



# Power Monitoring Expert Application

## Toyota Motor Manufacturing Canada

John Goodfellow

September 19, 2019

**TOYOTA**

# Woodstock & Cambridge Facilities



## West Plant

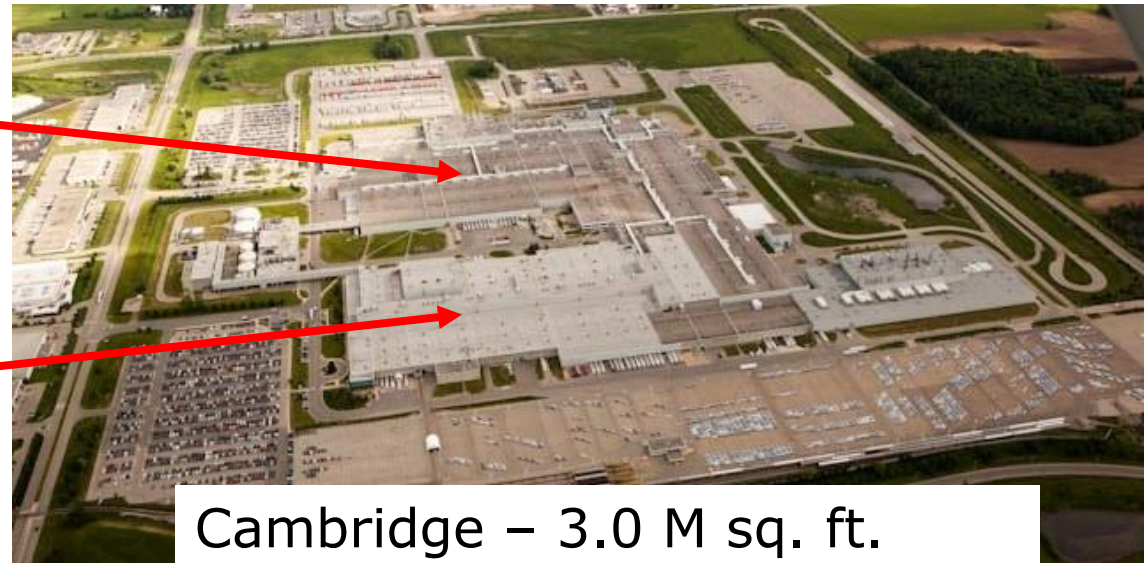
RAV4  
RAV4 Hybrid



Woodstock – 1.8 M sq. ft.

## North Plant

RAV4



Cambridge – 3.0 M sq. ft.

## South Plant

Lexus  
RX 350, RX 350L



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# Woodstock & Cambridge Facilities



- Approximately 8,000 employees
- Produce over 500,000 vehicles annually
- February 27, 2018 - TMMC produced its 8 millionth vehicle – a Blue Crush Metallic Corolla



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## Woodstock Facility

- Factory Built in 2007
- Direct Connected to Hydro One
- Demand 15 MW to 22 MW
- 7 Switch Rooms



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# Woodstock Facility

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25 Substations

- Schneider Square D  
- QED
- 2,500 to 3,500 KVA



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# Woodstock Facility

## Meters

- CM4250
- PM8000

## Breakers

- Masterpact NW with Micrologic 6.0 P control units





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**TMMC WOODSTOCK**

SS 7-1

SS 2-1  
SS 2-2

SS 3-1  
SS 3-2

SS 3-7  
SS 3-8  
SS 3-9

SS 3-5  
SS 3-6

SS 6-1

SS 1-1  
SS 1-2  
SS 1-3

SS 1-4  
SS 1-5

SS 3-3  
SS 3-4

SS 4-1  
SS 4-2  
SS 4-3

SS 4-4  
SS 4-5

- Utilities 5 kV
- Air Compressors
- Chillers

Compressed Air Monitor

SS 5-1  
SS 5-2

13.8 kV Bus

## Woodstock Facility - Architecture

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- PME 8.1
- Installed on a VMware server
- Meters are Ethernet connected
- Breakers are connected to the meters via Modbus
- Meters are on 3 Facility VLANs operating over the plant LAN



## Woodstock Facility - PME

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- Users: Facility Engineering and Facility Maintenance
- Most Used Modules:
  - Diagrams – Real Time Operations
  - Reports – Energy Billing to the Production Shops

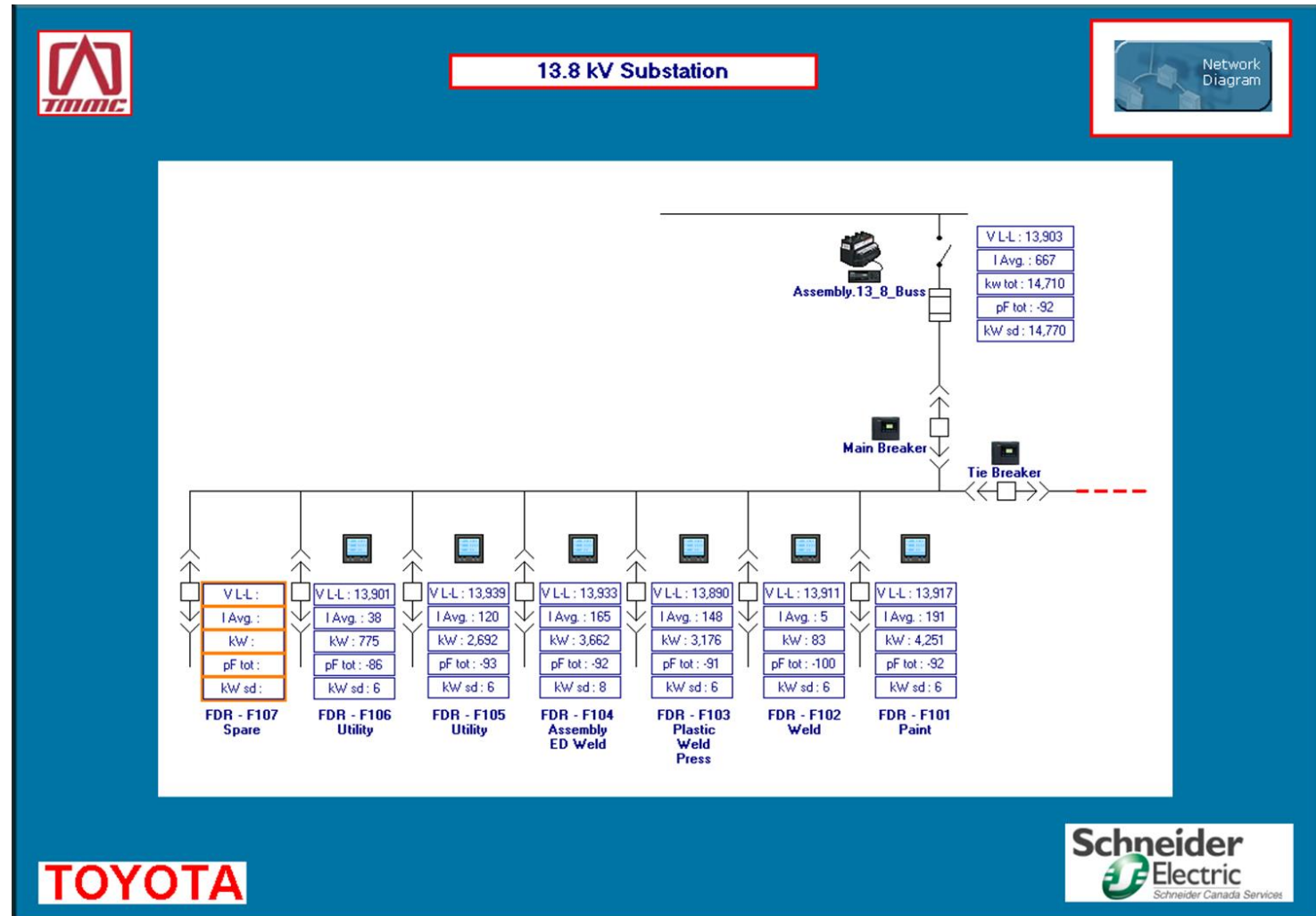
# Woodstock Facility – PME Diagrams

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- Real Time Operations
- Identifying Capacity on Bus Ducts, Power Distribution Panels (PDPs)
- Power Studies
  - Identify and Confirm Savings (M & V)
  - Look for Power Anomalies

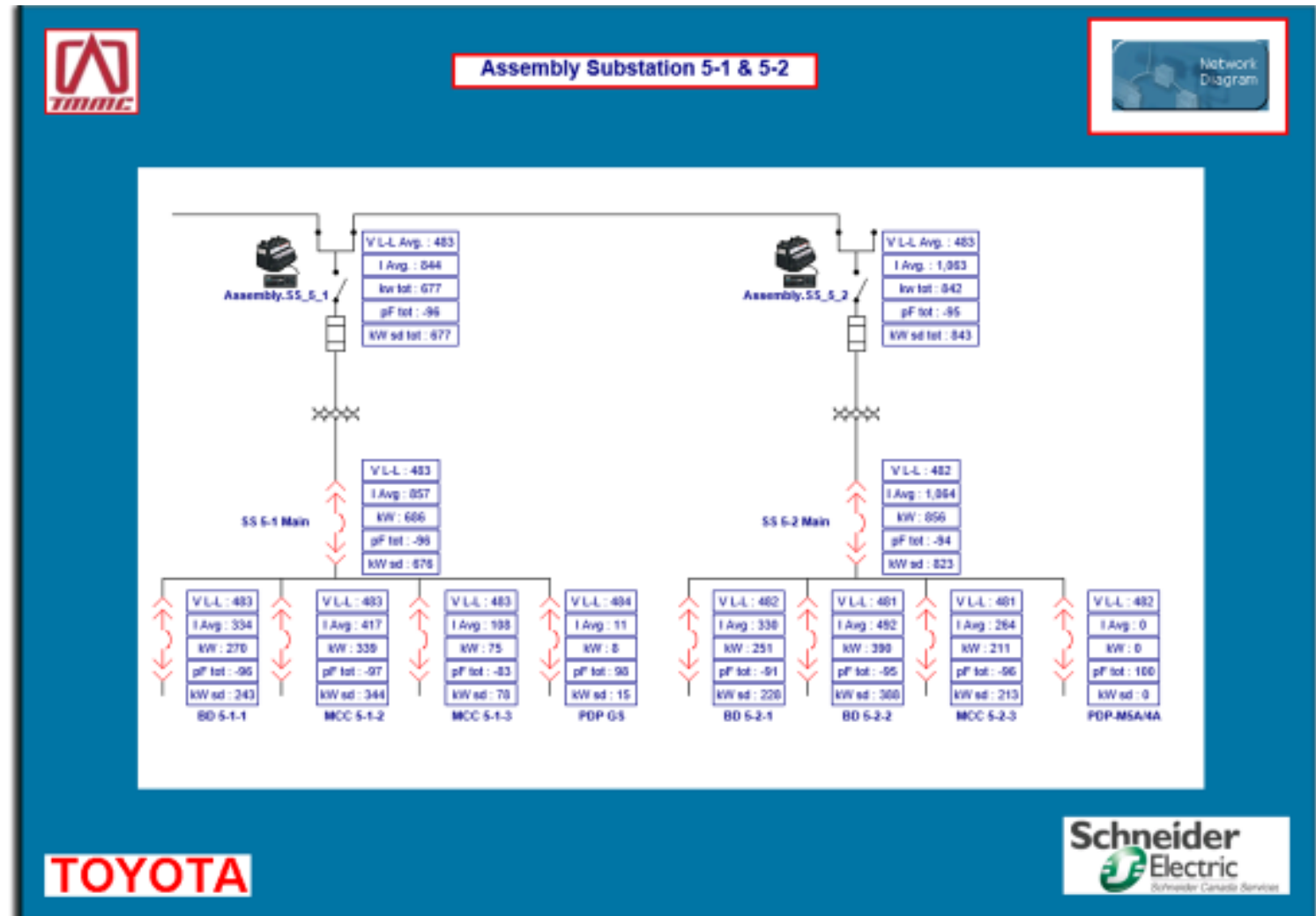
## Woodstock Facility – PME Diagrams

- Incoming Power Distribution



## Woodstock Facility – PME Diagrams

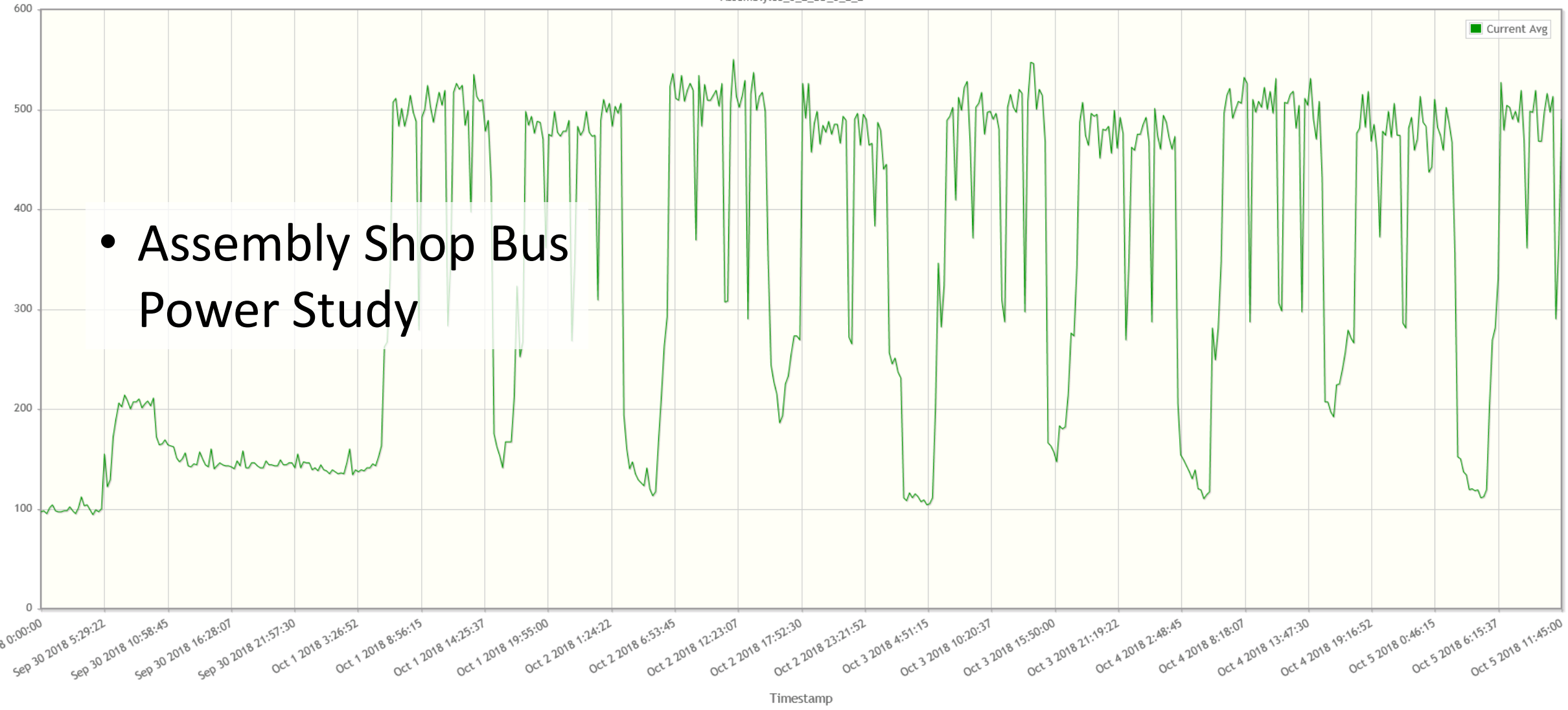
- Assembly Shop Power Distribution





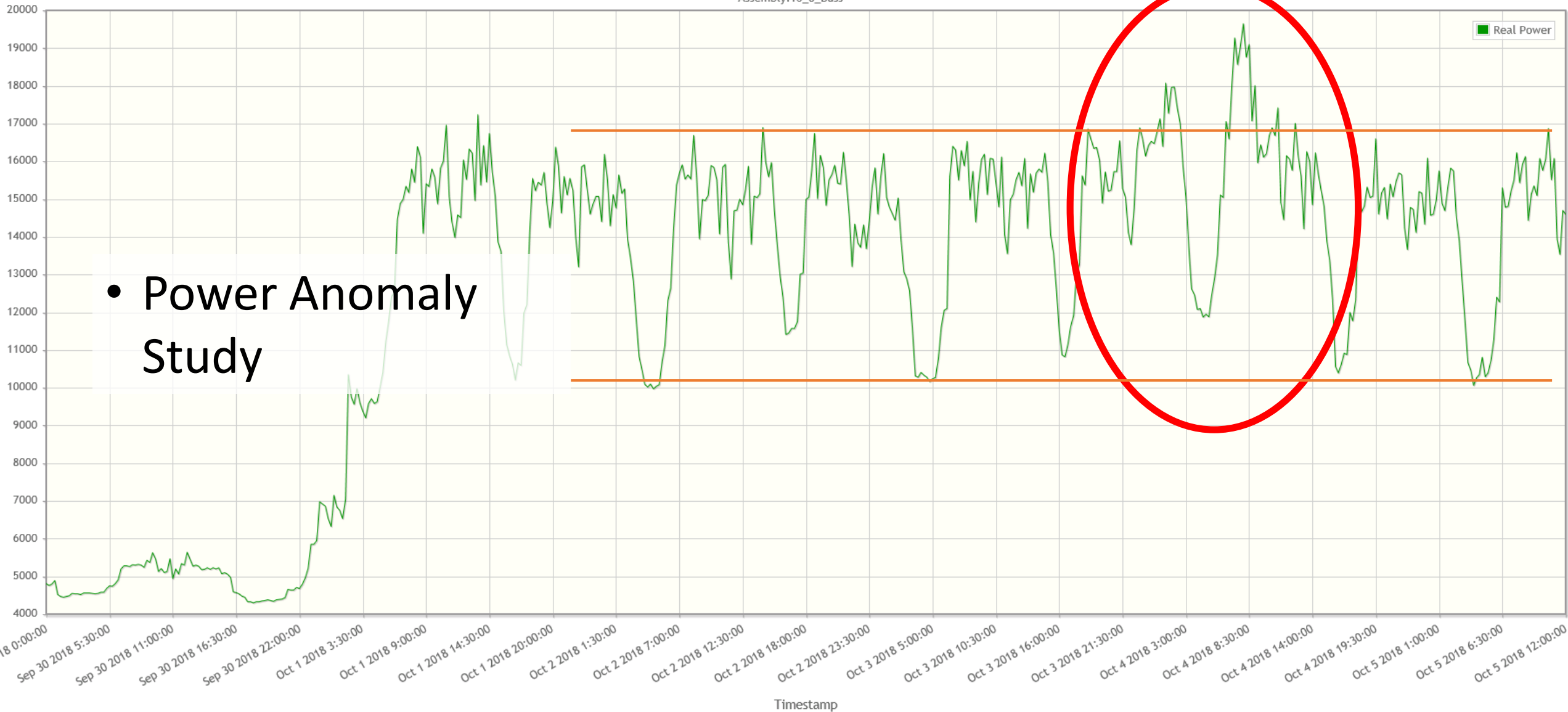
Device Diagram Show Table

Assembly.SS\_5\_2\_BD\_5\_2\_2



- Assembly Shop Bus Power Study

Left-click and drag to zoom. Double-click to restore.



• Power Anomaly Study



# Woodstock Facility – PME Reports

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- Generated Monthly
- Provide Billing Data for Production Shops
- Provide Data to Environmental for Tracking and Reporting

## Woodstock Facility – PME Reports

- Run Automatically and Distributed via Email
- Distributed Reports in Excel format

The screenshot displays the Microsoft Outlook interface. The title bar indicates the current mailbox is 'john.goodfellow@toyota.com'. The ribbon shows the 'Home' tab with various email actions like 'New Email', 'Delete', 'Reply', and 'Forward'. The left sidebar shows a list of emails, with the selected email titled 'PowerLogic ION Enterprise - Chillers & Compressors Monthly Report' dated 9/1/2018. The main pane shows the email content, including the sender's name and profile picture, the subject line, and a list of recipients: John Goodfellow (TMMC), Hetal Modi Devram (TMMC), Jodie Mels (TMMC), and Larry Murphy (TMMC). An Excel attachment named 'Chillers\_Compressors.xls' (117 KB) is visible below the recipients. The status bar at the bottom shows 'Items: 81.458 Unread: 4 Reminders: 9' and 'All folders are up to date. Connected to: Microsoft Exchange'.





# Woodstock Facility – PME Reports

- Shop usage for billing purposes



## Energy Usage By Shift Report

9/1/2018 12:00:00 AM - 10/1/2018 12:00:00 AM (Server Local)

### September/2018

Source	Shift 1 (kWh)	Total (kWh)
Assembly.13_8_BusF103PlasWeldPressMtr	2,001,795.52	2,001,795.52
Assembly.13_8_Buss_F101_Paint_Mtr	2,242,540.10	2,242,540.10
Assembly.13_8_Buss_F102_Weld_Mtr	240,301.34	240,301.34
Assembly.13_8_Buss_F104_Weld_Mtr	1,859,912.03	1,859,912.03
Assembly.13_8_Buss_F105_Utility_Mtr	1,587,832.92	1,587,832.92
Assembly.13_8_Buss_F106_Utility_Mtr	985,928.81	985,928.81
Assembly.SS_5_1	438,037.74	438,037.74
Assembly.SS_5_1_MCC_5_1_3	46,418.00	46,418.00
Assembly.SS_5_2	448,235.11	448,235.11
Paint.SS_4_2	451,833.97	451,833.97
Paint.SS_4_3	360,188.52	360,188.52
Paint.SS_4_4	590,472.28	590,472.28
Paint.SS_4_5	424,902.86	424,902.86
Press.SS_2_1	149,187.47	149,187.47
Utility.Maint_T_1_1	345,869.36	345,869.36
Utility.Maint_T_1_2	723,852.52	723,852.52
Utility.Maint_T_1_4	554,136.12	554,136.12

# Woodstock Facility – PME Reports

- Determine Utility Costs – Chilled Water, Compressed Air for Efficiency and Billing to Shops



**Data Warnings**

Message	Date Added
One or more gaps were detected in data used for this report.	10/1/2018 12:01:56 AM

**Usage Summary**

Source	Real Energy (kWh)
	September 2018
Utility.ACU_501_01	149.86
Utility.ACU_501_02	322.61
Utility.ACU_501_03	231.60
Utility.ACU_501_04	231.94
Utility.CH_501_01A	20.37
Utility.CH_501_01B	26.36
Utility.CH_501_02A	47.84
Utility.CH_501_02B	99.05
Utility.CH_501_03A	60.35
Utility.CH_501_03B	30.99
Utility.CH_501_04A	74.13
Utility.CH_501_04B	64.07
Utility.CH_501_05A	126.81
Utility.CH_501_05B	127.88
<b>Total</b>	<b>1,613.85</b>



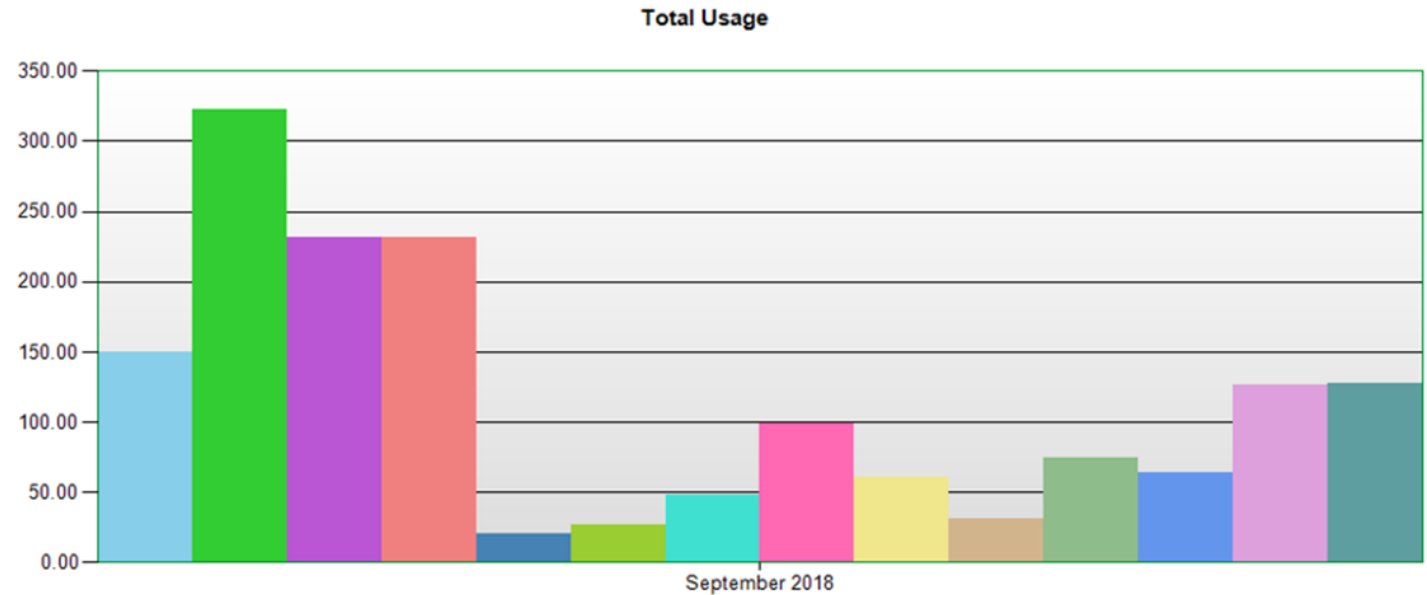
## Woodstock Facility – PME Reports



Chillers & Compressors

Relative Usage Column Chart

- Check Equipment Utilization



Utility.ACU_501_01	Utility.ACU_501_04	Utility.CH_501_02A	Utility.CH_501_03B	Utility.CH_501_05A
Utility.ACU_501_02	Utility.CH_501_01A	Utility.CH_501_02B	Utility.CH_501_04A	Utility.CH_501_05B
Utility.ACU_501_03	Utility.CH_501_01B	Utility.CH_501_03A	Utility.CH_501_04B	



# Woodstock Facility – PME Reports



Chillers & Compressors

- Easy to Get Daily History Details

## Interval Usage Data

Period : September 2018	Utility.ACU_501_01	Utility.ACU_501_02	Utility.ACU_501_03	Utility.ACU_501_04	Utility.CH_501_01A
1	2.19	0.00	16.21	0.00	0.00
2	0.00	0.00	16.07	0.00	0.00
3	0.00	0.00	16.17	0.00	0.00
4	20.57	0.00	17.33	1.68	3.79
5	11.45	0.00	9.54	0.00	0.00
6	30.76	0.00	25.07	3.22	0.00
7	21.33	0.00	17.26	0.41	0.00
8	9.84	0.00	16.50	0.00	0.00
9	0.00	0.00	16.12	0.00	0.00
10	0.00	17.99	16.95	0.00	0.00
11	0.00	21.60	17.40	0.00	0.00
12	0.00	21.36	17.24	0.00	0.00
13	0.00	21.40	17.63	0.59	0.00
14	1.14	20.55	9.79	7.56	0.00
15	0.00	10.33	0.00	13.29	0.00
16	0.00	0.00	0.00	15.63	0.00
17	1.34	20.36	0.00	13.58	3.81
18	2.39	22.20	0.00	14.58	3.13
19	1.94	22.37	2.26	12.57	0.77
20	3.85	22.30	0.07	13.73	0.00
21	9.21	21.64	0.00	8.67	8.86
22	0.00	6.76	0.00	11.98	0.00
23	0.00	0.00	0.00	15.24	0.00
24	1.13	18.41	0.00	16.36	0.00
25	2.39	21.89	0.00	15.09	0.00
26	20.44	2.23	0.00	15.04	0.00
27	9.09	13.29	0.00	14.70	0.00
28	0.80	22.47	0.00	14.26	0.00
29	0.00	12.75	0.00	10.48	0.00
30	0.00	2.70	0.00	13.27	0.00
Period Totals	149.86	322.61	231.60	231.94	20.37

## Woodstock Facility – Other Utilities

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- Used Modbus device importer to bring non-power device data into PME
- Challenge is to gather data from the Building Management System (BMS) BACnet and Rockwell Protocols and present the data in Modbus TCP to the PME

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- Developed a gateway to exchange data between systems

- Modbus to / from PME

- BACnet to / from JCI BMS

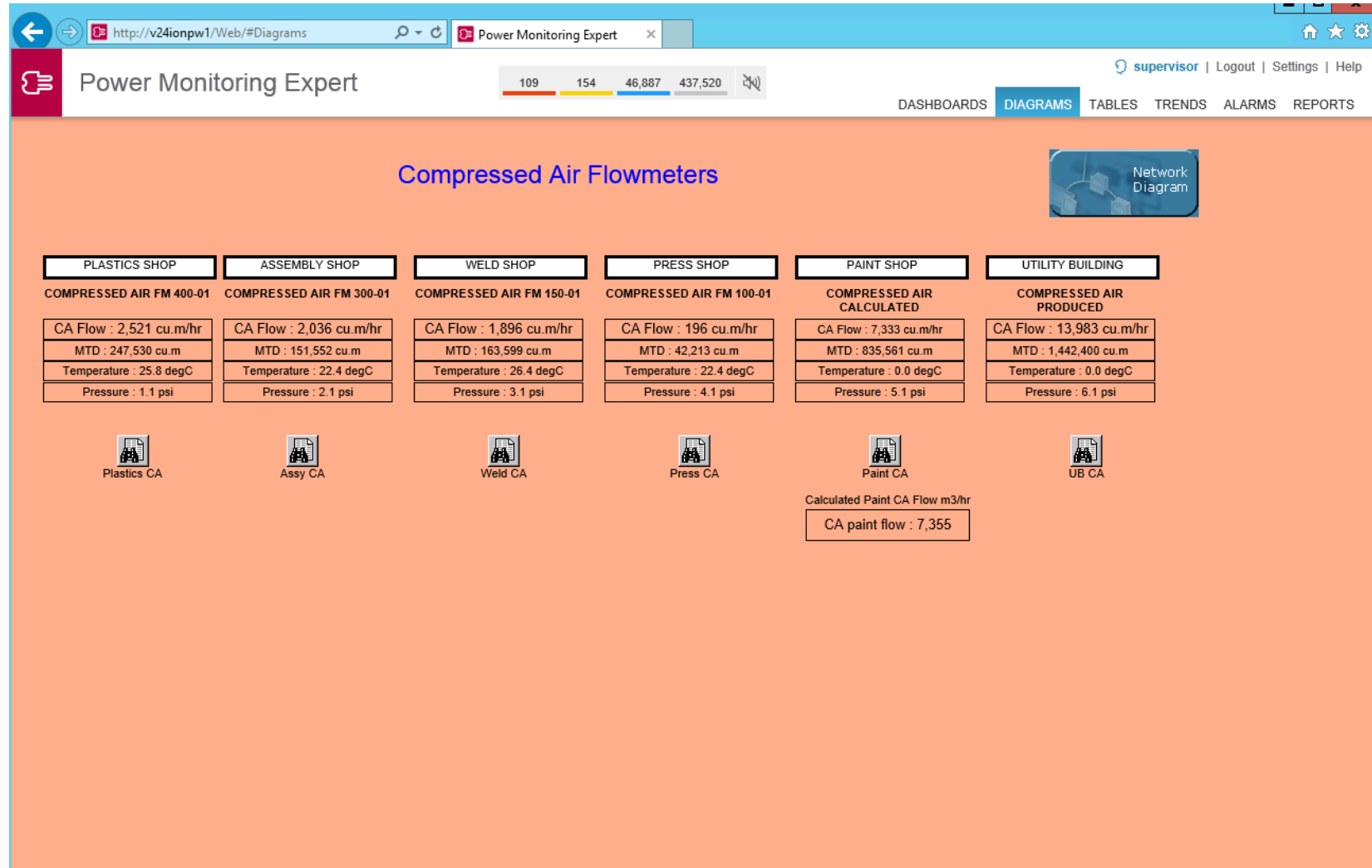


- AB Ethernet I/P from PLCs with flow meters



# Woodstock Facility – Other Utilities

- Compressed Air Data in PME



## Woodstock Facility – Next Steps

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- Upgrade to PME 2020 this fall
- Add Natural Gas and Steam Meter data to PME this fall
- Replace the incoming power meter with a new ION 9000 power meter



# Woodstock Facility – Future Projects

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- Gather Power Data From Our 2 Wireless LED Lighting Control Systems
- Consolidate the Steam and Chilled Water Systems onto PME

## Woodstock Facility – Future Projects



Wireless LED Fixtures



Wireless Gateways



Energy Manager (BACnet)



BACnet – Modbus Gateway

### LED Lighting

- Gather power data from each enlightened enabled LED fixture



- Peak Shaving mode capable

To / From PME

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# Woodstock Facility

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Questions ?



2019 RAV4