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White Paper

Saskatchewan's Geological Advantage: Developing Our Renewables and Compressed Air Energy Storage

Adding Cost Effective Diversity and Resilience to the Grid

Commissioned by the PTRC

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Saskatchewan's Geological Advantage: Developing our Renewables and Compressed Air Energy Storage - Adding Cost-Effective Diversity and Resilience to the Grid

Saskatchewan is investigating the refurbishment of coal and new nuclear as firm capacity for future electricity generation. **Including abundant renewables generation with long duration energy storage provides a third, cost-effective and reliable option, adding flexibility to the grid while financially benefiting rural Saskatchewan.**

The most secure energy sources are produced at home using our existing industrial strengths. In Saskatchewan, there are deep salt beds where we have developed and operated caverns over 163,000 m^3 (5.7 million ft^3) in volume for hydrocarbon storage. Similar caverns can be used for Long Duration Energy Storage using cheap and inexhaustible wind power to fill them with compressed air that can be used later to generate power on demand.

Previous studies have shown that generation from intermittent wind can be converted to firm capacity, similar to coal or nuclear in performance, using Compressed Air Energy Storage (CAES) technology. Using off-the-shelf turbomachinery in conjunction with Saskatchewan's expertise in operating salt caverns, CAES technology effectively balances the variable generation of wind. CAES alone adds significant up and down dispatchable capacity that has been proven to integrate with base-load generation such as coal and nuclear.

Saskatchewan's world class geology supports the development of large underground caverns for air storage. Given the immensity of this resource, the development potential of caverns effectively removes the ceiling on renewables development. Furthermore, having unlimited storage capacity, Saskatchewan is perfectly located to be a national energy storage hub that will directly support Canada's National Electricity Strategy.

Saskatchewan's Electricity Demand Forecast

The Saskatchewan First Energy Security Plan[1] forecasts an increase in electricity demand between 40-100% by 2050. With the current generation capacity being approximately 6000 MW, this represents the development of between 2400-6000 new MWs of capacity, plus the replacement of existing natural gas units as they reach their end-of-life. SaskPower's plan includes the refurbishment of approximately 1350 MW of coal generation that will operate until 2050 with additional capacity being provided by nuclear generation. The plan proposes that power generation will be carbon-emissions neutral by 2050.

This power generation buildout will be one of the largest industrial investment opportunities in Saskatchewan in decades. Including abundant renewables can be part of this development and will be the least expensive and most rapidly deployable method to achieve this transition while significantly supporting the economy of rural Saskatchewan and minimizing fuel reliance on other jurisdictions.

Economic Opportunity with Wind and Solar Development

Along with coal and nuclear, having abundant wind and solar generation with utility-scale, long duration energy storage, will help to fulfill our all-of-the-above efforts to increase the resilience of the grid. New wind and solar generation are by far the cheapest forms of electricity generation, and Saskatchewan has some of the best wind and solar resources in Canada.

[1] https://www.saskatchewan.ca/-/media/news-release-backgrounders/2025/oct/saskatchewan-first-energy-security-strategy-and-supply-plan-5114.pdf (accessed May5 2026)

One of the latest wind project being considered by SaskPower is the Seven Stars 200 MW Energy Project, located near Weyburn where Enbridge[2] will be investing approximately $500 million to construct the project.

The company estimates that economic benefits over $100 million will be added to the Weyburn region in the form of municipal taxes, lease payments to landowners, third-party contactors and operational staff.

For landowners, assuming lease payments of $15,000 per turbine[3], having four turbines installed per section would provide $60,000 in annual revenue. Indexed at 2% annually, this passive income can support agricultural operations with approximately $2.4 million per section over the 30-year project life - ***an exceptional benefit to farmers and ranchers, especially during times of drought and commodity uncertainty.*** In 2024, municipalities in Alberta received approximately $54 million in renewables-related revenue[4].

When considering the installation of turbines, the average footprint of a single unit with road access is approximately four acres, or less than 3% of the arable land area per quarter section. Assuming a running average of $200 per acre net income loss from this installation, the total annual loss per turbine would be approximately $800, verses up to $15,000 income from a turbine lease - ***18 times*** *the net farming revenue with zero inputs*.

Wind development in other grain producing regions with competitive power markets suggest that acceptance and participation are much greater in these jurisdictions, showing that a higher mix of wind even without significant storage is economically feasible and socially acceptable. For example, estimates in 2024:

	MW Capacity	Grid Mix
North Dakota (EBSCO)	4500	40%
South Dakota (State Gov)	3470	30%
Iowa (State Gov)	13010	64%
Texas (State Gov)	43960	24%
Alberta (CER)	3620	22%
Saskatchewan (SP)	818	13%

As Saskatchewan's wind development expands, best practices established for wind developers will encourage community engagement and support an alignment with community interests. Having $500,000-$615,000 paid annually as taxes to Rural Municipalities hosting development will reduces the tax burden ratepayers must otherwise pay for required services.

Converting Intermittent Renewables to Electricity-on-Demand

Due to their intermittency, renewables must be co-developed with utility-scale, long duration energy storage technologies to cover the gap when generation is unavailable. Batteries can provide service for a few hours; however, in Saskatchewan, using our geological salt resources, purpose-built salt caverns can be constructed as giant storage vessels. When there is abundant production from renewables, this electricity is used to pressurize atmospheric air into the caverns. Later, when renewables generation is not available, this compressed air is controllably released into a turbine-linked generator. This process converts the electricity from intermittent renewable sources to electricity-on-demand.

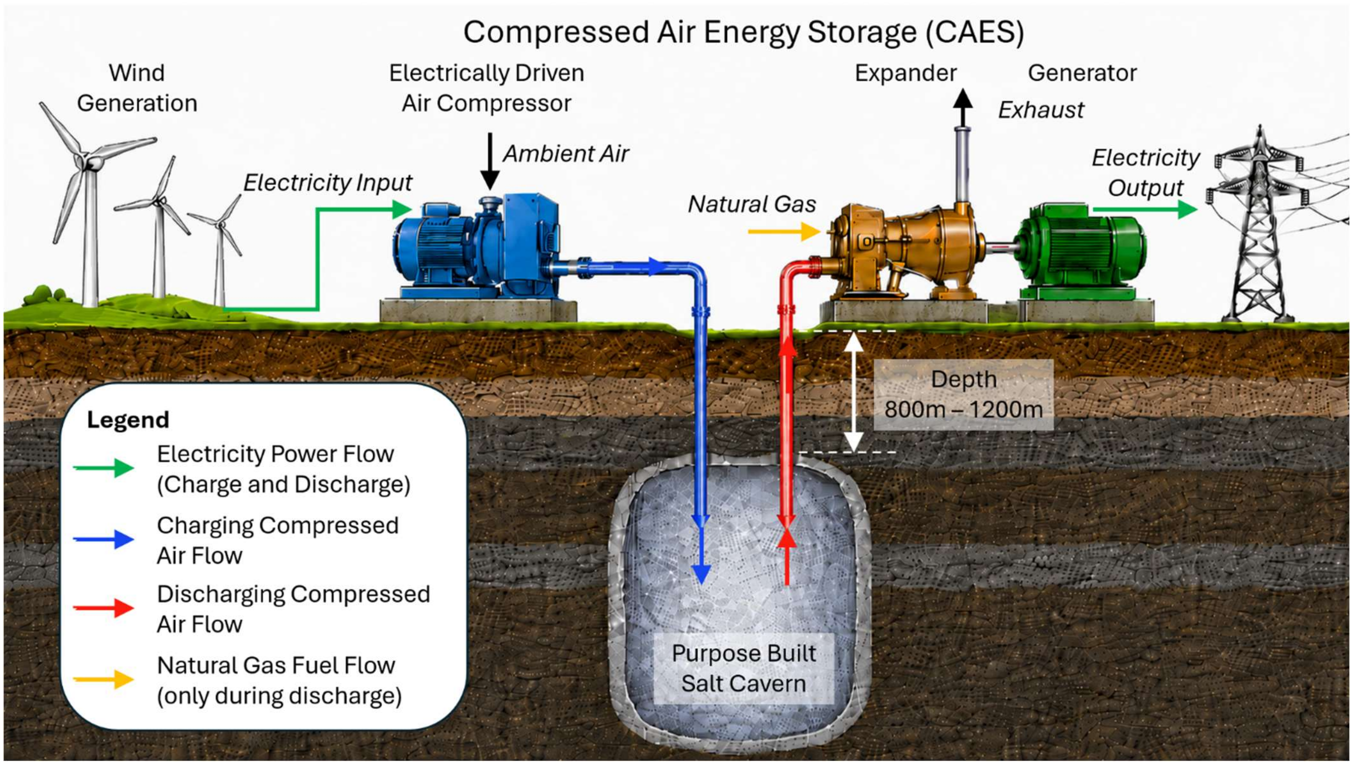
Compressed Air Energy Storage (CAES)

CAES is a proven technology with a Technology Readiness Level of 8 that has provided net demand balancing services to nuclear generation at Huntorf, Germany since 1978 and to coal generation at McIntosh, Alabama

[2] Seven Stars Energy Project - Enbridge Inc.
[3] Pers comm with potential landowners
[4] https://businessrenewables.ca/resource/infographic-2024-alberta-renewable-energy-municipal-tax-revenue-map

since 1991. Combined, these operations have provided the power industry with over 80 years of operational experience. Power utility operators in Europe and the USA are developing CAES facilities, while several new plants are already operating in China.

CAES, coupled with wind generation in Saskatchewan, could provide the same service, and is cost competitive with new, best in class Combined Cycle Gas Turbine (CCGT) generation while using 80% less natural gas. For example, a 300 MW CAES facility operating four, five million ft^3 caverns at approximately 1000 m depth, can provide up to 60 hours of continuous power generation, bridging the gap when wind is unavailable. Scalability is cost effective as additional caverns can be constructed to provide greater duration.[5] The following image shows how CAES works:



Approximately 900 MW of wind generation (200 x 4.5 WM turbines) are required to create a 300 MW CAES baseload, meaning that independent power producers would have to invest approximately $2.3 billion in wind generation infrastructure. This development will have ***4-5 times the economic impact*** of the anticipated 200 MW Seven Stars Wind Project, where there could be approximately $450 million in economic benefits to local rural municipalities. Annual lease payment estimates would be over $3 million to landowners, providing significant, reliable non-farming income.

The wind generation does not need to be at one location or co-located with a CAES facility, enabling the economic benefits of wind development to be spread across much of southern Saskatchewan's grain belt. Having several CAES facilities located across the province may also reduce the need for additional transmission infrastructure. Having several facilities of this scale would multiply the benefits to many billions of dollars.

Power Arbitrage Opportunity

Having power interties with Alberta, Manitoba and North Dakota provide opportunities to buy cheaper electricity from these jurisdictions when they have excess generation, but **only if we need it**. When export prices

[5] https://www.linkedin.com/posts/robert-stewart-phd-p-eng-8a299357_cost-of-base-load-ultra-low-and-zero-emissions-activity-6863537780346228736-ss0M?utm_source=share&utm_medium=member_desktop&rcm=ACoAAAwRzjoBsW49c-SoUQRZZunKN7SVE0uTdQI

are low and **we *don't* need the power**, having storage provides an economic opportunity to purchase this power and store it in a CAES asset, then sell it back to these jurisdictions later, or use it ourselves in high-demand periods. Having utility-scale storage provides a major market opportunity.

For example, the Noth Dakota intertie connects Saskatchewan to the Southwest Power Pool, which includes fourteen states located between Saskatchewan and Texas, where negative pricing in real-time markets occurred 12% of the time in 2025[6].

Canada's National Electricity Strategy[7] anticipates doubling our national grid capacity by 2050 to support clean energy generation, system security and reliability. Having unlimited storage capacity and with our centralized location, Saskatchewan could be a major national storage hub, proving potentially GWhs of high-value capacity to the national grid.

Projected Costs for Generation Infrastructure Options

All generation options will be expensive:

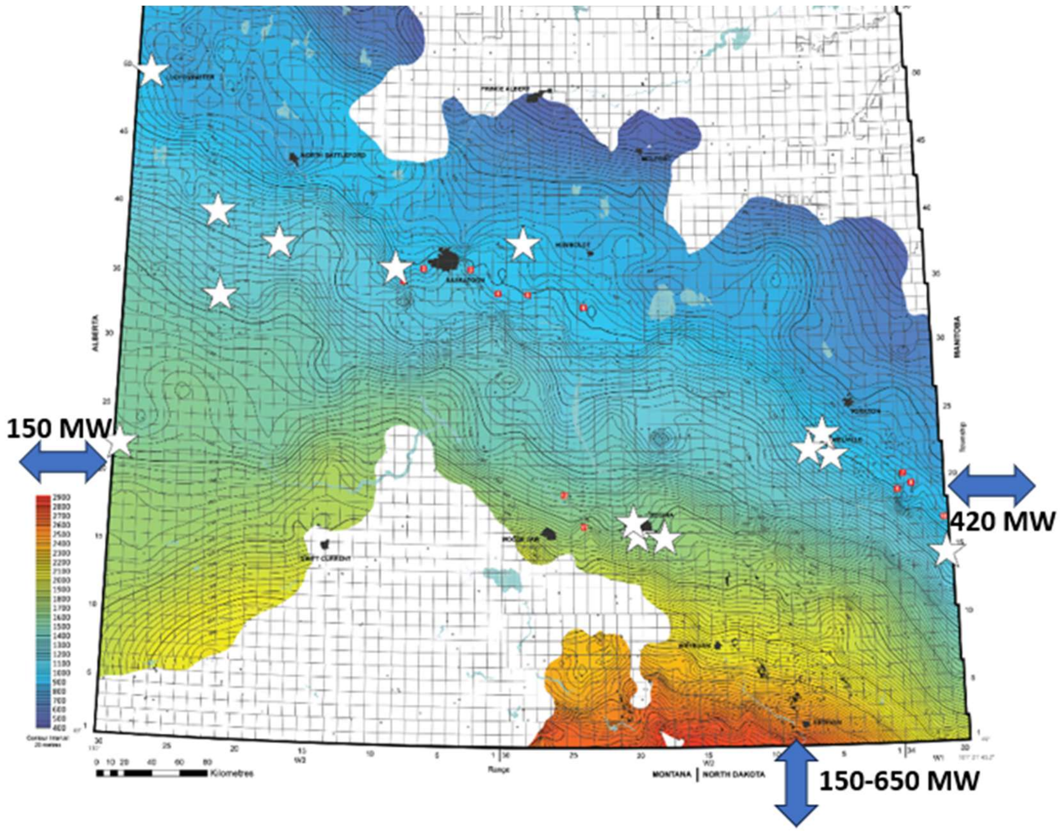
- Refurbish 1350 MW of coal generation
    - Current budget is approximately $2.6 billion[8]
    - Possibly add 2-3 Carbon Capture Units for an additional approximate $1.2 billion[9] each
    - There may be significant risk exposure to rate increases with the Industrial Carbon Price
- Develop nuclear generation for future capacity by 2050
    - Assuming a 50% average capacity increase will require approximately 3000 MW of new generation
    - Requires the development of 10 x 300 MW SMRs at $5-7 billion[10] per unit ($50-$70 B by 2050?)
    - Possibly develop large-scale nuclear units
    - May need additional natural gas or coal assets to fill any generation gaps by 2050
- The development of 900 MW of wind generation will support a 300 MW CAES facility, providing the same service at a potentially significantly lower cost than coal or nuclear generation
    - A third-party wind developer will invest approximately $2.3 billion to install the wind generation
    - Each 300 MW CAES facility could cost approximately $1.7 billion, based on estimates for the Aspen CCGT powerplant
    - One development could provide up to $450 million in local economic benefits over the 30-year life of the wind farms, with annual lease payments of approximately $3 million to landowners
    - This technology is supported by our world-class geological salt resources

Geology

Saskatchewan has the salt resource suitable for cavern development and CAES operation. Our cavern operators are well experienced, working with over 65 caverns since the 1960s to store pressurized natural gas, other liquid hydrocarbons and industrial waste. SaskEnergy has significant experience in operating natural gas storage caverns and could also benefit from additional storage capacity as natural gas demand and price volatility increase. The potential capacity for cavern development is so large it removes any ceiling on renewables development.

[6] Southwest Power Pool, 2025 Market Statistics, https://www.spp.org/documents/76798/2025_annual_state_of_the_market_report.pdf, accessed June 3, 2026)
[7] https://www.pm.gc.ca/en/news/news-releases/2026/05/14/prime-minister-carney-announces-forthcoming-national-electricity
[8] https://www.cbc.ca/news/canada/saskatchewan/refurbishing-coal-plants-2-6-billion-9.7147583
[9] CCS Knowledge Centre, Regina, *pers comm* May 30, 2023; value inflated.
[10] Tennessee Valley Authority 2024 annual report

The following map[11] shows the distribution of the Prairie Salt Formation across southern Saskatchewan. Warmer colours represent greater depth, and stars show the location of over 65 previously developed salt caverns. Interties with Manitoba, Alberta and North Dakota (150 MW currently with plans to increase to 650 MM) are shown.



Summary – Capturing a Generational Industrial Opportunity

The economic impacts associated with the development of renewables in rural Saskatchewan are significant and can be distributed across a large portion of the southern part of the province. Lease payments to farmers and ranchers will provide significant non-farming income, helping to balance increasing crop production costs, commodity price uncertainty and the impacts of drought and other uncontrollable events.

Our wind and solar resources are among the best in Canada and are the cheapest form of new electricity generation. When combined with Compressed Air Energy Storage technology, intermittency is converted to firm capacity that can be efficiently used for dependable and dispatchable electricity for generations. Having storage can support base load generation, rapid ramping, and load balancing services for coal, natural gas and nuclear generation within Saskatchewan. Salt caverns can also be used to store hydrogen and helium.

Having interties with Manitoba, Alberta and Noth Dakota provide an opportunity to purchase and store electricity when prices are low or negative in these jurisdictions, then use or sell this power when prices are higher. And as Canada increases the national grid capacity, Saskatchewan could be a national storage hub in the middle of the prairies for potentially GWhs of electricity. Soon, energy security will be measured not only by how much power can be generated, but also by how much can be stored.

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[11] Yang, C. and Love, M. (2021): Depth at the top of the Prairie Evaporite Salt in Saskatchewan; MER, Sask. Geological Survey. https://publications.saskatchewan.ca/#/products/111909

Our geological resources have provided great wealth to Saskatchewan's economy, and our salt resources can now specifically provide utility-scale energy storage vessels, or *air batteries,* to support the full inclusion of renewables in our energy supply mix. The storage development potential is effectively unlimited, thereby supporting unlimited renewables generation capacity. Cavern development also directly supports our oilfield contractors and tradespeople.

As Saskatchewan develops its coal and nuclear generation options, wind with Compressed Air Energy Storage provides a third and potentially less expensive complementary option.

Next Steps

SaskPower, SaskEnergy or Crown Investment Corp should lead this development opportunity. The best project development locations will require exploration drilling and salt capacity assessments to design a project. The PTRC could manage this initial work, including geological assessments, salt capacity assessments, cavern designs and a CAES FEED study.

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Bios

Brian Brunskill has provided geological consulting services to the petroleum and potash industries in Canada since 1985. From 2003-06, work included the geological assessment of deep saline aquifers for the injection and disposal of carbon dioxide and other industrial liquid-waste products. Since 2007, assessment work has included the potential for mining geothermal energy from deep aquifers in Saskatchewan to be used in direct heating and industrial process applications, and since 2019, work has included the assessment of how Compressed Air Energy Storage (CAES) technology can be applied within Saskatchewan's geological and power generation infrastructure.

Robert Stewart has worked on energy storage and project developments with a focus on CAES in Western Canada for over 10 years. Previously with Rocky Mountain Power, Robert worked to propose a CAES facility at Lloydminster to provide storage services to Alberta and Saskatchewan while enabling a virtual intertie. Robert has completed comprehensive modeling of renewables and energy storage to compare different power generation technologies. Recently Robert has supported PTRC with CAES investigations in Saskatchewan.

Eric Nickel is the president and CEO of the PTRC. He spent 15 years as a research geologist with the Petroleum Geology Branch of the Saskatchewan Geological Survey, investigating the Mississippian carbonates of southeast Saskatchewan while providing some of the original Midale reservoir characterization for PTRC's Weyburn oilfield CO2 utilization project that started in 2001. Erik joined the PTRC in 2014 and took on roles of increasing management responsibility in a range of subsurface energy types and in technical leadership of the PTRC team. He is now the president and CEO of the PTRC.