy Research Institute (AERI), Electric Power Research Institute (California), Basin Electric Power Cooperative (North Dakota)

Coal Gasification: *How?*

Genesee IGCC Project

Phase I	Technology Selection and Project Definition, 2006 – 2007
Phase II	Front-End Engineering Design, 2008 – 2009 (Genesee site)
Phase III	Regulatory Environmental Permitting for Construction leads to a decision to build an IGCC facility in Alberta, 2010 – 2015

Coal Gasification: *How?*

Phase II Update – technology vendor, new milestone

- Siemens AG of Germany will licence its SFG-500 coal gasifier technology to the FEED project.
- If subsequent investment and construction decisions go as planned, a 270-megawatt (net) generating station would be targeted to commence operations in 2015.
- Siemens has operated gasification technologies for more than 20 years, using a wide variety of energy sources as feedstocks for the conversion process.
- An RFP for an Integrated Gasification Combined Cycle power plant was issued in December 2008; decision to be rendered in April 2009.

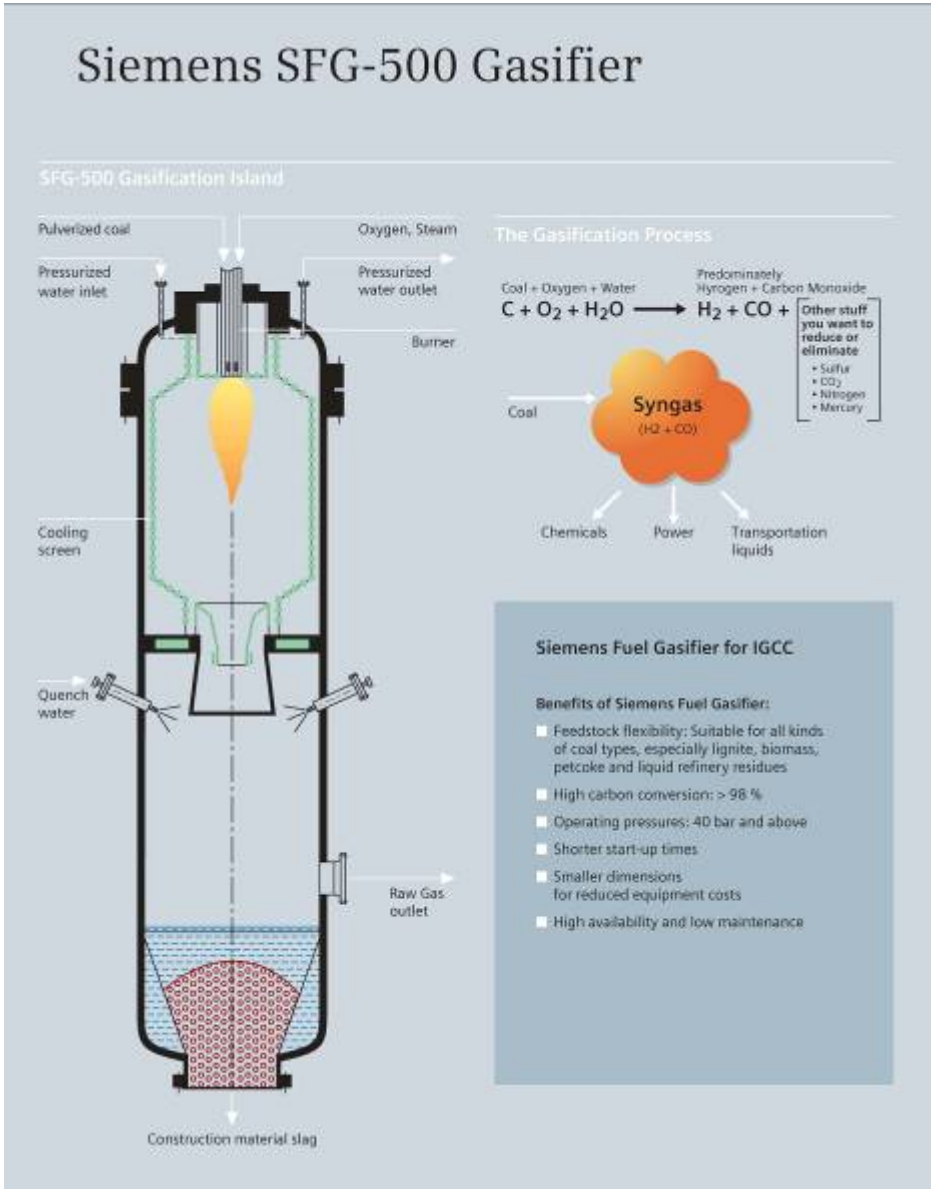
Technology:
IGCC and Gasification

Integrated Gasification Combined Cycle, or IGCC, combines two technologies – coal gasification and combined cycle.

With IGCC, impurities are removed before the syngas is burned in a gas turbine to produce power.

Waste heat from the turbine – and other process sources – are used to produce steam, which powers a steam turbine for electricity production.

This differs from conventional power plants where coal is crushed, fed into a boiler, and then burned.



Coal Gasification: *How?*

Removing technical barriers.

- When complete in 2009, Genesee IGCC front-end engineering and design work will define best technological path forward for Alberta.
- Priority must be placed on demonstrating CO_2 capture for pre- and post-combustion.
- Alberta Carbon Capture and Storage Development Council suggests a blueprint to advance CCS must include – a robust framework, clear regulatory framework, and comprehensive R&D and technology development program.
- On a macro level, a diverse, economy-wide approach needed to address challenge of meeting future energy requirements within a carbon constrained environment.

Coal Gasification: *How?*

Removing cost / risk barriers through public policy.

- Government and industry must find a path that mitigates carbon emissions yet continues to utilize coal to meet urgent energy needs.
- Successful commercialization of gasification technology requires meaningful dialogue with investors, customers, taxpayers about the cost of generating cleaner power. Costs and risks should be allocated between the three – no one source can bear all. If society desires zero-emission power, then society will need to pay for it.
- Government support will be needed for demonstration projects and R&D programs; given technical uncertainty and the absence of a carbon charge (in the U.S.), there is no economic incentive for private sector to undertake.
- Alberta Government $2 billion fund for CCS projects with a goal to sequester 5 million tonnes of CO_2 annually by 2015.
- Canadian Government's 2009 Budget provides $1 billion over five years to support clean energy technologies. Of this, $850 million directed toward development and demonstration of promising technologies, including large-scale carbon capture and storage projects.

Coal Gasification: *Progress*

- Genesee IGCC FEED project – milestone reached on potentially "world-first" project; Siemens selected as technology vendor
- Alberta Governments commits to further technology with $2 billion in funding for CCS projects.
  - two EPCOR projects advance to next stage for funding consideration; Genesee IGCC and amine scrubbing
- Government and the public are demanding change – it's up to industry, academia and governments to work together to move from rhetoric to results.