GIF Milestone Report Part A

Project Title: DSO Pilot Project (PowerShare)
Organization: Essex Powerlines Corporation
Milestone: 1
Project ID #:

SUBMISSION DATE: JUNE 26, 2024

Milestone Due Date (from the Contribution Agreement): May 31, 2024
Contract Termination Date: March 31, 2026

ieso
Connecting Today.
Powering Tomorrow.

1. Project Description

Project Title	Essex Powerlines DSO Pilot Project (PowerShare)
Organization	Essex Powerlines Corporation
Milestone Number	1
Total Number of Milestones	6
Milestone Payment Amount *must match amount on invoice (before HST) and cannot exceed contracted amount	$89,639.30
Submitter Name	Anthony Clavet
Contact information	[redacted]
Milestone Submission Date	June 26, 2024
Milestone Due Date (in original/amended contract)	May 31, 2024
Contract Termination Date (in original/amended contract)	March 31, 2026

Provide 1. A description of your project, and 2. State why you are doing this project.

The project ("PowerShare") will enable Essex Powerlines Corporation ("EPLC") to perform as a Distribution System Operator ("DSO") with a scalable market design for activation of DER flexibility in near real-time. Using the NODES platform, DER owners will be able to monetize their investments by selling excess or stored generation as flexibility to support grid resilience.

PowerShare will harness existing, and incentivize additional, DER flexibility in the grid as a non-wires alternative ("NWA"). Constraints in the Leamington area will be used to benchmark NWA performance of a DSO market while maintaining reliable service delivery to customers. Higher geographic and grid levels will be considered for market participation or simulation to demonstrate T-D coordination between DSO and IESO markets.

Essex Powerlines and partners propose to solve two major issues or barriers with this project: first, it will resolve local constraints on Essex Powerlines' grid and second, it will remove existing barriers related to DERs and assess their potential impacts on distribution system assets and market participation. Moreover, the project will test the coordination of DSO/IESO markets, helping solve grid constraints at a local, regional, and provincial level.

Milestone Description: Copy and paste the text from your Contribution Agreement below.

This milestone is crucial to the success of the project, as it will be utilized to determine the DSO market design and market rules to ensure alignment with the IESO and OEB. In addition, baselines will be determined for data collection and reporting to measure the success of the project.

---

2. Milestone Submission Attachments

The deliverable description must match milestone deliverables as outlined in the Contribution Agreement Table and Proposal. If multiple deliverables are contained in a single document, specify the page numbers/sections that reflect the specific deliverable.

ID	Deliverable Description	File Attachment Name	Section/Page Number
1	Milestone Report Part A	Essex Powerlines – GIF Milestone 1 Report Part A.docx	This document
2	Milestone Report Part B	Essex Powerlines – GIF Milestone 1 Report Part B.xlsx	NA
3	DER Integration Demonstration Framework	Essex Powerlines – DER Integration Demonstration Framework.xlsx	NA
4	Report for Market Design and Rules	[Package] Report on Market Design and Rules for Submission.pdf	Pages 1-17
5	Market Design for Approval	Same as above	Pages 18 and beyond

3. Project Technical Progress and Lessons Learned

In the following tables, summarize the key lessons learned. This information is intended to inform future work in the same area. The lessons generated will be used to inform the success of future GIF projects by identifying areas of concern / unknown barriers, inform broader industry to enhance success and avoid failure. Do not delete entries from previous milestones, rather, add new rows for the new milestone and populate the fields. Please be detailed in your description.

MS (Milestone): Milestone Number

Category (Cat): Cat 1=Customer/Participation Reach, 2=Data, 3=Process, 4=Project Management (Budget, Scope, Timeline), 5=Technology Interoperability/Integration, 6=Other

ID: Unique ID for each lesson learned

Challenge Description: A detailed description of the challenge and how it impacted the project

Resolution: A detailed description on how the challenge was resolved, the thought process behind the resolution and describe the resources used to resolve the challenge.

MS	Cat	ID	Challenge Description	Resolution (if applicable)
1	5	1	Meters Used; Required Metering or Telemetry Equipment availability in-field, sufficiency for DSO purposes, and accessibility to participants	Wholesale metering is not available nor accessible for most distribution-connected participants. IESO required telemetry is a major barrier to service provision by distribution-connected DERs. EPL decided to leverage existing AMI systems and set the maximum metering granularity to 15 minutes - metered intervals longer than 15 minutes are not considered for the project. The sampling rate of a Flexibility Service Provider's ("FSP") meters will be increased to 5 minutes, subject to EPL's metering infrastructure capabilities and constraints. In cases where an FSP cannot have a 5-minute sample rate, but otherwise needs to be evaluated at 5-minute granularity, the 15-minute sample rate will be averaged over the three 5-minute intervals. Reference to 5-minute metering granularity shall include the three 5-minute interval average metric (35IA, 15/3, other notation). The 15-minute granularity applies to all ShortFlex and LongFlex settlements such that delivery for a 30-minute product interval is the average of the two 15-minute intervals' delivery percentage. For regularity, where 5-minute metering is available it is summed to 15-minute for purposes of settlement.

				This design is supported by NODE's experience in European markets where a combination of DSO meters and FSP-provided sub-meters are used in settlement. Additionally, all metering activities are supported by existing systems provided to EPL by Utilismart. NODES uses data submitted by Utilismart from EPL's meters to validate delivery of the service against the offered amount on the NODESmarket Platform. Note: the use of existing metering was of particular interest in engagements with the Ministry of Energy throughout Milestone 1.
1	3	2	TD interoperability; how/when do communications with IESO happen	With the intention to implement and inform ongoing exploration of the Transmission-Distribution protocols, including through the TDWG, this project simulates submission of DSO activity and qualified participant offers following the Availability Declaration Envelope (ADE) submission process and the IESO gate closure 2-hours ahead of dispatch. NODES simulates a submission to the IESO at 10:00:00 day-ahead of dispatch of: the quantities of DSO contracted services (also called "LDC-directed") at a 'floor price', and the remaining available Qualified offers from each portfolio in price/quantity pairs. The DSO gate closure is at 125 minutes prior to dispatch. NODEES has 5 minutes to prepare, and at 120 minutes prior to dispatch (respecting the IESO's Mandatory Window), NODES simulates a final submission to the IESO of: LDC directed quantities at the floor price, and remaining Qualified offers from each portfolio that were submitted prior to the ADE submission. Data submissions to the IESO will occur on-request, during live demos, and during milestone submissions.
1	3	3	DSO commercial responsibility for assets in IAMs; DSO and platform provider hesitant	EPL and NODES share a hesitance to represent assets in IAMs. This function is termed as a 'superaggregator', a top-level aggregator for an area or local market which represents an additional layer of aggregation of direct assets and aggregations, potentially from different FSPs, to IAMs. A superaggregator would bear commercial responsibility for these assets. The T-D protocol in the project was designed with wholesale eligibility being an additional qualification that participants can opt in to test and demonstrate. (See T-D Coordination Methodology section 3.3 and NODES Schedule 5 section 2.4 for

				more on qualification for wholesale demonstration) Offers from qualified portfolios are then 'forwarded' to the simulated IESO for evaluation against purchasing scenarios rather than represented or 'superaggregated' by the DSO. EPL and NODES are interested in exploring combining offers across portfolios and potentially FSPs in later market designs and consider this to be an element to explore with the IESO and OEB since this will be affected by the concerns of commercial responsibility taken on by an LDC in an IAM. In this model, the commercial responsibility could be forwarded from the IESO market participating flexibility platform to the FSPs with aggregated assets. If this is solved in a satisfactory way, superaggregation would allow smaller portfolios and FSPs to access the IESO market, thus enhancing their potential revenue. This would contribute to further volumes and increased competition in the market for both DSO and the IESO.
1	4	4	Defining Maximum/Ceiling Price	To capture the full range of potential prices offered by distribution-connected DERs, the maximum price is undefined in the market rules. However, for procurements such as LongFlex tenders, the maximum activation price is set default at $2000/MWh whereas the budgetary allotment for ShortFlex activation is average $300/MWh less 5% for platform fees per the Budget.
1	4	5	Moving activities from planning/design milestones into demonstration milestones to reflect work, carry over of development work throughout the project	Working with NODES and Utilismart, the project benefits from spreading development through the market operation phases of the project. Particularly, activities that have been split between Milestones 3 and 4 were done so to reflect the second round of development necessary to implement the "Integrated Coordination" and other program or software enhancements which will come to the fore after use by end-users (participants and EPL staff). Continued development and user feedback marked as a lesson learned for future project submissions.
1	5	6	Identifying voltage regulation and thresholds for non-exporting and <10kW exporting DERs on the Distribution System, difficulty applying Conditions of Service of the LDC as a default standard like the IESO's "Voltage Variations" Grid Connection Requirements (Chapter 4)	Identifying the source of the standards or ranges for voltage variations as first the project-specific CIA/SIA study, then any connection agreements with LDC, then an LDC-accepted site/facility owner-approved DER Operation Plan if voltage ranges are an unresolved concern.
1	1	7	Territory Expansion Lesson	PowerShare's expansion to the entire service territory of EPL is driven by two factors: capacity constraints are existing or

				forecasted in all areas of our territory, and a market scale constraint. The scale constraint emerged from focusing specifically on EPL's service area in Leamington, which excludes many large load or generator customers that exist on shared EPL feeders ("hybrid feeders" per TDWG definitions).
1	4	8	Defining Participant Payment Cycles within Milestone Payment Structure	The Milestone-based payment cycle of the GIF leads the default payment of participants to follow milestones. However, from feedback from participant candidates that provided letters of support during application, advice from NODES from European markets, and from the dedication to accessibility of the market, EPL decided to conduct settlement and payment of participants on a monthly cycle. It was EPL's view that extended periods of service provision (and thus accrual of costs) by participants without payment would be a significant barrier to non-traditional market participants. This extends only to participants, whereas market-related invoices from project partners will align with Milestone submission. For example, the 5% market fee will be invoiced at the end of the milestone rather than monthly.
1	2	9	Baseline methodology and custom baseline methodology, considering IESO baseline methodology	NODES has a basic and accessible default baseline methodology of the five preceding weekdays based on EPL's meter data which is provided daily to NODES by Utilismart for each approved asset's meter. Baselines are evaluated at 15-minute granularity (see "meters used" lesson for more). Participants may nominate an alternative baseline capacity to better reflect their particular operations or asset type. EPL must agree to the proposed alternate baseline. EPL and NODES may conduct spot checks on alternate baselines and may suspend the participant from the platform until the baseline may be verified. From engagement with participant candidates that provided letters of support during application and with candidate aggregators, there was a clear desire to test alternatives to the IESO baselines. EPL and NODES intend to conduct variance analysis on the IESO baselines against the default baselines for settlement, to the extent appropriate.

				NODES' settlement formula from Schedule 5 of the Platform Rules: $BL_d^h = \begin{cases} \sum_{i=1,d-i\notin[\text{sat,sun}]}^{7} \frac{MD_{d-i}^h}{5} & if\ d \notin [\text{sat, sun}] \\ MD_{d-7}^h & if\ d \in [\text{sat, sun}] \end{cases}$ *where* BL_d^h *is the baseline value of day d and interval h and* MD_d^h *is the metered value of the day d and interval h*
1	3	10	Appropriate incentivization of service delivery, following the "least cost, no penalties or deposits" principle: Availability and Activations Payment Reduction Schedules	It is a leading goal of the Project to reduce to the extent possible any fees or charges required of Participants. This is prioritized to incentivize participation and enable relatively small DERs to participate with a minimal structural deficit. This determination was informed by stakeholder engagement with EPL customers and participant candidates which routinely discussed the cost barriers to wholesale market participation as a major concern. The Activation Payment (ShortFlex/energy) reduction schedule provides 100% payment for 90%+ delivery of the ShortFlex Contract Capacity. The reduction schedule drops quickly under 90% delivery, such as between 80-89.99% which provides 65% payment. Delivery of less than 40% of the ShortFlex Contract Capacity provides 0% payment. This schedule is designed to incentivize participants to deliver while also respecting the absence of penalty fees for under delivery. The Availability Payment (LongFlex/capacity) reduction schedule is calculated monthly on average delivery percentage of ShortFlex offers arising from a LongFlex contract. Unmatched ShortFlex offers provide full credit, matched ShortFlex provide credit depending on average delivery percentage, and unavailable ShortFlex offers provide no credit. This schedule is designed to incentivize participants to ensure ShortFlex offers are available for each contracted half hour Delivery Period. Availability payments are more drastically affected by unavailable ShortFlex periods than under delivery of particular periods. This schedule follows the same payment reduction as Activation Payment. Regular or repeated under delivery by a participant will prompt questioning from EPL, and potentially escalate to termination of the participant's eligibility to the Project market if it cannot be addressed.
1	3	11	Grid Nodes identification / Grid Node Representation Granularity; how to represent the Distribution	NODES provided examples of common hierarchies in European markets, which are often voltage or jurisdictional boundaries.

			System in a nodal hierarchy, informing the NODES Platform map and assignment of resources to the nodes	EPL originally planned to model granular portions of the distribution system as 'sections' created by automatic reclosers and to dynamically reassign those sections to a distribution feeder parent node. Challenges to this approach were appropriately representing the complex 'sections' of the distribution system in the platform in a simplified visual manner, and that the live reassignment is overly complex without automated checks between SCADA/SmartMAP/NODESmarket. SCADA integrations are dependent on EPL's ongoing Digital Utility and Joint Control Room projects. The resolution is to use feeders as the lowest node level which provides the benefits of being logistically manageable when network switching takes place and easy to understand visually on the platform. Live switching is an item marked for future exploration.
1	4	12	Participant Contracts: how to define eligibility or ineligibility, defining the role of the DSO versus Platform/Settlement Provider in intake and operation	PowerShare builds on the learnings from the publicly available York Region NWA contracts and program rules. Despite major differences in program design such as York having an auction-based procurement process versus PowerShare's open intake process, many elements were transferable. In particular, participant eligibility and ineligibility. PowerShare rules build further in defining the roles of the DSO (EPL) and the Platform/Settlement Provider (NODES). The PowerShare contract does not provide for payments to participants, which are instead conducted under NODES membership agreement. PowerShare's contract manages eligibility to access or offer services to the NODES Platform and this forms the primary method for the DSO to manage Flexibility Service Providers (FSP) and their assets. An asset may only make offers if they fulfil the requirements under the DSO contract. PowerShare also positioned the DSO to be in control of the registration process, where once an FSP has signed the DSO contract they are then connected with NODES to set up payment details and sign the platform membership agreement.
1	1	13	Clear Participant preference for ICI eligibility	An important lesson from the intake process with various participant candidates is their nearly universal interest in whether PowerShare participation is 'stackable' with ICI eligibility/activities. It is, and the team will be examining to the extent possible any coincidence of DSO needs with ICI peaks.

				In addition, many participant candidates expressed interest or curiosity in stacking market participation between DSO and IESO markets.
1	3	14	Asset Approval, Flexibility of Platform to enroll/disenroll or assign assets	Related to the learning on grid node identification, the flexibility of the Platform was harnessed to reinforce the discretion of the DSO in the approval, assignment, or removal of an asset from the platform. Once contracts are signed, each asset and its meter number must be approved by the DSO when assigning it to a node before it can begin trading with that asset. This ensures DSO control and visibility to the assets before they are added to existing portfolios.
1	3	15	Defining Wholesale Simulation: triggers for purchases, qualification of offers	Given that there is no integration with IESO tools and all activities are on a simulated basis, the PowerShare team endeavoured to capture the life cycle of simulated offers from qualification of assets to formation of offers and activation. Following engagement with GIF and IESO staff, PowerShare defines a two-step "qualification" for IESO offers. First, a portfolio must be tagged as 5-minute dispatchable. That portfolio must then offer at least 2 consecutive half-hour blocks of 100kW to meet the IESO's hourly offer duration and to simulate FERC 2222 compatibility. These offers are then forwarded, or 'seen' by the simulated IESO at T-2 hours. Activation can happen at any time after T-2 (IESO "Mandatory Window"). Engagement with IESO staff helped to identify price as the best trigger for activation rather than outages or capacity/quantity needs, since these are generally reflected in the prices. PowerShare has defined variable price triggers based on forecast Shadow Prices and a Market Clearing Price proxy adapted to the half-hourly market. More information is available in the Transmission-Distribution Coordination Methodology document. PowerShare noted that the $100 Shadow Price trigger used in the York Region NWA pilot did not result in a simulated wholesale activation and thus adapted to variable price triggers in an effort to capture more simulated IESO activity.
1	3	16	Adapting the Availability Declaration Envelope alongside DSO purchases, "LDC-directed quantities"	For the resources in PowerShare, the ADE is established such that real-time schedules will not exceed the quantity offered in the day-ahead timeframe. This principle is managed by the simulated IESO observing a limit on the qualified offers by qualified portfolios at the quantity offered in the ADE. The DSO also submits its "LDC-directed" quantities alongside the ADE submissions. These are submitted to reflect the total quantity of DSO purchases at ADE, regardless whether those

				portfolios or offers were qualified to be forwarded to the simulated IESO. If an otherwise qualified offer is made after the ADE, it is not made available to the simulated IESO to respect the assumed ADE submission of zero.
1	6	17	Embedded Distributor Considerations	It is a general learning of the project that being an Embedded Distributor is a confounding (though surmountable) challenge to Transmission-Distribution coordination for local energy markets. Connection Agreements must be leveraged to the extent they allow any flexibility-related activity and are a first step towards Host-Embedded distributor coordination since they must cooperate at the Connection Impact Assessment stage of connecting an asset. This step typically inserts delays into the process of connecting a new asset and may be a stage where the distributors may share information or availability of flexibility services from the asset, respecting negotiated limits or characteristics.
1	3	18	Adapting Outage Notifications for Forced and Planned Outages in a flexibility market	The Outage Notification process in PowerShare is managed by the DSO contract, as NODES does not have a forced/planned outage logic outside of managing them during contract formation. PowerShare adapted to this process by defining a forced outage as any outage affecting a 'matched' contract (in ShortFlex or LongFlex), with planned outages managed by refraining from making offers. Since participants are free to withdraw their unmatched ShortFlex offers, the DSO is only expecting the availability of matched offers to be delivered. Participants are expected to provide up to 48 hours notice of a Forced Outage, or to notify the DSO of it within 24 hours of its occurrence. Participants are not charged a fee for an outage; however the affected portions of the contract will be settled at zero percent delivery. The DSO may request additional information regarding a reported or suspected Forced Outage. The extent and frequency of Forced Outages may be considered in a future development of a 'reliability ranking' for local market participants but this will be manually tracked for purposes of the demonstration. Such a ranking could serve as a weighted parameter for selection of tender or service responses by FSPs.
1	3	19	Aggregator Portfolios / Flexibility of Approved Assets - differences	Using the NODESmarket functionalities, each Participant places their asset(s) in a Portfolio, which is the level used to generate

			of an Aggregator and a Direct Participant's portfolio management	baselines and make offers to the market. Functionally, Participants are free to arrange their assets as they like since they are held to the quantity of their offer rather than an assigned capacity of their assets. The enduring difference between Direct or Aggregator Participants would be the application of a Type/Technology Approval for their assets. This would be a sample of assets of the same technology selected by the DSO to demonstrate the dispatchability and market acceptance of that technology which the DSO can apply to other assets of the same type. The DSO must still approve each asset before it can be assigned to a portfolio, but it may simplify expanding an Aggregator's roster by leveraging the previously conducted testing.
1	3	20	Aggregator Portfolios, Prevention of Double Counting	Given the flexibility of Portfolios and the ability to transfer approved assets seamlessly between them, NODES implemented a check to prevent double-counting of assets via the Meter Point ID. This is used to prevent gaming or double-counting of services provided by an asset which might have appeared in multiple portfolios without that check, since it would contribute its asset baseline to the Portfolio baseline. A weighted delivery factor was considered as an alternate solution which would preserve the ultimate flexibility of portfolios while respecting the relative size of the concurrent offers (i.e. 5 MW, 3 MW, and 2 MW offers from three Portfolios which share an asset, the asset provides 50%, 30%, and 20% of its delivered flexibility to the Portfolios respectively). This is noted as a potential future enhancement for technology aggregators.
1	3	21	Testing, Standby and Activation Instructions adaptation to DSO platform functionalities	The NODESmarket platform does not provide 'standby notices' for activation. The only pre-matching information a participant would receive is whether they have a LongFlex obligation or a scheduled test. Notifications upon matching or X minutes before delivery is entirely defined by the Participant. For instance, if for operational reasons the Participant only wants to be notified 15 minutes before delivery, but not upon matching, that is possible for them. The test process is aligned to be the platform's "Market Acceptance" testing and the DSO's delivery test. The DSO and Participant agree on the time and quantity of the test, matching in the ShortFlex market. The Participant ensures they receive the notification of activation per their set preferences and then responds with delivery. This verifies the deliverability of the Participant's flexibility to the requirements of the DSO,

				and further testing may occur to confirm the ability of the Portfolio to be dispatchable with less than 2 hours notice for purposes of simulated IESO purchasing.
1	1	22	Onboarding Lessons	General learnings from recruitment discussions and onboarding processes include that many potential candidates were interested in the extent a Local Energy Market could help with justify net-new energy assets. This included interest from OEM or service providers in expanding their portfolio and local businesses interested in reducing energy expenses or to generate new revenues. Timing of onboarding in NODES' experience is that it takes approximately a month from the first meeting. This generally holds true in PowerShare, but can be as long as three months if a Participant requires accommodations to the process or the DSO contract.
1	1	23	Technology Aggregators, like EV OEMs are interested in programs like PowerShare but scale poses challenge to integration	There is a great interest in Technology Aggregators like EV charger and electric water heater OEMs in programs like PowerShare. The challenge seems to be developing integrations by the OEMs is limited by scale; one in particular remarked that Windsor-Essex County would be a scale better suited to develop a Demand Response program.
1	5	24	Hydrogen is not mature enough to source hydrogen-fuelled generation units or a reasonably priced supply in appropriate quantities for Local Market Demonstration	Despite the acceleration and interest in hydrogen projects, hydrogen is uneconomical in our modelling of a H2 fuelled unit operated on a rental basis and offering into PowerShare. The price of Hydrogen transportation and storage is a major impediment, since the points of supply are so far from the potential generation unit.
1	1	25	Finding Candidates for participation is the biggest challenge	Participation candidates like small and medium-sized businesses often do not consider energy/flexibility services as a main component of their business, and thus poses a challenge for recruiting capacity to a local energy market until capacity building or maturation can occur in the market. Although we assume this will come with time, NODES' European market experience has shown that the true scaling opportunity for flexibility is in residential. Large commercial/industrial assets want to be a small player in a national market rather than a large player in a local market; traditional capacity reservation is more aligned with their activation expectations since it minimizes interruptions to business. This notion is also discussed in the learning on Flexibility First. That said, large commercial/industrial assets are participating in local markets and have learned to use the activation price as a mechanism to illustrate their willingness to offer flexibility. A typical bidding profile could be comprised of a low/average reservation price

				and a high activation price. This would in turn reflect the FSPs expected frequency of activations (more information in the next section). Aggregations of residential "Internet-of-Things" demand response capable devices and their business models require maturation of machine learning/automation-based aggregators, given the high volume of devices and relatively small capacity. In other markets, NODES has explored the concept of a Flex Register which allows for the prequalification of technology and assets for flexibility services, serving also as a touchpoint to monitor or control data between TSO and DSO.
1	6	26	Flexibility First; application to distribution grid services	Informed by lessons from NODES' European markets, Flexibility First is an approach to Non-Wires Solutions which centers consumer choice and benefit. Value is captured in an open market based on the degree of voluntarism with which the grid service is provided, which sorts solutions into tiers which can sequence tool use in solving constraints or issues. The sequence where severity of the constraint/distribution issue increases: - 'Yellow Issue', solved with low-cost, highly voluntary flexibility such as a residential aggregator (thermostats, electric hot water systems, EVs). - 'Orange Issue', solved with higher cost, less voluntary flexibility such as C&I. - 'Red Issue', solved with all available flexibility and regulatory tools such as non-firm connections, interruptible rates. Emphasizing voluntarism in program design will lead to scaling and sorting of services into these tiers and will reduce the number or severity of involuntary flexibility provision such as through a non-firm connection. Ultimately there is a cost to solving grid constraints and by relying on involuntary solutions from customers, that cost is downloaded to them such as through lost production for C&I resources. See also the Regulatory Lesson re: Flexible Connection Agreements. A risk noted in this approach is that programs which allow a utility to access cheap or no-incremental-cost flexibility such as through traditional thermostat programs may reduce the liquidity in the market for those flexible assets. If these solutions form the lowest rung of the solution ladder, it may

				create a more difficult path towards maturation of other technology aggregators as they are directly competing with a DSO or TSO for those services.
1	5	27	Technical barriers to IoT and residential technology aggregators	Supported by learnings from Flexibility providers in Norway (i.e. Tibber), there are a number of challenges in the path to enabling residential flexibility at-scale. First is that the aggregators of these IoT technologies believe it is unreasonable to expect 1-second or other high granularity from a 1 kW scale asset the same as grid scale resources. Second is a suite of technical barriers: lack of data transparency and open protocols from device manufacturers, grid technical requirements being poorly matched to new kinds of assets, lack of standardization and scalability between markets, lack of investment certainty specifically for local flexibility which need to move from pilots to attract this kind of aggregator investment. Third is a "UX trilemma" where these aggregators must handle the grid service complexity with simple language to the end user, ensure ongoing engagement, and providing value. Ultimately making the customers understand the service and demonstrating the value for them to participate is a difficult balancing act.
1	1	28	Disseminating Results, Designs, and Principles to Industry including LDCs	LDCs are highly interested in PowerShare, publicly and privately. Industry conferences such as EDA's EDIST, CanREA's Energy Transition Hub Summits, and DistribuTECH have been integral to sharing the messaging and principles of PowerShare such as Flexibility First, the ability of LDCs to create and support Local Energy Markets, and the transition to DSOs.
1	3	29	Ramp Rate considerations	Given the market design and the under-delivery reduction methodology, Project decided to not consider ramp rate and the participant is expected to provide 100% of their offer at the contracted time regardless of ramp rate. Participants are encouraged to manage the ramp rate and consider any impacts on costs in their price and payment expectations.
1	3	30	Defining DSO Gate Closure vis-à-vis IESO Gate Closure	Defining the gate closure, or default 'expiry' of ShortFlex offers in PowerShare was a debate in the market design stages between two and three hours whether to mirror the IESO Mandatory Window or to provide additional time between DSO gate closure for the simulated IESO to receive the qualified dispatch data. The project settled at 125 minutes before dispatch hour, respecting the Mandatory Window and providing the time for NODES to provide the simulated IESO with the qualified offers and DSO information. Per TDWG, the DSO submits at some

				time prior to the Mandatory Window an "LDC-directed quantity" for all the local market activity within this period. Wholesale-qualified offers are also prepared and made visible to the simulated IESO in the 5-minute period. This is possible only because of the simulated nature of T-D coordination, and we expect that live coordination may have a longer time period unless reliably automated and technically integrated. NODES has experience with the latter in Sweden and Norway markets.
1	2	31	Identify Deadband for Dispatches/Activations	Reference to the 'Dispatch Instructions in Real Time Market' PDF shared by the IESO on March 1, 2023, facilities in this pilot that are less than 30 MW, the IESO expects facilities to operate as close as possible to the dispatch instruction. PowerShare hopes that findings from this project will help inform what a reasonable deadband for DER facilities would be, noting the IESO's interest in a +/-2% deadband. Operation as close as possible to the dispatch instruction will be supported and incentivized by the stepwise reduction of payment by % delivery.

4. Project Regulatory/Policy Considerations and Lessons Learned

Projects with an electricity distributor as lead proponent or partner: please ensure that the electricity distributor completes – or provides input – to this section.

In the following tables, summarize regulatory lessons learned, including any unanticipated legislative or regulatory barriers that were encountered and if/how any barriers were addressed in the project. The lessons generated may be used to inform regulatory and policy initiatives associated with innovative actitivies. Do not delete entries from previous milestones, rather, add new rows for the new milestone and populate the fields. Please be detailed in your description.

MS (Milestone): Milestone Number

ID: Unique ID for each lesson learned

Challenge Description: A detailed description of the challenge and how it impacted the project.

Response: A detailed description on how the challenge was addressed or resolved (if applicable), the thought process behind the response and describe the resources used to respond to the challenge.

MS	ID	Challenge Description	Response (if any)
1	1	Reporting of DSO activations in embedded generation categories	Essex Powerlines continues to include all embedded generation injections in monthly submissions if those injections offset the LDC's internal load. This portion of the LDC's load would not be accounted for by IESO upstream wholesale meters, and therefore the IESO depends on the LDC's submission to determine total monthly load (which is used as an input to calculate their Class B GA charges and IESO admin fee charges as well). While the embedded generator's participation in the pilot program may impact how they operate, it would not have an impact on the LDC's submission requirements.
1	2	Resource Exclusivity with IESO Markets	It is recognized that this is an understandable provision for the purposes of the Grid Innovation Fund, given concerns of double-dipping or subsidizing market participants unfairly. However, this was a challenge to recruitment where a significant constituency of mature energy market participants are unable to continue their regular business processes within the IAMs if they want to provide local flexibility. There is one example of a <100kW site that was part of an IAM aggregation which reallocated their portfolio to participate, largely driven by an interest in DSO models and local flexibility market learnings. Participant candidates were commonly interested in the extent of 'stacking' local and wholesale markets, such as capacity commitments outside of the IESO Capacity Auction availability windows.

1	3	DSO concerns representing assets to the Wholesale market in a "Superaggregation" model	EPL and NODES share a hesitance to represent assets in IAMs. This function is termed as a 'super aggregator', a top-level aggregator for an area or local market which represents an additional layer of aggregation of direct assets and aggregations to IAMs. A super aggregator would bear commercial responsibility for these assets, which is a risk to distributors. See technical learning "DSO commercial responsibility for assets" for more. In a theoretical design discussion, the IESO proposed that it would be possible to "translate" non-performance penalties to resource owners in a 'super aggregation' model. The LDC retains a preference for not being commercially responsible for IAM participants given the current risk models. EPL and NODES are interested in exploring combining offers across portfolios in later market designs and consider this to be an element to explore with the IESO and OEB since this will be affected by the concerns of commercial responsibility taken on by an LDC in an IAM.
1	4	Defining a mechanism for recovery of cost of energy and capacity services within Local Energy Market Demonstration	This is a pending matter with the OEB and may be subject to change. With legal counsel, EPL has made Application (EB-2024-0096) to the OEB for a deferral and variance account (DVA) to record the cost of grid services within the PowerShare local energy market, net of GIF funding and of HOEP. For discussion, LDCs incurring a cost of power for LDC-procured grid services for energy is unaccounted for in the current settlement processes. This will require investigation and maturation of the settlement pathways between the IESO and LDCs. Also for discussion, there is an attribution question which asks to whom the cost and benefits of operating a local energy market should be assigned. Whether it is entirely localized within the LDC, if it includes Host Distributors, the region, or the province as a whole is an important design for the use of DERs as NWSs - particularly within local energy market structures.
1	5	"Non-firm" Connection Agreements are becoming the “silver bullet” but become regulatory tools or ‘free flexibility’ which reduces the incentive to procure	Supported by learnings from European markets where non-firm connection agreements are becoming more popular, involuntary actions such as 'non-firm' disconnections compete with development of voluntary flexibility options. Non-firm

		voluntary flexibility (potentially reduce liquidity)	connections are not 'free flexibility' as they asymmetrically impose the costs of grid management actions on the customer/business which may have had no choice but to accept the non-firm agreement to receive a connection. These management costs should be borne more equally by all customers rather than imposed upon individual customers. In addition, the use of non-firm connection agreements, contrarily to market-based flexibility, gives no guarantee of dispatching the asset with the lowest dispatch cost, due to the absence of a prices signal. These solutions can form an important rung in the active management ladder, but the place for non-firm agreements should be after market-based processes to encourage growth and confidence in the 'lower' more voluntary flexibility services. Alternatively, non-firm connections could be coordinated with market, enabling the non-firmly connected grid user to pay for other grid users to provide flexibility instead of itself, and thus creating a price signal. See also learning on 'Flexibility First' for more on emphasizing voluntarism in grid service provision.

5. Project Victories

This section captures project victories that you wish to celebrate. For example, increasing head count, securing additional project funding or even a successful technology demonstration from your organization that is outside the scope of this project. Do not delete entries from previous milestones, rather, copy the table for the new milestone and populate the fields.

Milestone 1

Achievement 1: Developing the Market Rules Package

The preparation of the Market Rules Package was a showcase in collaboration between Essex, NODES, IESO staff, and many stakeholders like the OEB and Ministry of Energy. The staff engaged in developing the rules received exposure and context to many elements of the energy sector, deepening their competencies in exciting ways. Some learning elements include aspects of the IESO Market Rules, the Transmission-Distribution Working Group's DSO-TSO coordination protocols, OEB processes such as RRR and licensing, and the important learnings from foundational demonstrations like the York Region Non-Wires Alternative project.

Completing the Package required a clear understanding of the roles of a DSO, a platform service provider, and the customer/Flexibility Service Provider (FSP).

For NODES, the biggest challenge related to the Market Rules achievement was to reconcile two markets (the DSO and simulated IESO) with different metering and dispatch granularities and qualifications into a single market pathway for FSPs. This was a novel addition to NODES' markets.

Achievement 2: Developing Internal Competency on DSOs and Transmission-Distribution Coordination

Developing internal competency on DSOs and Transmission-Distribution Coordination has been a significant achievement in PowerShare which showcases the collaborative efforts of Essex Powerlines, NODES, the Independent Electricity System Operator (IESO), and other stakeholders. The project team engaged deeply with the IESO's Transmission-Distribution Working Group to develop essential T-D coordination protocols, ensuring the project aligned with regulatory and operational standards.

By seeking to resolve local constraints and addressing barriers related to Distributed Energy Resources (DERs), the project is set to demonstrate effective coordination between DSO and simulated IESO markets. Understanding this coordination is crucial for enhancing grid resilience and reliability. The integration of the NODES platform enables DER owners to monetize their flexibility, contributing to grid stability and market efficiency.

Moreover, the project team gained valuable insights into the complexities of market design and rules, enhancing their understanding of the roles and responsibilities within a DSO framework. This experience has equipped Essex Powerlines and its partners with the knowledge and skills necessary to navigate and influence the evolving energy market landscape in Ontario, positioning them among leaders in the transition towards more dynamic and responsive energy distribution systems.

Achievement 3: Presenting the PowerShare Initiative at EDIST for the Energy Industry in Ontario

The PowerShare initiative marked a significant milestone when it was co-presented by the Independent Electricity System Operator (IESO), Essex Powerlines, and NODES at the Electricity Distributors Association's (EDA) 2023 EDIST conference. This collaborative presentation showcased the innovative aspects of the PowerShare project, emphasizing its potential as a scalable model for local distribution companies (LDCs) of all sizes.

The presentation highlighted the success of PowerShare in addressing local energy constraints through a dynamic and flexible market model. By detailing the coordination efforts between DSOs and TSOs, the presenters were able to demonstrate how the project integrates distributed energy resources (DERs) to enhance grid reliability and efficiency. This was supported by insights from the IESO on the Grid Innovation Fund, the provincial energy outlook, and a remark that "PowerShare is key to understanding how to unlock DERs" as well as testing coordination protocols.

Feedback from the conference attendees underscored the perceived scalability of the PowerShare model. Participants from various LDCs expressed interest in adopting similar approaches within their jurisdictions, recognizing the potential for widespread application. The warm reception and interest garnered from attendees was certainly an achievement. Overall, the presentation at EDIST served as a major moment for the PowerShare project by reinforcing its position as a forward-thinking solution and cementing wider industry interest in the project.

Achievement 4: Perceived as a Scalable Model for Small, Medium, and Large LDCs, as well as Beyond Ontario

PowerShare has been widely recognized for its scalability and adaptability, making it a model for local distribution companies (LDCs) of all sizes. The project has been presented to global audiences at DistribuTECH 2023 and 2024, European audiences at Nordic Flexibility Day and Nordic Energy Day 2023, Canadian audiences at the CanREA Energy Transition Hub and EDIST 2023, as well as represented at conferences in Los Angeles, Montreal, and others.

The collaborative efforts between Essex Powerlines, NODES, and the IESO were pivotal in crafting a comprehensive market rules package that can be scaled and replicated across different jurisdictions. This foundational work ensures that LDCs can work towards adopting similar models, benefiting from shared insights and best practices. Feedback from the various conference attendees reinforced the perception of PowerShare-like markets as a versatile and scalable solution – with PowerShare serving as a Flexibility Market touchpoint in North America. Representatives from various LDCs expressed interest in implementing the model within their regions.

6. Looking Back

Knowing what you know now, what specific decisions/actions would you have changed/taken differently? Do not delete entries from previous milestones, rather, copy the table for the new milestone and populate the fields.

Milestone 1

Reflection 1: Balancing Technical and Regulatory Focus

During the initial stages of work the project team initially concentrated heavily on technical details such as the setup of market rules and operational integrations in SmartMAP, which is the DSO operational tool hub for Essex Powerlines. This focus on the program framework and technical infrastructure was necessary to support DSO functionalities like the meter data submission to NODES or to manage the intake process.

However, this intense focus on technical details resulted in the team not immediately recognizing the requirement of submitting a request for a Deferral and Variance Account (DVA) to the Ontario Energy Board for the specialized circumstances of PowerShare. Perhaps the team understood the OEB's May 31, 2022 letter confirming PowerShare is considered distribution activity by OEB Staff as sufficient regulatory guidance; allowing the team to so intensely focus on the technical and rule design of the project. However, once the DVA application was proven essential for regulatory compliance and the financial arrangement of the project, the manner of structuring the DVA was not clear to the team.

The PowerShare team recognizes that while their focus on the technical aspects was necessary, an earlier submission of the DVA could have garnered more timely regulatory feedback and possibly accelerated regulatory approval processes to recover the cost of power. This insight has been incorporated into the project's ongoing and future phases, ensuring a closer alignment between technical development and regulatory submissions to enhance project execution and scalability.

See Regulatory/Policy Lesson "Defining a mechanism for recovery of cost of energy and capacity services within Local Energy Market Demonstration" for more discussion of the DVA.

Reflection 2: Expanding project area, overly focused on Leamington constraints

PowerShare was designed with a focus on existing constraints in the Leamington area. The highly localized approach was beneficial for focusing the project team on specific issues, but inadvertently limited the scope of the project market and its applicability to the larger, notably constrained Essex County region.

Given the immediate needs and significant constraints of Leamington, the area was a logical starting point for deploying the Local Energy Market demonstration. However, the narrow focus restricted the integration of numerous and diverse Distributed Energy Resource (DER) assets across Essex Powerlines' service territory. Additionally, Project learnings and engagement with aggregators highlight that aggregators require a larger market scale to begin effective integration. Additionally, according to the

learnings of NODES in European projects, aggregated residential resources are essential for scaling Local Energy Markets and integrating electrified resources. The limited geographic area posed a challenge for attracting and incorporating these aggregators.

Looking back, the team acknowledges that an expanded geographic scope could have provided valuable insights into the scalability of the DSO model and its applicability to regions experiencing similar constraints earlier. A wider market area would have facilitated better integration of diverse DER assets, enhanced market competition, and improved market liquidity at the early stages of PowerShare. This lesson is essential for future iterations of Local Energy Markets where a more inclusive, regional, or cross-LDC approach could enhance the attractiveness and effectiveness of a Local Energy Market.

Reflection 3: Transforming Initial Interest into Active Participation

PowerShare made a specific effort to engage potential participants and stakeholders during this Milestone. We held detailed discussions and engagements early on to ensure all participant candidates understood the market design and the participant-facing technical aspects of the platform. Cross-team market design work covered permissive asset participation requirements, metering requirements, product duration, and minimum bid sizes to enable a diverse array of distribution-connected assets. These early meetings highlighted the importance of engaging DER asset owners in the Leamington area - a focus that remained central throughout the market design process.

During the project application phase, we received many letters of support from potential participants indicating strong initial interest. However, these expressions of support did not always translate into active participation. Despite our extensive groundwork, there is always room for improvement. This experience highlights the importance of continuous and wide participant outreach, not just for initial engagement but throughout the project lifecycle.

Looking back, we recognize the opportunity to further enhance participant outreach. Engaging a broader range of participants earlier and increasing the frequency of our engagement activities might have facilitated earlier trading and attracted more candidates. Nonetheless we recognize the significant effort put forth understanding that we operated at our highest capacity given the constraints.

7. Collaboration & Acknowledgement

In the table below, acknowledge exceptional individual contributions from the project team and partners. For example, acknowledging the individual contributor that conceived and implemented a solution to a challenge applicable to this milestone, ideation of novel methodology/process that improved the success of the project, or contributed valuable domain knowledge that mitigated a problem in the future. Do not delete entries from previous milestones, rather, copy the table for the new milestone and populate the fields.

Milestone 1

Contributor 1 Name & Organization: Jacob Godfrey, Essex Power Corporation

In this milestone we would like to acknowledge Jacob Godfrey who played a crucial role in the success of the project through his meticulous preparation and coordination efforts. Jacob's dedication in crafting agendas, spearheading meetings, and preparing minutes for nearly all project meetings reveals the work of a phenomenal coordinator. His diligent work provided a clear and consistent record of our progress and decisions, ensuring that our discussions were organized and documented thoroughly.

Despite onboarding to PowerShare well after the GIF submission and design, Jacob hit the road running as the primary drafter and coordinator of the market rules package - a fundamental component of our project. His efforts in organizing and reflecting the outcomes of design workshops in the rules package were instrumental in shaping the project's framework between the DSO and Platform Rules. Jacob's ability to coordinate between various stakeholders and ensure that all points were captured and addressed significantly contributed to the project's success thus far, and the primary achievement of Milestone 1.

Jacob’s diligent work not only facilitated smoother project operations but also ensured that we maintained a high level of organization and clarity throughout our efforts. His contributions exemplify the collaborative spirit and commitment to excellence that drive our project forward.

Contributor 2 Name & Organization: Guro Grøtterud, NODES

We would like to acknowledge the exceptional contributions of Guro Grøtterud, whose expertise and project management skills have been invaluable to the PowerShare initiative. Guro brought extensive regulatory experience in European flexibility markets and distribution-transmission coordination, which significantly informed and enriched our project and approach to the energy transformation in Ontario.

Guro’s insights into the development and implementation of Flexible Connection Agreements and the Flexibility First approach were particularly impactful. Her deep understanding of these areas helped us navigate complex challenges and align our strategies with proven practices from European markets. By

sharing her experiences and lessons learned from NODES' projects, Guro provided us with a broader perspective that enhanced our planning and execution.
Moreover, Guro played a crucial role in NODES' project management side following the example of her colleague, Sofia Eng, who provided great value as a NODES' Project Manager during the inception of PowerShare.

Guro's expertise and leadership have been crucial in advancing our project. Her contributions not only improved our regulatory and operational strategies but also fostered a collaborative environment through her willingness to share her knowledge.

Contributor 3 Name & Organization: IESO Staff

Our team would like to make a special acknowledgement of the IESO Staff which have had a hand in supporting this project. Not only the Grid Innovation Fund team, who have contributed greatly to the visibility and successful growth of PowerShare thus far, but also a few notable contributors to PowerShare-IESO coordination (non-exhaustive):

- Angeli Jaipargas; for expert insight to IESO market operations and how best PowerShare can identify and simulate the most impactful elements, as well as guidance in capturing the market metrics with the greatest value to the IESO.
- Ali Golriz; for significant contributions to the understanding of Transmission-Distribution coordination design in PowerShare as well as presenting informed and thoughtful questions on the design of the project.

The contributions of all IESO and GIF Staff cannot be entirely enumerated here, but the PowerShare team would like to recognize their efforts in support of the project.

8. Additional Information

Please provide any information here that is not covered elsewhere in this report (include photos where available).

9. Administration (IESO STAFF USE ONLY)

Report & Submitted Attachments Approved	☐ **Yes**	☐ **No**

Payment Amount
Amount:

Signature of Fund staff (IESO)

_____

Name:
Date:

_____

Name:
Date:

Independent Electricity System Operator
1600-120 Adelaide Street West
Toronto, Ontario M5H 1T1

Phone: 905.403.6900
Toll-free: 1.888.448.7777
E-mail: customer.relations@ieso.ca

ieso.ca

@IESO_Tweets
facebook.com/OntarioIESO
linkedin.com/company/IESO

Connecting Today.
Powering Tomorrow.