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MICROGRID USE CASES
SUMMARY

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Indra Monash Smart Energy City:

Use Case Summary Report

Prepared for:

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Introduction

Purpose of This Report

This is an interim progress update report on the Indra Monash Smart Energy City (SEC) project following an industry roundtable conducted in August 2020. It seeks to document use case development as a result of the industry engagement that has occurred for the benefit of stakeholders.

Specifically, this *Project Update Report* has been compiled to:

- Report back on feedback from the industry roundtable held in August 2020;
- Update stakeholders on progress to date, including the development of priority functionality of the SEC platform that provides the test-bed for use cases;
- Define, clarify and expand on the diversity of use-cases that could realistically be deployed and tested;
- Invite new and existing partners to further collaborate with the project team on use cases – to improve the robustness of outcomes and SEC progress; and,
- Provide an opportunity for stakeholders to provide additional feedback.

As with many programs of work in 2020, the SEC project team has had to remain agile, and adjust existing plans to maintain fulsome engagement with industry and other stakeholders.

Project Overview

The Indra Monash Smart Energy City (SEC) project team is working towards developing a platform or 'living-lab' to facilitate research on key industry challenges. This incorporates end-user behavioural sciences, transacting value at the distribution level, DER integration, microgrid services and commercial, and regulatory and operating models. Collaboration with industry is critical in maximising the value of the research conducted on the platform. Therefore, the project team sought input from stakeholders to co-develop, specific use cases that align with the current and emerging challenges the industry faces.

The Indra Monash SEC is a transactive energy solution for the smart energy management of a precinct scale microgrid. It will drive the management and control of the aggregated DER flexibility to achieve microgrid management functions, such as tariff optimisation, as well as providing external services, such as demand response and network services. The strategy for aggregating the microgrid's available flexibility will be based on an internal market approach where each DER will act as an independent customer that will, where it chooses to, offer and commit to providing their available flexibility as a commercial service to the transactive energy market (TEM). The TEM will then be able to apply this internal market functionality to aggregate the microgrid's available flexibility. The TEM will complete the application of the Smart Energy Framework in delivering a smart energy platform for the Monash Microgrid. It will demonstrate how smart energy management enables a precinct-scale microgrid to provide aggregated flexibility services through the creation of internal competitive markets that ensure DERs are able to optimise their energy cost while also being rewarded for contributing their available flexibility towards TEM internal and external needs and goals.

Project Goals

The Smart Energy City project seeks to:

- Inform the development of standards, guidelines and regulations for technology platforms to support microgrid operation
- Support potential microgrid operators to participate in the energy market and bid into ancillary market services
- Enhance competition for demand response services, potentially leading to more cost-effective network support and investment
- Support the safe production, storage and consumption of DER
- Provide a research and teaching platform to develop new solutions and train the next generation of energy industry professionals.
- Create a platform that enables the testing of future markets, technologies, regulations, and user behaviours in a real-world environment.

Project Update

Summary of Outputs from Roundtable 1

Background

In August 2020, a two-part roundtable was held to provide a range of stakeholders with the opportunity to provide their insights relevant to the work of the TEM project. Following an informational presentation, participants were assigned into five groups and tasked with the following activities:

1. **Challenge Identification and Prioritisation:**

   Identifying priority challenges from pre-populated and participant submitted lists grouped under Users, Transactive Energy Markets, Commercial and Operating Models, DER Integration and Microgrid Services.

2. **Challenge Breakdown**

   Identifying the evidence base and key partners required to address high priority challenges.

The summary outputs from each of these three broad activities are outlined below.

Challenge Identification and Prioritisation

Prioritisation of Pre-populated Challenges
The heat map below represents stakeholder's collective categorisation of the project team's pre-populated challenges relevant to the TEM platform:

High Priority | | | | | Low Priority

Users	*How do building occupants respond to automation and cooling systems?*	*What support do building managers require to set a building flexibility strategy?*	*How does design of a microgrid control system factor in user preferences?*	*How do users respond to different incentives or behavioural interventions to maximise flexibility?*
TEM	*How can a microgrid stack/optimise various revenue sources?*	*How can we more accurately forecast microgrid baseline load and flexibility load?*	*What role do distributed ledgers play in transactive energy markets?*	*What mechanisms can be leveraged for internal markets?*
Commercial and Operating	*What are the install and operating costs for a microgrid system?*	*What is the flexibility required to make a microgrid commercially viable?*	*What are the ownership structures and service models for a microgrid?*	*What are the key regulatory challenges to broader uptake of microgrids and transactive energy markets?*
DER Integration	*What are the main cyber security threats the system is exposed to?*	*How do you monitor the performance and manage firmware updates of multiple distributed IoT devices optimally?*	*Does a 4G wireless communication network work for the system?*	*Do legacy proprietary protocols in OT systems increase the integration times, complexity and costs for the implementation of a microgrid system?*
Microgrid Services	*What voltage services can a microgrid provide?*	*How do various DER (BESS, EV, buildings) perform in aggregate to provide FCAS?*	*What is required to island a microgrid or a portion of a microgrid?*	*How can we understand DER utilisation in periods of abnormality e.g. pandemic related lockdowns?*

Participant Submitted Key Challenges

The select substantive additional challenges outlined below have been distilled from an extensive list of participant contributions under each category:

Users	• What is best practice for engaging customers in such a way that:
	  o The complex is made simple, particularly as it relates to participation in a more dynamic electricity system
	  o Positive perceptions, trust and buy-in increase
	  o Broad societal knowledge of high-level concepts underlying pricing structures and supporting technology is advanced
	  o Behaviours that enable whole of system benefits are incentivised, both by financial and altruistic reasons
	• Who should own and control increasingly granular and voluminous customer data, and what protections should be put in place?
	• How much EV capacity can be orchestrated, and how are more real-time customer preferences captured and applied?

TEM	• What protocols, standards and other design decisions could promote replicable repeatable, yet diverse microgrids? • How is a microgrid external interface with NSPs best designed and operated to support mutually beneficial interactions? • How to ensure the SEC is simple, transparent, and meets customer needs, as opposed to an engineering (or system) need?
Commercial and Operating Models	• How can commercial arrangements support value stacking in a standardised way? • How is risk distributed and assigned, as it relates to internal commitments of microgrid participants (under/over or non-delivery) and external commitments/contracts? • What is best practice for determining DER hosting capacity? • How might future increasingly large greenfield owner operated microgrids interact with regulators?
DER Integration	• What standards and protocols are best suited to microgrids for both communications including redundancy and interoperability with a variety of end-devices? • How is the flexibility of DERs best forecast, especially building HVAC loads? • How is DER hosting capacity best predicted and managed?
Microgrid Services	• What standard suite of replicable products and services could microgrids provide the broader market? • What value could the microgrid provide as a backup generator, or load centre to address the challenges of minimum demand? • At what thresholds do requests from the microgrid controller become directions to maintain internal network security?

Challenge Breakdown

The five breakout groups nominated the challenges outlined below for further analysis and preliminary use case development.

Key Challenge	**Evidence Base Required to Address**	**Potential Collaboration Partners**
Users: *What is the best mechanism to elicit customer preferences up front to enable a lasting flexibility strategy?*	• Customer feedback based on DR trials • Data on the degree to which user preferences are dynamic or static Test customer preferences for different contracting arrangements	• ARENA DER Trials • Recurve Open EE Meter – Part of LF Energy
TEM: *What flexibility is required to make a microgrid commercially viable?*	• Analysis of costs of implementation and management (capital, fixed, and variable) against kW of demand flexibility at varying scales compared with BESS • Quantify all possible value streams • Assess potential to maximise participation by implementing standard protocols	• ARENA/AEMO IEEE2030.5 Working Group • DEIP • Sunspec Protocol Working Group • DOE (US) Grid Interactive Efficient Building Program • University of Queensland – Tesla Battery Project • ESB – Two-sided Markets work
Users: *How to ensure the TEM is simple, transparent, and meets the needs of customers, as opposed to an engineering need?*	• Data to support consumer willingness to move from passive to active participation • Data to support increased engagement corresponding to better visibility of energy savings, CO2 reductions etc as a result of TEM participation • Assessment of other schemes in other jurisdictions	• Customer Advocates such as Energy Consumers Australia • Design thinking and Customer Experience Managers • Other VPP and microgrid trials
Users: *How does design of a microgrid control system factor in user preferences?*	• Analysis of historic customer energy use patterns • Determine generally accepted hard-limits on variables such as building temperature per user profile • Assess varying designs of user interface/user experience for submission and control of preference variables	• Other VPP and microgrid trials

Key Challenge	Evidence Base Required to Address	Potential Collaboration Partners
Users: *How does design of a microgrid control system factor in user preferences? (Continued)*	• Identify minimum sets of key metrics and variables to holistically capture user preferences	• Other VPP and microgrid trials
TEM: *What approach should be prioritised – prices to devices or customer signals?*	• Assess willingness of customers to cede control to third party • Assess materiality of responsiveness per asset class to economic signals • Customer insights and feedback through longitudinal study	• Ofgem (UK) • Distribution Businesses (Horizon, SAPN, Western Power) • OEM Device Vendors • GridQube
Users: *Where does request and direction overlap?*	• Assess option of operator requests aligned with user flexibility, and operator directions aligned with user hard-limits • Analyse user perceptions of operator directions, including degree of trust	
Users: *What is best practice for integrating EVs from technological, legal, and user preference perspectives?*	• Develop mechanisms for understanding driver profiles and usage patterns • Assess impact of availability of charging infrastructure and price points against user adoption of EVs, choice of charging time and location, and participation in flexibility schemes	

Key Roundtable Takeaways

Following the project team's review of the above stakeholder contributions, the following key takeaways were identified:

1. The need to re-assess the role of standards, such as IEEE 2030.5, in the design of the TEM Platform.

2. The important contribution the project can make to understanding end-user behaviour and experience as they interact with the more TEM platform, and consequently, the value of collating user feedback in a structured, thought-through approach.

3. The importance of quantifying the level and value of flexibility, including both potential and under ordinary operation of the TEM.

4. The need to understand and define clear and simple commercial models and value streams and determine appropriate productising, packaging and messaging of those models to end-users, while also evaluating receptivity.

These takeaways and findings will be further evaluated by the project team as consideration is given to progressing the next stage of work. A further stakeholder update is planned at a future roundtable.

Use Case Development

The project team continues to explore and collaborate on potential high-value use cases that realistically could be deployed on the SEC microgrid platform. As prerequisites to use case deployment, development work is focused on establishing core priority functionality, adoption of common standards and interoperability frameworks, and shortlisting high-potential use cases. Updates on each of these key areas are set out below.

Priority Functionality

Informed by stakeholder input and collaboration, the SEC project team is focused on developing a suite of platform functionality that will enable use cases to be implemented and valuable empirical data obtained to address key challenges. As a direct result of engagement with industry and other stakeholders, a particular focus is being placed on first assessing and subsequently incorporating fit-for-purpose standards and relevant protocols into the platform development. This pivot will allow for greater interoperability and more robust integration of a variety of technologies, agnostic of their own native standard adoption. This approach requires defining abstracted forms of controllers and services that allowed for a variety of standards to be adopted. The platform functions to be prioritised and their associated standards adoption are outlined below.

Transactive Energy Market Design and Implementation

Stakeholder engagement has provided valuable input into the development roadmap for the Transactive Energy Market (TEM) layer, specifically in relation to considering standards. Through the adoption of common forms and services the TEM layer will consider incorporating standards such as IEEE 2030.5 and provide services that are able to build on common functional and technical representations of DERs. Platform components, such as the transactive market design, have already commenced incorporating the capability to adapt to IEEE 2030.5. Likewise, consideration is being given to the adoption of protocols such as Universal Smart Energy Frameworks (USEF), Industrial Data Space (IDS) for other aspects of the platform, including the Market Operator and Distribution Ledger functionality. These advances will ensure maximum integration potential is realised.

Standards considerations:

- IEEE 2030.5
- USEF
- IDS
- Open ADR
- Open FMB

BESS Asset Response

Implementation of two battery assets of differing chemistry (flow and Li-ion) with the ability to respond as two separate systems. These assets will have the ability to be optimised for a variety of value streams, which have varying returns and impacts on operations. As precinct scale assets, the ability to respond to various value streams will demonstrate the potential for DERs to provide value beyond network security through coordination.

Value stream considerations:

- Demand response
- Peak demand management
- Future value streams e.g. FCAS
- Commercial impacts

Standards considerations:

- IEEE 2030.5
- Open ADR

PV Management

Implementation of PV management to facilitate curtailment functionality in order to ensure export restrictions under the precinct's Connection Agreement are not exceeded. This will allow the precinct to avoid investment in costly electrical (physical) infrastructure and provide greater visibility of PV operations.

A number of components are in development in the platform to enable this functionality including:

- Site load
- Site load forecasts
- PV generation forecasting incorporating environmental conditions
- PV system control through Indra's Active Grid Management platform

Standards considerations:

- IEEE 2030.5
- Open ADR

HVAC Flexibility Potential

Complete integration of buildings with the building controllers across the microgrid, starting with the ability to test aggregate flexibility potential across enrolled buildings as per flexibility strategies already developed.

Secondarily, assess and initiate ability for buildings to respond to DR and peak demand signals akin to batteries and in line with their Flexibility Strategies. Compensation will be provided to each building commensurate with flexibility provided and as per the rules under development.

Lastly, it is intended that buildings will be able to make autonomous decisions on the flexibility they can provide outside of predefined flexibility strategies.

Standards considerations:

- IEEE 2030.5
- Open ADR

Electric Vehicle Coordination

Electric vehicle (EV) chargers are incorporated into the available DER assets that can respond to flexibility requests from the operator. Following a similar approach to building flexibility, EV users will be able to participate in market events by submitting their preference, which are to be captured via the billing platform.

The platform will have the ability to:

- Adjust ramp charging rates up and down
- End or pause charging sessions
- Coordinate the discharge EV batteries across the precinct via future functionality and deployment of vehicle to grid charging infrastructure.

Operator Functionality

Implement a system to manage contractual constraints, DER registration and commercial and operational reporting. Settlement of the Smart Energy City market activity against the relevant contracts will form a key component of this functionality. Aiding this component of the platform is the development of a distributed ledger which will underpin the certification of the Operator functionality. In addition, the system feature-set is to include visualisations, transaction logging and management of billing/reporting.

In subsequent iterations, enhanced Operator functionality will include the ability to manage virtual peer-to-pool trading of PV. This design will allow buildings with PV to monitor and record their excess PV for resale through the central operating entity to those buildings without generation assets.

Standards Considerations:

- IEEE 2030.5
- USEF

Monitoring/Data Sharing

Implement monitoring of power and energy data via Operational Intelligence System (OIS) and expand ability to share OIS dashboards and reports.

Data to be included is:

  - Site load information
  - Building load information
  - Power Quality load information

- Power Quality event information
- Response to market signal visualisations

Future Functionality

In addition to the priority functionality outlined above, the project team has also identified the following as key functionality for implementation in the medium term:

- Provision of voltage control including ability to control solar PV inverter for internal voltage services and external network services

- Leverage contracting opportunities, including:
  - Hedging linked to PPA forecast
  - Additional external contracts, such as FCAS, and network DR

- Further integrate operational functionality of the TEM Market, including the application of submitted user preferences, and further decentralised operation

- Provide ability to run simulations on behalf of other potential microgrid sites to assess value

Partnerships and Collaboration

A critical metric to the success of the Monash Indra SEC Platform is the extent to which industry, technology vendors and others share-in and benefit from lessons learned and expertise developed. The foundational premise of the microgrid is that it functions as a living laboratory, where external parties can co-design use cases for co-trailing in a live environment capable of providing real-world results.

The project team aims to invite industry partners to collaborate on the SEC platform throughout 2021 and beyond on the functionality presented in this document.

The project team warmly invite interested stakeholders to contact netzero@monash.edu to initiate a preliminary exploratory discussion on potential collaboration opportunities.