Electricity plays a critical role in powering our everyday lives. We flip the switch and the power is there. It gets us out of bed on time, keeps our food cold, cleans our clothes, irrigates our crops and lets us read long after the sun has gone down. Albertans count on safe, reliable electricity to power our businesses, industry and farms. Electricity enables Alberta’s economic progress, our livelihood and our well-being.
This brochure provides an overview of the AESO’s most recent Plan. A copy of the Plan is available on the AESO’s website at www.aeso.ca

We take a comprehensive approach to strengthening the transmission system. We focus on the long term to ensure that all Albertans can continue to depend on safe, reliable electricity.

Alberta’s electric transmission system is like a highway. It moves power from where it is produced to where it is used — just like a highway moves traffic from point to point. The electricity highway is essential because power must be available the instant we flip a switch. We cannot store electricity in large volumes in any practical way with today’s technologies so our transmission lines must be able to deliver the power we need when and where we need it — instantly. If the transmission highway is too small to handle the needed flow of electricity, then it can become congested, costly and inefficient to run. There needs to be a plan to make sure that this does not happen, and the AESO is responsible for Alberta’s Long-term Transmission System Plan.

When creating the Plan, the AESO examines the forecast future demand for electricity and a variety of economic scenarios. We compare this information with existing and future resources, identify gaps and consult with stakeholders to find the best solutions to strengthen the grid.
The power of electricity

Electricity plays a critical role in powering our everyday lives. We flip the switch and the power is there. Albertans count on safe, reliable electricity to power our businesses, industry and farms. It enables Alberta’s economic progress, our livelihood and our well-being. In 2008, Alberta’s wholesale power market completed over $8 billion in electricity transactions.

Knowing critical transmission infrastructure is in place ensures power generators can be confident that Alberta’s grid can accommodate new generation investment. It also provides confidence to customers who need dependable electricity to power their homes, business or industry.

Alberta has over 12,000 megawatts (MW) of generation from hydro, coal, gas, wind, biomass and other energy sources as well as about 21,000 kilometres (km) of transmission lines. Together, this system continuously and instantly delivers electricity to Albertans in every corner of the province.

In the past several years, and until late 2008, our province’s growth has been strong. In electric system terms, our growth for the past few years has been equal to adding two cities the size of Red Deer to the power system every year.

But virtually no major additions to the critical Edmonton to Calgary “backbone” of the electric system have been built in over 20 years. Portions of our electricity highway are congested and aging. It is stretched and incapable of meeting the province’s future needs in its current state.

The AESO has approximately $3.2 billion in transmission system reinforcements currently underway (including projects approved, pending approval and under construction) throughout the province. However, additional critical transmission infrastructure is required as soon as possible. Now is the time to catch up and close the gap between the system and its current strained condition and what is needed to power Alberta’s future prosperity.

New critical transmission infrastructure is key to unlocking the potential for Alberta’s additional renewable resources such as wind, hydro or biomass energy for example. Many of these resources are not located near existing transmission lines or power consumers.
3. Markets

Transmission lines need to be built before generation developers will invest in new power plants.

A strong transmission system assures business and industry that electricity will be available to power their future factories or industries.

When Albertans have access to ample supplies of power generation from a variety of sources, like wind power or natural gas-fired electric generators, prices will reflect this competition. Like any product we buy, when supply is diverse and plentiful, prices are usually lower.

Interties are transmission lines that connect Alberta to our neighbours, allowing us to import and export power. With only two interties — one with B.C. and the other with Saskatchewan — Alberta is one of the least interconnected jurisdictions in Canada. In fact, since 2002 Alberta has imported more electricity than it has exported. Interties give us access to other markets so we can sell power that is surplus to Albertans' needs. They also provide access to additional power in times of emergency. The amount of power that can flow over the interties will remain limited until the transmission system between Edmonton and Calgary is reinforced. We need to strengthen the transmission system within Alberta and restore the interties so they can carry the amount of power they were designed to deliver.

People who invest in building new sources of power make their decisions, in part, when they are confident that infrastructure will be in place to move the electricity they generate to consumers who need it. A large part of deciding whether to locate or expand a business or industry in Alberta is based on being reasonably certain that an adequate supply of electricity is accessible.
Alberta’s Provincial Energy Strategy was introduced in December 2008, signalling a new energy future for the province. Electricity is at the heart of it. The Provincial Energy Strategy states that Alberta should strive to be “… a global leader, recognized as a responsible world-class energy supplier, an energy technology champion, a sophisticated energy consumer, and a solid global environmental citizen.”

To achieve this, the Provincial Energy Strategy focuses on three major outcomes:
- clean energy production
- wise energy use
- sustained economic prosperity

A new vision for electricity transmission

The vision of electricity transmission in the Provincial Energy Strategy includes building critical transmission infrastructure so it leads business investment decisions that rely upon consumption of power or electricity generation.

Just like preparing the soil before planting, critical transmission infrastructure will be in place once Alberta’s robust energy economy again hits its full stride. Knowing that an important piece of their business — essential transmission — is in place sends a signal to investors that our province is open for business and well-positioned for a return to a strong, healthy economy.

This long-term approach enables Alberta to use a window of opportunity created by the current economic situation to our advantage. Materials, labour and equipment to build transmission facilities are more readily available and may be purchased at lower cost. This window of opportunity is limited as Alberta will be competing for construction resources like wire, steel and skilled workers who are needed to build transmission throughout North America and many parts of the world. Acting now will provide Alberta access to these resources, and create the necessary confidence for investors who require reliable electricity.

Construction on critical transmission infrastructure to connect key regions of the province is planned to begin in 2010. The transmission lines will be sized to accommodate long-term growth and will use advanced technology where possible to maximize efficiency and minimize environmental impacts.

Having a strong transmission system in place ahead of investor decisions benefits all Alberta consumers by energizing our economy.
Electricity at work

A. Generating plants
Power is generated using a fuel source to create a rotating motion that is then turned into electricity.

B. Transmission substation
A set of large transformers increases the voltage of power coming from a generating plant for its long journey through the transmission grid to customers. Voltage can be compared to water pressure in a hose.

C. Transmission line
Transmission is the backbone of the electrical system, moving power from where it is generated to where it is needed in our homes, farms, businesses and industry. Towers and poles support sets of high capacity wires. Transporting power at higher voltages is best over long distances because this reduces line losses. Electrical current creates heat on a power line; this heat is lost energy as it does not reach the customer. Typically, two to five per cent of the power entering a line is lost due to resistance of the wire as electricity moves along the line.

D. Intertie
Connections with neighbouring electric systems act like a valve that can be opened and closed, allowing power to move in or out of the province.

E. Solar panels
Solar panels can be installed on roofs of office towers and other buildings to capture the sun’s energy.
Industrial customer
Industry uses about 60 per cent of Alberta’s total electricity supply; some companies build their own power sources to support industrial operations such as steel mills, forestry and petrochemical processing plants. When Alberta needs more power, some industrial customers can send their extra energy onto the power system. Together, industrial and commercial customers account for about 80 per cent of electricity usage in Alberta.

Run-of-river hydro power
These hydroelectric plants use the natural flow of river water to turn turbines and generate electricity.

Power meter
The amount of electricity delivered to a home, farm or business is measured using a meter.

Distribution line
Low voltage power lines are best suited for transporting electricity over short distances. These power lines carry electricity from a substation to homes, farms and businesses.

Distribution substation
Power lines enter the substation, where a transformer reduces the voltage to a lower level that can be safely carried on distribution power lines that deliver electricity to homes, farms and businesses.
At the AESO, we keep a close watch on how well the provincial transmission system is meeting Albertans’ needs. These efforts include conducting technical studies and consulting with the public to find ways to improve our “electricity highway” across the province.

Our work has shown us which areas of the transmission system need to be reinforced, and we are moving forward to develop and implement the best solutions.

The electric transmission system has many jobs. It first must be able to move enough power to meet Alberta’s electricity needs; it boosts and supports our economy, which depends on power. And it enables renewable forms of energy to come on stream. The AESO envisions critical transmission infrastructure as a connected, integrated and comprehensive system that is necessary to undertake the job at hand — a reliable power system and strong economy.

We have identified critical transmission infrastructure that will strengthen the system to:

- Maintain system reliability.
- Catch up to growth. For the past several years, growth has been equal to adding two cities the size of Red Deer to the power system every year.
- Keep ahead of future growth expected to average three per cent annually over the next 10 years.
- Enable renewables and low-emission generation.
- Provide certainty to new power generators and power consumers.
- Deliver the power we depend on now and into the future.
- Minimize land-use impacts.
- Increase intertie capability.
- Increase efficiency, reducing costly and wasteful transmission system losses.

**Enabling renewables**

Increasing renewable generation means growing the need for additional critical transmission infrastructure. That is because renewable generation occurs when and where nature provides it, which is often a significant distance from power customers. A strong transmission system is needed to transport electricity when the wind is blowing or when rivers flow at a high level at hydro plants. Conversely, transmission is key to maintaining reliability when renewable generation output is low (like on calm days or when rivers run low) since energy from other generation sources needs to be delivered to consumers to ensure an uninterrupted supply of electricity.

**Transmission options**

Transmission lines can be built to use either alternating current (AC) or direct current (DC). Alberta’s existing transmission system has been developed to work with the AC electricity generated at power plants and the AC power that we use in our homes, farms and businesses.

Some DC transmission lines called high voltage direct current (HVDC) are able to carry a large amount of power. We’re continuing to study options for this technology in Alberta.

DC systems also need additional equipment to convert the power from AC to DC and back to AC so we can use the power in our homes, farms and businesses.

HVDC is a technology that has been used in many places around the world for several decades. It is generally more expensive for smaller-scale projects and has different operational advantages and disadvantages compared to conventional AC transmission.

In some cases, however, HVDC is the preferred choice. These include situations where there is a need to pack more energy carrying capacity into a smaller transmission line corridor. HVDC lines increase efficiency and minimize land-use impact with smaller towers and rights-of-way compared to AC lines that would move the same amount of power. HVDC can accommodate long-term growth without the need for future construction in a corridor.

Continued detailed analysis, including technical, transmission loss and operational cost studies, will be undertaken to confirm the HVDC option.
Critical transmission infrastructure (CTI)

Tier 1 includes critical transmission infrastructure that the AESO identified in our Plan for immediate advancement. The required technical analysis and public consultation has been completed or is underway on these projects. Tier 1 infrastructure will:

- Create a stronger system between Edmonton and Calgary that can carry more power to customers in central and southern Alberta.
- Address the power needs of industry in the Industrial Heartland around Edmonton and north to Fort McMurray.
- Increase the ability of the southern system to connect new wind farms and deliver that power to where it is needed by customers throughout the province.
- Upgrade the system in and around the city of Calgary so it can carry additional electricity and provide stronger connections and power service to the city and nearby towns.

Tier 2 includes additional critical transmission infrastructure that requires further technical analysis and public consultation. These projects will be advanced over the next several years. Interties are included in these projects.

Note: For illustrative purposes only; does not depict actual line routes or substation locations.

CTI – Tier 1
1. Edmonton-Calgary
2. Heartland
3. Wabamun Lake-Edmonton-Fort McMurray
4. Southern Alberta (wind)
5. South Calgary

CTI – Tier 2
6. Wabamun Lake-Northwestern Alberta
7. Fort McMurray-Slave River Hydro
8. Interties

HVDC: high voltage direct current
kV: kilovolt
AC: alternating current
Alberta’s transmission highway

Critical transmission infrastructure (CTI – Tier 1)

Edmonton to Calgary

Increased demand for electricity in southern and central Alberta is stressing the existing system. By 2014, the transmission capacity serving the region will fall short of its capability, increasing the risk of outages. Without reinforcement, the system would be operating below North American reliability standards.

Two new high capacity and high efficiency transmission lines between Edmonton and Calgary will provide the critical transmission infrastructure required to:

► Address reliability issues.
► Accommodate long-term growth.
► Lead generation development decisions.
► Maximize efficiency and minimize impacts.
► Restore the capacity of the B.C. intertie to its full design capability.
► Interconnect new renewable and low-emission energy (e.g., a biomass or large hydroelectric facility in northern Alberta).
► Provide capability for wind power located in southern Alberta to reach customers located throughout the province.
► Strengthen a key piece of infrastructure (the system backbone) so new intertie development can occur.

Heartland
(Sturgeon, Strathcona and Lamont Counties)

The power requirements to extract and upgrade bitumen in the oilsands industry are expected to continue to grow over time and drive the need for critical transmission infrastructure in the northeastern part of Alberta.

Although current oil prices have decreased from their record levels, world oil supplies continue to diminish while investment in the oilsands industry is expected to be strong over the long term.

We are continuing to evaluate the following options to strengthen the system into the Heartland area:

► A new 500 kilovolt (kV) double circuit line from an existing substation in south Edmonton (Ellerslie) to a new substation in the Industrial Heartland area.
► A new 500 kV double circuit line connecting into an existing line on the west side of Edmonton and to a new substation in the Industrial Heartland area.
Fort McMurray
(Heartland/Wabamun Lake to Fort McMurray)
The oilsands industry is expected to continue its growth and is the primary driver of the need for new critical transmission infrastructure in the northeastern part of Alberta. The specific facilities being recommended to meet needs in this area are a 500 kV AC line from the Genesee generating station west of Edmonton to a new 500 kV substation in the Fort McMurray area, and a 500 kV AC line from the new Heartland substation to the new Fort McMurray 500 kV substation.

Southern Alberta
(renewable-source power)
The South region is Alberta’s primary wind power generation area. To date, the AESO has received more than 11,500 MW in applications for new wind generation (7,500 MW of which is located in the South region). Given that the requirement to move electricity out of the region exceeds the existing transmission capacity, the South region infrastructure requires substantial improvements. This includes multiple new transmission lines and substations and upgrading existing facilities to accommodate the wind power interconnections.

The AESO filed a transmission plan with the Alberta Utilities Commission (AUC) at the end of 2008 that is flexible enough to accommodate various possibilities for wind developments.

South Calgary
The AESO is looking at various options to strengthen the transmission system in southern Calgary and will conduct further analysis and stakeholder consultation. These reinforcements may include an additional substation and/or new transmission lines.
Who pays for electricity transmission?

The regulator determines how transmission system costs are allocated. Most transmission costs are charged to distribution utilities and industrial customers, based on their use of the transmission system. In Alberta, transmission facilities are owned, built and maintained by companies known as transmission facility owners (TFOs). TFO costs, as well as other costs of planning and operating the transmission system, are recovered through charges paid by all electricity consumers in the province. All consumers – whether industrial, residential, commercial, farm or irrigator – pay for transmission service. The pie chart below represents an approximation of how most transmission costs are allocated in Alberta. Generators pay for all transmission system losses.

### Cost summary of critical transmission infrastructure

The current estimate for the required critical components in the previous summary would amount to approximately $8 billion in 2008 dollars. This total translates to an increase of about $8 per month on the transmission component of a typical residential customer’s bill by 2017. This estimate assumes average electricity usage of 600 kilowatt hours per month. Given that any increase will not occur until the specific facilities have been built and placed in service starting in 2012, the magnitude of the bill impact will vary over time. These cost estimates will be refined as the developments proceed and additional in-depth analysis, consultation and detailed information about the facilities becomes available.

**Critical transmission infrastructure (CTI – Tier 1)**

<table>
<thead>
<tr>
<th>Facility Description</th>
<th>Cost estimate (2008 $ millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edmonton to Calgary</td>
<td>3,135</td>
</tr>
<tr>
<td>Heartland</td>
<td>387</td>
</tr>
<tr>
<td>Fort McMurray</td>
<td>2,045</td>
</tr>
<tr>
<td>Southern Alberta (wind)</td>
<td>2,454</td>
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<tr>
<td>South Calgary</td>
<td>100</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>8,121</strong></td>
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**Additional critical transmission infrastructure (CTI – Tier 2)**

<table>
<thead>
<tr>
<th>Transmission to renewable and low-emission energy zones</th>
<th>Cost estimate (2008 $ millions)</th>
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</thead>
<tbody>
<tr>
<td>Northwest</td>
<td>500</td>
</tr>
<tr>
<td>Northeast</td>
<td>1,400</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>1,900</strong></td>
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</table>

**Transmission infrastructure under development**

<table>
<thead>
<tr>
<th>Cost estimate (2008 $ millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulk transmission system infrastructure currently underway</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cost estimate (2008 $ millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-term regional transmission system plan</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>
Interties provide the ability to import power into Alberta when provincial demand exceeds supply. Since 2002, Alberta has been a net importer of power. Interties also allow surplus energy to be exported to other jurisdictions when supply exceeds demand.

Interties are essential to integrating Alberta’s plentiful low-emission resources (e.g., wind and hydro power) into the transmission system. The Plan recognizes that Alberta is part of an electricity grid that spans North America. Alberta’s interties are an essential part of a reliable electricity system and of maintaining a competitive market.

The Alberta government’s Provincial Energy Strategy reinforces direction provided by the existing Transmission Regulation to increase the capability of the transmission lines that connect our province with its neighbours. This creates a sense of continuity and consistency in public policy and long-range critical infrastructure planning. The AESO’s Long-term Transmission System Plan addresses the need for some interties today while laying the foundation to develop needed additional interties in the future.

The potential new interties described in the following section are included as additional critical transmission infrastructure (CTI) Tier 2.

There are several benefits of additional intertie capacity including:

- Facilitating fair and efficient electricity market development in Alberta.
- Enabling additional renewable generation (e.g., wind or hydroelectric) and large-scale baseload generation development.
- Providing access to other markets for increased reliability of supply.

New interties from Alberta could potentially connect to three jurisdictions: B.C., Saskatchewan/Manitoba or the U.S. Pacific Northwest.

**B.C.** – A new intertie between northern Alberta and northern B.C. would significantly increase electricity supply capability to northern Alberta and the Fort McMurray area.

**Saskatchewan** – There is a possibility of an intertie between the Fort McMurray area in northern Alberta and northern Saskatchewan.

**Alberta/Saskatchewan/Manitoba** – Discussions are underway regarding an intertie between Alberta, Saskatchewan and Manitoba, which has the potential to help meet climate change targets, provide competitive clean energy and increase the security and reliability of supply.

**U.S. Pacific Northwest** – A possible intertie directly to the Pacific Northwest.
Merchant interties

In addition to the AESO’s transmission planning efforts, two merchant interties are being planned. Should these merchant lines be built, the project developers will be responsible for construction costs. The developers will look to recover their costs from companies who will pay to use the line to transport power. The AESO ensures these projects are reliably connected with Alberta’s existing transmission system, and is responsible for identifying any direct benefits that could be delivered to Alberta as a result of the interties.

<table>
<thead>
<tr>
<th>Additional critical transmission infrastructure (CTI – Tier 2)</th>
<th>Cost estimate (2008 $ millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.C. intertie</td>
<td>200</td>
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<tr>
<td>Alberta/Saskatchewan/Manitoba intertie</td>
<td>760</td>
</tr>
<tr>
<td>Saskatchewan intertie</td>
<td>350</td>
</tr>
<tr>
<td>U.S. Pacific Northwest intertie</td>
<td>815</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,125</strong></td>
</tr>
</tbody>
</table>

The Montana-Alberta intertie

Montana Alberta Tie Ltd. is proposing to construct an intertie between Lethbridge, Alberta and Great Falls, Montana. The project proponents currently have a permit from the federal National Energy Board, with approval from the AUC and all approvals from the necessary agencies in the U.S.

NorthernLights merchant transmission project

The NorthernLights bi-directional merchant transmission project is being developed by TransCanada Corporation from the Industrial Heartland (Fort Saskatchewan) area of Alberta to the U.S. Pacific Northwest where energy can reach the Pacific Northwest and California markets. The transmission line would be 1,550 km long and has a tentative in-service date of 2015.
As part of the Provincial Energy Strategy, the Alberta government plans to support a variety of conservation efforts across all sectors of the provincial economy.

This increased focus on using energy resources wisely may change how much, when and where we use electricity in the future. For example, changes in metering and grid control technology will allow consumers to make more informed and timely choices about how they use electricity.

Patterns showing the times when consumers use the most electricity and the results of increased conservation can be monitored through smart grid and advanced metering infrastructure (AMI) technology. AMI is technology that gathers, processes and uses customer electricity consumption data in a more detailed way than conventional metering. There are many possible uses for this technology. One option is real-time monitoring of electricity usage that allows customers to manage their power consumption.

Smart grid technology is used to improve efficiency of the electricity system. Smart grid technology can be integrated with AMI. For example, a distribution company could seek a customer’s permission to remotely turn off their air conditioner when system demand is high.

AMI and smart grid technology have the potential to affect the way consumers use electricity by shifting demand from higher cost, peak times to periods when demand is reduced and electricity prices are potentially lower. In the long term, overall electricity usage patterns may change and this could increase the efficiency of electricity production and transmission in the province.
Involving stakeholders

The AESO carries out extensive public consultation when we are considering proposals to develop or expand the transmission system.

Consulting with stakeholders — the general public, elected officials, special interest groups, industry, consumer groups and others — provides broad input into the AESO’s planning process on things such as geographic options, potential technologies and environmental and social considerations.

Our ongoing stakeholder consultation is built on the fundamental principle that all stakeholders have the opportunity to comment on, and be informed of, the AESO’s plans, decisions and actions in a timely way. To help us communicate more effectively, we use various methods like open houses, town hall meetings, small group meetings, letters, email, videos and document sharing via the AESO website.

A plan for the future

Our Long-term Transmission System Plan is consistent with the Alberta government’s Provincial Energy Strategy.

The Plan uses a comprehensive approach to ensure the electric system remains robust so all Albertans can depend on safe, reliable electricity. At the same time, it identifies critical transmission infrastructure that will bolster the confidence of investors — including those who want to build renewable and more energy efficient power generation for Alberta’s competitive market — and provide a way for electricity to move from where it is generated to where it is needed.

The Plan, together with the regulatory changes contemplated in the Provincial Energy Strategy, sets a foundation for action that will allow Albertans as individuals, and the province as a whole, to benefit from a strengthened and more effective transmission system.

Work has already begun on some of the critical transmission infrastructure projects and extensive planning, technical work and stakeholder consultation has taken place. We look forward to continuing the substantial work already underway that will help us build a stronger foundation for Alberta’s energy future.

For more information about the AESO’s Long-term Transmission System Plan, please visit our website at www.aeso.ca