Smart Power Video Script

# Intro

Welcome to our video presentation for the Discover AI challenge for smarter and sustainable economies. Introducing the team, we have:

- Adam Dunn, an electrical engineering graduate from Western University

- Dheeraj Ghangas, an Honour’s Bachelor of Business Administration graduate from Wilfrid Laurier University

- Nathen Gay, an Honour’s Bachelor of Technology student at Seneca College

For our project we wanted to be able to leverage AI and analytics with reliable data as well as incorporate the Microsoft Azure Cloud platform to do so. With that in mind, the Smart Cities pillar seemed like the perfect fit to start our project.

# Need for Product

From the smart cities topic we wanted to investigate new methods of short-term energy demand forecasting on a regional basis. The current methodology used by the Independent Electricity System Operator has difficulty estimating for fluctuations resulting from holidays, extreme weather or other force majeures. These inaccuracies in forecasts can cause a surplus in electrical generation, asset investment risk and additional fees to the downstream customer.

The way a power system works is that all load must be consumed at some point and a surplus eventually becomes a liability. To eliminate a surplus, the System Operators sell it as a loss leader which leads to a reduced or negligible profit margin. In some cases when it is difficult to sell the surplus, the IESO must pay a neighboring operator to accept the load.

In the past, reducing surplus by at least 1% in the Ontario energy market has generated $100-200k in initial savings and can have a cascading effect on improved asset investment in the $2-4 million range.

# Idea and Solution

Our team idea seeks to improve the prediction accuracy and reliability by using a machine learning time series model. It creates a matrix of inputs from real historical data to learn trends, and has inherent advantages of handling nonlinear functions faster.

To develop this type of solution, we used the Azure Machine Learning Workspace to train a model using existing datasets from Toronto, Ottawa and the Bruce Peninsula; giving various population sizes.

* For any kind of machine learning, the dataset must be first cleaned by removing irrelevant, missing or unfinished values that could misdirect the program. For this we designed a pipeline to delete rows with missing values, which focuses the dataset to only relevant time, regional load or weather data.
* To find the best fit model, we used an Automated Machine Learning tool in Azure that optimized the normalized root mean squared error result from our dataset and had incredible performance for Toronto and Ottawa regions
* The next stage is being able to use the time series model to forecast future power demand and the best way to offer this as a product is as a web service which is made easy on the Azure platform.
* Using the Azure Kubernetes Service, we can deploy and manage a containerized web service application with CI/CD to continue to retrain the model with new data. The platform is completely scalable by adding additional AKS production clusters. For our prototype, we successfully deployed our model to an AKS cluster to build our web service however the costs associated made it unfeasible to keep it sustainably running during the development and testing phase.
* For testing our models as a proof of concept, a basic webservice was built using the machine learning pipelines.

# Example Walkthrough

# Business Model and Cost Estimates