12-22 North

IOTconduit

An Internet of Things lab, testbed, and proving ground

Taking Back Control:

Building Resiliency through HVAC controls and the Industrial Internet of Things

AJ Rossman

Efficiency Vermont BETTER BUILDINGS BY DESIGN

VIRTUAL CONFERENCE FEBRUARY 2–4, 2021

12-22 North

Proworking - Stay Safe and Connected

Learn more: www.12-22North.com

IOTconduit

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Learn more: www.IoTConduit.com

BUILDING RESILIENCE

“For a commercial building owner, ‘building resilience’ can be defined as the ability to protect, maintain, or restore the functionality of, value of, and income generated by a building after a damaging event or circumstance within a prescribed time frame”

Development of a Tool for Assessing Commercial Building Resilience (2017)

What does that mean for Commercial Buildings in 2021 ?

- Renting space in a COVID-19 environment
- Improving air quality without breaking the bank
- Responding to extreme weather events

Challenge 1 - COVID-19

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Challenge 1 – Loss of Tenants Due to Pandemic

12-22 North Pandemic Timeline

March 2020 - State of Vermont Executive Order shut down public spaces. Strict requirements put into place.

April 2020 - Health and Safety Plan implemented using WordPress. Started discussions with Infiense, StreamLogic and Healthy Kingdom on how to adapt their building models to re-open building faster.

May 2020 - Installed camera in side lot Food Alley for StreamLogic. Healthy Kingdom opens Smoothie stand in lot. Sensors ordered from InfiSense. SteamLogic deploys and calibrates HealthWatch at Food Alley.

June 2020 - InfiSense provisioned 10 Smart Room Sensors and deployment design. StreamLogic refines HealthWatch and shares initial statistics. Healthy Kingdom ponders how to integrate his IoT Technology vision

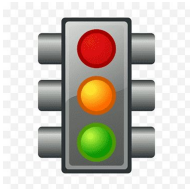
July - August 2020 - Integrate all technologies into 12-22 North web portal

September 2020 - Re-opening to new tenants

Coronavirus Safety Station Concept

IoT Sensor Clusters

Cameras

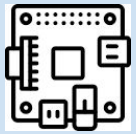


Visual Risk Alert Displays

Large-format LED Display
[42-70+”]

IoT Gateway

Edge Computing



Technology Integrations

- Occupancy and space usage
- Abnormal Temperature Detection
- Indoor Air Quality
- Contact Tracing Database
- Social Distancing Metrics
- Cleaning supply inventory
- Educational Messaging
- Branding Opportunities

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Coronavirus Safety Station Technologies

InfiSense
eGauge
MEASURE EVERY MOMENT

IoT Gateways

PHILIPS
hue personal wireless lighting

Visual Risk Alert Displays

Schneider Electric

Fresh Air Controls

Node-RED

TEKTELIC communications

IoT Sensor Clusters

RaspberryPi

Edge Computing

streamlogic

Camera AI

SMART RESOURCE LABS

Independent Datalayer

CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

Weather Stations

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Coronavirus Safety Station Implementation

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Coronavirus Safety Station Demo

Room Ready Status

- Flex Space Room Ready Status
- Office 2 Room Ready Status
- Office 3 Room Ready Status
- Office 4 Room Ready Status
- Office 5 Room Ready Status
- Office 6 Room Ready Status
- Solarium Room Ready Status

All rooms cleaned

Cleaning

- Flex Space Cleaning Status
- FLEX SPACE CLEANING COMPLETED
- Office 2 Cleaning Status
- OFFICE 2 CLEANING COMPLETED
- Office 3 Cleaning Status
- OFFICE 3 CLEANING COMPLETED
- Office 4 Cleaning Status
- OFFICE 4 CLEANING COMPLETED
- Office 5 Cleaning Status
- OFFICE 5 CLEANING COMPLETED
- Office 6 Cleaning Status
- OFFICE 6 CLEANING COMPLETED
- Solarium Cleaning Status
- SOLARIUM CLEANING COMPLETED

Offices are occupied

Room Ready Status

Only some rooms need cleaning!

- Flex Space Room Ready Status
- Office 2 Room Ready Status
- Office 3 Room Ready Status
- Office 4 Room Ready Status
- Office 5 Room Ready Status
- Office 6 Room Ready Status
- Solarium Room Ready Status

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Challenge 2 - Air Quality

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Challenge 2 - Indoor Air Quality

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Step 1 - Hire a Professional for Focus

Building Evaluation Report

Risks...

According to the OSHA Occupational Risk Pyramid classification for COVID-19 per OSHA publication 3990: Guidance on Preparing Workplaces for COVID-19 [1], the exposure risk level for the current and likely prospective tenants at 12-22 North Street is “Lower Exposure Risk” for most IoT Conduit activities, or “Medium Exposure Risk” considering Laboratory B activities which include public-facing events.

Recommendations...

While the OSHA guidelines for Lower and Medium Risk spaces do not explicitly recommend ‘Engineering Controls’ beyond physical barriers such as Plexiglas,1
the CDC website on COVID-19 Employer Information for
Office Buildings [2] is clear about HVAC system recommendations based on ASHRAE guidance. These can be summarized as:

- Ensure adequate ventilation air volume
- Disable demand-control ventilation (DCV) which could reduce ventilation air volume
- Improve air filtration with portable HEPA filters and ultraviolet germicidal irradiation (UVGI) units
- Ensure less clean air is properly exhausted

Action Items...

Since most of the administrative and basic hygiene controls are already in place at 12-22 Pro-Working, the HVAC system recommendations should be the primary focus for isolating occupants from COVID-19 hazards.2
The existing 12-22 North Street HVAC systems include an air-cooled cold-climate heat pump for heating and cooling, and a gas-fired central air handler with ducted supply and return.
The following action items are recommended:

1. Improve ventilation in the building in consultation with an HVAC professional [2]. This includes:

...

Report by Emily Cross, The Evaluators

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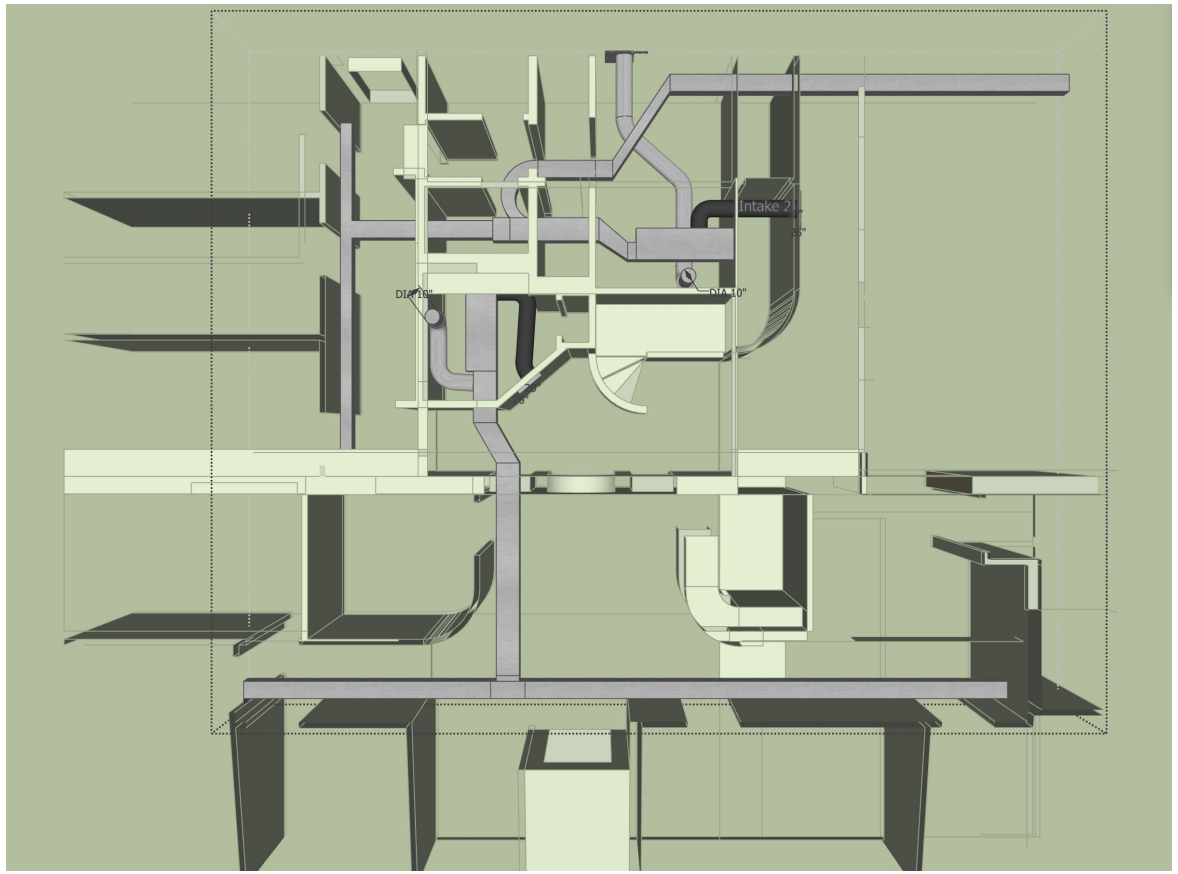
Existing Infrastructure - No Outside Air



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Step 2 - Make Changes and Adapt Controls

- Added schedule for fresh-air ventilation
- Integration in process to bring in real-time measurements using IoT

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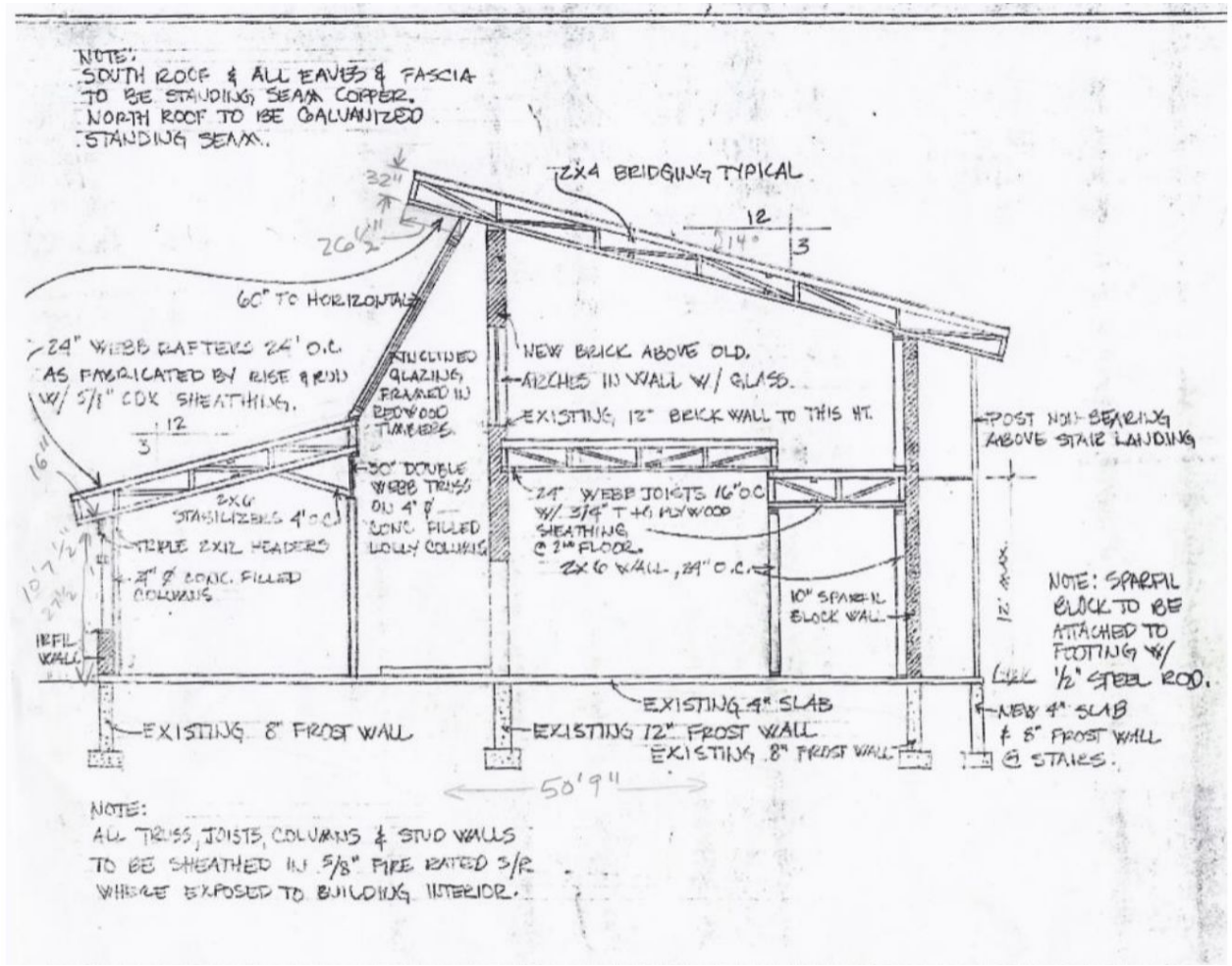
Step 3 – Measurement & Verification [TBD]



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Step 4 - Report Building Safety Status to Tenants

— Ventilation Update

In order to comply with updated ventilation requirements for buildings, 12-22 North has been taking steps to **upgrade our ventilation systems** to allow for more fresh air intake and outflow of air. We have actively been monitoring and increasing our **indoor air quality** to ensure indoor protection from the virus.

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Challenge 3 - Extreme Weather

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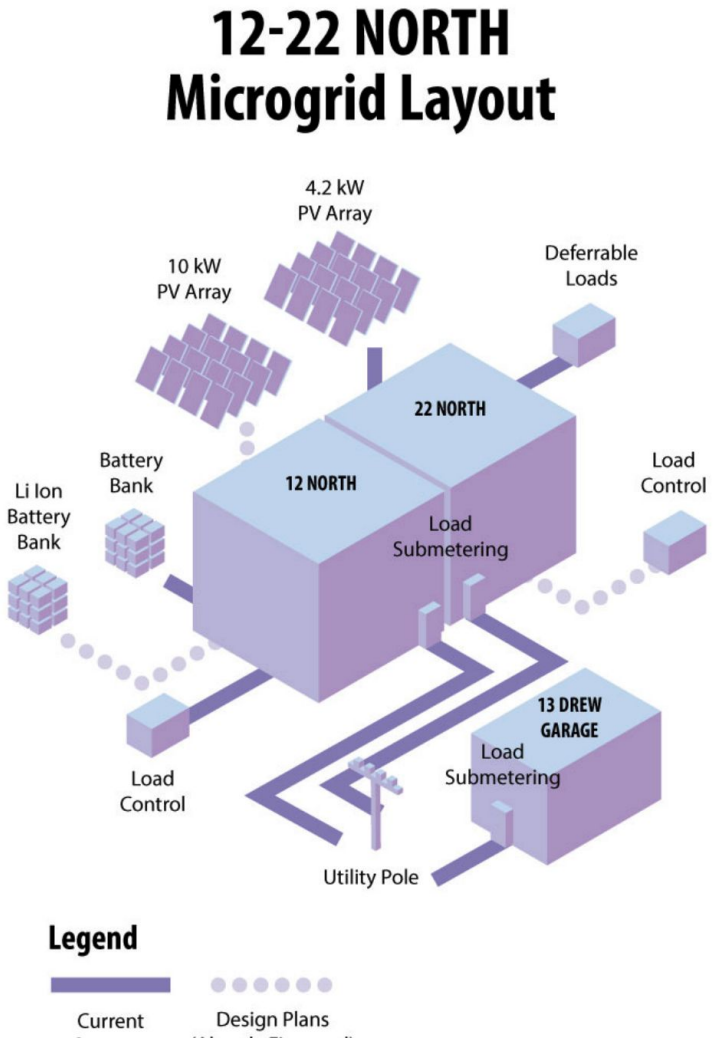
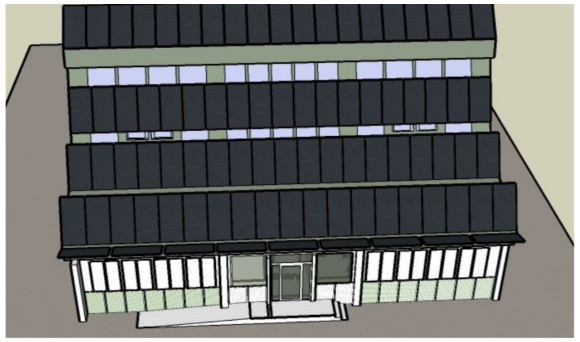
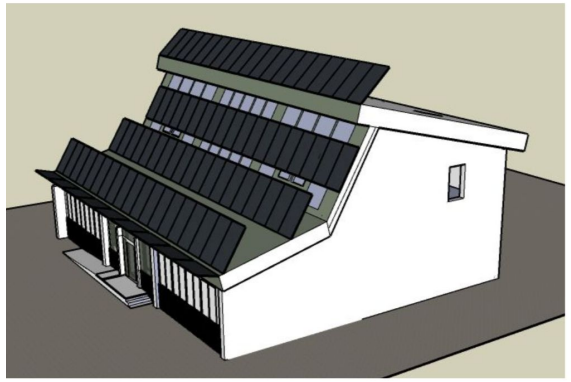
Challenge 3 - Mitigating Extreme Weather

Challenge 3 – Microgrid Design







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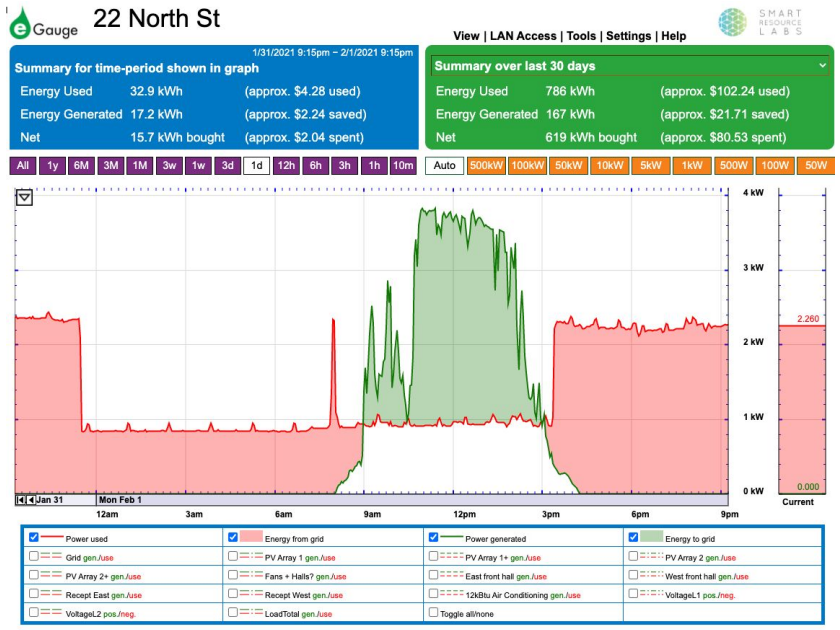
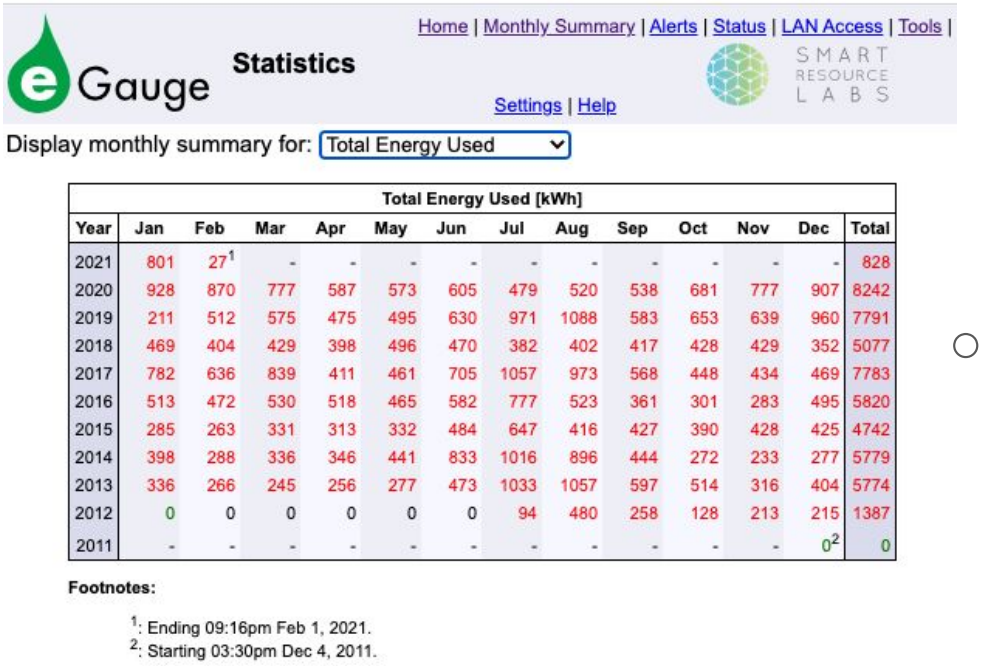
Challenge 3 – Microgrid Power Design

Step 1 - Submeter for Granular Load Profiling





Total Energy Used [kWh]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2021	801	27[1]	-	-	-	-	-	-	-	-	-	-	828
2020	928	870	777	587	573	605	479	520	538	681	777	907	8242
2019	211	512	575	475	495	630	971	1088	583	653	639	960	7791
2018	469	404	429	398	496	470	382	402	417	428	429	352	5077
2017	782	636	839	411	461	705	1057	973	568	448	434	469	7783
2016	513	472	530	518	465	582	777	523	361	301	283	495	5820
2015	285	263	331	313	332	484	647	416	427	390	428	425	4742
2014	398	288	336	346	441	833	1016	896	444	272	233	277	5779
2013	336	266	245	256	277	473	1033	1057	597	514	316	404	5774
2012	0	0	0	0	0	0	94	480	258	128	213	215	1387
2011	-	-	-	-	-	-	-	-	-	-	-	0[2]	0

Footnotes:

[1]: Ending 09:16pm Feb 1, 2021.
[2]: Starting 03:30pm Dec 4, 2011.

- Critical Loads
  - Heating system (controls, pumps)
  - IT Network
  - NOC Center
- Deferrable / Sheddable Loads
  - Water heater

Use an IIoT BMS to Verify Assumptions for Sizing Storage Capacity

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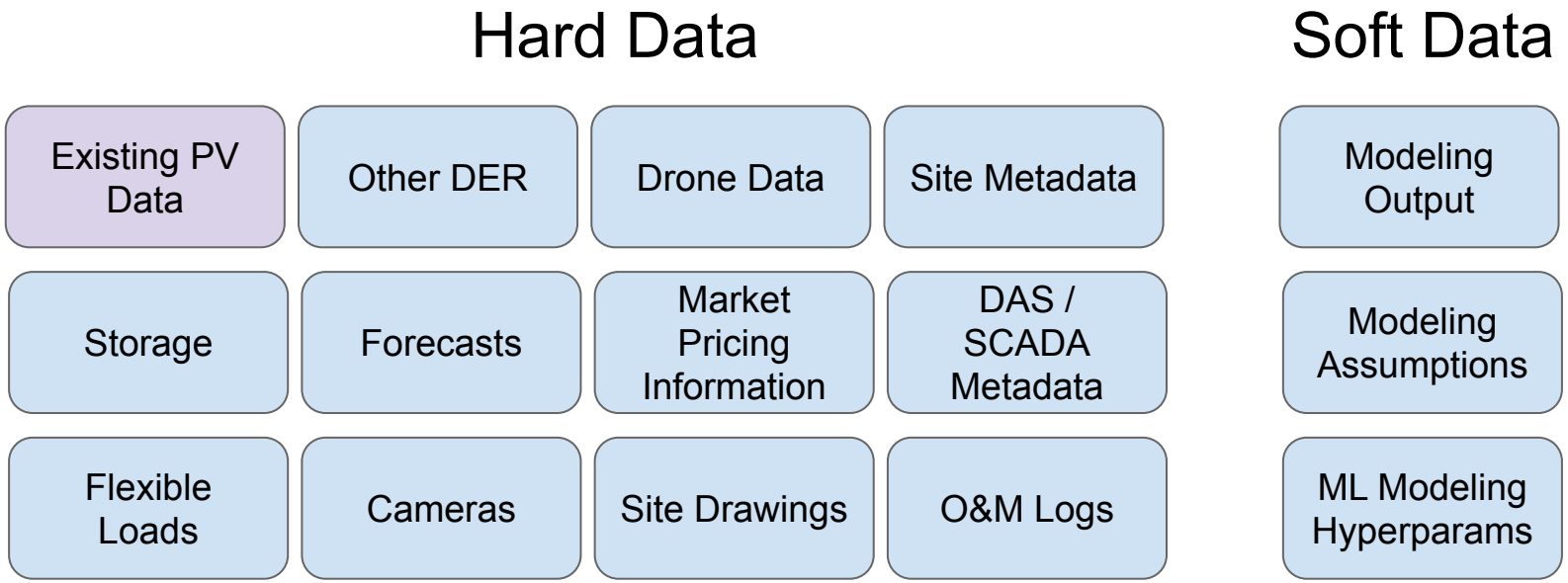
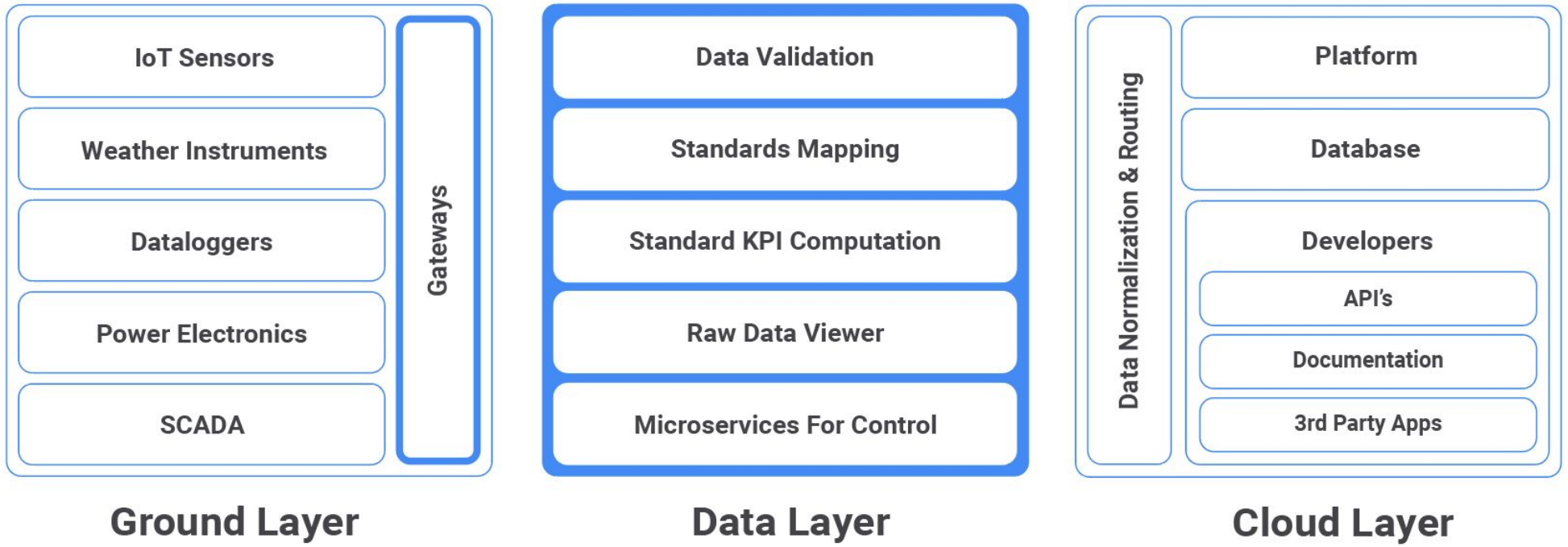
Challenge 3 - Microgrid Power Design

Step 2 - Integrate Independent DataLayer for System Interoperability



Challenge 3 - Microgrid Power Design

Step 2 - Integrate Independent DataLayer for System Interoperability



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Challenge 3 – Microgrid Power Design

Step 2 - Integrate Independent DataLayer for System Interoperability

Device Commissioning

Commissioning Document

SMART RESOURCE LABS

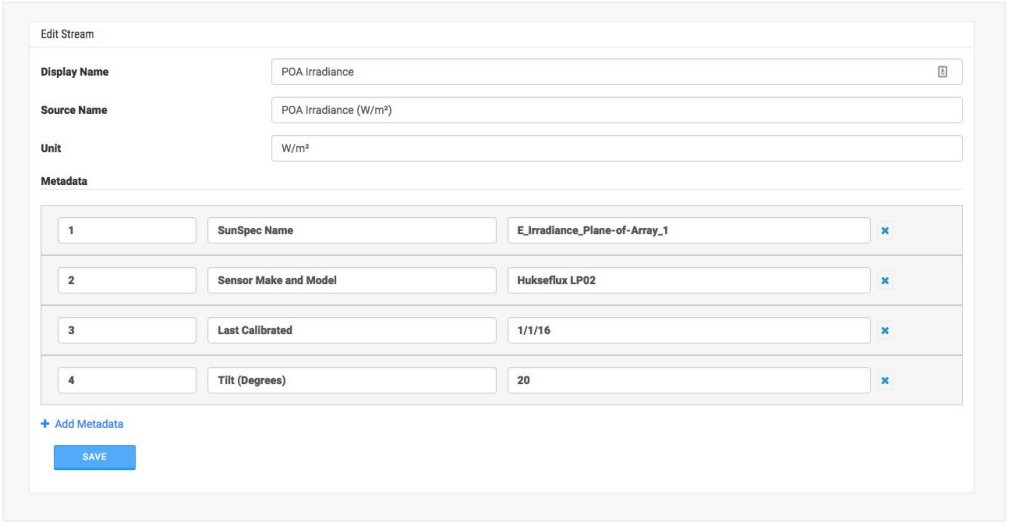
Device Information				
Location	Cell Air Compressor Test / Drew St Garage	Device Name ☐	Cell eGauge tester 23111	Device ID
Hostname ☐	CellTest	Serial Number ☐		MAC Address ☐
IP Address ☐	192.168.1.88	Confirm Date & Time ☐		

Voltages	eGauge	Measured
L1		
L2		
L3		

Channel	CT Label	Ω	eGauge Reading (A)	Amp-clamp Reading (A)	Power Factor	Notes
1	Ch.1 240 V Test Circuit -L1					
2	Ch.2 240 V Test Circuit -L2					
3	Ch.3 Air Compressor -L1					
4	Ch.4 Mains -L1					
5	Ch.5 Mains -L2					
6	Ch.6 Spotlight -L1					

Signature		Date	

Metadata Management



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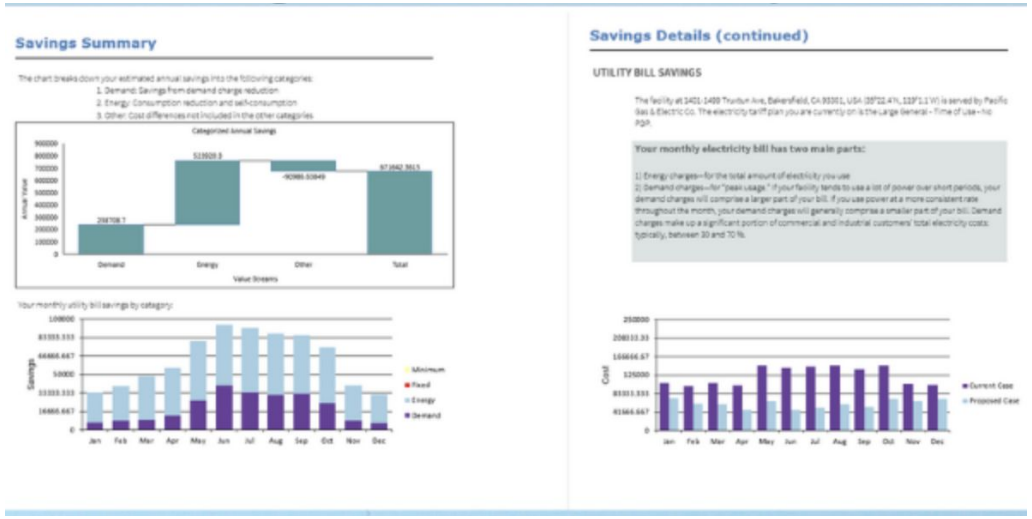
Challenge 3 – Microgrid Power Design

Step 3 - System Design and Simulation [FUTURE]

NREL SAM + ReOpt

UL HOMER



Use an IIoT BMS to Properly Size Storage Capacity

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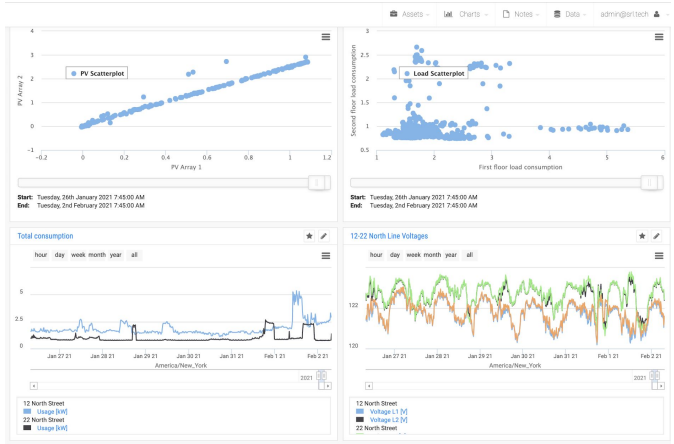
Challenge 3 – Microgrid Power Design

Step 4 - Optimize Operations [FUTURE]

streamViewer



MBCx

Control Optimization

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