Lesson Learnt Report

Development and experimental implementation of transactive demand response management system through open ADR-approach for institutional buildings

Project DCH5

27th May 2022

Swinburne University of Technology

About i-Hub

The Innovation Hub for Affordable Heating and Cooling (i-Hub) is an initiative led by the Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH) in conjunction with CSIRO, Queensland University of Technology (QUT), the University of Melbourne and the University of Wollongong and supported by Australian Renewable Energy Agency (ARENA) to facilitate the heating, ventilation, air conditioning and refrigeration (HVAC&R) industry's transition to a low emissions future, stimulate jobs growth, and showcase HVAC&R innovation in buildings.

The objective of i-Hub is to support the broader HVAC&R industry with knowledge dissemination, skills-development and capacity-building. By facilitating a collaborative approach to innovation, i-Hub brings together leading universities, researchers, consultants, building owners and equipment manufacturers to create a connected research and development community in Australia.

This Project received funding from ARENA as part of ARENA's Advancing Renewables Program.
The views expressed herein are not necessarily the views of the Australian Government, and the Australian Government does not accept responsibility for any information or advice contained herein.

Primary Project Partner

i-Hub Lessons Learnt Report

Lead organisation	Swinburne University of Technology		
Sub-Project number	DCH5		
Sub-Project commencement date	26th February 2021	Completion date	29th June 2022
Report date	27th May 2022		
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Lessons learnt

Lesson learnt #1	Difficulty in building data ingestion					
Category	Commercial					
Choose from:	*Technical*	*Commercial*	*Social*	*Regulatory*	*Logistical*	*Other (specify)*

Describe what you learnt about this aspect of the Project.

Unfortunately, we have learned that we should not have presumed that today's buildings are intelligent, connected, and digital, capable of providing excellent data on demand. We were informed that the IT team has BMS (building management system), BACnet, or Modbus, as well as open systems or systems connected to the Internet through IP. They have, to some extent, but there is a significant gap between the reality of linked building systems and the sort of data quality required to get a significant return on investment. Furthermore, obtaining the BMS supplier to accept the setpoint was the primary worry. The setpoints change based on the actual mechanical architecture of the building, which was not considered during the early phase of this project.

Sensor retrofitting to accommodate the required data integration to the current BMS system is sometimes an unjustified investment. Furthermore, obtaining clearance to include them is a lengthy and bureaucratic procedure that is difficult to complete within the project's timeline. The building operations staff is frequently in the field on the same assets over several years. Introducing a new package that saves money and energy, enhances comfort, or reduces maintenance is sometimes viewed as a threat by current employees, who sometimes perceive that such technology may be revealing how poorly they have been doing in their function.

Please describe what you would do differently next time and how this would help. What are the implications for future Projects?

It is up to each person to persuade others to participate in the plan, explain why it is beneficial, and show how it would enhance their professional or career path somehow. Since our programs do not often include working directly with operational teams, we do not typically have the chance to participate in events of this nature. Observing hindsight, we could have done a better job of explaining DCH to the operational teams.

If your Project learnings have identified any knowledge gaps that need to be filled, please state it below.

An efficient strategy should specify a comprehensive list of requirements across many functional areas, including information technology (IT), operations, human resources, corporate real estate, and security. It should also define the team of key stakeholders based on the project requirement. Then it should prioritize the task based on the criteria to set realistic time frames and make the appropriate investment in proofs-of-concept.

Please include any other information you feel is relevant or helpful in sharing the knowledge you learnt through this stage of the Project. This may be qualitative or quantitative and may include a graph, chart, infographic or table as appropriate.
N/A

Lesson learnt #2 Asset management team are reluctant to share some critical data

Category	Logistical					
Choose from:	*Technical*	*Commercial*	*Social*	*Regulatory*	*Logistical*	*Other (specify)*

Describe what you learnt about this aspect of the Project.
We want to express our gratitude to Swinburne University's authorities, logistics, and asset management team for their consistent support of the project. However, we have realized that not all the building information/data that they possess can be distributed to a project such as ours. This is a lesson that we have learned. For instance, initially, we thought the occupancy information could be collected from the already installed CC-CAM. This camera is easily accessible and can deliver occupancy data for specific areas within the buildings. In order to have access to this information, we reached out to the Swinburne team. However, the authorities refused to provide access to such material, citing concerns about the individuals' right to privacy. We clarified to them that we do not want the actual video footage, but instead, we are simply interested in the total number of individuals counted (built-in function of the CC-CAM). After several attempts to get in touch with them, we were informed that a different firm manages the surveillance cameras and that the business cannot supply us with the information we want.
Please describe what you would do differently next time and how this would help. What are the implications for future Projects?
We would first conduct a pilot programme with our internal management team to test our theory of a better solution before implementing any new technology. The programme should focus on providing training and documentation and identifying subject matter experts or mentors who are accessible to help the management with their inquiries. We would also bring in a few industry experts to assist us in building our case. Both of these options would come before implementing any new technology. All too frequently, the assumption is made that the new instrument is easy to use. That might be true for us, but the asset manager could not agree. So, we would include them in the decision-making process so that they could suggest ways that information from the current system could be shared or help us come up with other solutions.
If your Project learnings have identified any knowledge gaps that need to be filled, please state it below.

N/A
Please include any other information you feel is relevant or helpful in sharing the knowledge you learnt through this stage of the Project. This may be qualitative or quantitative and may include a graph, chart, infographic or table as appropriate.
N/A

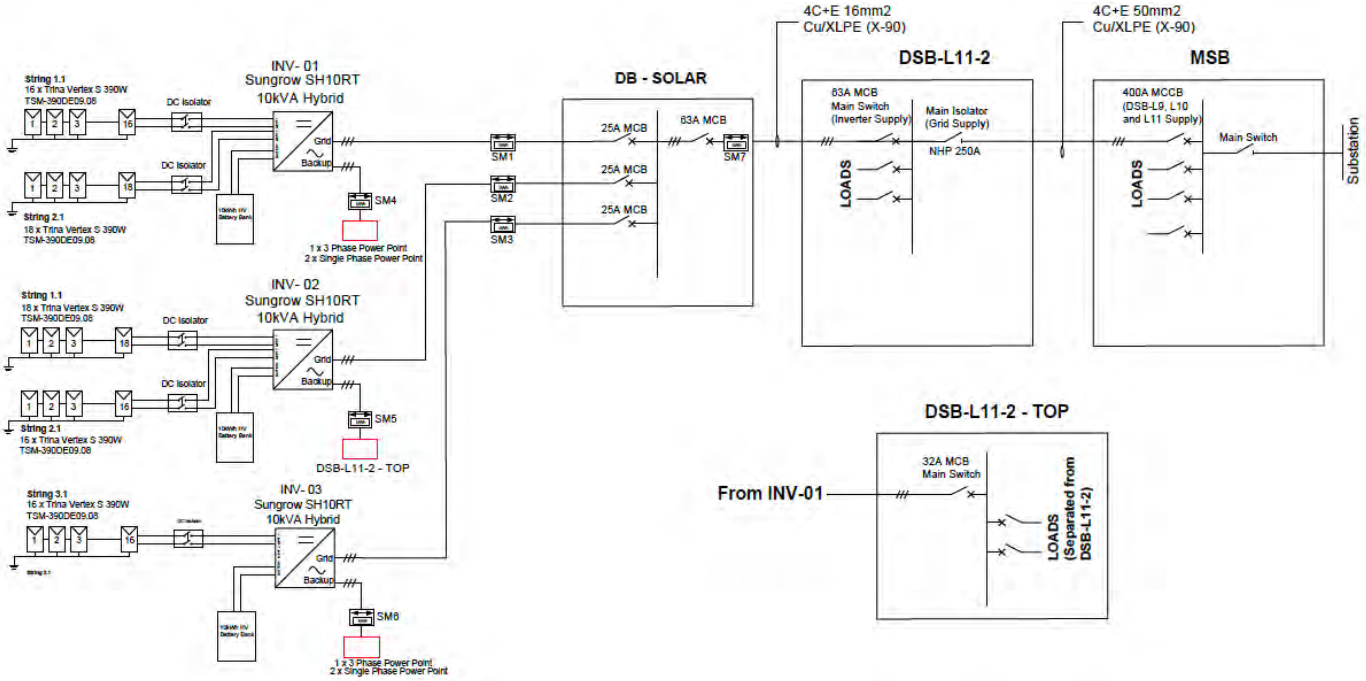
Lesson learnt #3	Difficulty of sharing energy within the neighbourhood					
Category	Technical, Regulatory					
Choose from:	*Technical*	*Commercial*	*Social*	*Regulatory*	*Logistical*	*Other (specify)*

Describe what you learnt about this aspect of the Project.
We understand that the potential for sharing the surplus energy within the community, although increases the market returns of the onsite energy through transactive demand response, is not legally possible until the existing Australian regulation is revised.
Please describe what you would do differently next time and how this would help. What are the implications for future Projects?
Due to legal restrictions on interconnecting buildings drawing power from multiple substations, we chose to place all onsite renewables and inverters on one building to replicate a community microgrid in which each inverter acts as a separate entity within the community. As a result, the energy exchange between buildings may be tested and assessed. Furthermore, a separate DC microgrid may be built using the same arrangement to study various alternatives to sharing excess energy throughout the community without breaking the regulator limitation. Since we have a regulatory limitation in terms of interconnecting the buildings sourced from two different substations, we were limited in the project context to have all the onsite generation installed in one building and emulate the three inverters to be considered as the three entities of the Community microgrid. The alternate method to try this simulation would be to establish a separate DC line for the community to share the surplus with the other microgrids within the community. The load emulator and the EMS control implemented using the NIcRIO will integrate with the VENs and VPNs participating in the openTDR game. The energy reduction due to the raised TDR event will be emulated using the programmable loads to evaluate the energy sharing across multiple inverters. Various simulations are to be experimented with in the upcoming milestone.
If your Project learnings have identified any knowledge gaps that need to be filled, please state it below.

The knowledge gap identified in this milestone of the DCH 5 project highlights the regulatory restrictions that limit us from interconnecting buildings. The successful completion of the project outcome through the emulator setup would prove evidence to advocate the changes to the legislative policies.

Please include any other information you feel is relevant or helpful in sharing the knowledge you learnt through this stage of the Project. This may be qualitative or quantitative and may include a graph, chart, infographic or table as appropriate.

The proposed emulator setup to simulate the transactive demand response in community microgrids is indicated in the following diagram.



Lesson learnt #4	IT team should be part of the project team from the beginning of the project					
Category	*Logistical*					
Choose from:	*Technical*	*Commercial*	*Social*	*Regulatory*	*Logistical*	*Other (specify)*

Describe what you learnt about this aspect of the Project.

A significant portion of this project is concerned with integrating the Internet of Things (IoT), which refers to combining new devices, data, platforms, and IoT applications with existing IT assets. This requires making minor to moderate adjustments to the current network, upgrading the firewall, and expanding the network. Due to this, it was necessary to maintain open contact lines and discussions with the IT staff. It should come as no surprise that getting the IT team to understand the needs of this project would be a challenging endeavor. In addition, the procedure must be carried out from the beginning every time another individual replaces the person in charge of it for any reason that cannot be avoided, such as sick leave. Furthermore, retrofitting a straightforward expansion of the current network involves a permission process and hiring a third-party provider to install the appropriate hardware and cabling, resulting in an unnecessary increase in both time and expense. Consequently, we invested substantial time and effort in negotiating with Swinburne's IT supplier, which was an unanticipated lesson that we learned during the project.

Please describe what you would do differently next time and how this would help. What are the implications for future Projects?

It would be a very safe and realistic call to directly bring the IT team to participate in the project. They are well ware of the necessary change and technology involved in implementing the project. Task relevant to network upgrade and modification should be identified early so that the project management team can roll the ball smoothly.

If your Project learnings have identified any knowledge gaps that need to be filled, please state it below.

N/A

Please include any other information you feel is relevant or helpful in sharing the knowledge you learnt through this stage of the Project. This may be qualitative or quantitative and may include a graph, chart, infographic or table as appropriate.

N/A

Lesson learnt #5	Cyber security issues related to the network architecture of the system

Category	*Technical and Logistical*					
Choose from:	*Technical*	*Commercial*	*Social*	*Regulatory*	*Logistical*	*Other (specify)*

Describe what you learnt about this aspect of the Project.

The Networking related cyber security issues are to be considered with higher importance when designing a community microgrid communication framework.

Please describe what you would do differently next time and how this would help. What are the implications for future Projects?

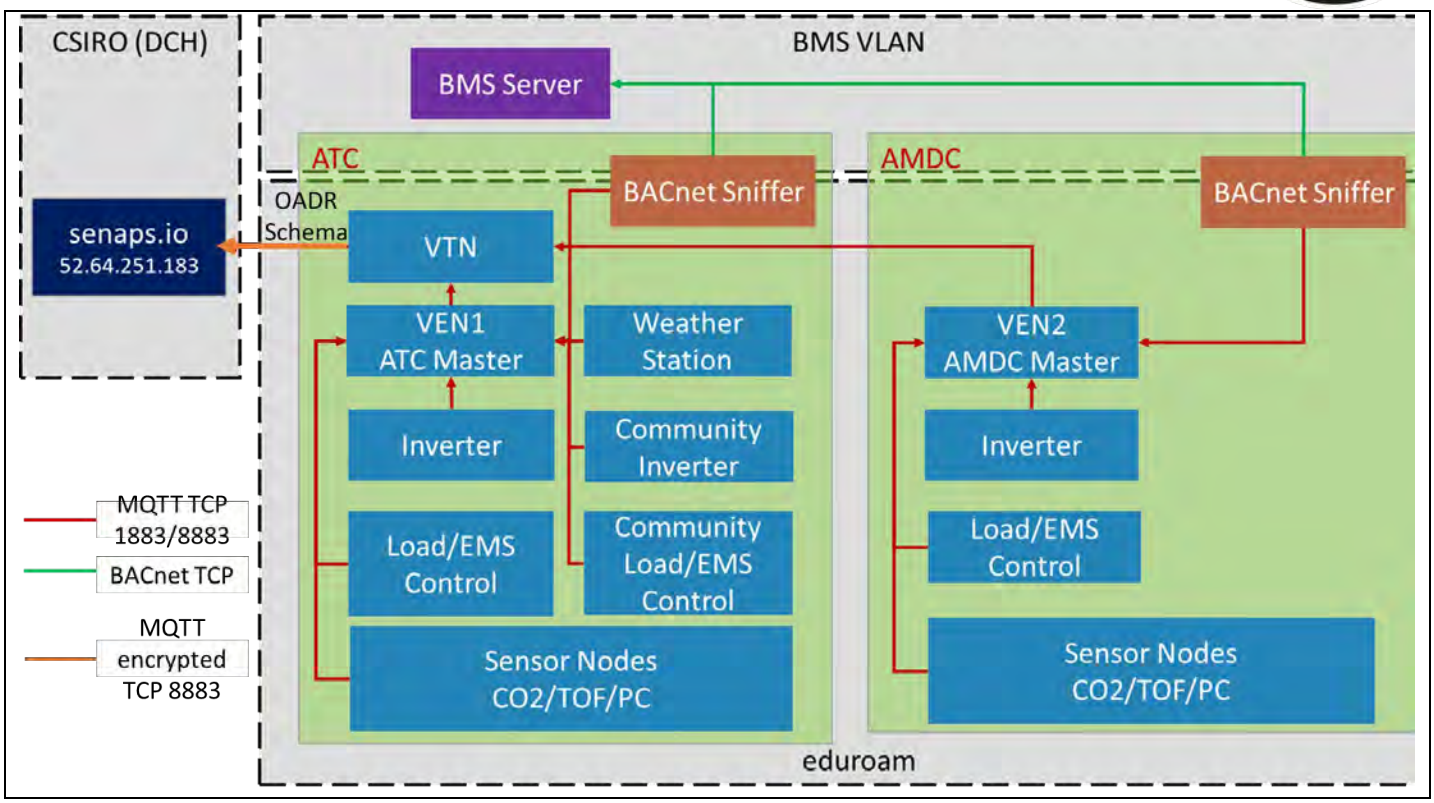
The consideration of the individual subnets for establishing a secure connection of the sensor nodes and the BACnet gateways with the VENs and VTNs would be something that we can test in the future and have a direct link of every device to communicate directly with the DCH is something we can do if the cyber security restrictions permit us to do in the upcoming research projects.

If your Project learnings have identified any knowledge gaps that need to be filled, please state it below.

The knowledge gap identified in this milestone of the DCH 5 project highlights the lack of proper standards for the data communication in relationship to the transactive demand response event using the OpenADR ontology.

Please include any other information you feel is relevant or helpful in sharing the knowledge you learnt through this stage of the Project. This may be qualitative or quantitative and may include a graph, chart, infographic or table as appropriate.

The proposed network architecture of addressing the limitation of the cyber security issues is shown below. The system is configured with all the appropriate firewall settings and the data integration with DCH is successfully implemented.


CSIRO (DCH)
BMS VLAN
BMS Server
ATC
AMDC
BACnet Sniffer
BACnet Sniffer
OADR
Schema
senaps.io
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VTN
VEN1
ATC Master
Weather
Station
VEN2
AMDC Master
Inverter
Community
Inverter
Inverter
MQTT TCP
1883/8883
BACnet TCP
MQTT
encrypted
TCP 8883
Load/EMS
Control
Community
Load/EMS
Control
Load/EMS
Control
Sensor Nodes
CO2/TOF/PC
Sensor Nodes
CO2/TOF/PC
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