ENERGY.AI3 ACCELERATOR

How can artificial intelligence and machine learning enable Alberta to thrive in a competitive, low-carbon world?

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With the support of the RBC Foundation, the Energy Futures Lab (EFL) has been exploring the intersection between artificial intelligence, machine learning, energy and climate since fall 2018.

The EFL's Energy.AI initiative overarching ambition is to develop collaborative initiatives that apply machine learning and artificial intelligence to address climate change and environmental challenges within the energy and power sectors.

Machine learning can be applied in the analysis of historical data, such as energy production a consumption, and turn them into predictive models. These technologies can help organizations turn quality data into insight and advanced analytics into foresight, resulting in greater efficiency and improved decision quality.

Since 2018, the EFL has held three Energy.AI workshops to explore the potential of new digital innovations.

The first Energy.AI workshop shared insights and experiences from seasoned AI and energy innovators and practitioners, as well as creating a space for dialogue and experimentation.

The second workshop, Energy.AI2, focused on digital up-skilling and building awareness on how machine learning can be applied to energy and climate challenges, and on crafting compelling "problem statements" related to energy, climate and digital innovation.

The third event in the Energy.AI series, the Energy.AI3 Accelerator, harnessed the expertise of technology innovators to work with energy professionals to advance solutions for a small set of problem statements identified at the previous Energy.AI2 workshop.

The three areas of focus were:

- Industrial Energy Efficiency and Reducing Emissions with AI
- Improving Power System Data Quality to enable AI Applications
- Advanced Technologies to Depolarize Energy Dialogues

This report records the progress made in advancing solutions to these problem statements at the Energy.AI3 Accelerator event.

Accelerator Agenda

Technology innovators and energy professionals attending the Energy.AI3 Accelerator event were divided into groups based on their expertise pertaining to the three problem statements:

- Industrial Energy Efficiency and Reducing Emissions with AI
- Improving Power System Data Quality to enable AI Applications
- Advanced Technologies to Depolarize Energy Dialogues.

Experts outlined the opportunities and challenges present in each solution space.

The attendees in each group then completed a "force field" analysis to identify forces that hinder and help address the problem.

Strategy sessions were then held to develop solutions to each of the problem statements.

These solutions were then presented to all Accelerator attendees.

Industrial Efficiency and Reducing Emissions with AI

With industry consuming 30 percent of all energy globally, Greg Bennett of AIRIA Cloud said there is a great opportunity to reduce emissions through AI, while acknowledging the challenge of navigating established operational systems, large volumes of existing data and significant infrastructure.

The complexity and size of industrial operations are major challenges. Digital assets are tightly coupled with organizational structures, sometimes creating organizational silos and silos of both structured and unstructured data. The scale of industrial operations, where there are billions of external connections, adds to this complexity. Physical and digital infrastructure is sometimes decoupled, disconnecting data from operations.

Industrial operations also have a critical focus on safety, making adopting AI more difficult than in more experimental and agile sectors. There is a need for high reliability and high security.

Bennett said cloud native solutions could be the foundation to address many of these challenges. Cam Crockett of Google Customer Engineering said Google has transitioned to an AI company and currently has a major initiative under way to democratize AI, making it available to all industries.

Crockett said Google has used AI to improve energy efficiency in a variety of sectors. The application of AI at a data centre resulted in the centre using 50 percent less energy than similar data centres. Google's Project Sunroof is an AI application that uses roof angles, weather patterns and historical data to forecast and find solar potential in urban environments. The technology company is also using AI to improve wind energy productivity and uptime. It is using drones to take photos and using visual computing to inspect blades for maintenance, cracks, blade angles, etc. The company is also using AI to predict the presence of geological features like faults or fault structures in petroleum exploration.

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FORCE FIELD ANALYSIS

During a breakout session the attendees focused on industrial efficiency and reducing emissions with AI. They identified the following hindrances and helpers to integrating AI into operations:

Hindering Forces:

- An internal culture resistant to change
- A lack of external collaboration with technology providers
- Concerns around impacting company's safety and environment programs
- A lack of integrated data platforms to enable AI
- A lack of understanding of AI value

Helping Forces:

- A focus on safety and environment
- The current economy driving efficiency and cost savings
- AI and digital hype is driving executives to support initiatives

The Industrial efficiency group developed strategies for moving AI forward in the sector. These were:

- Matching leaders with practitioners to integrate AI into operations, including:
- Creating engagement between small and large companies practicing AI
- Finding business champions, show successes, share
- Rethinking the royalty regime in Alberta to tie royalty payment to the amount of innovation and engagement with small solution providers to drive progress
- Finding solutions that align with leaders driving for sustainability

They also provided the following strategies towards building a more collaborative connected business environment:

- Identifying champions within companies and connecting solution providers with these champions and other technical staff in companies
- Holding events like training workshops, "Dragon's Den" style innovation pitch competitions or annual awards ceremonies for best innovations
- Consolidating innovation groups and consortia and having this new group develop an agile path to innovation – fail fast, iterate, be transparent
- Building joint designated test facilities to try innovations in digital
- Leveraging IT technologies like building a public platform to share ideas, successes, failures. This could things like podcasts or unique tools an emissions reduction clock to provide visual feedback on progress
- Considering a public energy-coding repository to share coding tech (or do this within the company itself)

The following three solutions were then prioritized for future development:

Creating a showcase for successes (and failures) using AI to improve energy efficiency and reduce emissions. This could be a website or podcast

Creating a joint test facility for innovation focused only on data and machine learning

Creating a forum for practitioners to share data, code, and crowd source solutions

Improving Power System Data Quality to enable AI Applications

Jeff Bell from Alberta Economic Development said to stay competitive globally Alberta needs to use AI/ML to improve the efficiency of its power industry.

The key economic drivers pushing AI in the industry are customer engagement and retention.

Bell said there is a global trend towards the electrification of energy, creating a huge market for AI/ML technologies that can improve efficiencies and reduce GHG emissions. There is a diversity of use cases for AI in the sector, from improving reliability, optimizing the grid, to integrating renewables into the grid.

With the potential for clearly defined rules and the relative ease of collecting data, the power sector has a number of advantages in integrating AI into its operations, he added.

Alberta's unique power market also provides a number of advantages to moving AI forward, including:

- A deregulated market with reduced barriers to market entry
- Complex but clearly defined rules
- Richness of data from AESO
- Entrepreneurial and research talent
- Existing infrastructure for use cases

POSSIBLE USE CASES FOR AI/ML IN POWER MARKETS

The group identified possible uses in industrial and consumer power markets.

For industrial power markets, the following use cases were identified:

- Onsite storage + generation cost/carbon optimization for large industrial consumers
- Onsite load optimization for demand side management
- Geographic optimization of grid infrastructure installation and strategic infrastructure planning, and EV planning
- Reactive power optimization
- Outage management and prediction
- Predictive maintenance

In consumer markets, the following use cases were identified:

- Onsite storage + generation cost/carbon optimization for residential consumers
- EV charging optimization
- Micro-grid optimization: micro-grid owner to grid operator and peer-to-peer
- Neighbourhood level batteries management

Bell said there are significant data challenges to integrating AI into the power system that could delay progress, including:

- Data availability - data must exist
- Data quality - data must be accurate
- Data resolution - data must be of sufficient resolution
- Data volume - there must be sufficient data
- Data access - must be able to obtain and utilize data
- Data value proposition - must be worth everyone's while

He suggested two possible routes to begin solving the data issue. The first route would be a "top-down" effort led by government to create a public data inventory everyone could use. The second would be an industry-led initiative with sharing of data between private parties. He said the more realistic plan would be an industry-led effort to build the needed data inventory.

Devin Beaton of Nutana Power said having quality data is important in integrating renewable energy into the power grid. Despite falling costs of renewable generation, namely in wind and solar, the inability to control the timing of power generation limits its implementation and economic viability, Beaton said. To get around the intermittency issue, Nutana is focused on integrating a hydro-battery storage system with wind power generation to create a renewable peaker-plant that can take advantage of periods when prices are highest in the Alberta power market. By using a smart operating system to find price spikes in wholesale markets, Nutana hopes to target the five per cent of the hours in a day where 50 percent of revenue is generated.

Where machine learning comes in is turning this smart operating system from a static trigger to dynamic trigger, allowing Nutana to get 10-15 more income through better targeting of sales.

Data from distribution owners would help generators properly site and scale projects, said Beaton. The renewable sector needs data as a service from regulators or utilities to align goals better.

Beaton said by having the right data available it can use AI to optimize its plant design and operation, and use data to inform energy storage development and integration.

Owen Zarazun of EQUS, the largest member-owned electrical co-operative in Canada, said improving data quality to enable AI applications is challenging in the rural areas EQUS serves in Alberta.

EQUS is replacing approximately 12,000 manually-read electrical meters with an advanced metering infrastructure (AMI) system that will provide two-way communication between the meter and EQUS staff and ultimately its members.

The AMI system will provide EQUS another conduit to connect with its members and in the future this will be fundamental in providing future opportunities to EQUS in its growth, he said.

Zarazun said new technology, evolving customer needs and desires, environmental awareness, and an increased focus on grid resiliency and optimization are driving change in the power sector.

Metering technology has vastly improved over the past five years providing more than just a monthly meter reading for billing, he noted. With the ability for two-way real time communication between the meter and the utility it opens up many more possibilities for the utility and the consumer.

The benefits of the AMI system include:

- No more meter reading or estimates resulting in fewer billing inquiries/concerns
- More information and quicker notification and response to outages resulting in quicker outage restoration time
- Savings due to reduced metering inventory
- Metering standards and specialized staff managing the metering
- Validation for system planning and accountability for system improvement projects

FORCE FIELD ANALYSIS

During a breakout session, the attendees focused on improving power system data quality to enable AI applications. They identified the following hindering and helping forces:

Hindering Forces:

- A lack of standards results in no clear sets of data available to everyone. There are many different protocols as every utility operates differently. There are areas where data is lacking. For example, there is no good data for micro-generation or micro-grids. There are different data needs for different applications, and a lot of machine learning applications require very specific data
- Challenges getting granular data down to community level. There is a need for localized information for scalability of AI projects. Power companies have data that's hyper-localized. Data exists in super high resolution but is locked up due to privacy issues. Consumers don't care about providing data, they only care if it impacts their wallet
- The majority of power demand comes from commercial and industrial customers, making residential a small piece of the pie.
- Because data is more valuable, companies are less likely to collaborate. This comes from the myth you can get insight from data by yourself

Helping Forces:

- Alberta has research talent to develop AI to improve efficiency
- There is big opportunity on the commercial industrial side where energy demand is an issue
- There is a market incentive for high quality data
- The cost of smart meters has declined so that installing them no longer a barrier
- Computational power is now astronomical, making edge analytics easy
- The speed of AI research and development globally is rapidly increasing and most technology developers are industry agnostic, meaning their technology can be applied to power systems

Strategies were then discussed to move AI forward in the sector. Three priorities were developed:

1. Anonymize data to avoid privacy issues in sharing data. Some options to make this possible include:
   - Stripping out personal data and only using sensor data
   - Sharing data analysis but allowing the original owner to keep the data
   - Sharing raw data if it doesn't need explicit sign-off for use
   - Creating a ledger network where people can transact without privacy issues for data owners
2. Form an organization to collect and standardize data. Some options suggested to make this possible include:
   - Government taking a leadership role in building the shared data pool Government could create

the vision for centralized data storage that includes market mechanisms to encourage sharing
- Having an independent third party centralize and anonymize data to protect individual players' competitive edge. This third party could also develop the best practices so data is collected the same way, with the same metadata, and the same language describing the data
- Building pilots in subsectors of the industry that could then be used as a model for wider collection and standardization

3. Create incentives for data owners to share data that extends from the energy consumer all the way up the value chain to power generators. This includes aligning interests across the sector to ensure everyone benefits.

The group examining improvements to power system data to enable AI identified three potential projects to advance AI:

- A pilot project bringing together solar energy system manufacturers, installers, system owners, distribution and retail companies to share data to develop AI programs to improve efficiency
- Energy co-ops where you contribute something to get something back could encourage data sharing. Consumers are interested in rewards and would need to see energy savings to participate
- An independent third party company to collect behind the fence data from industry, anonymize and standardize the data, and share it. This data marketplace could use a distributed ledger to put data up, and get data out

Advanced Technologies to Depolarize Energy Dialogues

This group focused on using advanced technologies to depolarize energy dialogues. They were tasked with:

- Developing a better understand how technology, in particular machine learning, is being used to reinforce polarized views and spread inauthentic news
- Exploring innovations in which machine learning can be used to help depolarize the energy conversation.
- Identifying ways in which collaborators can advance these innovations through the EFL platform

Barend Dronkers of Energy Efficiency Alberta began the discussion by defining the use of 'polarization' and 'depolarizing.' He defined depolarize as coming to a compromise, find common ground to move forward. He defined polarizing as dividing into two polar perspectives.

Dronkers pointed to the rise of social media as having a polarizing effect on the public by driving users into "filter bubbles" – increasingly like-minded communities whose views are reinforced and become more extreme. He said the problem facing the dialogue over energy is it has become polarized, creating an "empty middle" where conversations about solutions would normally occur.

Abbas Sarraf of Aimsio provided an outline on how AI/ML is being used in social media and how it results in increased polarization. Sarraf said huge amounts of data are being generated by social media users that are being fed into AI/ML applications allowing data brokers to build extensive profiles on entire populations and to predict individual and group behaviour. These profiles can be used to manipulate people through a variety of methods, including using the resonance effect, where nudging is customized to

each individual, or by reflecting opinions back at individuals to solidify any given viewpoint.

This causes social polarization, resulting in the formation of separate groups that no longer understand each other and find themselves increasingly at conflict with one another. Humans use social information to modify their behaviour and make decisions, and when that social information is easily manipulated, human decision can also be manipulated, he said. Sarraf said these tools are being used to generate and disseminate low-cost fake news, and increasingly to create deep fakes (manipulated images).

To avoid this manipulation, it is important to control personal data, he said. This includes paying for information. If a product is free, 'you are the product,' he explained. He added using your Internet browser on incognito mode helps limit the amount of data that can be gathered. He also said people need to think twice about sharing on social media.

Lianne Lefsrud of the University of Alberta said depolarizing the dialogue on sustainability and energy transition requires an engaged and open discussion amongst diverse stakeholders about the risks of various scenarios (inaction and action), and the possible means and processes to balance people, profit, and planet.

From the EFL and industry perspective, Lefsrud said inaction is not a solution. Instead, it is about looking at various scenarios, pulling together various stakeholders to look at those scenarios, and defining where action/inaction is constructive or not.

Risk communication principles (enlightenment, behaviour, trust, conflict resolution) need to be leveraged to find middle ground. External and internal communications strategies need to be developed. And communicators need to understand the role of emotion in shaping public attitudes.

Lefsrud suggested some steps to depolarize the conversation, including:

- How can we create enlightenment? (Do folks fully understand risks and what it means to be risk literate)?
- How can we drive behavioural change?
- How can we build trust?
- How do we resolve conflict?

From an organization perspective, she said there is a need to look at all risks (environmental, safety and economic). Everyone in the conversation needs to know that there are many complex interactions between an operating production process and the environment.

Lefsrud said industry needs to do a better job communicating risk and making its audience more risk literate. She said many people hold opinions and enforce others to see their viewpoint when they don't really understand the risks of holding that opinion or belief.

As organizations define risk, analyze and evaluate risk, they need to ask if they are communicating their risk pathways clearly.

Lefrsud said public distrust in NGOs, government, business and media continues to grow. At the same time, media is being increasingly amplified by social media. A lot of engagement growth comes from education. More women than men tend to amplify stories.

Lefsrud's research shows that emotional similarity is the best predictor of linkage between people. The higher the emotional similarities, the more people will link to each other (share information outward and back). The higher the emotional difference, the greater chance that we will not be connected or related.

To positively influence their reputation in the social media world industry spokespeople need to attach themselves to technological findings, and attach to social movements, she said.


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Lefsrud said we now live in a post trust, post reality world. As a result industry needs to work with others to communicate risks and changing risks, it needs to recognize what words help to amplify/attenuate its messages. And it needs to identify the sources that can deliver its message, and the channels across which those messages are sent. It needs to be careful of "hot button" words but also be aware of why/how others use them.

Trust is not produced but instead is earned, she said. Trust is performance based and tied back to how you communicate risks.

FORCE FIELD ANALYSIS

The event attendees provided the following insight into the issues surrounding polarization of the energy dialogue:

Hindering Forces

- Perception of media is polarized, with each side accusing the other of bias. Figuring out what created the poles of the political spectrum in media is important
- Accuracy and depolarized opinions can only be created by reading articles from different perspectives.
- The media platforms need to commit to presenting diverse viewpoints and opinions
- Existing ideologies and political viewpoints make it challenging to change minds

Helping Forces :

- People are realizing they are being polarized. Social media has pushed users to either side
- Numeracy is being taught in education. This is a positive to depolarization

The roundtable discussions also identified ways advanced technologies could be used to depolarize the energy dialogue. These included:

- Using dialogue frameworks coupled with advanced technologies to enforce good dialogue behaviour.
- Finding ways to use AI to facilitate the human element to solve the polarization problem. One example is an application that monitors conversation and uses verbal analysis and synthesizes the tone to facilitate self awareness tools
- Using online profiles to identify context and where people sit on the issues. Is there space to try to allow them to see other 'contexts'? Could something help us identify their gaps in knowledge and then choose to either do something about it or not? Where does privacy and ethics stop us in this manner?
- The ALBERTA NARRATIVES PROJECT is one example of work being done to identify algorithms showing how people can be or cannot be moved to the middle
- Using AI to help create or curate content
- Tracking hash tags as a means of understanding what different generations see as important

The roundtable participants also suggested areas where the EFL could play a role in depolarizing the conversation, including:

- Helping to define where the lines are as it relates to accuracy

- By providing discussion points to allow people to come to their own conclusions
- Identifying people to create content or using AI to create the content and then asking people how they feel about the certain topic/ discussion/question
- Using AI to pull various streams of content to create more content or discussion points from the cross referencing of risks

The attendees tasked with using advanced technologies to depolarize energy dialogues came up with the following three potential solutions:

1. Create an online game to help move the conversation toward the middle. The goal would be to help the average person to engage in the energy transition. The game would:
   - Have a push component to expose people to thinking about relationships and complexity in a critical way
   - Monitor the reactions and the decisions made by the populous
   - Have AI technology synthesize the values and decision-making process
   - Promote introspection and self-awareness (forces people to face complicated and critical challenges)
   - Build a community around the game to help market it
   - Encourage understanding of alternate perspectives
   - Help manage complexities early in primary and secondary education

2. A podcast to share ideas. Topics could be identified by what other podcasts are saying, or by finding topics not being covered in the media.

3. Create a forum/hub for practitioners to drop research information. The hub could be used to showcase staged development of different technology solutions.

CONCLUSION

The Energy.AI3 Accelerator brought together technology innovators to work with energy professionals to advance solutions for a small set of problem statements identified at the previous Energy.AI2 workshop.

The three areas of focus were:

- Industrial Energy Efficiency and Reducing Emissions with AI
- Improving Power System Data Quality to enable AI Applications
- Advanced Technologies to Depolarize Energy Dialogues

In each of these areas, attendees engaged in dialogue to explore how they could work collaboratively to address the opportunities and challenges in these areas, identifying a set of initiatives to continue to explore together.

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