

A Clean energy future

A complete copy of AERI's
Strategic Research Plan
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Alberta Energy Research Institute's
Sustainable Energy Strategy

Alberta will become the premier energy provider in North America.

Premier Ralph Klein

ALBERTA IS ABOUT ENERGY

Alberta is home to an abundance of natural energy resources. The energy industry creates jobs and wealth for Albertans and Canadians alike, and is an important driver for developing knowledge based industries and economic diversification.

Since the discovery of the Leduc oilfield in 1947, oil and natural gas have powered the Alberta economy. In 2001, provincial oil and natural gas exports alone generated \$33 billion in revenue.

However, the energy industry faces an enormous and complex challenge as it shifts to developing sustainable, clean energy. This is a time of increasing constraints on water use, atmospheric pollution and greenhouse gas emissions. There is also a growing concern over energy security, declining conventional resources and volatile prices.

Greenhouse gases, such as carbon dioxide (CO₂), are emitted during the production and burning of coal, oil and natural gas. The Kyoto Protocol, an international treaty on climate change, is calling for major reductions on these emissions.

Alberta needs new energy technologies to do its part to reduce emissions and develop its abundant oil sands, coal and coal bed methane resources. And if something is not done soon, the impact on the provincial economy will be severe.

The challenge Alberta faces is maintaining energy as an engine of economic growth while, at the same time, protecting the environment. That means the province must look for ways to:

- Make the most of abundant coal resources by developing clean coal technologies.
- Increase recovery of conventional oil reserves by using CO₂.
- Reduce energy required to produce better quality of synthetic crude oil from Alberta's oil sands.
- Reduce the intensity of greenhouse gases and other emissions.
- Develop new sources of energy, such as natural gas from coal beds.

Alberta will meet this challenge by continuing to invest in research and development, and working together with industry, universities and other governments. Alberta has successfully done this in the past and will continue to do so, now and in the future.

WASTE NOT WANT NOT

Sustainability and environmental protection are part of Alberta's heritage. Pioneering Albertans had no choice but to be self-sufficient. They achieved that goal through ingenuity and using the resources at hand. Animal fat and ashes became soap. Clay and straw provided insulation. Wells doubled as refrigerators. Nothing was wasted.

And this innovative tradition has continued in the province.

In 1976, the Alberta Oil Sands Technology and Research Authority was formed with the vision of unlocking the secrets of the oil sands for the benefit of Albertans. Today, almost 50 per cent of Alberta's oil comes from oil sands – providing employment and economic opportunities throughout the country.

This same vision must now be applied to all of Alberta's energy resources – to unlock their potential and provide a sustainable future – economically, environmentally and socially – for generations of Albertans to come.

Alberta will only realize its goal of becoming the premier energy provider in North America by investing in research and developing new technology to allow the province to make the most of its current resources and explore new sources of energy.

The Government of Alberta, through the Alberta Energy Research Institute's (AERI) Strategic Research Plan, will play an integral role. This document outlines AERI's long-term plan for economic and environmental prosperity.

A WEALTH OF ENERGY RESOURCES

Alberta is the world's single greatest repository of hydrocarbon resources. The province has coal resources that will last for several centuries, 75 per cent of the world's oil sands resources, and natural gas to heat Alberta homes and provide clean hydrogen for the rest of this century. These resources are found throughout the province, from Medicine Hat to Fort McMurray, from Lloydminster to the B.C. border.

Alberta is also rich in agriculture and forestry resources, which will contribute to the renewable, environmentally responsible energy industry of the future.

THE STRATEGY

Oil, gas, coal, power, and petrochemicals have traditionally been viewed separately. Today, these sectors need to work together as a single, integrated industry focused on clean energy products and services.

All sectors of the energy industry must have the same vision: efficient use of Alberta's energy resources and a commitment to environmental protection. Realizing this vision requires research and technology development in the following areas:

- Managing CO₂ and other emissions by developing technology to capture, transport, and use CO₂ to increase oil and gas recovery, and to inject into coal beds to release methane.
- Burning coal cleanly to generate electricity; using coal and other feedstocks to produce steam, hydrogen (for oil sands upgrading and fuel cells); and capturing concentrated CO₂ streams for enhanced oil and gas recovery.

- Increasing the value of bitumen through oil sands upgrading technology to produce new products customized for North American refineries.
- Moving from a hydrocarbon to a hydrogen economy.
- Developing alternate sources of clean energy, including bioenergy.

CARBON DIOXIDE MANAGEMENT

Producing energy creates CO₂ emissions, which have been associated with climate change. However, it is possible to use these emissions as a resource. A concentrated CO₂ waste stream could be used to help extend the life of Alberta's conventional oil and gas reserves. It could also be used to release natural gas trapped in deep coal beds, which could replace Alberta's rapidly depleting reserves of conventional natural gas.

CLEAN COAL

Alberta has 620 billion tonnes of recoverable coal. About 26 million tonnes are used every year to generate more than 70 per cent of Alberta's electricity. To realize the full potential of Alberta's coal reserves, the province must develop new technology allowing coal to burn as cleanly as natural gas, while capturing CO₂.

AERI will continue to support research in this area, in order to:

- reduce emissions
- provide an abundance of low-cost electricity
- free up natural gas for other uses
- allow coal to be used for generating value-added products, such as hydrogen, petrochemicals and steam

INCREASING OIL RECOVERY

Production from Alberta's conventional oil reserves is declining, and the province needs to find ways to ensure the sustainability of this resource.

Current oil production technology only recovers about 30 per cent of the oil in the ground. This means there are billions of barrels of oil that aren't being used to develop Alberta's economy.

New technology is needed to enhance recovery rates for new and existing oil reservoirs.

This is critical to the provincial economy because every one per cent increase in recovery rates will provide the government with an additional \$5 billion in royalties, which can be used to benefit Albertans.

One potential way of enhancing oil recovery is by injecting CO₂ into new and existing oil reservoirs. Using CO₂ has two distinct environmental benefits. First, it would replace the water currently used to flush oil reservoirs. Second, it would trap CO₂ in the reservoir, reducing the amount released into the atmosphere.

AERI will continue to work with the energy industry to coordinate an enhanced oil and gas recovery program, and develop strategies to manage CO₂ and use coal bed methane.

SUSTAINING OIL SANDS DEVELOPMENT

Alberta's oil sands contain an estimated 1.63 trillion barrels of bitumen – about the size of the oil reserves in the Middle East. Further development of the oil sands poses several challenges to long-term sustainability.

Expanding the Market

Many North American oil refineries cannot easily accept synthetic crude produced from bitumen because of its high aromatic and sulphur content. Research is urgently needed to increase the amount of synthetic crude accepted by such refineries. This is critical, since bitumen and synthetic oil production are expected to triple in the next 15 years.

AERI will fund research into less energy intensive upgrading processes and will support the development of customized synthetic products to increase the value of synthetic crude.

Reducing Energy and Water Consumption

Sustainable oil sands production requires reducing the amount of energy and water it takes to mine, produce and upgrade bitumen, as well as developing more effective methods for water and tailings management.

AERI will continue to work with the Canadian Oil Sands Network for Research and Development (CONRAD) to develop less energy-intensive in situ and extraction processes, as well as methods for reducing water use and improving the management of tailings.

Reducing Natural Gas Consumption

Natural gas is currently the major fuel used to upgrade bitumen, but conventional resources are declining.

During the next 25 years, Alberta's petrochemical industry will undergo a major transition, as supplies of natural gas

liquids, used as feedstock, gradually decline, but petrochemical demand increases.

To enhance the growth of the petrochemical industry, AERI is establishing programs to produce petrochemical feedstocks from low-cost energy resources such as coal, coke and bitumen.

ALTERNATIVE ENERGY DEVELOPMENT

To maintain its position as a global leader in the energy industry, Alberta monitors and participates in new energy technology developments.

AERI's interests in alternate energy relate to:

- hydrogen
- fuel cells
- bioenergy

New renewable energy technologies are being developed around the world. Alberta has the natural resources and agricultural base to take full advantage of new developments in bioenergy fuels, and wind and solar energy.

AERI will continue to work with the renewable and alternative energy industries to help them meet their research priorities.

ALBERTA'S HYDROGEN ADVANTAGE

Hydrogen will likely be a preferred fuel in Alberta by 2050, due to sustainability and environmental issues.

Natural gas is now used to produce most hydrogen. In Western Canada, hydrogen is used mainly in oil upgrading and refining. To remain a premier energy provider, Alberta must participate in research leading to the large-scale production, transportation and handling of hydrogen.

Fuel Cell Technology

Fuel cells are a rapidly growing market (two fuel cell manufacturers are currently located in Alberta), and AERI has identified the technology needs of this industry and what is required to spur its growth.

As part of its integrated research strategy, AERI is developing a Fuel Cells Research Strategy for Alberta to assist in research related to fuel cells and hydrogen.

Developing fuel cells and alternative forms of generating electricity will create a full range of energy suppliers who will be able to produce power for the provincial grid.

SUMMARY

The world of energy is changing, and Alberta has the drive and the resources to turn this change into opportunity. AERI's vision is to help Alberta become the premier energy provider in North America.

To achieve this, and to develop an integrated industry that provides clean energy for Albertans and Canadians, requires continued investment in energy research and further commitment from industry and government. By working with its partners, AERI will be able to leverage investments and create benefits not only for Alberta, but for the entire country as well.

Alberta successfully unlocked the mystery of the oil sands – now the province will find the keys to unlock the clean energy sources of the future.

DEFINITIONS

Biomass: Plant material or vegetation that can be converted to useful fuel and is considered a potential source of energy.

Bioenergy: Biomass that is converted into electric power.

Conventional Oil: Oil that flows naturally or is capable of being pumped without further processing or dilution.

Heavy Oil: Oil that is thick and does not flow well, requiring specialized recovery, dilution and upgrading processes that allow it to be transported and refined.

Feedstock: Any material that is converted to another form or product. In the energy context, it generally refers to energy used for non-fuel purposes e.g. using ethane to manufacture ethylene.

Coke: Heavy residue, mainly in the form of carbon, from oil upgrading and refining.

Tailings: In an oil sands context, the liquid-solid slurries produced during the extraction of bitumen from oil sands.

In situ: Latin for “in its proper position or place.” Refers to various methods used to recover bitumen, without removing the oil sands from the reservoir.

Bitumen: A thick, sticky form of crude oil that must be heated or diluted before it will flow into a well or through a pipeline. It is sometimes called extra-heavy oil.

Hydrogen Economy: The vision of building an energy infrastructure that uses hydrogen to store and carry energy. Hydrogen is considered to be “clean”, since it only produces water when it is burned or used in a fuel cell.

Fuel Cell: A device that generates electricity by combining hydrogen and oxygen.