

A blue Toyota SUV is parked on a paved area in front of a modern building with large glass windows and concrete pillars. The car is the central focus of the image.

# Power Monitoring Expert Application

## Toyota Motor Manufacturing Canada

John Goodfellow

November 8, 2022

**TOYOTA**

# Woodstock & Cambridge Facilities



## West Plant

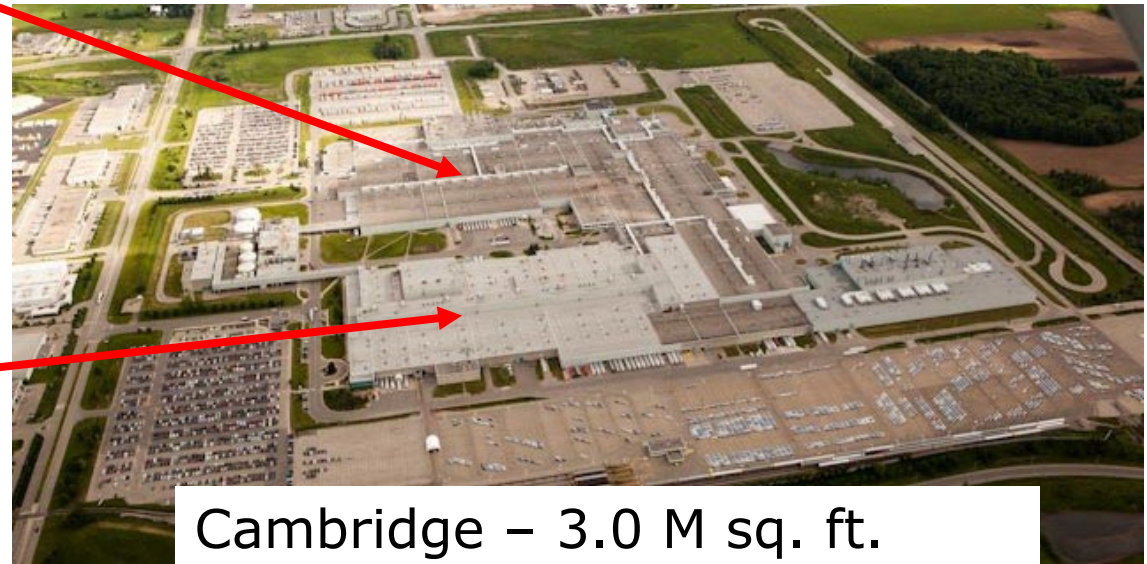
RAV4  
RAV4 Hybrid



Woodstock – 1.8 M sq. ft.

## North Plant

RAV4,  
Lexus NX



Cambridge – 3.0 M sq. ft.

## South Plant

Lexus  
RX 350, RX 350h



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# Woodstock & Cambridge Facilities



1988 Corolla with our 10,000,000 vehicle  
– a 2022 Red Lexus NX

- Approximately 8,500 employees
- Produce over 500,000 vehicles annually

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## Woodstock Facility

- Factory Built in 2007
- Direct Connected to Hydro One
- Demand 14 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
- 3 x 5 kV Subs, 5,000 kVA





# Woodstock Facility

## Meters

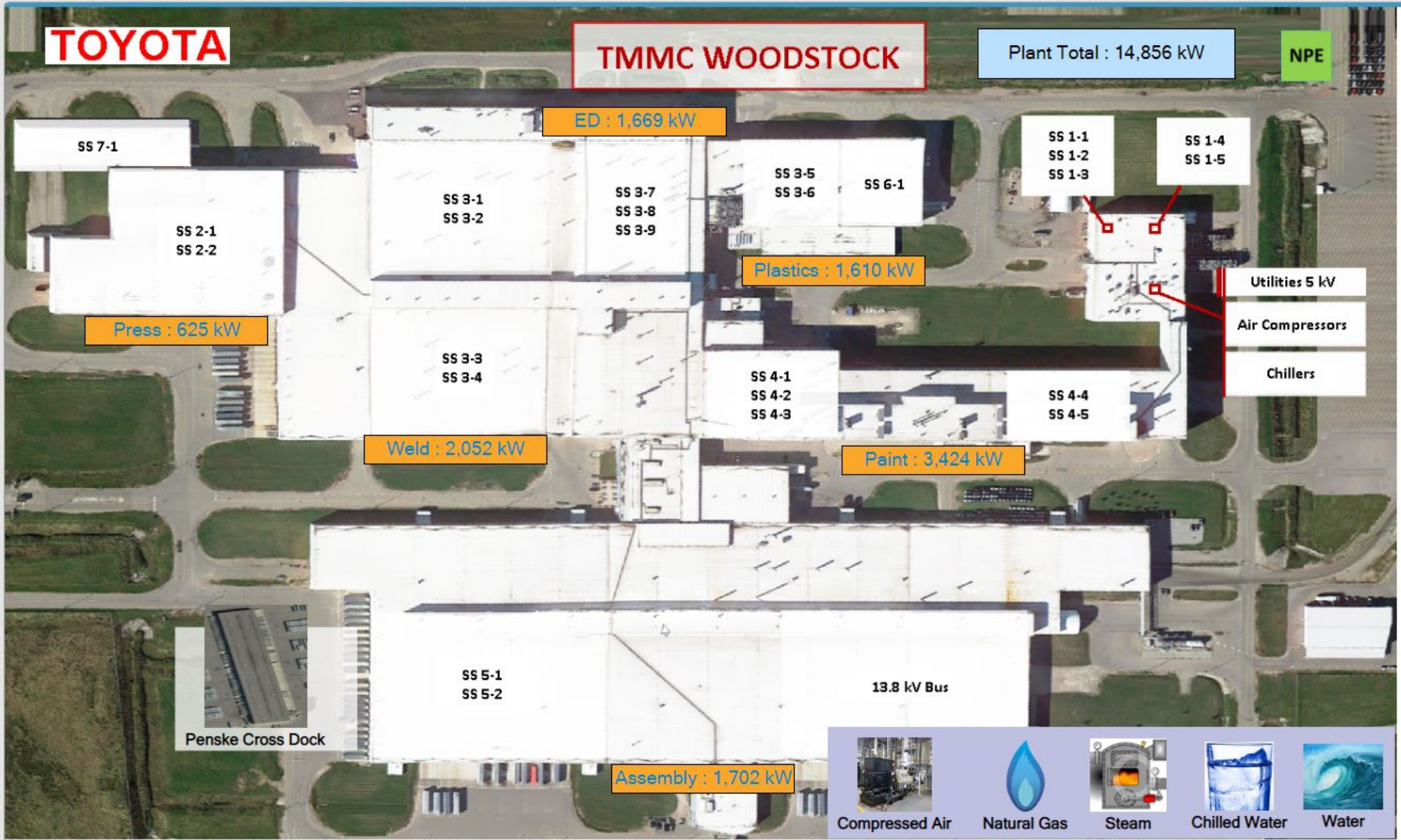
- CM4250
- PM8000
- ION 9000 for incoming power

## Breakers

- Masterpact NW with Micrologic 6.0 P control units



Diagram Library



# Woodstock Facility - Architecture

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- PME 2020
- 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 Maintenance
  - Production Shop Engineering and Maintenance
- Most Used Modules:
  - Diagrams – Real Time Operations
  - Reports – Energy Billing to the Production Shops

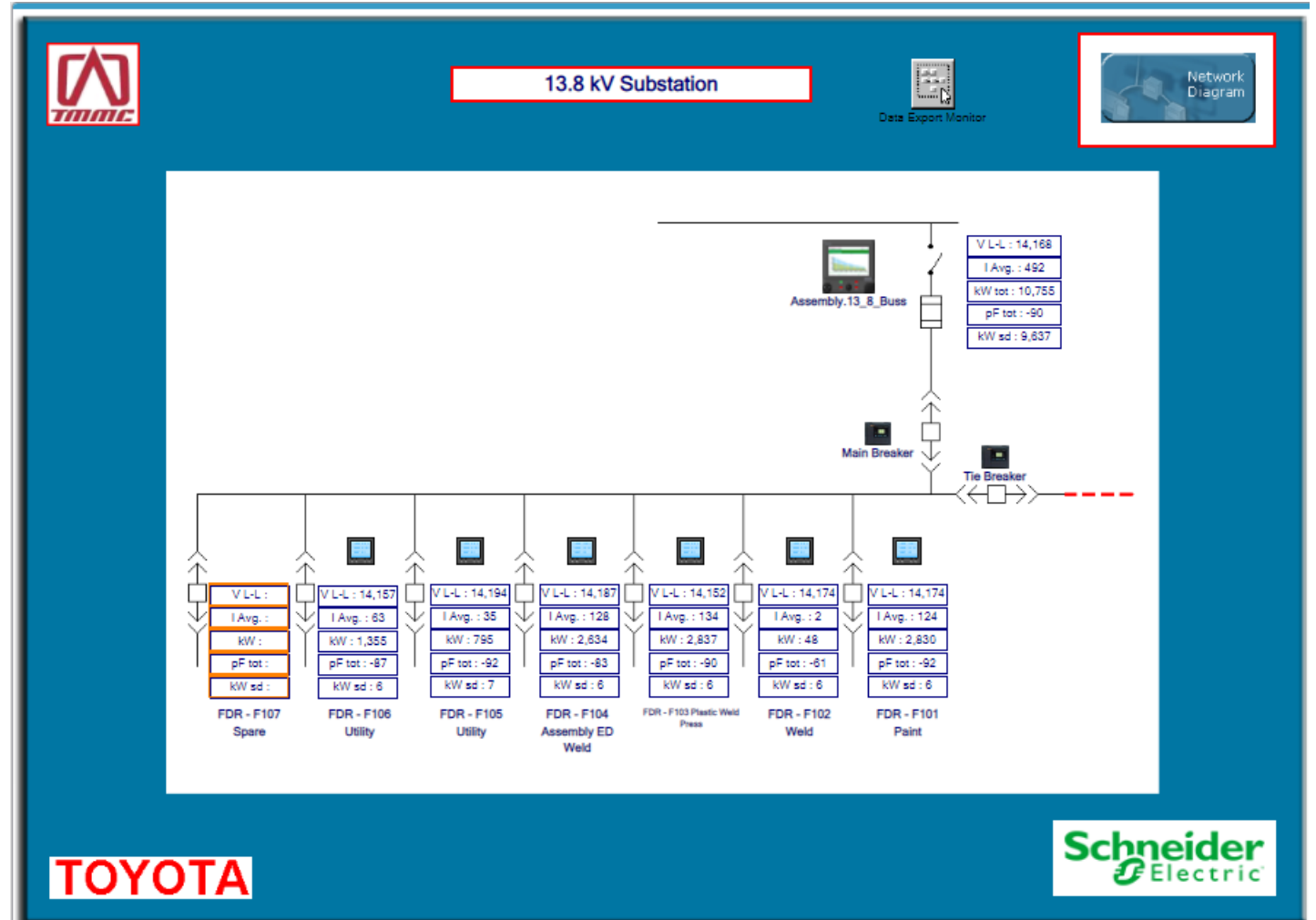
# Woodstock Facility – PME Diagrams

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- Real Time Operations
  - Loading Studies
  - Non-Production Energy (NPE) Consumption
- 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 13.8 kV Power Distribution





# Woodstock Facility – PME Reports

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

## 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 account is 'john.goodfellow@toyota.com'. The ribbon shows the 'Home' tab with various email actions. The left sidebar shows the 'Current Mailbox' with a list of emails. The selected email is from 'PowerLogic ION Enterprise <john.goodfellow@toyota.com>' with the subject 'Chillers & Compressors Monthly Report', dated 'Sat 9/1/2018 12:03 AM'. The email body shows a list of recipients: John Goodfellow (TMMC), Hetal Modi Devram (TMMC), Jodie Mels (TMMC), and Larry Murphy (TMMC). An attachment named 'Chillers\_Compressors.xls' (117 KB) is visible. 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 accounting 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



# Non-Production Energy Challenge

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- Support TMC Non-Production Energy (NPE) Goals
- 45% Between Shifts
- 23% On Weekends

## Non-Production Energy Challenge

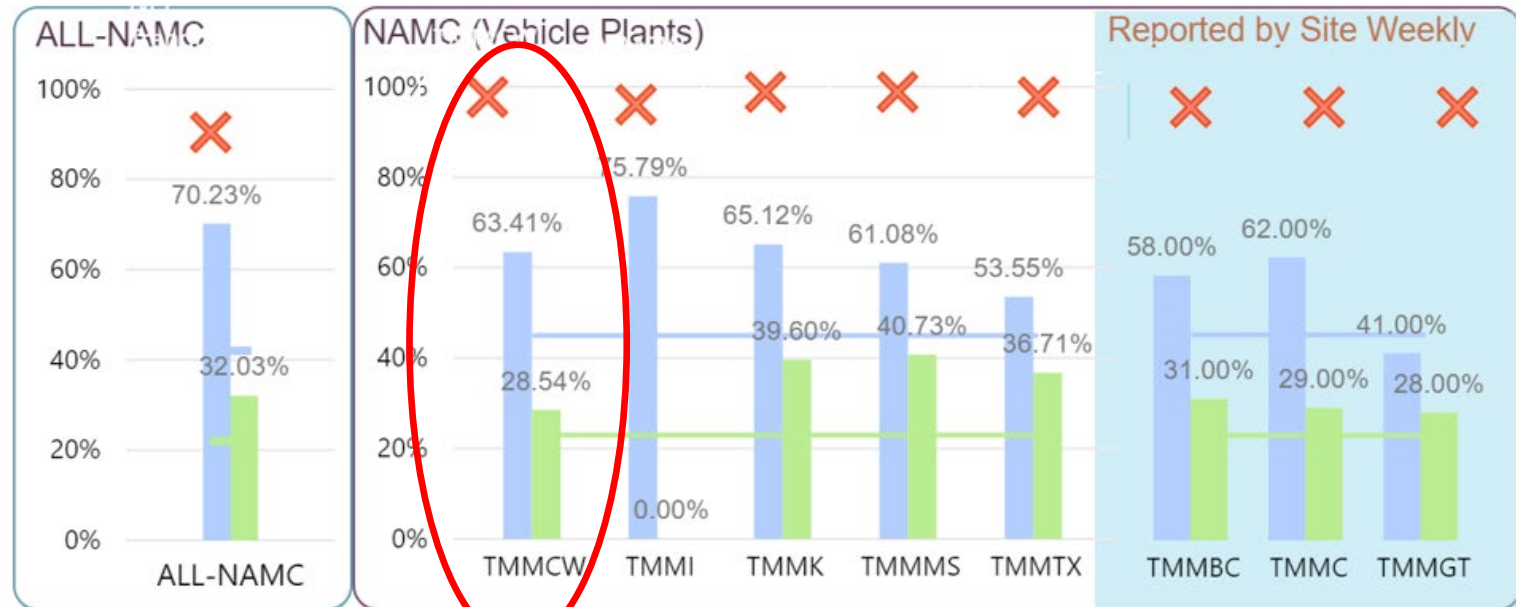
### NPE Goals:

- 45% Between Shifts
- 23% On Weekends

### 2020 GAP - X

- Not Meeting NPE Goals
- 63.4% Between Shifts - X
- 28.5% On Weekends - X

### Review Week : 6/15/2020 - 6/21/2020



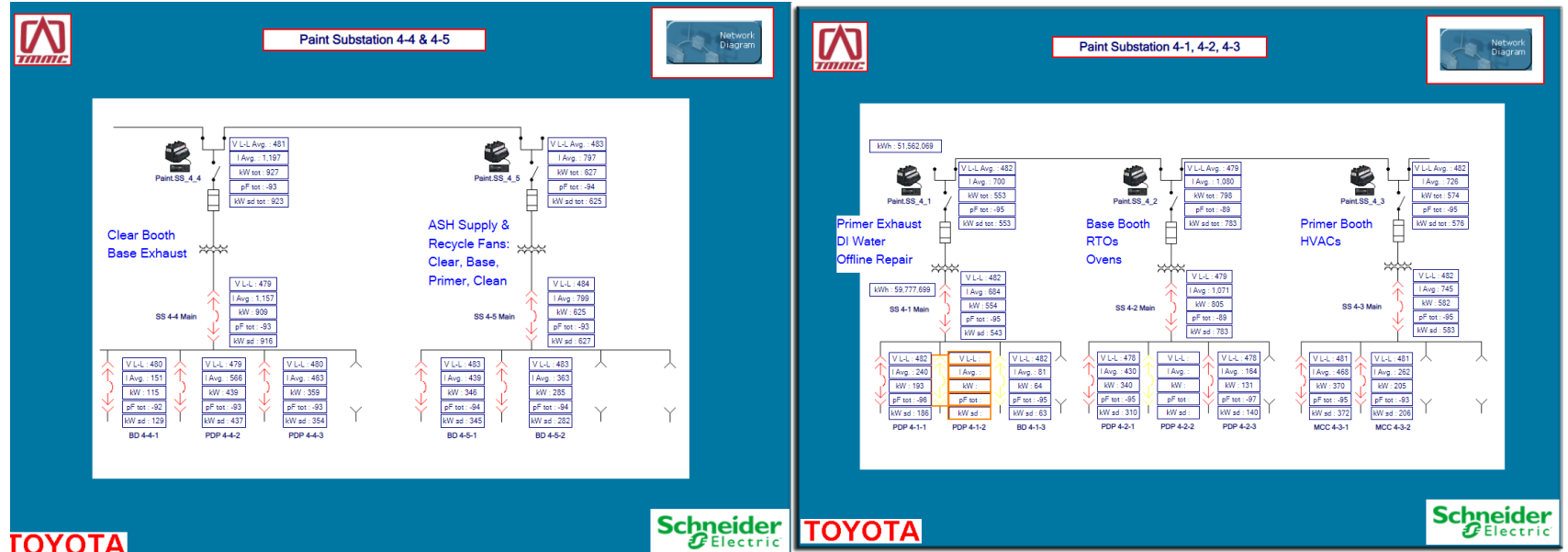




# Non-Production Energy Challenge

Typical  
Metering Pages:

Paint Shop –  
5 Substations



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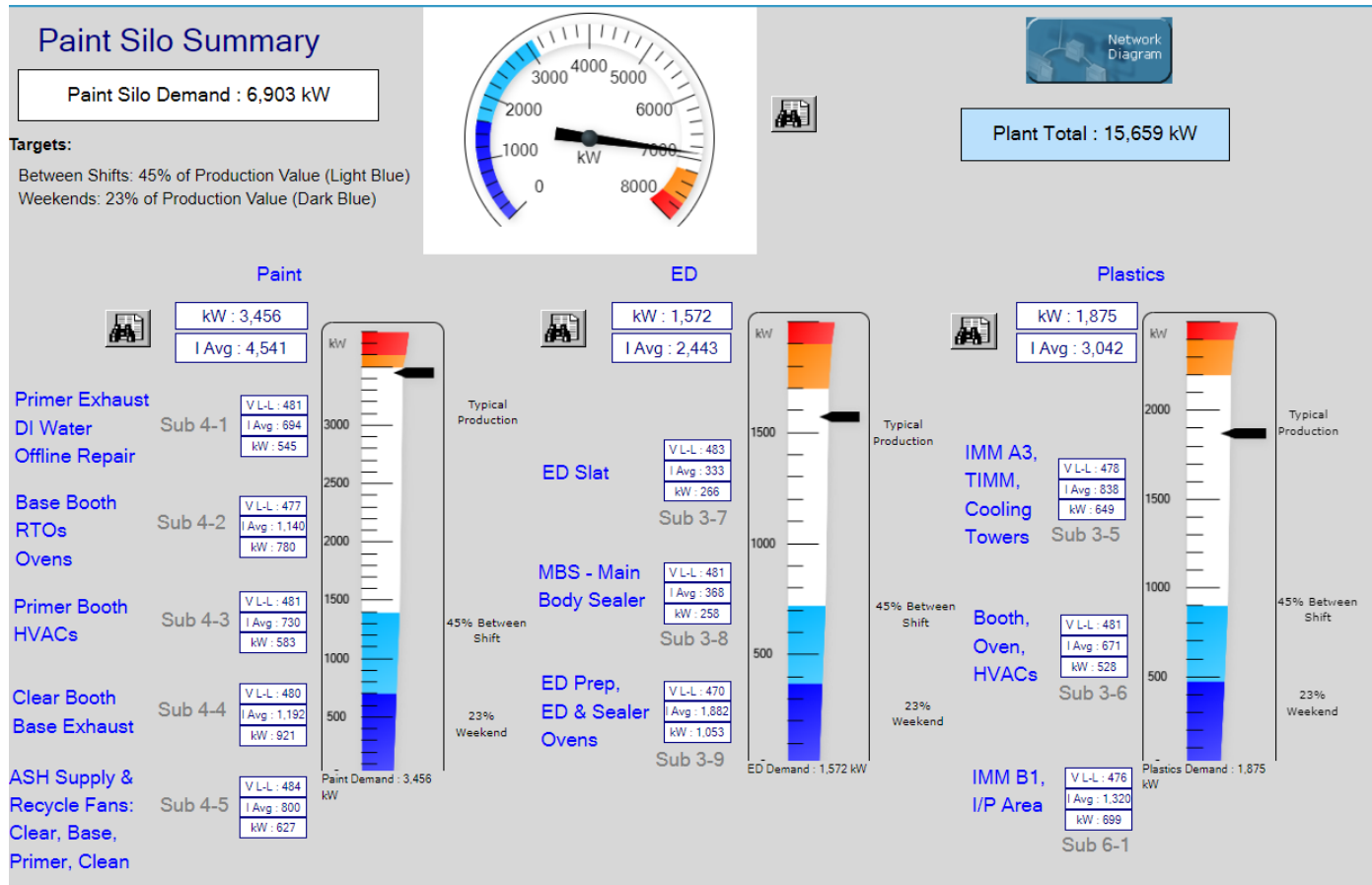
# Non-Production Energy Challenge

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- Metering pages supplied with Power Monitoring software are difficult to analyze in real time
- To achieve the NPE targets, Shop Maintenance and Production needed a tool to:
  - Summarize their shop electrical consumption
  - Make targets very visual with colour
  - Show real time data

## Non-Production Energy Challenge

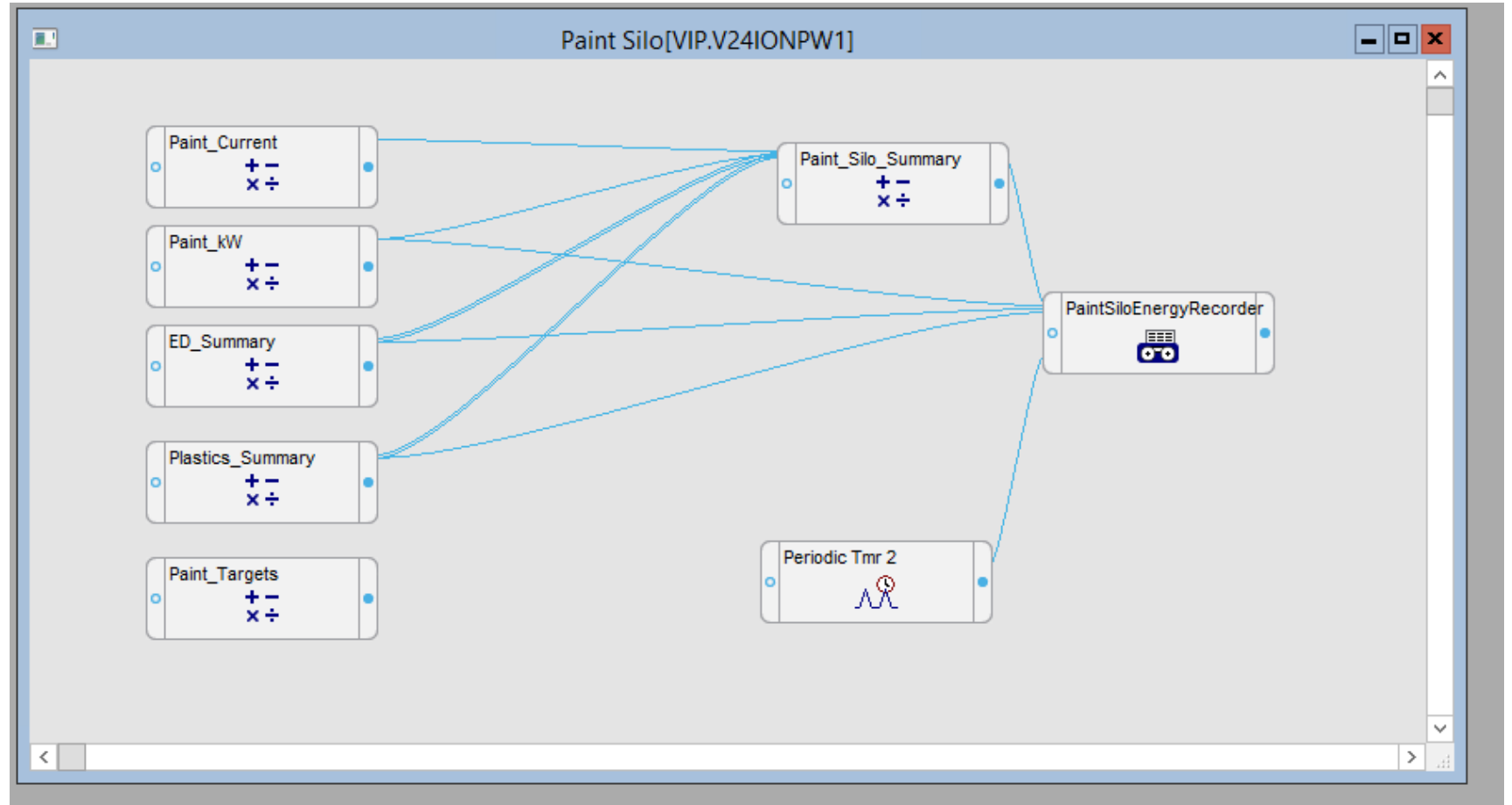
**KAIZEN:** This *Paint Silo Summary PME* screen summarizes targets and electrical data from 3 shops and 11 substations





# Non-Production Energy Challenge

Processed  
Meter Data In  
VIP for the  
Paint Silo  
Summary  
Screen





# Non-Production Energy Challenge

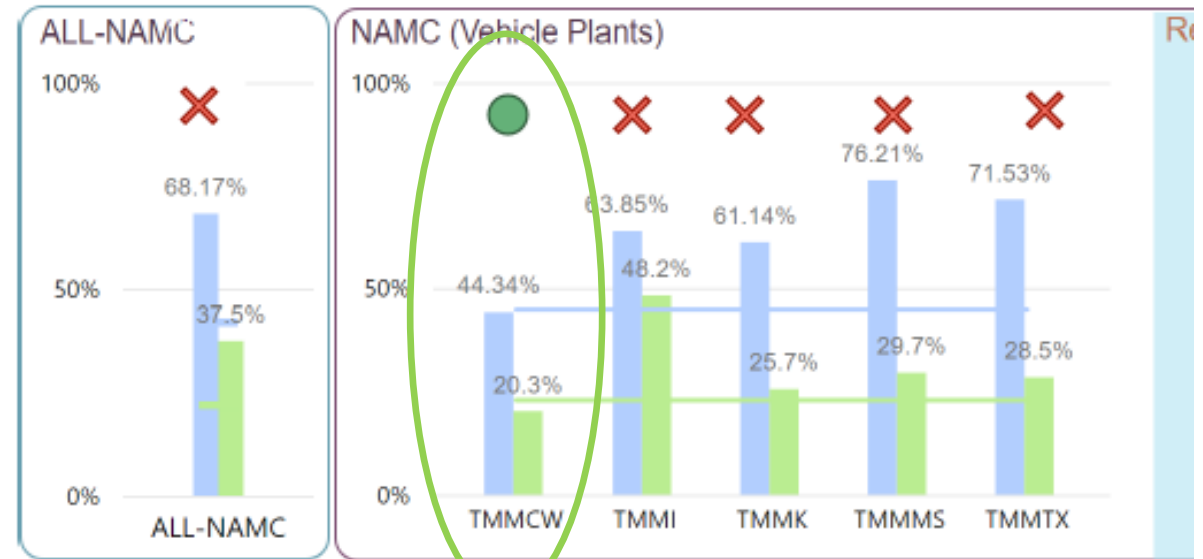
## NPE Goals:

- 45% Between Shifts
- 23% On Weekends

## TARGET - ○

- Met All NPE Goals
- <45% Between Shifts - 44.3% ○
- <23% On Weekends - 20.3% ○

Current Week : 6/27/2022 - 7/3/2022





# Woodstock Facility

## Collection of Other Utility Data

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### Challenge:

- Gather Data from
  - Building Management System (BMS) - BACnet
  - Allen-Bradley PLCs – Ethernet I/P
  
- Present the data to PME over Modbus TCP



# Woodstock Facility Collection of Other Utility Data

- Used Device Type Editor to import non-power meter device data into PME

Device Type Editor - C:\Program Files (x86)\Schneider Electric\Power Monitoring Expert\config\templates\FAC\_meter\_pr...

File View Advanced Tools Help

Measurement Tree

- Factory Modules
  - FAC
    - Plastics
      - Plastics.CA\_Flow
      - Plastics.CA\_Total\_MTD
      - Plastics.CA\_Temp
      - Plastics.CA\_Press
      - Plastics.Gas\_HVAC\_Flow
      - Plastics.Gas\_HVAC\_MTD
      - Plastics.Gas\_Proc\_Flow
      - Plastics.Gas\_Proc\_MTD
      - Plastics.CW\_HVAC\_Flow
      - Plastics.CW\_HVAC\_MTD
      - Plastics.CW\_Proc\_Flow
      - Plastics.CW\_Proc\_MTD
      - Plastics.PW\_Flow
      - Plastics.PW\_MTD
      - Plastics.Steam\_Flow
      - Plastics.Steam\_Total\_MTD
      - Plastics.Oven\_Flow
      - Plastics.Oven\_MTD
      - Plastics.ASH\_Flow
      - Plastics.ASH\_MTD
      - Plastics.GasProcess\_Flow
      - Plastics.GasProcess\_MTD

Modbus Map

Drag a column header here to group by that column

Name	Modbus Address	Format	ION Handle	Mask	Scale	Multiplier
Plastics.CA_Flow	40001	UJINT16	134218241			
Plastics.CA_Total_MTD	40002	UJINT32	134218242			
Plastics.CA_Temp	40004	UJINT16	134218243		10	
Plastics.CA_Press	40005	UJINT16	134218244		10	
Assembly.CA_Flow	40021	UJINT16	134217986			
Assembly.CA_Total_MTD	40022	UJINT32	134217987			
Assembly.CA_Temp	40024	UJINT16	134217991		10	
Assembly.CA_Press	40025	UJINT16	134217989		10	
Weld.CA_Flow	40041	UJINT16	134218498			
Weld.CA_Total_MTD	40042	UJINT32	134218499			
Weld.CA_Temp	40044	UJINT16	134218500		10	
Weld.CA_Press	40045	UJINT16	134218501		10	
Press.CA_Flow	40061	UJINT16	134218754			
Press.CA_Total_MTD	40062	UJINT32	134218755			
Press.CA_Temp	40064	UJINT16	134218756		10	
Press.CA_Press	40065	UJINT16	134218757		10	
Paint.CA_Flow	40081	UJINT16	134219010			
Paint.CA_Total_MTD	40082	UJINT32	134219011			
Paint.CA_Temp	40084	UJINT16	134219012		10	
Paint.CA_Press	40085	UJINT16	134219013		10	
UB.CA_Flow	40101	UJINT16	134219266			
UB.CA_Total_MTD	40102	UJINT32	134219267			
UB.CA_Temp	40104	UJINT16	134219268		10	

Register is Mapped - cannot edit value

Name: Plastics.0001

Label: Plastics.CA\_Flow

Value:

Record 1 of 135

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- Developed a gateway to exchange data between systems

- Modbus to / from PME

- BACnet to / from JCI BMS



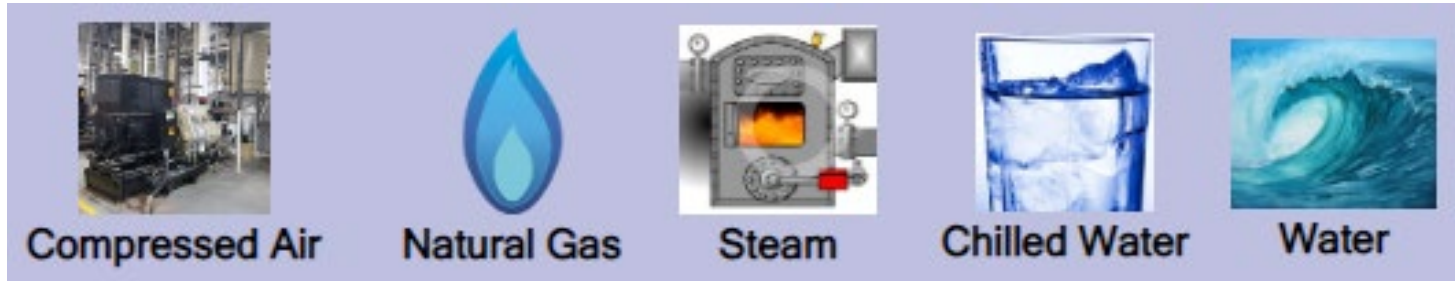
- AB Ethernet I/P from PLCs with flow meters





# Woodstock Facility – Other Utilities

- New Menu Bar On The Woodstock Home Page





# Woodstock Facility – Other Utilities

- Compressed Air Data in PME

The screenshot displays the 'Compressed Air Flowmeters' dashboard in the Power Monitoring Expert (PME) system. The interface includes a navigation bar with 'DASHBOARDS', 'DIAGRAMS', 'TABLES', 'TRENDS', 'ALARMS', and 'REPORTS'. A 'Network Diagram' button is visible in the top right. The main content area is divided into six columns, each representing a different shop or building. Each column contains a table of metrics including CA Flow, MTD, Temperature, and Pressure. Below the tables are icons for each shop and a summary box for 'Calculated Paint CA Flow m3/hr'.

PLASTICS SHOP	ASSEMBLY SHOP	WELD SHOP	PRESS SHOP	PAINT SHOP	UTILITY BUILDING
COMPRESSED AIR FM 400-01	COMPRESSED AIR FM 300-01	COMPRESSED AIR FM 150-01	COMPRESSED AIR FM 100-01	COMPRESSED AIR CALCULATED	COMPRESSED AIR PRODUCED
CA Flow : 2,521 cu.m/hr	CA Flow : 2,036 cu.m/hr	CA Flow : 1,896 cu.m/hr	CA Flow : 196 cu.m/hr	CA Flow : 7,333 cu.m/hr	CA Flow : 13,983 cu.m/hr
MTD : 247,530 cu.m	MTD : 151,552 cu.m	MTD : 163,599 cu.m	MTD : 42,213 cu.m	MTD : 835,561 cu.m	MTD : 1,442,400 cu.m
Temperature : 25.8 degC	Temperature : 22.4 degC	Temperature : 26.4 degC	Temperature : 22.4 degC	Temperature : 0.0 degC	Temperature : 0.0 degC
Pressure : 1.1 psi	Pressure : 2.1 psi	Pressure : 3.1 psi	Pressure : 4.1 psi	Pressure : 5.1 psi	Pressure : 6.1 psi

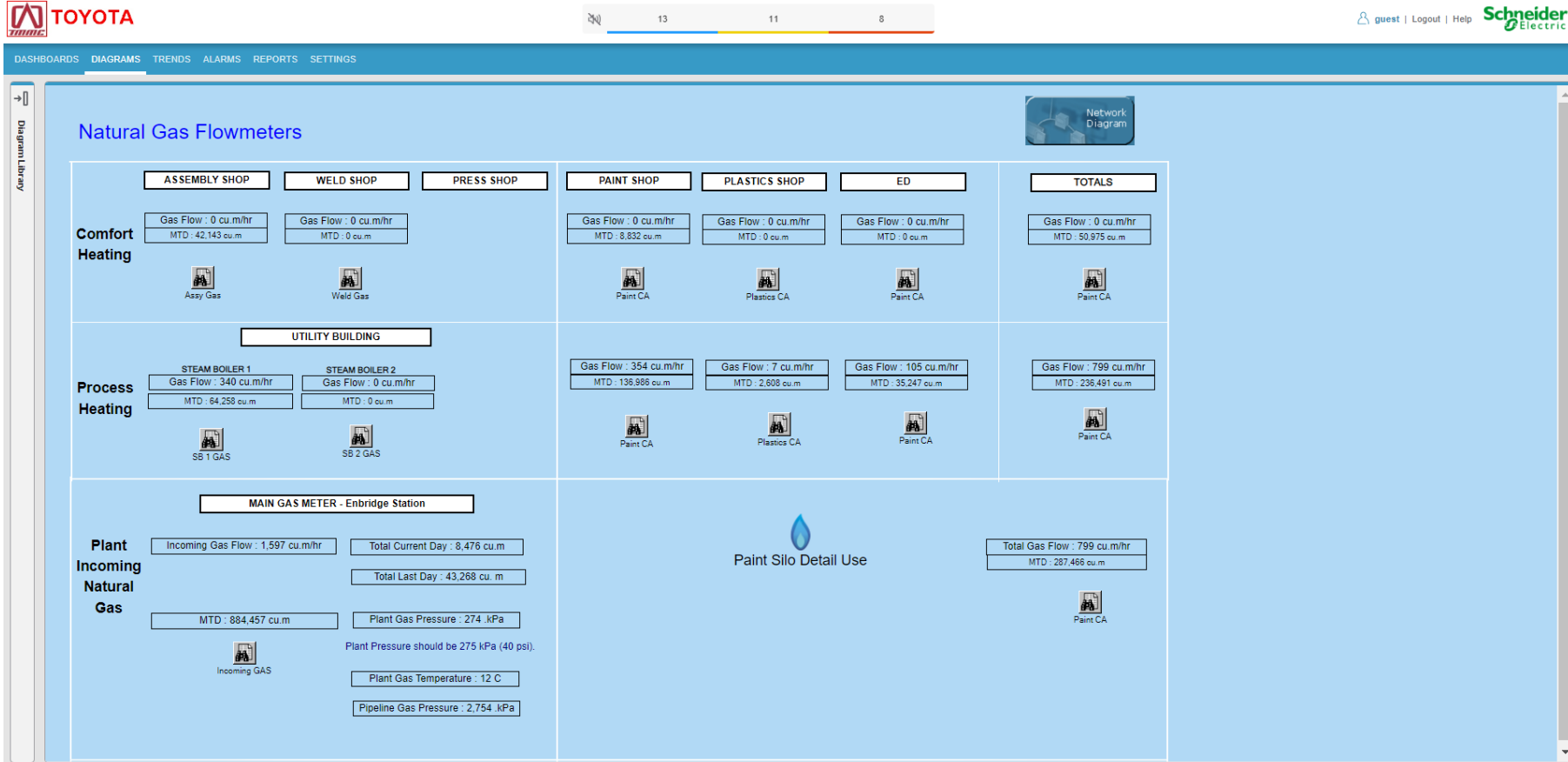
Icons: Plastics CA, Assy CA, Weld CA, Press CA, Paint CA, UB CA

Calculated Paint CA Flow m3/hr  
CA paint flow : 7,355



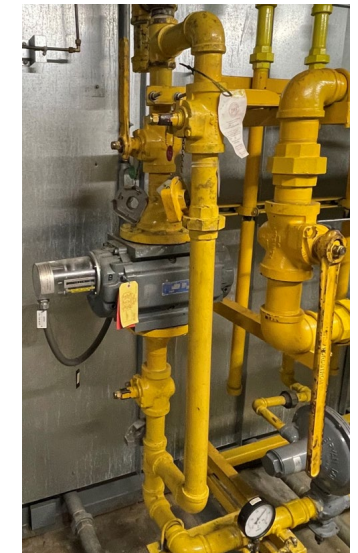
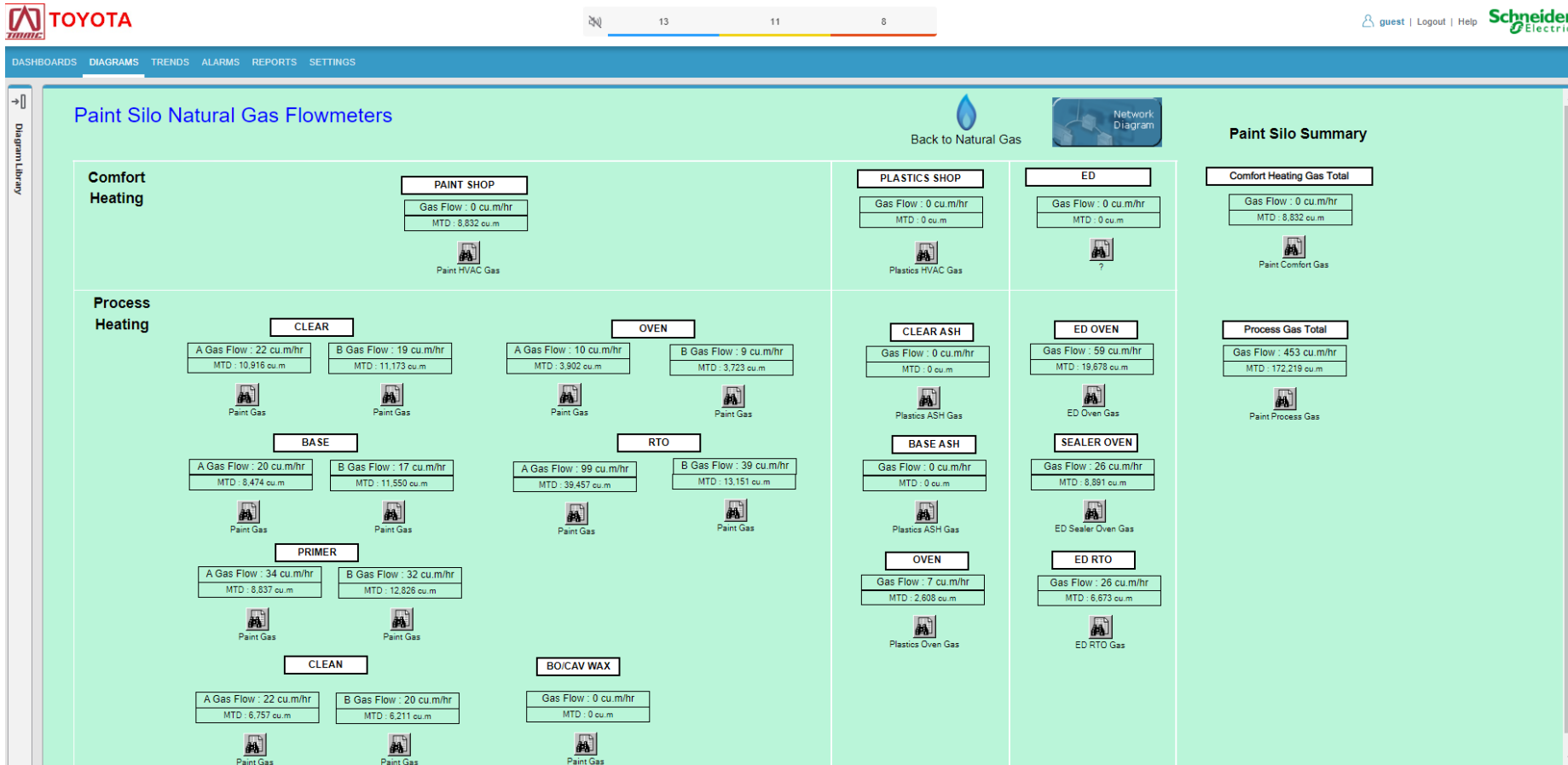
# Woodstock Facility – Other Utilities

- Natural Gas Data in PME



## Woodstock Facility – Other Utilities

- Paint Silo Natural Gas Summary in PME



## Woodstock Facility – Next Steps

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- Consolidate the Steam, Water, and Chilled Water Systems Utility Data into PME
- Integrate Cambridge Plant into PME
- Collect Data from our BMS to Calculate Chiller Efficiency in Real Time

## Cambridge Facility – Next Steps

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- Migrate Eaton Power Meters into PME
- Current Eaton Meters Communicate via Modbus TCP
- Legacy INCOM Meters – Used Eaton’s Power Xpert Gateway



## Cambridge Facility – Next Steps

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14 11 8

guest | Logout | Help Schneider Electric

DASHBOARDS DIAGRAMS TRENDS ALARMS REPORTS SETTINGS

Diagram Library

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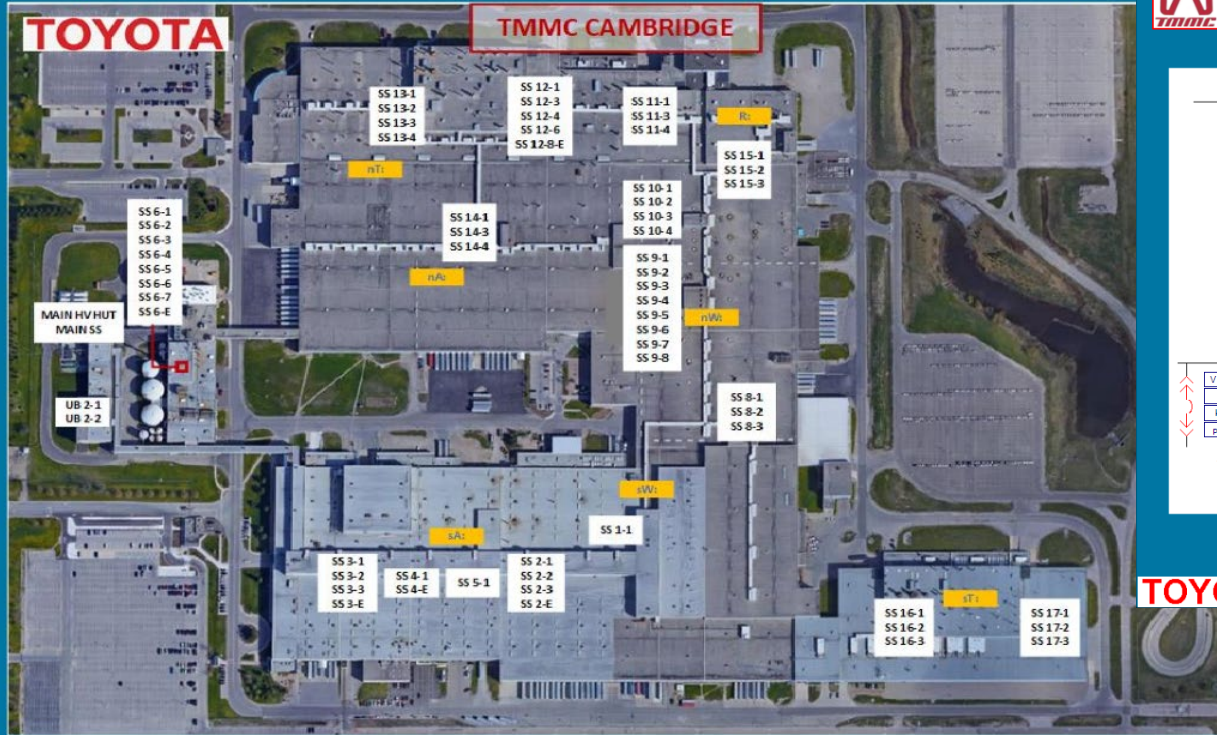
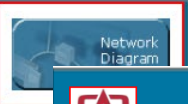
**Cambridge**

**Woodstock**

Schneider Electric

The image shows a screenshot of a web-based monitoring interface. At the top left is the Toyota logo. Below it is a navigation menu with options: DASHBOARDS, DIAGRAMS, TRENDS, ALARMS, REPORTS, and SETTINGS. A status bar shows a signal strength icon, a volume icon, and three colored bars (blue, yellow, red) with values 14, 11, and 8. On the top right, there is a user profile icon labeled 'guest', a 'Logout' link, a 'Help' link, and the Schneider Electric logo. The main content area has a blue header with the Toyota logo and a 'Diagram Library' sidebar on the left. The central part of the screen displays two aerial photographs of industrial facilities. The left photo is labeled 'Cambridge' and the right photo is labeled 'Woodstock'. Both photos show large, multi-story industrial buildings with extensive parking lots. The Schneider Electric logo is located in the bottom right corner of the main content area.

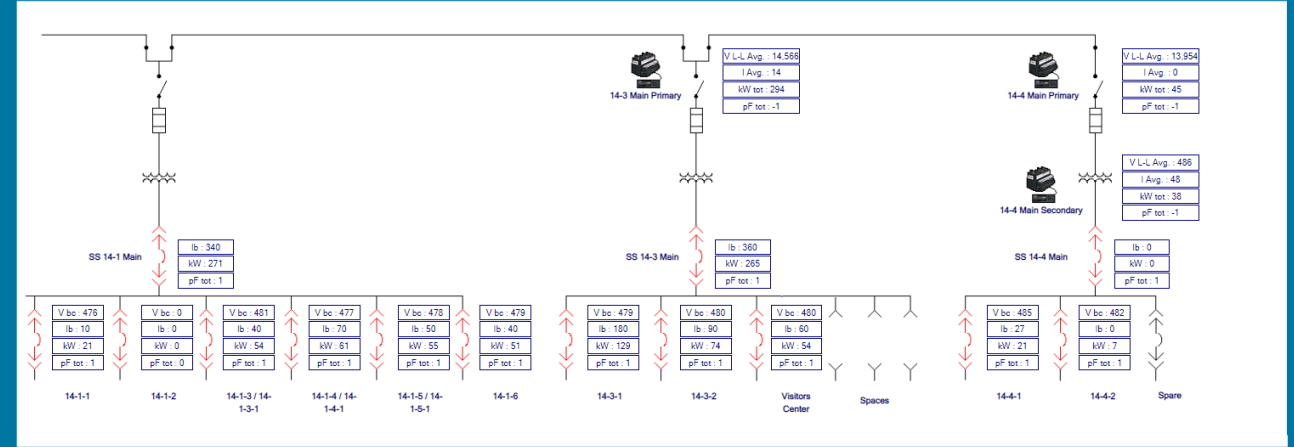
## Cambridge Facility – Next Steps



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Cambridge Assembly Shop Substation 14







# Woodstock Facility – Future Projects

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- Gather Power Data From Our 2 Wireless LED Lighting Control Systems

## 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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Questions ?



2023 RAV4 Hybrid