

CASE STORY

NOVA SCOTIA POWER

Unlocking Grid & Load Insights with AI Meter Data Analytics



As electric vehicles, heat pumps and other electrification technologies transform Nova Scotia's energy landscape, Nova Scotia Power faced a critical question: How could they understand what was truly happening behind the meter? The answer lay in turning millions of data points from their Advanced Metering Infrastructure (AMI) into actionable intelligence.

"Once we adopted AMI, we could see when they were using electricity, but we didn't know what they were using it for," explains Riley Cook, Nova Scotia Power's lead data scientist.

The utility turned to Bidgely's UtilityAI™ and its Analytics Workbench tool to gain deeper understanding into customer energy usage patterns to inform critical business objectives, including:

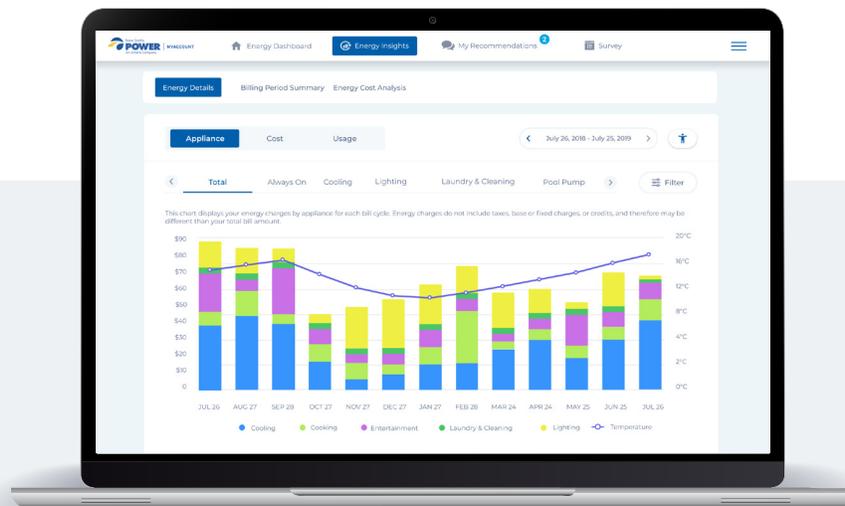
- ✓ Designing effective time-varying pricing (TVP) rates
- ✓ Understanding who is electrifying and the impact of that electrification on the grid
- ✓ Improving load forecasting accuracy
- ✓ Supporting renewable energy goals
- ✓ Better segmenting and understanding their customer base

“We need to first understand who is electrifying and how they’re doing it. We’re also trying to understand how our ecosystem is changing, especially with renewable energy targets of 80% by 2030. We have to understand how that change is happening from a bottom-up approach rather than just a top-down approach.”

Validation: Building Trust in AI Insights

“It’s really a journey. At the beginning of the journey, you really don’t know what to expect,” says Cook about relying upon Bidgely’s analytics. “You’re given these numbers and classifications, and first try to validate whether or not they make sense. We don’t want to use things blindly, of course, especially if we’re going to derive insights from the analysis to inform key decisions.”

Nova Scotia Power conducted extensive validation to determine if they could rely on Analytics Workbench’s insights before full implementation.



Electric Vehicle Detection

Nova Scotia Power compared Bidgely's EV detection against a list of 199 known EV owners who participated in the utility's Smart Grid Nova Scotia pilot and self-reported through surveys on the utility's Bidgely-powered "My Energy Insights" customer experience platform.

Initial validation in 2023 showed Analytics Workbench detected 46% of known EVs, which included plug-in hybrids and also any type of charging (L1 or L2). This detection improved to 65% by 2024 after Bidgely refined its algorithm to eliminate interference from electric thermal storage heating systems. The algorithm also does not pick up customers who do not regularly charge at home or have a plug-in hybrid. More importantly, the false positive rate was near zero: When customers reported not having an EV, Analytics Workbench correctly classified them as non-EV owners.

Heat Pump Classification

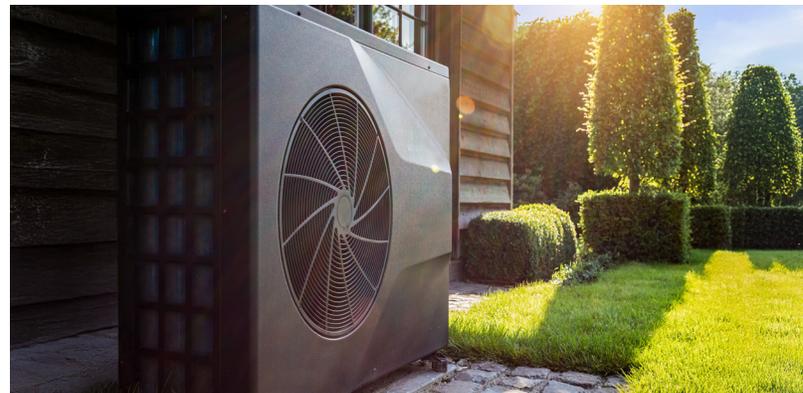
Nova Scotia Power provided Bidgely with a known list of heat pump customers from their historical on-bill financing program. This provided a baseline dataset that Bidgely could use to train their machine learning algorithm to classify heat pump ownership across the utility's entire system.

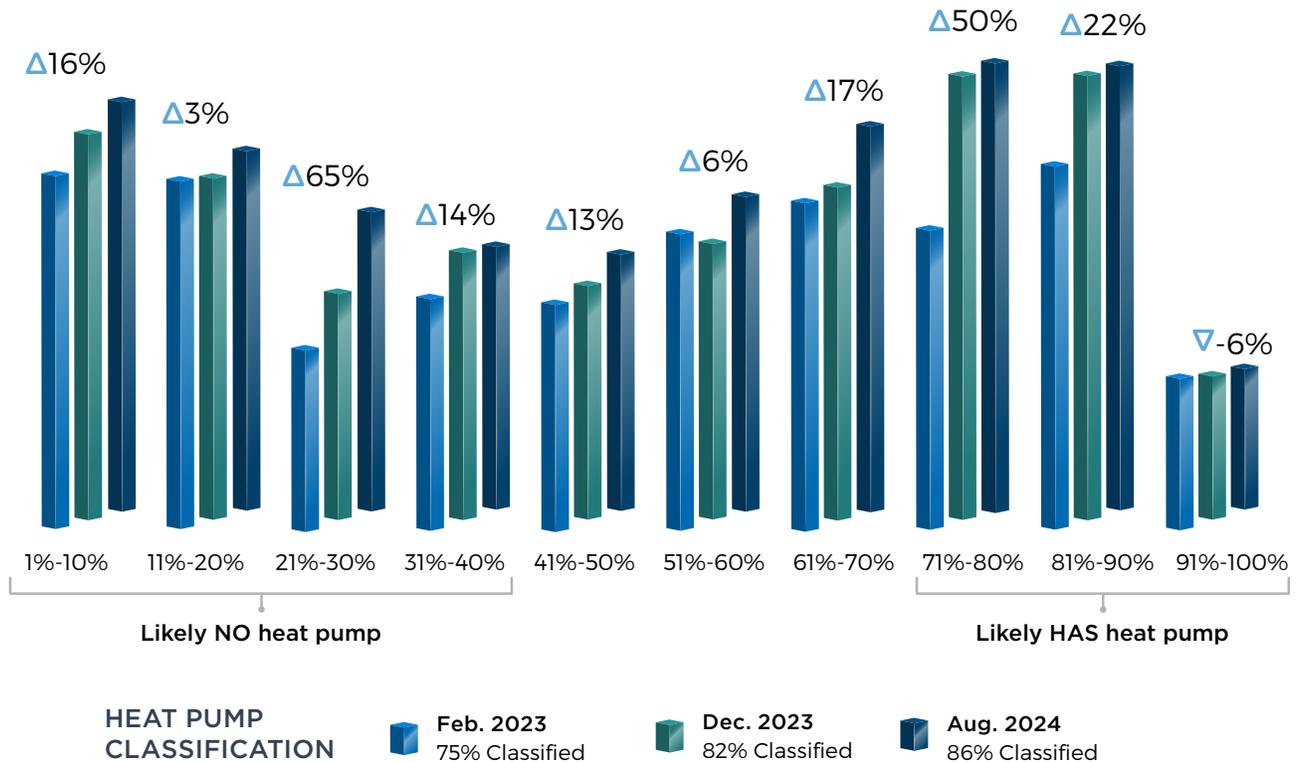
The classification used a probabilistic model that assigns each customer a likelihood percentage of having a heat pump. Nova Scotia Power ran this model multiple times (February 2023, December 2023, and August 2024), improving classification rates with each iteration. By August 2024, only 14% of its customers remained unclassified.

One of the key outputs of the modeling exercise was determining where to "draw the line" for classification. After analysis, Nova Scotia Power established that:

- ✓ **Customers with 40% or lower probability were classified as "likely no heat pump"**
- ✓ **Customers with 71% or higher probability were classified as "likely having a heat pump"**

Rather than setting these thresholds arbitrarily, Nova Scotia Power validated them by cross-referencing with their "top-down" market knowledge. They knew approximately how many heat pumps existed in their territory through their preferred contractor network (around 130,000 at the time). When they plotted this known quantity against their probabilistic model results, the lines intersected precisely at the 70% mark, confirming this as an appropriate threshold.





Heating Type Classification

Nova Scotia Power also compared its legacy internal heating type classification model that segmented customers into three heating categories (primary electric, secondary electric, non-electric) with Bidgely's more-detailed Analytics Workbench six-category classification system.

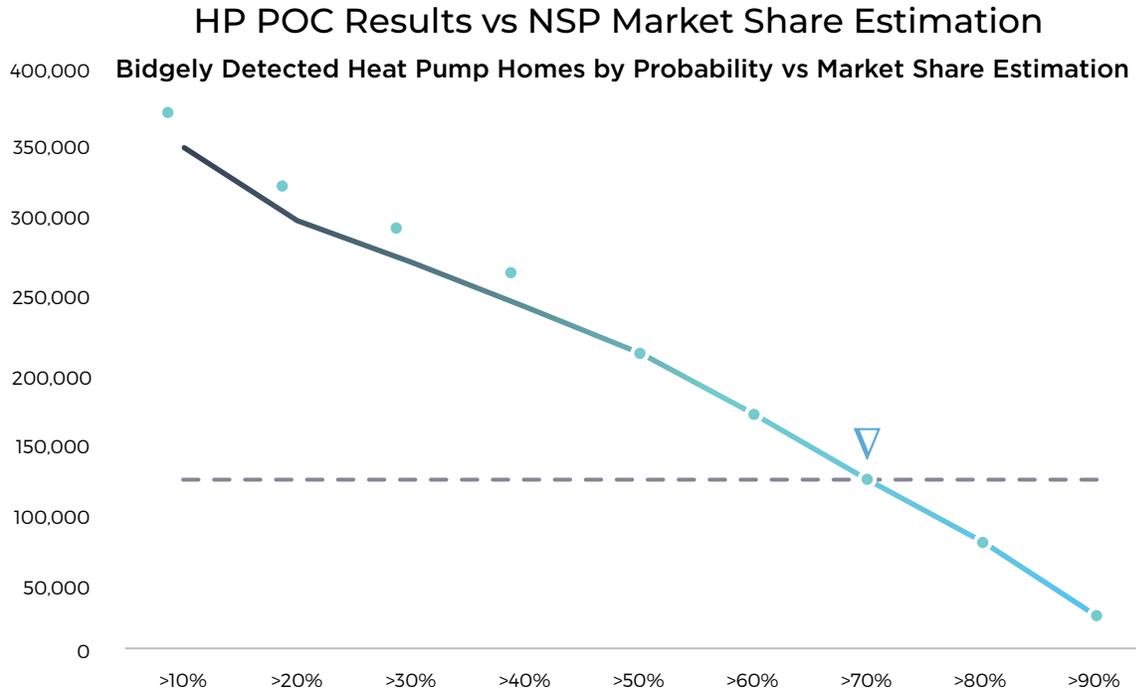
The validation showed 82% agreement between Nova Scotia Power's internal model and Analytics Workbench. Virtually all the disagreements involved cases in which the utility classified customers as non-electric, while Analytics Workbench detected some form of electric heating signature.

After investigating specific cases where the models disagreed, Nova Scotia Power found that Analytics Workbench was correctly detecting occasional electric heating signatures that were outside the detection scope of their model by design.. The discrepancy wasn't about accuracy, but rather about classification definitions. Nova Scotia Power's model was looking for primary electric heating (used consistently), whereas Analytics Workbench was detecting any electric heating, even if used infrequently.

After reviewing hundreds of these cases, Nova Scotia Power refined its internal model based on the Analytic's Workbench insights.

✓ **The validation showed 82% agreement between Nova Scotia Power's internal model and Analytics Workbench.**

“We found that a lot of times, we might want to tune our model. So we actually refined our model a little bit. It was a small tweak, but it added a few more percent to that 82%. So we might agree about 85% of the time now. But what it did was help us refine our methods. So that was really good,”



—●— Bidgely % Probability
 - - - 2022 Marketshare Estimation

Commentary:

- NSP estimated there were 125K heat pumps as of year end 2022
- This aligns with Bidgely's >70% probability which estimated 128K as of February 2023



From Data to Action

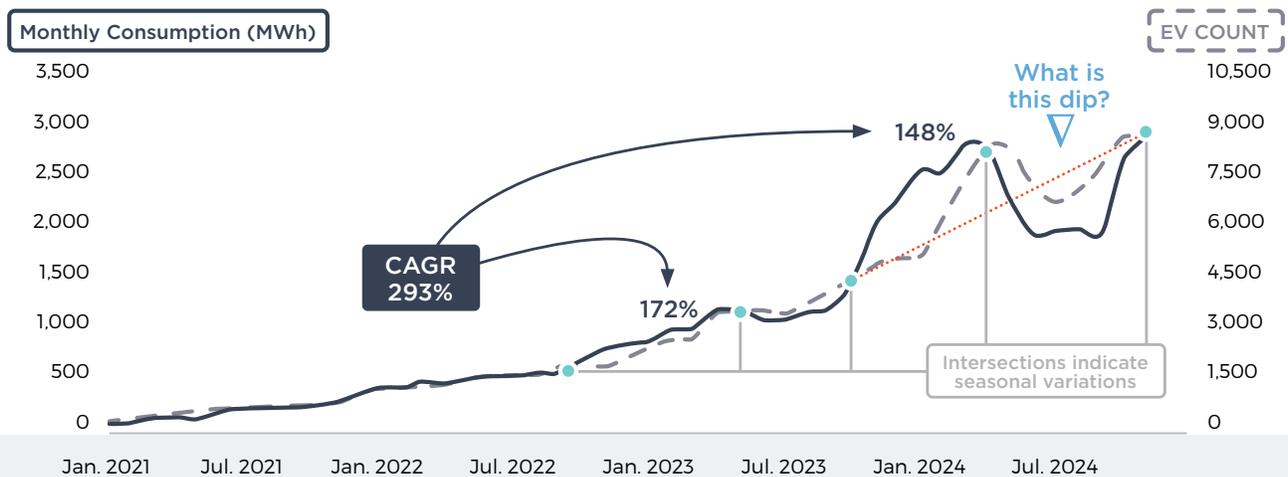
“My group’s vision is to provide data-driven insights that can inform actionable business decisions. In order to be actionable, it has to have a sizable market associated with it. So of course, we’re looking into things that are growing and changing,” explains Cook. “EV adoption is a big one, because we see a lot of EVs coming onto the system.”

Understanding EV Growth Trends

With confidence established, Nova Scotia Power began using the data to track EV growth through a bottom-up approach that measured EV adoption by aggregating individual customer data. Key insights included:

- ✓ EV adoption in Nova Scotia is growing significantly, aligning with their load forecasts
- ✓ EV consumption follows seasonal patterns, with higher usage in winter and summer
- ✓ EVs use approximately 3,820 kWh per year/car – a highly accurate figure that could be directly integrated into load forecasting models
- ✓ Peak demand impact per EV is much lower than theoretical charger capacity (under 1kW per EV versus 7-11kW charger capacity)

What does EV growth look like in Nova Scotia?



“People thought, ‘Oh, how can the grid handle EVs? Grids are already very constrained. These EVs are very high power. Everybody plugs-in at once. Everything’s going to fail.’ reflects Cook. “I think when you use real data-driven insights, which is what we’re getting from this, it helps support the idea that, ‘no, the grid doesn’t have to fail.’ In fact, it can actually help the grid in many different ways.”

Time-Varied Pricing

“We do a lot of work around rate design as well, because we’re trying our very best to put as much downward pressure on rates as possible. The whole point of knowing how customers are consuming electricity is so that we can design better electricity rates,” He Says.

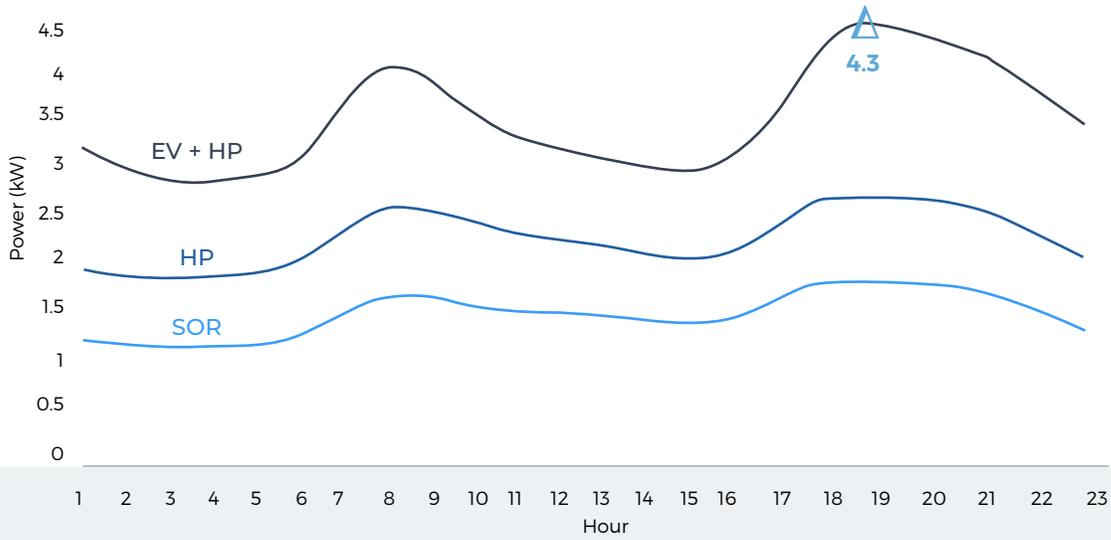
The ability to create load profiles to illustrate the energy use patterns of hyper-targeted customers segments has proven instrumental in rate planning.

“One of the ways we can really use detection and classification is to create more sophisticated load profiles,” Cook explains. “For example, as customers electrify, what does their load profile look like? Especially when we start splitting profiles into our various rates plus these classifications, we see that we have the potential to significantly reduce on-peak load – such as customers who own EVs adopt time-varying pricing. That’s an insight that you would expect to happen. But you can actually quantify it now. So it’s really useful from a load forecasting and grid impact perspective as to how things are likely to evolve over time. What’s it going to do to our peak if, for example, if we have 20,000 more EVs on our grid over the next few years? What the load profile can show is if we manage EV adoption correctly and put the right rates out there for those customers to adopt, we might not see any impact to our peak.”

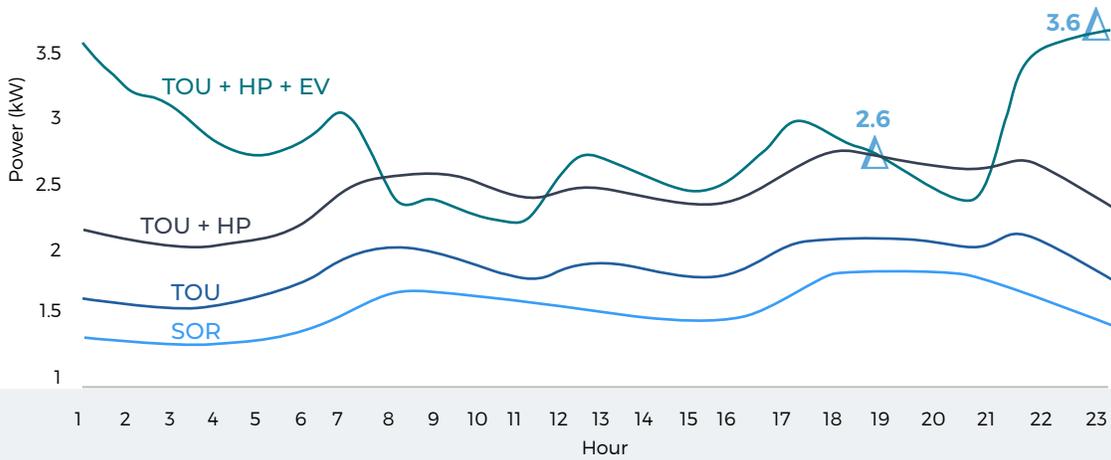
- ✓ **Standard offer rate customers with EVs and heat pumps increase consumption during both peak and off-peak periods**
- ✓ **Time-of-use (TOU) customers with EVs shift consumption to off-peak hours, with peak consumption remaining similar to non-EV TOU customers**
- ✓ **Critical Peak Pricing (CPP) customers with EVs and heat pumps dramatically reduce consumption during peak events, falling below the average standard offer customer on non-event days**



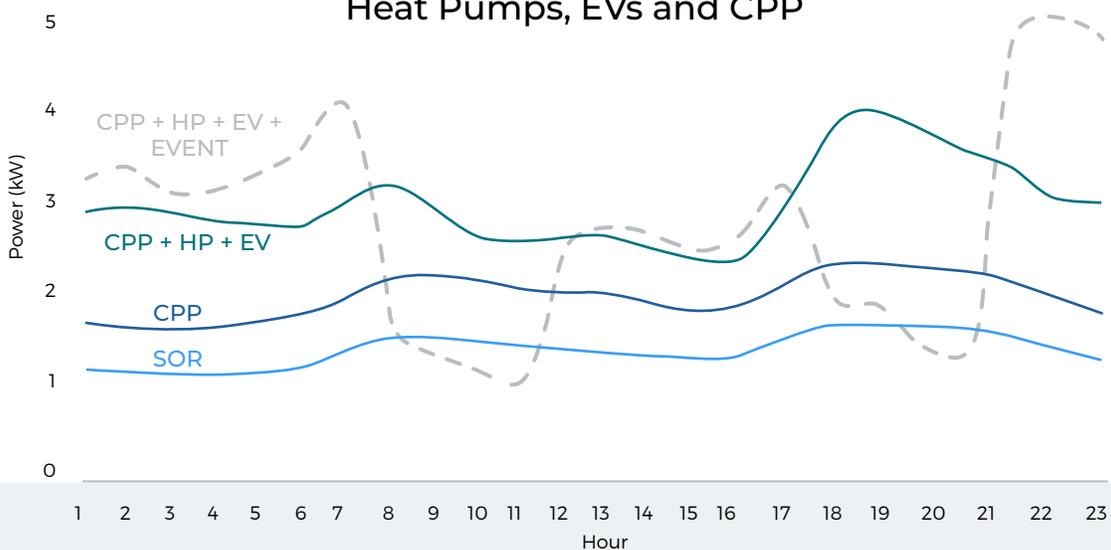
Heat Pumps and Electric Vehicles



Heat Pumps, EVs and TOU



Heat Pumps, EVs and CPP





“It’s incredible to see what the combination of these shiftable electric loads and critical peak pricing and time varying pricing in general can really do,” says Cook.

The insights enabled Nova Scotia Power to identify pathways to beneficial electrification — where electrification benefits both customers and the grid:

“If we can create this classification model that we’ve talked about and we combine it with time varying pricing, customers who adopt these rates can save on their electricity bill while we’re also saving money as a utility.”

The Grid of Tomorrow

Looking ahead, Cook sees a wide-range of potential applications for behind-the-meter data.

Predictive Modeling for Demand Response

“Short term, I think something we can really benefit with this data is predictive modeling for demand response and leveraging machine learning for day-ahead predictions as to how our DR programs are going to perform.

Machine Learning Integration into Regulatory Filings

“We currently don’t use a lot of machine learning in models as part of what we file with the Nova Scotia Energy Board. I think there’s a lot of opportunity to start doing so, and we need to slowly work our way there.”

AMI 2.0 and Distributed Energy Resource Management

“Long term, I think we’re going to see increasing detection accuracy. With AMI 2.0, we’re going to get down to that one second granularity of data. And when we’re doing grid edge calculations, we’re going to get very accurate. We’re going to know exactly what’s happening behind the meter. That’s going to be a huge proponent to our distributed energy resource management, and our strategies leveraging and optimizing all of these DERs.”

Solar Production Validation

“We look at customers that have solar production, and don’t really have insight into how that electricity is being produced. We only have the net. Bidgely actually classifies the total solar production. It would be very useful to us to understand, maybe on a really cold day in the morning, how much solar was being produced.”

The Value of Smarter Energy Insights

Nova Scotia Power’s journey with Bidgely and Analytics Workbench demonstrates the value of turning AMI data into actionable insights through a careful validation process. By understanding how customers are using electricity, particularly when it comes to EV and heat pump adoption, Nova Scotia Power is able to better design rates, forecast load, and support its operational goals across the board.

“These insights do help us get closer to the Goldilocks zone where customers are saving, we’re saving, everybody’s saving, and we’re doing things for the grid that are sustainable in the future,” Cook emphasizes.



To hear more from Riley Cook and learn about Nova Scotia Power’s data-driven approach to understanding electrification trends and informing rate design, **watch the on-demand webinar “Unlocking Smarter Energy Insights: AI-Driven Electricity Consumption Analysis Through Validation.”**