SARNIA·LAMBTON
Economic Partnership

Powering a Sustainable World®

SARNIA-LAMBTON

SARNIA-LAMBTON SUSTAINABLE ENERGY CLUSTER

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Past, Present, Future

For over a century Sarnia-Lambton, Ontario, Canada, has been at the centre of Canada's energy industry and a major contributor to North American production of petroleum and petrochemical products, electricity generation, plastics, synthetic rubber and chemicals.

Recognizing the need to move away from fossil fuel-based feedstocks to renewable sources and the opportunities this presented in southwestern Ontario, in 2004 a regional initiative was implemented to develop and grow the Sarnia-Lambton Hybrid Chemistry Cluster, merging the hydro-carbon based and industrial bio based economies. Ten years later, by bringing together the depth of manufacturing experience in the area and the availability of agricultural products, the community is emerging as the leading Canadian location for the commercialization and production of renewable chemicals, fuels and industrial bio products.

The regional strategy underway to build on the local energy infrastructure and knowledge base to develop the Sarnia-Lambton Sustainable Energy Cluster has the goal of becoming a leading North American centre of excellence for sustainable power generation, energy storage and alternative energy technologies.

Collaborative partners include Bluewater Power, TransAlta Energy, the Sarnia-Lambton Economic Partnership, Enbridge Energy, Union Gas, Lambton College and the Western Sarnia-Lambton Research Park.

In terms of innovation, Sarnia-Lambton has a long tradition of leadership in the advancement of energy technologies.

The area has the infrastructure and workforce to host demonstration projects, produce components, complete scale up and final commercialization.

In 1973, Dow Chemical replaced a coal-fired high pressure steam generation system serving its Sarnia petrochemical complex with a 165 MW combined cycle system. This project represented the first combined cycle cogeneration plant in Sarnia. The Dow power plant also demonstrated the ability of a cogeneration system to island and maintain electrical supply during gird failure, allowing the continued operation of the complex. TransAlta Energy now owns the former Dow assets, which were expanded to form the Sarnia Regional Cogeneration Plant in 2002. With a capacity of 506 MW, the TransAlta facility is the largest cogeneration plant in Canada, supplying four industrial customers, and with land and capacity in their Bluewater Energy Park available to supply others.

New investment in electricity generation continues. Since 2008, over 1600 MW of new gas fired generation have come on stream in the community. As of March 2014, Eastern Power is in the process of building the 300 MW Greenfield South Power Project.

Renewable Energy in Sarnia-Lambton

Ontario is the first jurisdiction in North America to close all of its coal-fired generating facilities, and is one of the leading North American jurisdictions in the generation of renewable energy. Sarnia-Lambton is playing a leading role. The region is home to one of the largest solar projects in North America, the Enbridge/First Solar 80 MW farm in Sarnia. To meet provincial targets approximately 3,000 MW of solar PV is needed in the province by 2018.

Two large wind energy projects are currently in development: Suncor Energy, Cedar Point Wind Power Project (100 MW), Township of Plympton-Wyoming; and NextEra Energy's Jericho Energy Centre (150 MW), Municipality of Lambton Shores. Ontario is expected to install more than 5,600 MW of new wind energy capacity by 2018.

Sarnia-Lambton renewable energy projects

Sky Generation
Proof Line Wind Farm
Lambton Shores
6.6 MW Capacity

Sky Generation
Ravenswood Wind Farm
Lambton Shores
9.9 MW Capacity

Enbridge Inc. / First Solar
Sarnia Solar Project
City of Sarnia
80 MW Capacity

NextEra Energy Canada
Moore Solar Farm
Township of St. Clair
20 MW Capacity

NextEra Energy Canada
Sombra Solar Energy Centre
Township of St. Clair
20 MW Capacity

Bluewater Power Generation Corporation
Sarnia Landfill Facility
City of Sarnia
1.6 MW Capacity
Landfill to energy

Waste Management / Bluewater Power Generation Corporation
Petrolia Landfill Facility
Town of Petrolia
2.4 MW Capacity
Landfill to energy

Waste Management / Twin Creeks Landfill
Township of Warwick
Ontario's second largest landfill site with 750,000 tonnes per year, with a life expectancy of 35 years. It represents a unique opportunity for future low-cost energy from methane gas

Transmission

Lambton transmission lines

When it comes to the reliable transmission and delivery of electricity, the region has the required infrastructure. Sarnia-Lambton is serviced extensively by a high voltage transmission system, at a voltage level of 230 Kilovolts (kV), that is part of the provincial transmission grid, owned and operated by Hydro One as a regulated system. Six 230 kV lines service the region. Hydro One is in the process of completing a significant upgrade to the Lambton to Longwood Transmission Line, which will increase transfer capability and enable the connection of additional renewable generation to the provincial transmission grid. The project will be completed in 2014.

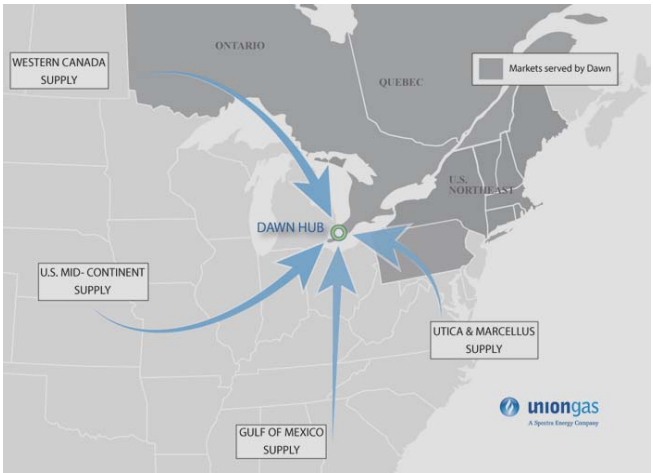
The ability to export power to the United States is available, as Hydro One maintains three 230 kV circuit ties with DTE Energy in the State of Michigan.

Natural Gas – the Abundant and Cleaner Fossil Fuel

The North American shale gas phenomenon continues to alter the dynamics of the continental energy sector.

In Sarnia-Lambton, the necessary assets are in place to capture the benefits of this abundant, affordable and cleaner fossil fuel and natural gas liquids.

Union Gas, a business unit of Spectra Energy, operates the Dawn Hub, located 35 kilometres southeast of Sarnia. With 155 billion cubic feet of high deliverability storage, the Dawn Hub is the largest integrated natural gas storage facility in Canada and one of the largest in North America. It is a world class natural gas trading hub. The hub is part of the North American integrated natural gas system and is serviced by multiple pipelines, making it an important link in the movement of natural gas from Western Canada and U.S. supply basins.



Map source – www.uniongas.com

Enbridge's Tecumseh Gas Storage, which has an additional capacity of approximately 112 billion cubic feet, is located in close proximity to the Dawn Hub.

Large industrial consumers of natural gas in the regional refining and petrochemical complex are well serviced by a series of high and low pressure natural gas main distribution systems supplied from TransCanada Pipelines and from Union Gas.

Hydrogen – the Future is Now

Hydrogen is the emerging energy storage and chemical feedstock of the future; as a transportation fuel, in fuel cell applications, and as a storage medium to improve the utilization of renewable energy sources.

The Sarnia-Lambton Hybrid Chemistry Cluster has a long tradition of producing and utilizing hydrogen.

Air Products' hydrogen plant, located in St. Clair Township, produces over 80 million standard cubic feet per day of hydrogen, while NOVA Chemicals provides the raw hydrogen to a second Air Products facility that manufactures liquid hydrogen fuel. Praxair also supplies industrial customers with hydrogen from its Sarnia plant.

Hydrogen is transported within the regional refining and petrochemical complex by a 30 kilometre pipeline network.

Hydrogen Generation and Fuel Cells In 2007-2008, the Sarnia-Lambton Economic Partnership and Lambton College participated in the Hydrogen Fuel Cell Demonstration Project, where a range of market-ready devices were tried and tested in the community. The two year $1.5 million project received $500,000 in funding through the Ontario Fuel Cell Innovation Program. The community has continued to develop capacity and support for fuel cell technology.

Hydrogen Fuel Cell demonstration project

Lambton College has state-of-the-art equipment and laboratories to carry out applied research projects in hydrogen generation, fuel cell efficiency and applications. Research and development activities extend from materials

science to system development and technology demonstration.

The College has specific interests in the development of advanced materials for fuel cells, fluid dynamics, simulations of fuel cells, and novel designs for microalgae photo-bioreactors with titanium nanotubes for hydrogen generation.

Bluewater Technology Access Centre

The Bluewater Technology Access Centre (BTAC) provides innovation support to companies and organizations in the petrochemical, energy and emerging biochemical sectors within Sarnia-Lambton, while enriching the Lambton College student learning experience. The mission is to provide innovation support and to help attract new companies to the area based on local services, expertise, facilities and resources, while at the same time providing an enhanced practical learning experience for students.

Through the resources available at Lambton College and with its partners, BTAC collaborates with and provides services to companies to achieve goals in the areas of: process design; process integration; modeling; system optimization, control and automation for various sector applications (process manufacturing, waste water treatment, etc.); bio based materials and fuels; renewable energy management; energy storage and conversion; hydrogen for energy storage; and public safety.

Applied Research and Innovation at Lambton College

Lambton College laboratory

Lambton College has implemented a progressive strategy to ensure it remains at the forefront of research innovations and industry developments both locally and globally.

The College also has expanded its in-house research and development capabilities to accelerate the advancement of the regional Sustainable Energy Cluster.

Energy Conversion, Storage and Management
The College has also implemented an innovative program for working with local industry to provide applied research services to small and medium-sized enterprises in the renewable energy sector. The scope of research activities include: prototype development of energy systems; energy management; dynamic optimization and control; and energy storage analysis.

Instrumentation, Process Control and Optimization
In addition to providing trend setting instrumentation and control system training programs to meet the varied needs of local industries, the College is able to offer the use of state-of-the-art laboratories for the development of integrated optimization and control strategies.

Western Sarnia-Lambton Research Park

Western University's Sarnia-Lambton Research Park is a key contributor to the commercialization of alternative energy technologies. The Park is home to the Bowman Centre, which provides client companies with access to over 50,000 square feet of office, laboratory and pilot plant facilities. The Bowman Centre is Canada's largest clean-tech incubator, with a focus on industrial technologies, including fuels, products and processes.

Laboratory at Western Sarnia-Lambton Research Park

Staff at the Research Park provides professional consulting and strategic study services to industries, businesses and governments in the bio-economy, energy, environmental, petrochemical and water treatment sectors. These services are augmented by access to a team of semi-retired engineering, science, environmental and management professionals with extensive industry experiences.

The Supportive Infrastructure for Energy Innovation

The Sarnia-Lambton Industrial Alliance is a cluster of progressive manufacturers, machine shops, engineering and environmental service companies. Within the cluster, specific areas of expertise include mechanical, electrical/power, instrumentation, process technologies, custom fabrication and pipeline development. International expertise is offered in these disciplines.

Global participants include SNC Lavalin, Siemens and Worley Parsons.

The member companies in the Alliance have the capabilities to meet the requirements of emerging companies in the sectors of sustainable power generation and alternative technologies - from component fabrication to the provision of electric/energy related services.

INTERTEC Sarnia This German based multinational manufactures high-performance enclosures, shelters and heating and cooling components for many of the word's best-known energy and processing companies and engineering firms.

Labour The region's skilled labour force is exceptionally strong in the areas of science, engineering, process operations, instrumentation, metal fabrication, construction and managerial ability.

TransAlta Energy Corporation

Traditional Power in Sarnia-Lambton

Eastern Power Limited
Greenfield South Power
Township of St. Clair
Combined cycle natural gas
300 MW Capacity
Under Construction
February 2014

Greenfield Energy Centre LP
Township of St. Clair
Combined cycle natural gas
1005 MW
Commercial Operation 2008

Imperial Oil – Sarnia Site
90 MW Cogeneration Plant

Invenergy LLC
St. Clair Energy Centre
St. Clair Township
Combined Cycle natural gas
584 MW Capacity
Commercial Operation 2009

TransAlta Energy Corporation
Sarnia Regional Cogeneration Plant
506 MW Capacity
Commercial Operation 2003

Harnessing the Energy of Innovation

AVEtec Energy Corporation

Inspired by the process that creates natural twisters, Sarnia-based electrical engineer Louis Michaud has designed a non-polluting source of swirling power called the Atmospheric Vortex Engine. In the design, a controlled vortex is produced by admitting warm or humid air tangentially into a circular station. The temperature difference between the heat source and the upper atmosphere supports the vortex and can continuously drive multiple turbines. The heat source can be solar energy, warm seawater, warm humid air or waste industrial heat from thermal power plants. There are no carbon emissions and no need for energy storage. With funding from the Thiel Foundation's Breakout Labs and the Government of Canada, AVEtec is a partnering with Lambton College to build and study a prototype of the Atmospheric Vortex Engine.

Electrical engineer and inventor, Louis Michaud of AVEtec Energy Corporation, demonstrates the Atmospheric Vortex Engine.

TODA Advanced Materials Inc.

Located in Sarnia, TODA Advanced Materials Inc. is a joint venture of TODA Kogyo Corporation and ITOCHU. The Sarnia plant is the premier facility to meet the emerging demands for cleaner and energy efficient methods of power generation. The plant produces nickel hydroxide powders, the essential raw material for the production of rechargeable batteries used in hybrid-electric vehicles and electronic equipment.

Ubiquity Solar Inc.

Ubiquity Solar's technology is developing an evolutionary approach to improve the performance and cost effectiveness of silicon photovoltaic cells. The company is in the process of developing a pilot plant in Sarnia that will produce polysilicon wafers. It is anticipated the plant will be operational in mid-2015.

Biogenerator Energy Solution

This firm is developing and commercializing a revolutionary new electricity generation technology developed at Western University. The BioGenerator is the first commercially viable biotechnology for power generation. The system generates electrical power from hydrogen, and is reliable, safe, quiet, environmentally-friendly, cost-effective, and highly efficient. The system is highly scalable, stable, reliable, and power output can easily be regulated to match demand.

A Centre of Excellence for Sustainable Power Generation and Alternative Energy Technologies

Moving forward, a regional strategy is under development, and Sarnia-Lambton is positioning itself as a centre for the development and commercialization of generation, energy storage technologies and integration systems.

These developing technologies are demonstrating significant potential for enhancing stability of the system-wide electricity grid and cost effective integration of increased renewable energy supplies; enhancing the local grid resiliency for large industrial users as well as distributed generation.

Sarnia-Lambton offers a unique opportunity for energy storage. The underground caverns utilized for the storage of gas and natural gas liquids have the potential to host bulk energy storage technologies such as compressed air energy storage and power-to-gas.

In addition, there is a need to incorporate fast-acting storage technologies such as batteries and flywheels in order to help sensitive industry loads survive momentary upsets due to lightning, etc.

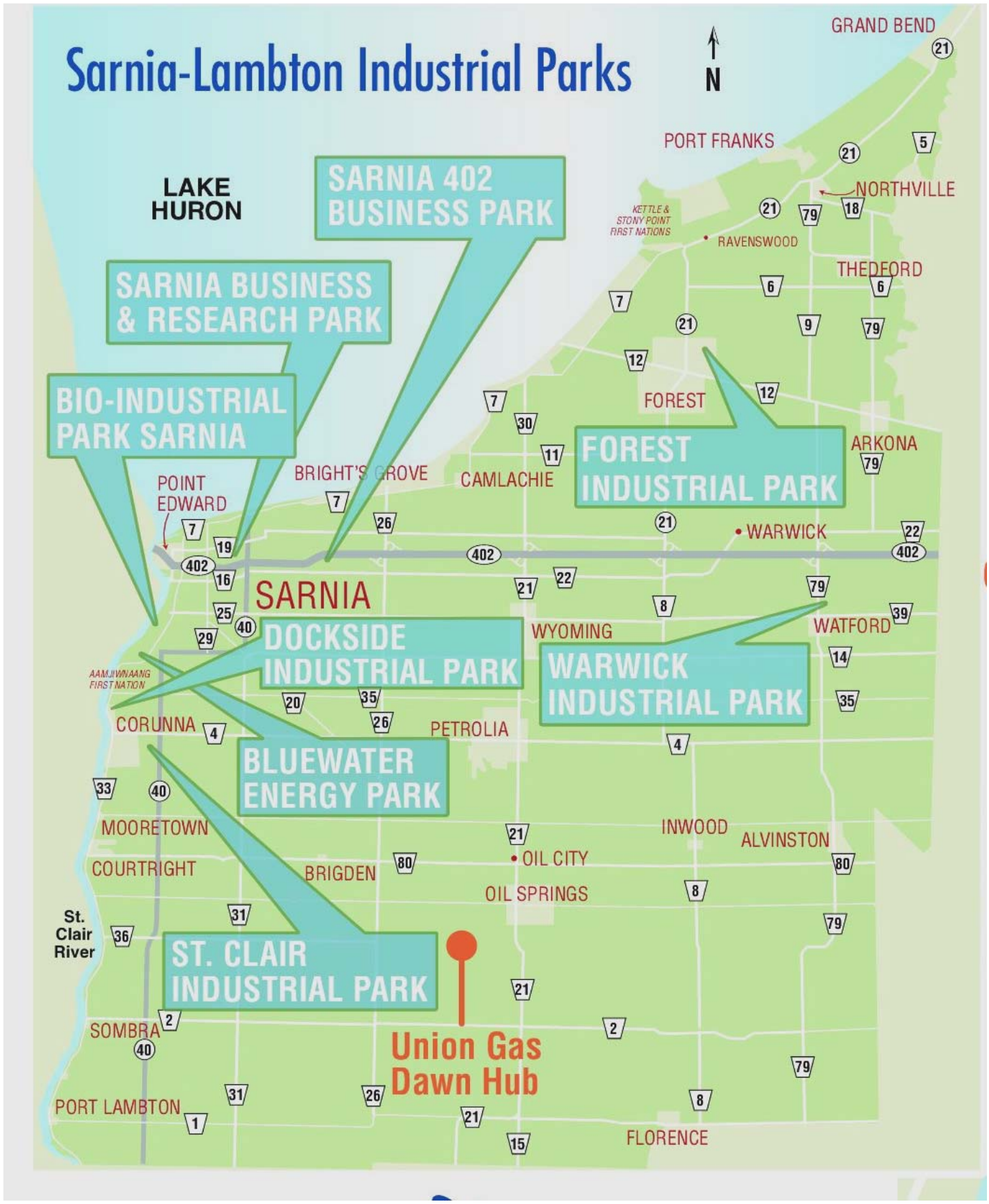
To assist in strategy formulation, a provincial conference and workshop was held in November 2013. A major opportunity identified at the conference was the establishment of a "smart microgrid" to insulate the region against power fluctuations and provide non-interruptible power.

To make this vision a reality, the regional collaboration is looking for partnerships with leading industries, energy storage providers, government bodies and academia.

An open invitation is extended to develop the Sarnia-Lambton Centre of Excellence for Sustainable Power Generation and Alternative Energy Technologies.

Prime Location on the Michigan / Southern Ontario border, at Lake Huron's most southerly point.

- 158 Million consumers within one day drive
- $17 Trillion marketplace under the North America Free Trade Agreement
- Ontario market of 13+ Million people with Canada's highest personal incomes


Sarnia-Lambton Industrial Parks
N
LAKE HURON
SARNIA 402 BUSINESS PARK
SARNIA BUSINESS & RESEARCH PARK
BIO-INDUSTRIAL PARK SARNIA
FOREST INDUSTRIAL PARK
DOCKSIDE INDUSTRIAL PARK
WARWICK INDUSTRIAL PARK
BLUEWATER ENERGY PARK
ST. CLAIR INDUSTRIAL PARK
Union Gas Dawn Hub
GRAND BEND
PORT FRANKS
NORTHVILLE
KETTLE & STONY POINT FIRST NATIONS
RAVENSWOOD
THEDFORD
FOREST
ARKONA
POINT EDWARD
BRIGHT'S GROVE
CAMLACHIE
WARWICK
SARNIA
WYOMING
WATFORD
AAMJIWNAANG FIRST NATION
CORUNNA
PETROLIA
MOORETOWN
INWOOD
ALVINSTON
COURTRIGHT
BRIGDEN
OIL CITY
OIL SPRINGS
St. Clair River
SOMBRA
PORT LAMBTON
FLORENCE

Sarnia-Lambton Hybrid Chemistry & Energy Cluster

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April 2014. For illustrative purposes only. Not to scale.