



Enlighten Innovations' Big Ugly Battery, seen above, produces and stores near-zero emissions energy. It was stumbled upon while the company was creating a cost-effective, low-sulphur marine fuel.

INNOVATIVE PROJECT REFINES LOW-GRADE OIL AND HATCHES "BIG UGLY BATTERY"

While Enlighten Innovations was developing a cost-effective, low-sulphur marine fuel to address new, tighter, international shipping regulations, they stumbled on a way to produce and store a near-zero emissions energy source.

Funded in part by \$10 million from ERA's Oil Sands Innovation Challenge, Enlighten's Clean Seas Project partially upgrades heavy oil into low-sulphur marine fuel. Enlighten estimates the process also reduces greenhouse gas (GHG) emissions on a lifecycle basis by up to 40 per cent compared to alternative methods of producing marine fuel.

But then, something big (and ugly) happened.

"We started out creating a cleaner process for making ISO-compliant marine fuel oil from bottom-of-the-barrel feedstocks in Alberta," said Neil Camarta, CEO & Co-Founder of Enlighten. "We succeeded at that—but we also created a big ugly battery along the way."

Enlighten's Long Duration Energy Systems (LDES) just might be a game-changer. Cost-effective, scalable, and sustainable, this made-in-Alberta solution relies on locally-sourced materials and offers the opportunity to store energy for hours, days, and even weeks. An answer that meets the demand of long-term energy storage.

It's all based on Enlighten's NaSICON technology, a solid-state separator that isolates sodium and

sulphur ions. Basically, a catholyte that contains sodium and sulphur ions is dissolved in a solvent. As the solvent is pumped between the NaSICON separator and an electrode, electricity forces the sodium ions through the ceramic separator, liquid sodium is produced on the other side, and the battery is effectively charged. As the battery discharges, the sodium passes back through the ceramic separator and recombines with the sulphur ions to release electrical energy.

The practical applications for the battery are considerable. Along with offering backup power when renewable sources are unavailable, the process allows for large-scale grid support, capacity for peak usage management, and has a minimal environmental impact.

By employing this technology, places like California that rely heavily on renewables and experience regular climate-related power disruptions, can supply reliable energy to populations efficiently and safely while minimizing emissions.

Enlighten's projects illustrate how thoughtful investment in technology solutions can lead to further innovation.

"It speaks to Alberta's ingenuity and entrepreneurship. We're prepared to take risk, put our money on the line, put our careers on the line, and just get at it—wonderful things come from that," Camarta said.



A combined Heat and Power (CHP) system, like the one shown above, will soon transform Structural Precast's power-hungry, 80-year-old building into a modernized, low-emissions facility.

ENERGY SAVINGS FOR BUSINESS PROGRAM DRIVES CO-GENERATION POWER TRANSITION

Whether it's a factory, farm, community pool, or shopping mall, combined heat and power (CHP) systems can have a big impact on lowering emissions and cutting costs. One upgraded Alberta manufacturing facility is set to be a prime example of how this technology can help give old facilities new life.

With funding from ERA through the Energy Savings for Business (ESB) program, a CHP system at Structural Precast in Claresholm, AB will transform a power-hungry, 80-year-old building into a modernized and low-emissions facility.

"As the world transitions to a more sustainable energy supply, Alberta's innovators and entrepreneurs are seizing the opportunity to be leaders in this space," said Frank Klaassen, Vice President of Business Development, Structural Precast. "Thanks to the support from ERA, we have chosen to install a CHP co-generation unit to further reduce the carbon footprint in our manufacturing facility."

The CHP unit, installed by Alberta's CHP Solutions Inc., will reduce emissions from the facility by over 300 tonnes of CO₂ per year. ERA committed almost \$120,000 in incentives to the \$460,000 project.

CHP generates electricity from the combustion of a fossil or renewable fuel. The wasted thermal energy generated from the power generation unit is captured and used for space heating, domestic

hot water, and industrial processes such as steam generation. When paired with an absorption chiller, they can also provide cooling to buildings.

CHP technology is scalable, can be customized to suit a range of applications, and installs directly onto the grid through the Alberta microgeneration system. The grid connection makes it easy to offset energy use at the facility.

When power is needed, the CHP system directly feeds into the facility's loads. And, when excess energy can be exported to the grid, the facility receives credit on their utility bill. If more energy is required than the CHP system produces, the grid continues to automatically provide energy as required.

While CHP is already widely used in countries like the United Kingdom and Germany, and by some local Alberta facilities like CF Chinook Centre, Sierras of Tuscany Condominium Corp. in Calgary and Mount Royal University, the transition to co-generation CHP is just starting to take off in Alberta.

"Structural Precast's facility is a really good fit for CHP technology because they need a lot of heat to speed up the curing of their slabs. Our machine provides electricity and heat for their process," Sean David from CHP Solutions. "We see a great opportunity in Alberta, on the whole. Its potential is massive."

COMMITTED TO ACTION

- ▶ ERA is a key partner in helping to achieve Alberta's climate and economic priorities. We fund and de-risk late-stage technologies to reduce GHG emissions and help grow and create competitive industries in Alberta.

CONVENING RESOURCES FOR COLLABORATION

- ▶ For more than 12 years, ERA has been investing revenues from the carbon price paid by Large Final Emitters (LFEs) to accelerate the development and adoption of innovative and clean technology solutions.
- ▶ We work with industry, government, and technology developers to make Alberta a hub for innovative ideas that reduce GHG emissions and improve economic competitiveness.
- ▶ We convene resources and facilitate strategic partnerships with industry, government, business, academia, and other funders to foster a suite of policy, regulatory, program and business innovation tools that will help address barriers to commercialization.
- ▶ With our stakeholders, we developed a Technology Roadmap that guides investment decisions and informs our investment portfolio mix.

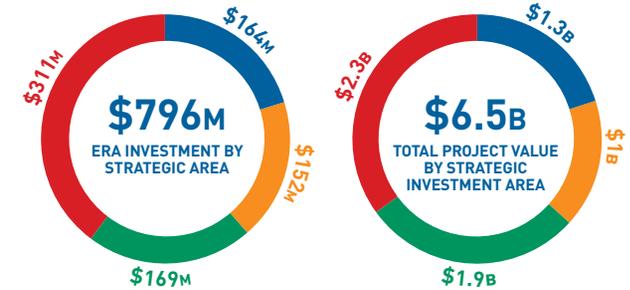
| FUNDING OPPORTUNITY | WHAT'S IT ABOUT? | ERA FUNDING | HIGHLIGHTS |
|--|--|-------------|---|
| GRAND CHALLENGE | Technologies to transform CO ₂ from waste to value-added | \$30M | 2 projects awarded \$5M each in the final round |
| METHANE CHALLENGE | New methane detection and reduction technologies | \$23M | 11 projects funded worth \$60M in total project value |
| OIL SANDS INNOVATION CHALLENGE | Late-stage, GHG-reducing technologies to help Alberta's oil sands industry remain competitive | \$45.6M | 7 projects funded worth \$572M in total project value |
| INDUSTRIAL EFFICIENCY CHALLENGE | Technologies to increase efficiencies for LFE industrial facilities | \$56.4M* | 9 projects funded worth \$235M in total project value |
| BEST CHALLENGE | GHG-reducing technologies in biotechnology, electricity, and sustainable transportation | \$76M | 13 projects funded worth \$295M in total project value |
| NATURAL GAS CHALLENGE | Unlocking innovation across Alberta's natural gas value chain | \$58M | 20 projects funded worth \$159M in total project value |
| FOOD, FARMING, AND FORESTRY CHALLENGE | Accelerating innovation for sustainable growth | \$33M | 17 projects funded worth \$117M in total project value |
| SHOVEL-READY CHALLENGE | Support for companies ready to implement leading-edge technologies in applications for both greenfield and brownfield operations | \$166M* | 16 projects funded worth over \$2B in total project value |
| PARTNERSHIP INTAKE PROGRAM | Evaluating promising GHG-reducing projects referred to ERA by Trusted Partners | \$61M* | 18 projects funded to date worth over \$1.2B in total project value |
| ENERGY SAVINGS FOR BUSINESS | Support for small- and medium-scale industrial and commercial businesses for cost-saving and emissions reducing projects | \$55M* | \$24.1 million in incentive obligations to date |

*This program is funded in part by the Government of Canada's Low Carbon Economy Leadership Fund.

INVESTING IN A DIVERSE PORTFOLIO

220 Projects

- ▶ **Cleaner Oil & Gas** (73 Projects)
- ▶ **Low Emitting Electricity System** (28 Projects)
- ▶ **Food, Fibre, & Bioindustries*** (60 Projects)
- ▶ **Low Carbon Industrial Processes & Products** (59 Projects)



*In 2012, ERA provided funding for three adaptation projects in consultation with Alberta Environment and Parks.

CUMULATIVE PROJECT EMISSION REDUCTIONS

6.1 Mt CO₂e Total by 2020



42 Mt CO₂e Total by 2030



Note: We have estimated emission reductions for all projects with approved funding commitments and executed funding agreements and assumed the projects will continue successfully and as planned. Should circumstances change for these projects, emission reduction estimates may change materially. These projections do not include the Energy Savings for Business program.

LEVERAGING FUNDING AND CREATING JOBS

Technology is the engine of environmental and economic opportunity. For every ERA dollar we commit to advancing new technologies, over \$7 has been invested by funding partners.



*A person-year is equal to one-year of employment for one individual. Please note: economic impact is reported on a calendar year basis, not fiscal year.