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MITSUBISHI HEAVY INDUSTRIES GROUP

# Energy Management System (EMS)

DIASYS Netmation®



2022.August.22

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# CONTENT

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# Energy Management System

What is EMS & Features

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# Energy Management System

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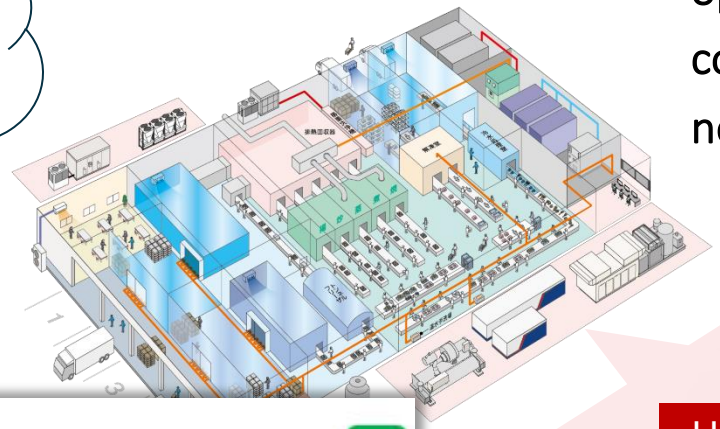
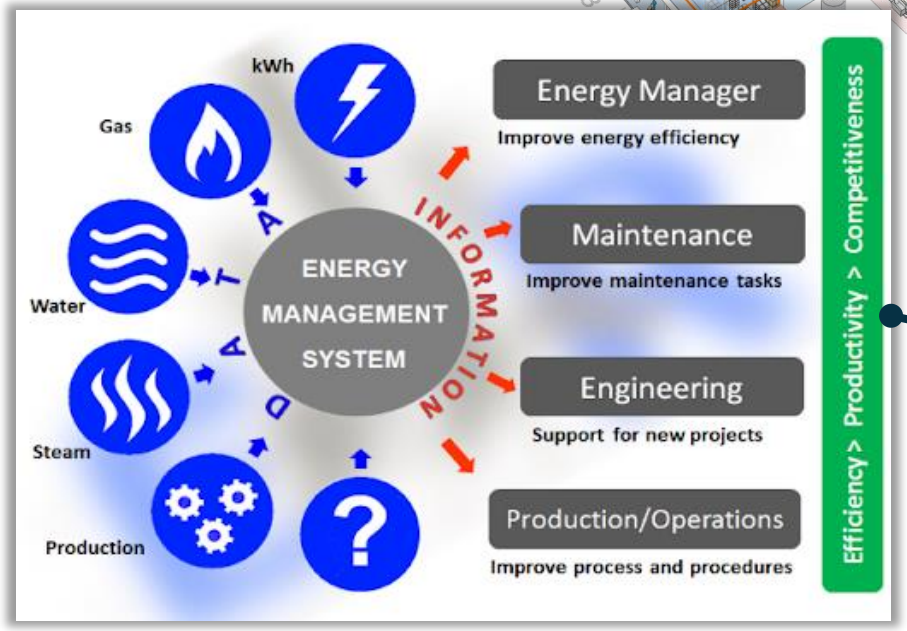
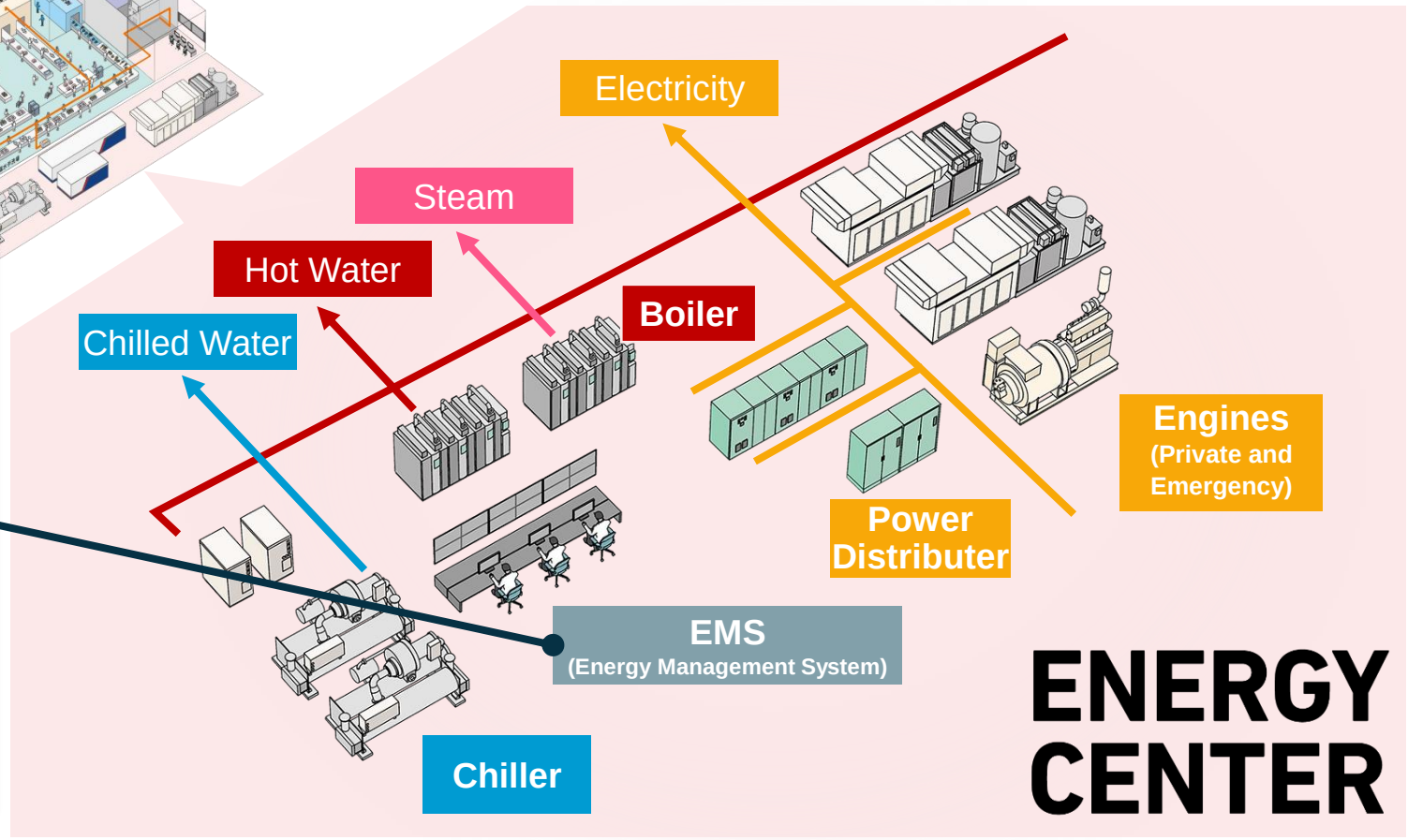
A single system managing the whole factory utilities is the final goal of our expectation.



We offer the energy supply equipment essential to factory operation (electricity, steam, hot and chilled water, air conditioning) as “Energy Center” package, tailored to your needs.



# Energy Management Development Cycle

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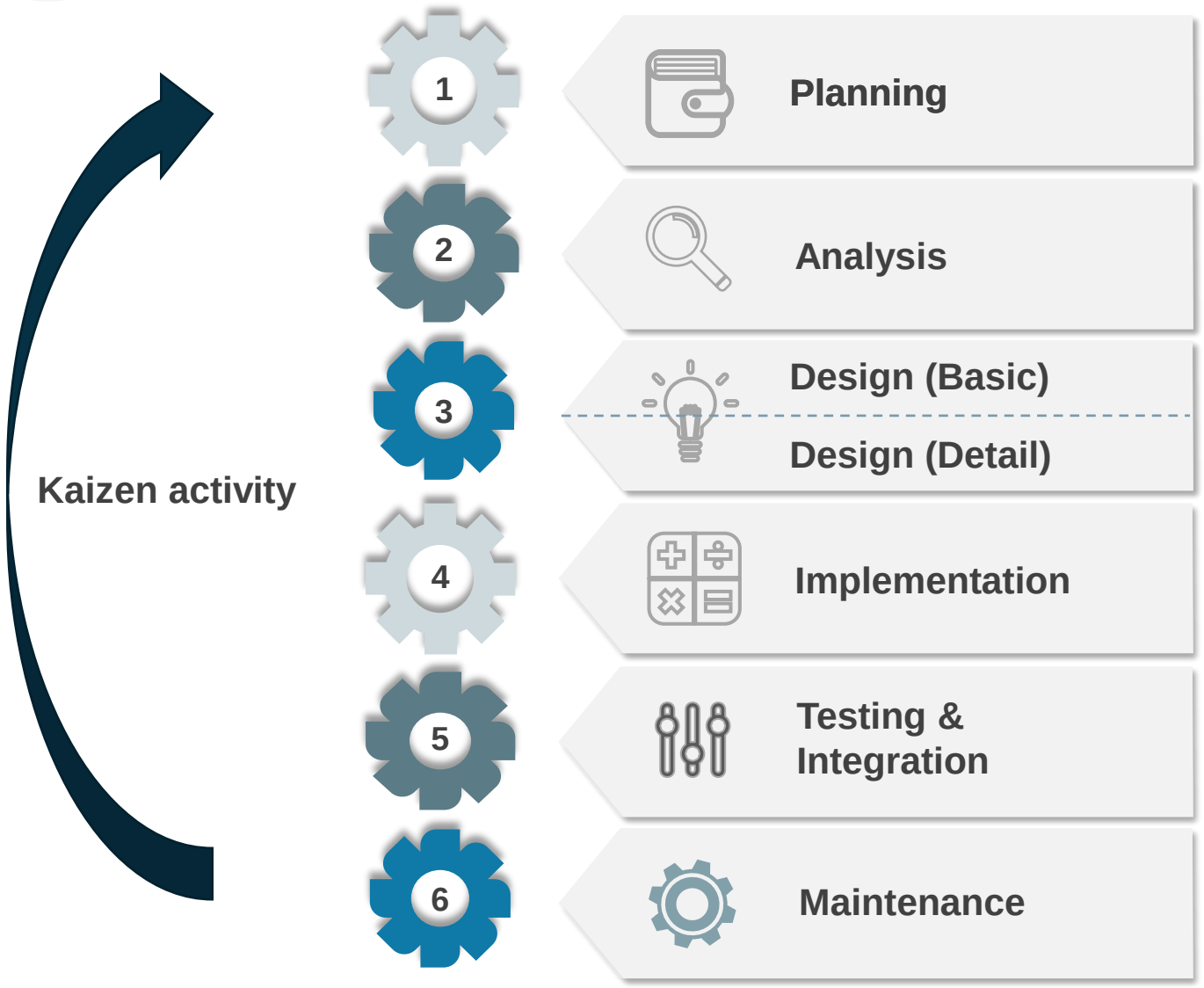


***Support by MHI without fee***

Sale contract signed

Complete commissioning

Support by MHI
Upon customer request case by case

# Manual Operation VS Energy Management system

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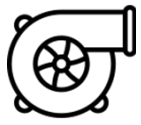
Production Requirement

Production Requirement

Man-Power



Pumps

Valves

Chillers

Cooling Towers

Energy Saving

Man-hour Lost

Report Handling

Alarm Response

# Manual Operation VS Energy Management system

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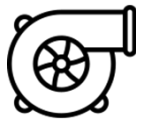
Production Requirement

Production Requirement

Energy Management



Pumps

Valves

Chillers

Cooling Towers

Energy Saving

Man-hour Lost

Report Handling

Alarm Response

# Distribute Control System VS Programable Logic Controller

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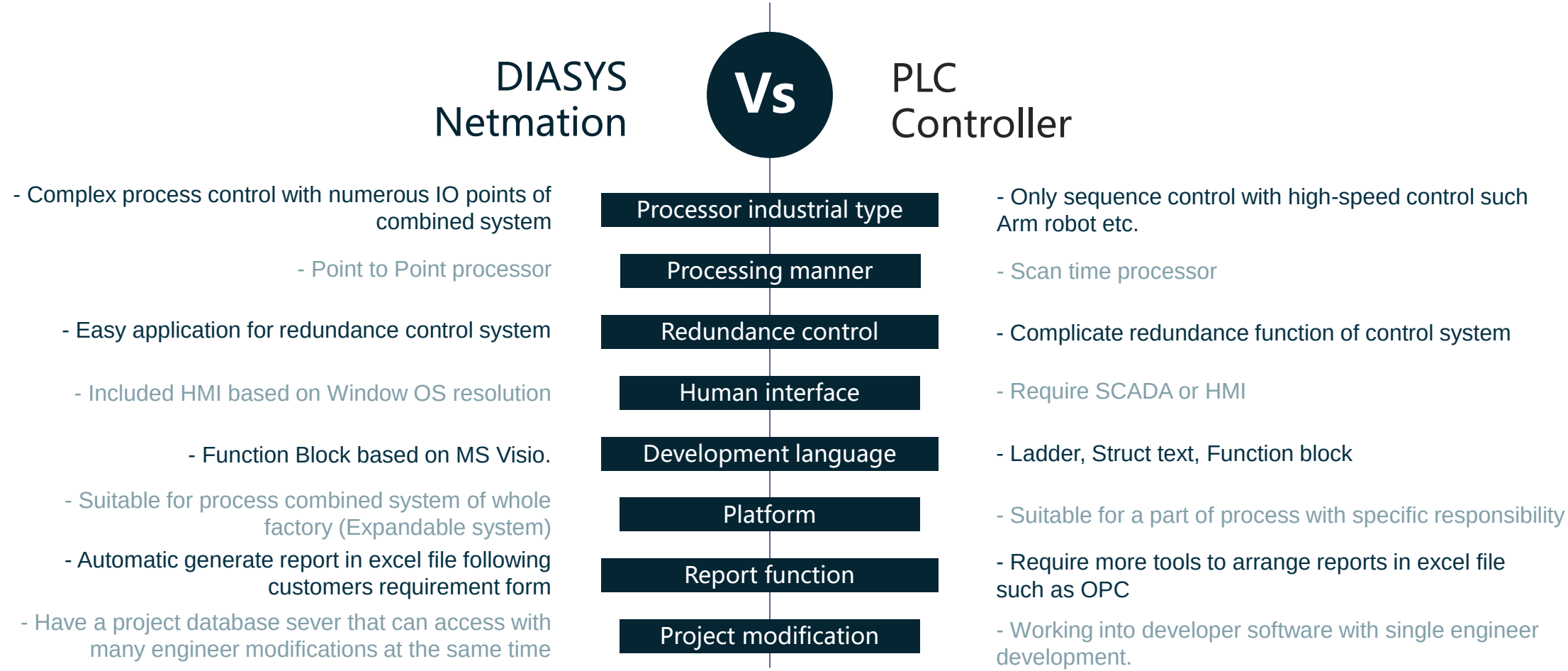
DCS can be compatible with many system, such PLC level, OPC level, even field level. Furthermore, the systems can be integrated working interrelated to each other. You can monitor the whole factory within one system.



# Features - Benefits

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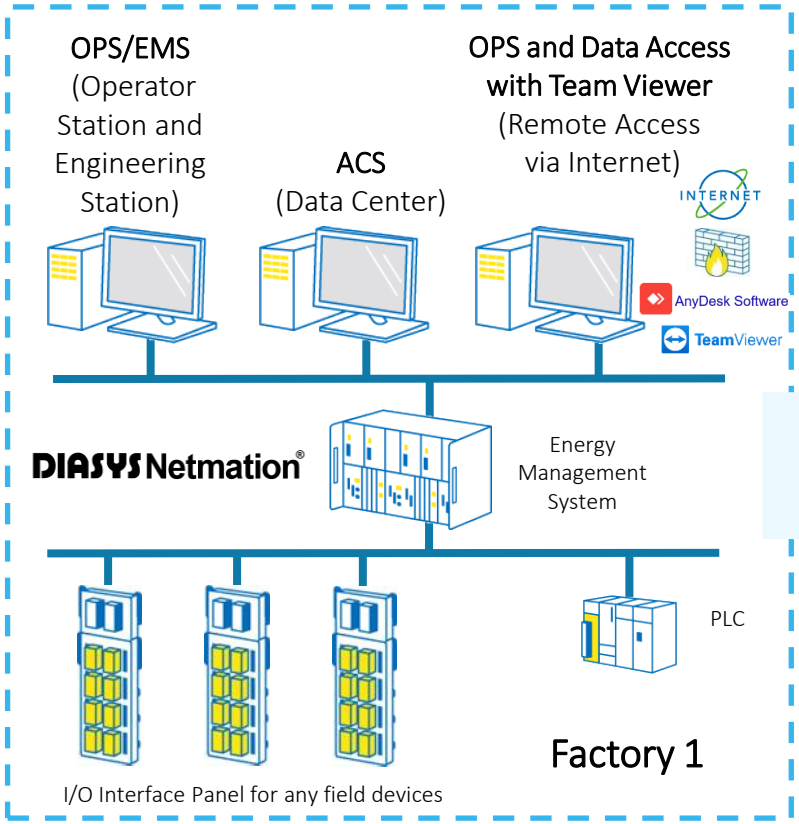
Management Level is able to access to Energy Management System via Smart phones / Tablet / Notebook

- Access to operator screens
- Access to the energy report
- Access to the utility cost report


## Features and Benefits

- Real-Time Utility's Cost Monitoring for each shops, each production lines
- Real-Time Machine Status Monitoring such as chillers, air compressors, and boilers
- Real-Time Machine's Efficiency Monitoring
- Waste/Loss Energy Monitoring
- Real-Time Trend Function Monitoring for operator
- Automatic Reporting
- Automatic Alarming
- Remote Monitor via Smart Phone
- Reduce OPEX for long-term maintenance
- Communication with the existing system (PLC, DCS, SCADA)

# System Configuration Supply

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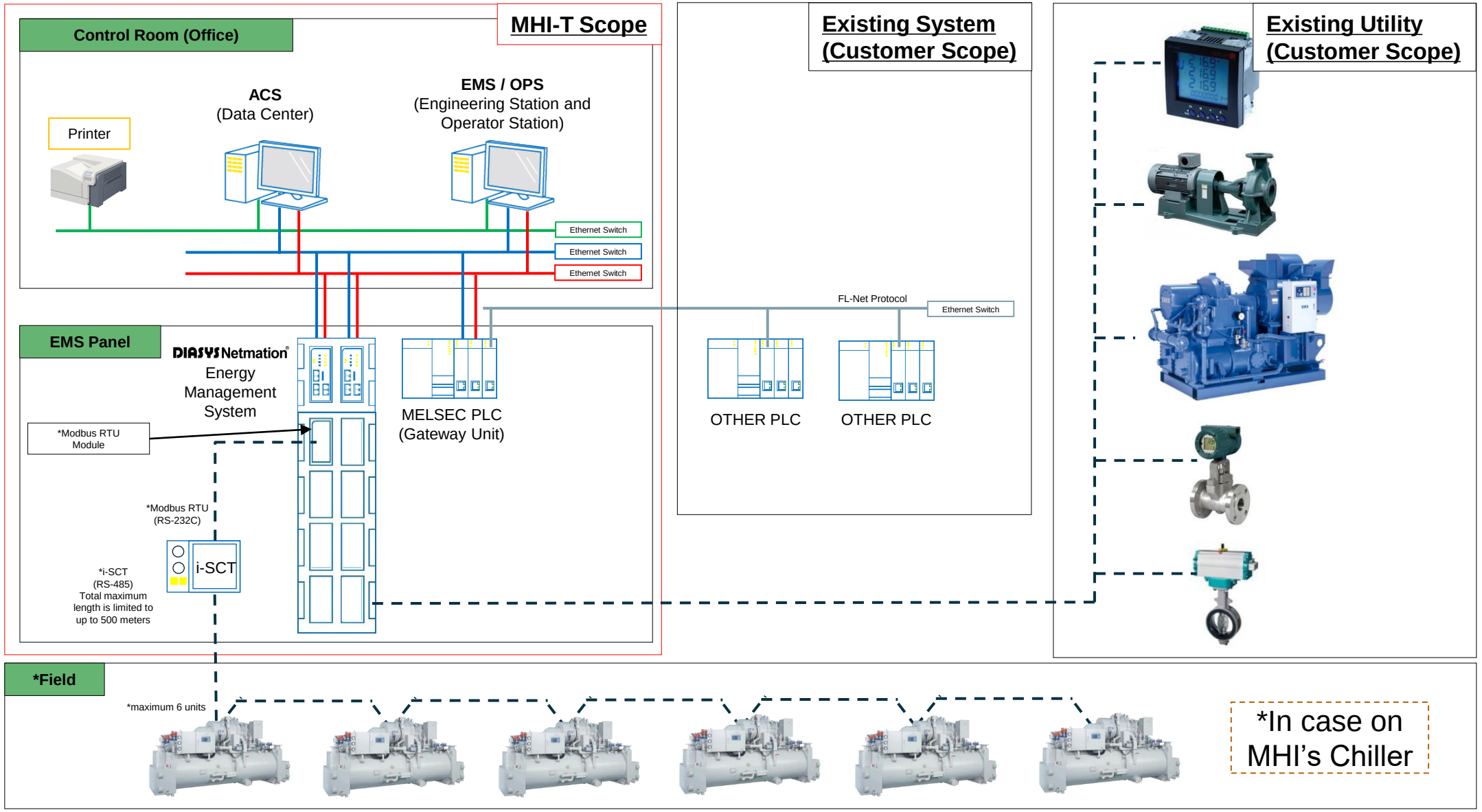

# Software Main Features

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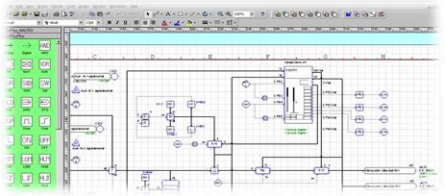
SOFTWARE MAIN FEATURES

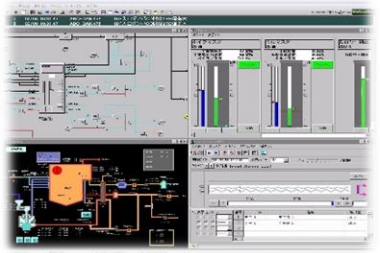
## Logic Modification

- ✓ Easy to expand, modify, upgrade ⇒ Reduction of cost
- ✓ No skill required (Function box language based on Microsoft VISIO)
- ✓ Modification, upgrade and expand are allowed



## Window Layout Flexibility

**Netmation focuses on the useful operability of monitoring and operation screens.**
In Netmation, it is not necessary to fix monitors for some specific purpose. By mouse operation, the scalable structure of multiple-screens is available and saving of screen layout as “My favorite” is available.

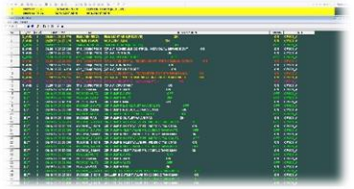


## Automatic Reporting

- ✓ Daily report and Monthly report
- ✓ Automatically printing able to be set

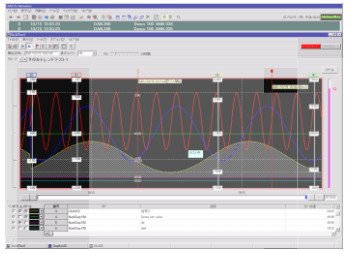
## Event Alarm Detection

- ✓ Buzzer is included
- ✓ Alarming priority can be set



## Trend display as Report

**Netmation focuses on the sufficient usability to support monitoring and reporting work.**
“Monitoring convenience” enables Operator to use screen image as report on paper.



# Trend Function

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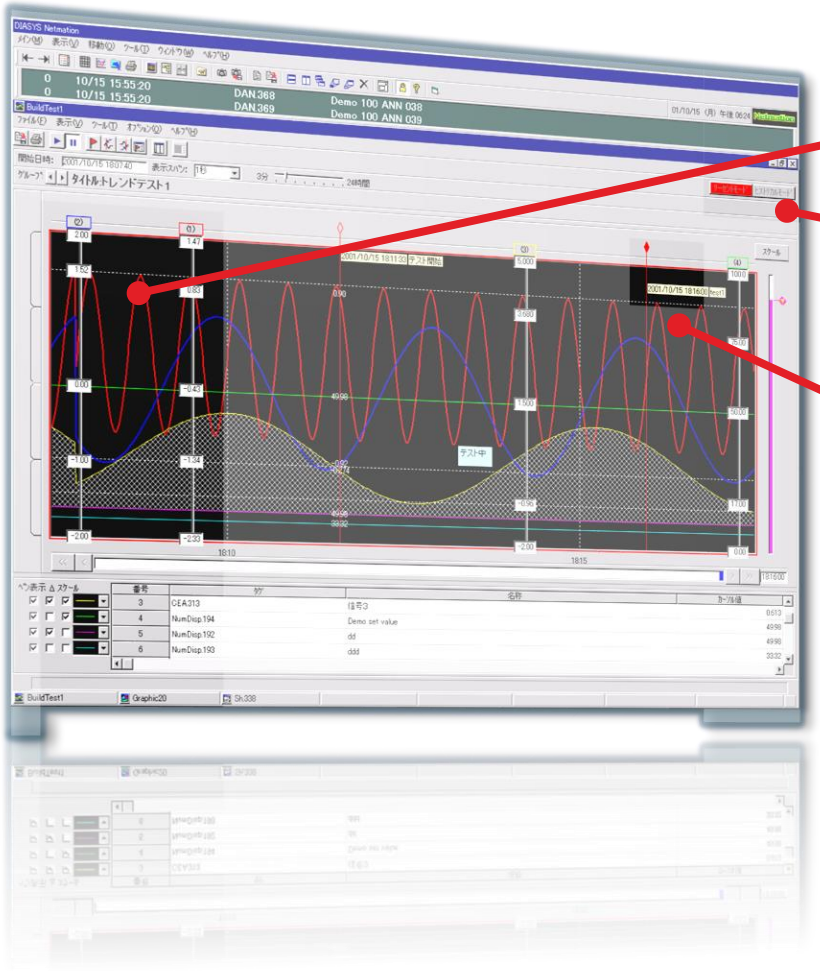
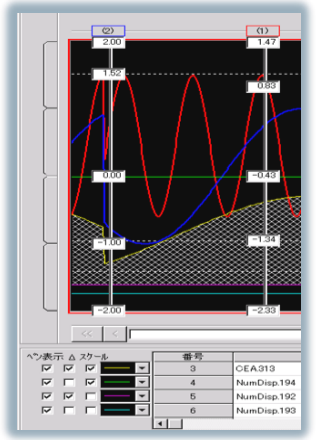


## Trend display as Report



**Useful function (1)**

- Many selections of background color, line color and line type

- Flexible scaling

**Useful function (2)**

Recent mode: displays real time data
Historical mode: displays historical data


Data collection cycle and time can be set as you like (according to storage capacity). * *

**Useful function (3)**

Post-it and flag marking are included as standard. The flag can be set by drag & drop from alarm/event. The information traceability is upgraded.


** Standard setting of each mode (It is settable according to storage capacity.)
The standard data collection cycle and time of each mode (recent / historical) is as follows.
- Recent mode: 1-second cycle within 24 hours
- Historical mode: 10-second cycle, over 24 hours and up to 31 days

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Part . 2

# Project references

Our success stories

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# Success Stories – Yarn Manufacturer

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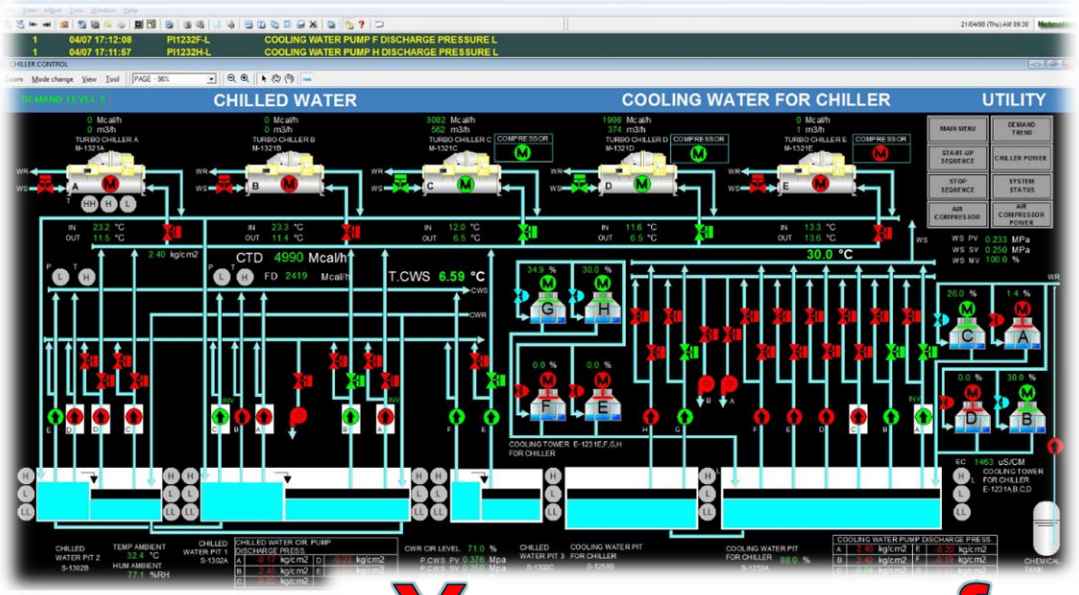
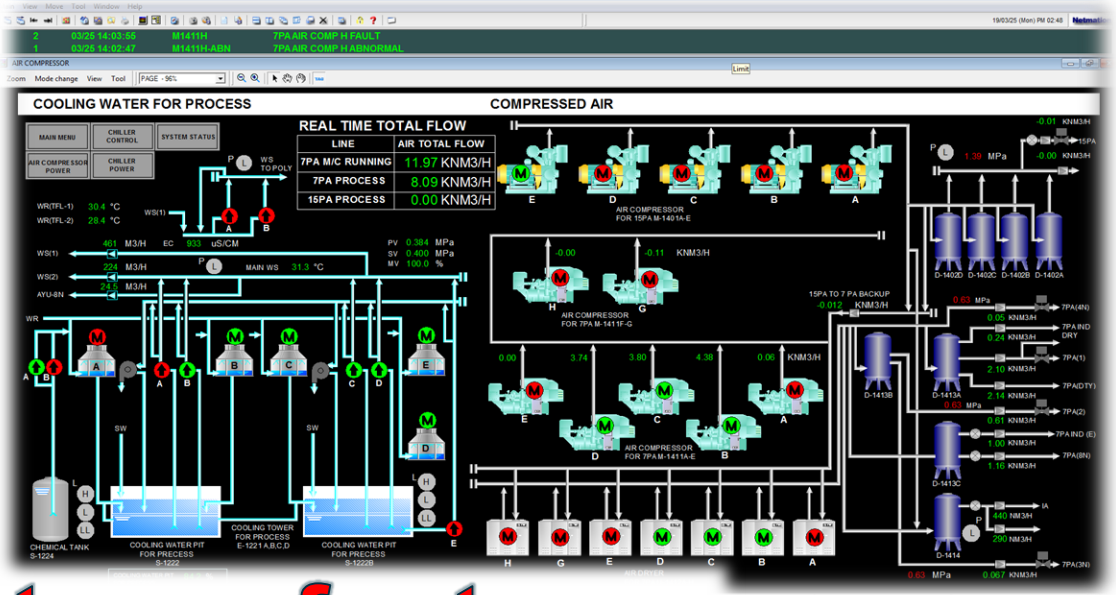
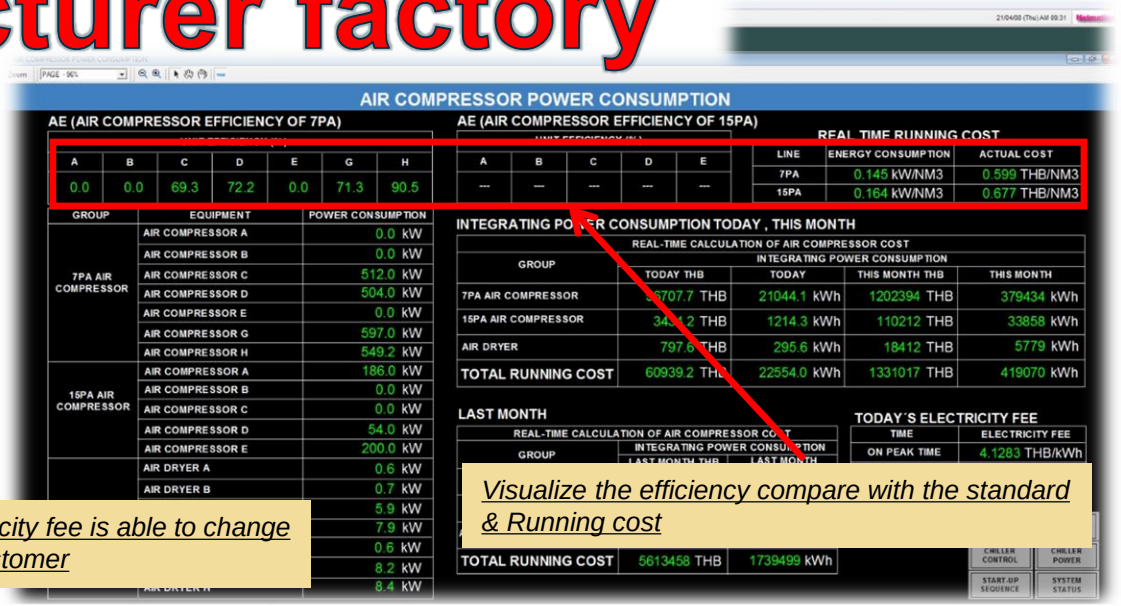



# Yarn manufacturer factory


*Electricity fee is able to change by customer*

*Visualize the efficiency compare with the standard & Running cost*

# Success Stories – Yarn Manufacturer

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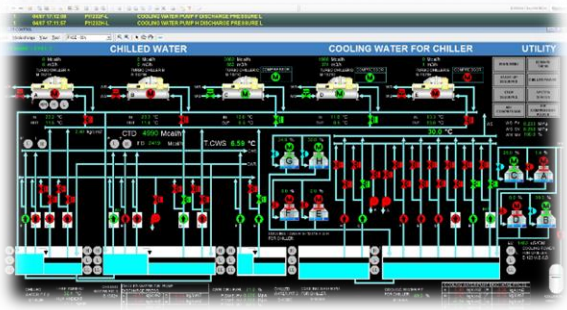
**Improvement of chiller system (Feb 2021)**
- Replacement of 1 existing chiller with MHI high efficiency model (Fix)

06




**Further Improvement (June 2016 to March 2018)**
- Replacement of 1 existing chiller with MHI high efficiency model (VSD)

04

**Air Com Efficiency Monitoring (March 2019)**
- Efficiency monitoring and reporting
- Cost monitoring and reporting
- Loss monitoring

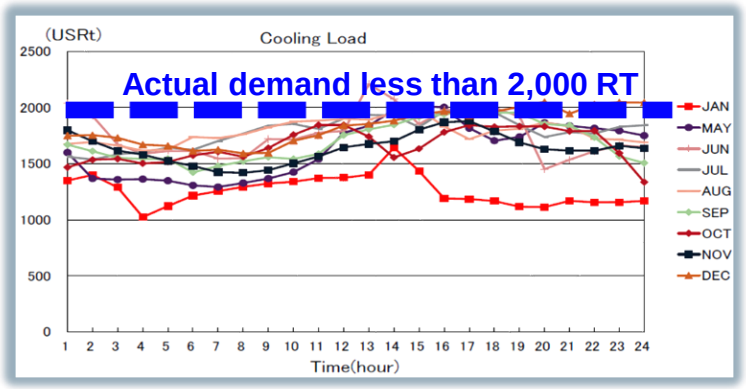
05

**MHI Solution (May 2015)**
- Automatic start and stop of Chillers and Aux. equipment by EMS considering factory demand

02

**Effect of Improvement (May 2015 to March 2016)**
- 10% of Energy Cost Saving with ROI: 2.5 year (EMS + Modification of valves and sensing devices)

03




**Monitoring, Visualization & Analysis (Sep 2014)**
- 3,300 RT (1,100 RT x 3 sets) Chilled System always operated in manual
- However, actual thermal demand is less than 2,000 RT

01

# Success Stories – MSG Manufacturer

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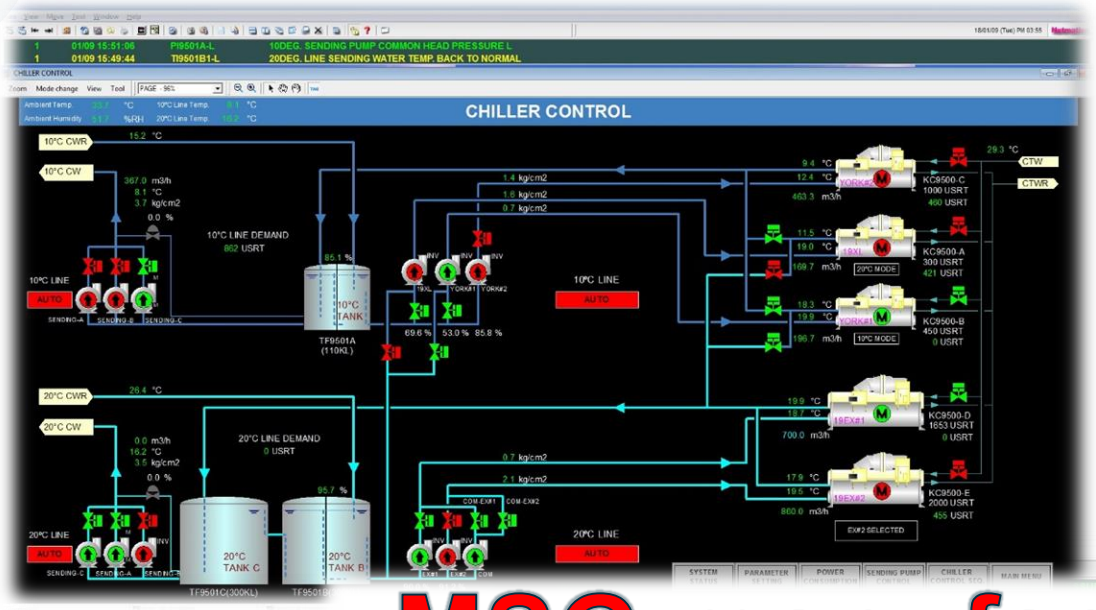


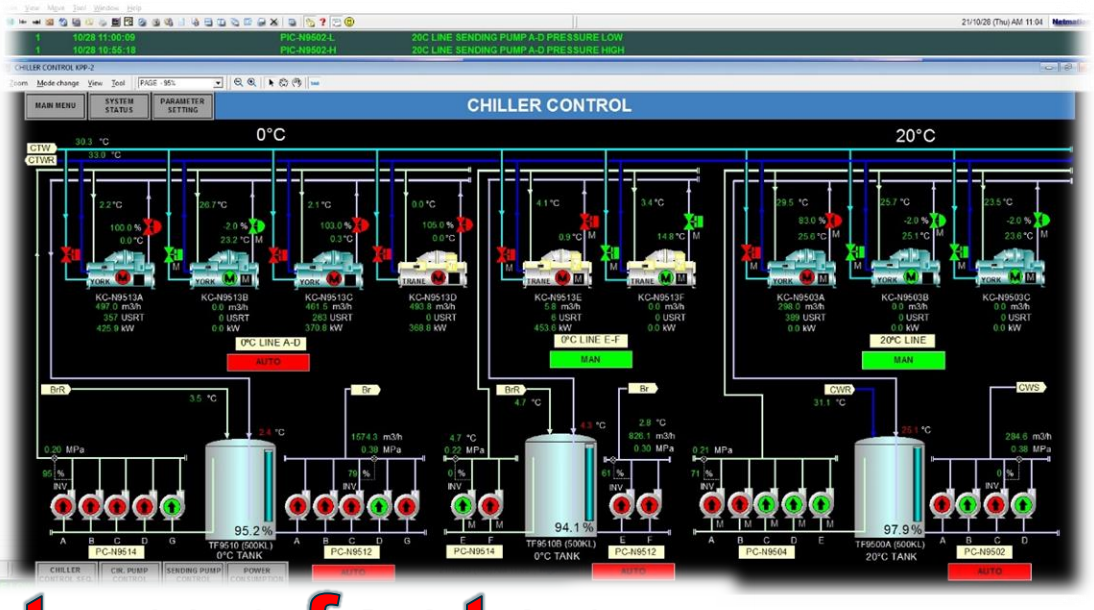


# MSG manufacturer factory

**0°C LINE A-D**

| GROUP | DEVICE | POWER CONSUMPTION |
|---|---|---|
| CHILLER | KC-N9513A | 425.0 kW |
| | KC-N9513B | 0.0 kW |
| | KC-N9513C | 361.1 kW |
| | KC-N9513D | 354.8 kW |
| Br SENDING PUMP | PC-N9512A | 109.4 kW |
| | PC-N9512B | 95.8 kW |
| | PC-N9512C | 37.3 kW |
| | PC-N9512D | 0.0 kW |
| | PC-N9512G | 104.9 kW |
| Br CIR.PUMP | PC-N9514A | 33.3 kW |
| | PC-N9514B | 29.3 kW |
| | PC-N9514C | 13.3 kW |
| | PC-N9514D | 40.4 kW |
| | PC-N9514G | 0.0 kW |
| TOTAL | | 1604.7 kW |

**20°C LINE A-C**

| GROUP | DEVICE | POWER CONSUMPTION |
|---|---|---|
| CHILLER | KC-N9503A | 0.0 kW |
| | KC-N9503B | 0.0 kW |
| | KC-N9503C | 0.0 kW |
| CHW SENDING PUMP | PC-N9502A | 51.2 kW |
| | PC-N9502B | 0.0 kW |
| | PC-N9502C | 0.7 kW |
| | PC-N9502D | 0.0 kW |
| CW CIR.PUMP | PC-N9504A | 18.0 kW |
| | PC-N9504B | 23.4 kW |
| | PC-N9504C | 0.0 kW |
| | PC-N9504D | 0.0 kW |
| | PC-N9504E | 0.0 kW |
| TOTAL | | 93.4 kW |

**0°C LINE E-F**

| GROUP | DEVICE | POWER CONSUMPTION |
|---|---|---|
| CHILLER | KC-N9513E | 453.5 kW |
| | KC-N9513F | 0.0 kW |
| Br SENDING PUMP | PC-N9512E | 14.7 kW |
| | PC-N9512F | 114.8 kW |
| Br CIR.PUMP | PC-N9514E | 0.0 kW |
| | PC-N9514F | 43.2 kW |
| TOTAL | | 626.3 kW |

**TODAY´S ELECTRICITY FEE**

| TIME | ELECTRICITY FEE |
|---|---|
| ON PEAK TIME | 4.1283 THB/kWh |
| OFF PEAK RATE | 2.6107 THB/kWh |

MAIN MENU | SENDING PUMP CONTROL | CHILLER CONTROL | CHILLER CONTROL SEQ. | CIR. PUMP CONTROL | PARAMETER SETTING | SYSTEM STATUS

**COP(Coefficient Of Performance)**

| KC-N9513A | KC-N9513B | KC-N9513C | KC-N9513D | SYSTEM COP |
|---|---|---|---|---|
| 2.89 | 0.00 | 2.67 | 0.00 | 1.37 |

| KC-N9513E | KC-N9513F | SYSTEM COP |
|---|---|---|
| 0.00 | 0.00 | 0.00 |

| KC-N9503A | KC-N9503B | KC-N9503C | SYSTEM COP |
|---|---|---|---|
| 14399124... | 0.00 | 0.00 | 15.42 |

**INTEGRATING POWER CONSUMPTION**

**REAL-TIME CALCULATION OF CHILLED WATER COST**

| GROUP | | INTEGRATING POWER CONSUMPTION | | | | | |
|---|---|---|---|---|---|---|---|
| | | TODAY THB | TODAY | THIS MONTH THB | THIS MONTH | LAST MONTH THB | LAST MONTH |
| 0°C LINE (A-D) | CHILLER | 28082 THB | 9472 kWh | 358793 THB | 109983 kWh | 0 THB | 0 kWh |
| | Br SENDING PUMP | 2513 THB | 3825 kWh | 197836 THB | 60012 kWh | 0 THB | 0 kWh |
| | Br CIR. PUMP | 2513 THB | 847 kWh | 171971 THB | 55671 kWh | 0 THB | 0 kWh |
| | SUB TOTAL | 41717 THB | 14144 kWh | 728599 THB | 225666 kWh | 0 THB | 0 kWh |
| 0°C LINE (E-F) | CHILLER | 12742 THB | 4381 kWh | 177971 THB | 55510 kWh | 0 THB | 0 kWh |
| | Br SENDING PUMP | 3862 THB | 1329 kWh | 63519 THB | 19375 kWh | 0 THB | 0 kWh |
| | Br CIR. PUMP | 1361 THB | 469 kWh | 37868 THB | 10494 kWh | 0 THB | 0 kWh |
| | SUB TOTAL | 17965 THB | 6179 kWh | 279358 THB | 85379 kWh | 0 THB | 0 kWh |
| 20°C LINE (A-C) | CHILLER | 2639 THB | 1011 kWh | 11277 THB | 3311 kWh | 0 THB | 0 kWh |
| | CHW SENDING PUMP | 732 THB | 237 kWh | 32570 THB | 10480 kWh | 0 THB | 0 kWh |
| | CHW CIR. PUMP | 993 THB | 351 kWh | 212390 THB | 55140 kWh | 0 THB | 0 kWh |
| | SUB TOTAL | 4365 THB | 1598 kWh | 256236 THB | 68931 kWh | 0 THB | 0 kWh |
| TOTAL RUNNING COST | | 64047 THB | 21921 kWh | 1713434 THB | 379976 kWh | 0 THB | 0 kWh |

# Success Stories – MSG Manufacturer

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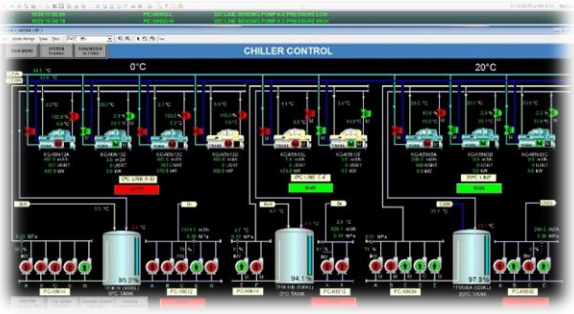
**06**

**Modification of chiller system (Feb 2022)**
- Add blackout function to chiller system Utilities 1 combination with new biomass power plant 9.9 MWe




**05**

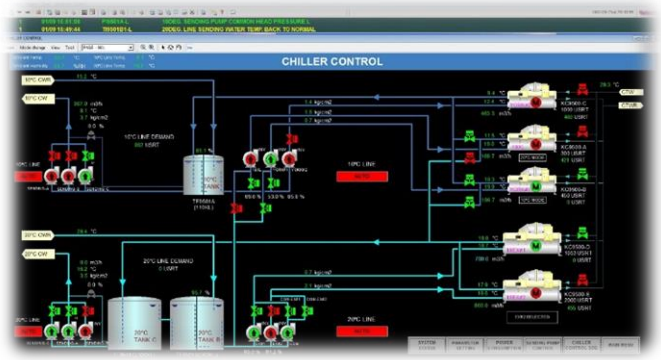
**Chiller Optimization for Utilities 2 (Dec 2021)**
- Established EMS separately from Utilities 1

**04**

**Further Improvement (Jan 2019)**
- Full auto control running
- Actual ROI: around 1.5 year

**02**

**Chiller Optimization for Utilities 1 (May 2017)**
- Automatic start and stop of Chillers and Aux. equipment by EMS considering factory demand
- Run priority chiller




**03**

**Support customer (Jun 2017 to Dec 2018)**
- Equipment fixing consultation by MHI
- Valves and sensing devices modification
- Programming modification

**01**

**Data Analysis (2016)**
- 5 sets of chiller operation manner analysis.
- Chillers always operated in manual
- Actual thermal demand is less than 2,000 RT

# Success Stories – MSG Manufacturer

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**Table: Production amount (ton) VS Energy consumption (kWh)**

| | Ton-Product (Monthly) | | | | |
|---|---|---|---|---|---|
| | 2015 | 2016 | 2017 | 2018 | 2019 |
| Jan | 4,098 | 4,077 | 2,818 | 4,187 | 4,253 |
| Feb | 3,633 | 3,915 | 2,334 | 3,799 | 1,481 |
| Mar | 4,019 | 3,941 | 4,223 | 3,691 | 4,246 |
| Apr | 3,993 | 4,013 | 4,161 | 3,544 | 4,218 |
| May | 4,129 | 4,184 | 2,553 | 3,968 | 4,065 |
| Jun | 3,932 | 4,030 | 2,328 | 4,093 | 3,934 |
| Jul | 3,949 | 4,196 | 3,799 | 4,171 | 4,320 |
| Aug | 4,112 | 4,252 | 4,072 | 4,063 | 4,019 |
| Sep | 3,892 | 4,120 | 3,977 | 3,963 | 4,042 |
| Oct | 4,012 | 4,202 | 4,313 | 4,089 | 4,094 |
| Nov | 2,072 | 4,061 | 2,748 | 4,110 | 4,107 |
| Dec | 4,079 | 4,270 | 4,393 | 3,995 | 3,669 |
| **Total** | **45,919** | **49,261** | **41,718** | **47,673** | **46,447** |
| | 93% | 100% | 85% | 97% | 94% |

| | kWh (Monthly) Total 10 + 20 degC | | | | |
|---|---|---|---|---|---|
| | 2015 | 2016 | 2017 | 2018 | 2019 |
| Jan | 568,665 | 522,259 | 413,921 | 505,190 | 531,426 |
| Feb | 401,378 | 600,412 | 350,807 | 566,765 | 272,305 |
| Mar | 606,226 | 571,385 | 531,808 | 616,486 | 494,380 |
| Apr | 694,847 | 775,615 | 542,325 | 523,200 | 530,050 |
| May | 706,691 | 1,069,806 | 383,508 | 605,181 | 554,181 |
| Jun | 480,830 | 1,048,676 | 366,137 | 649,976 | 497,440 |
| Jul | 606,653 | 813,472 | 547,597 | 674,590 | 407,790 |
| Aug | 616,909 | 783,315 | 578,732 | 665,292 | 414,430 |
| Sep | 585,872 | 959,973 | 562,600 | 697,687 | 435,930 |
| Oct | 606,820 | 939,549 | 545,946 | 510,593 | 452,850 |
| Nov | 369,801 | 786,437 | 373,450 | 543,918 | 361,880 |
| Dec | 557,249 | 577,754 | 508,672 | 524,364 | 567,510 |
| **Total** | **6,801,941** | **9,448,653** | **5,705,503** | **7,083,242** | **5,520,172** |
| | 72% | 100% | 60% | 75% | 58% |

# Success Stories – MSG Manufacturer

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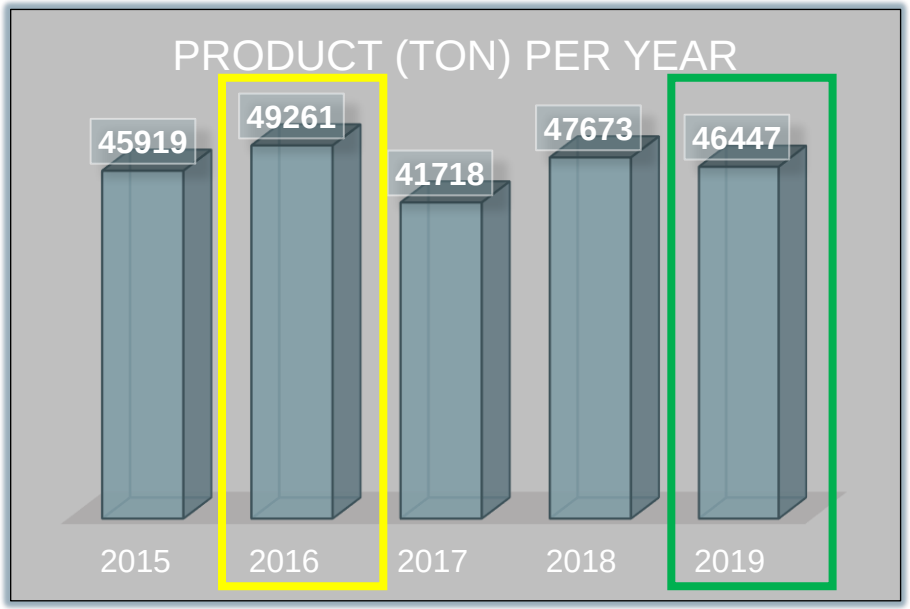
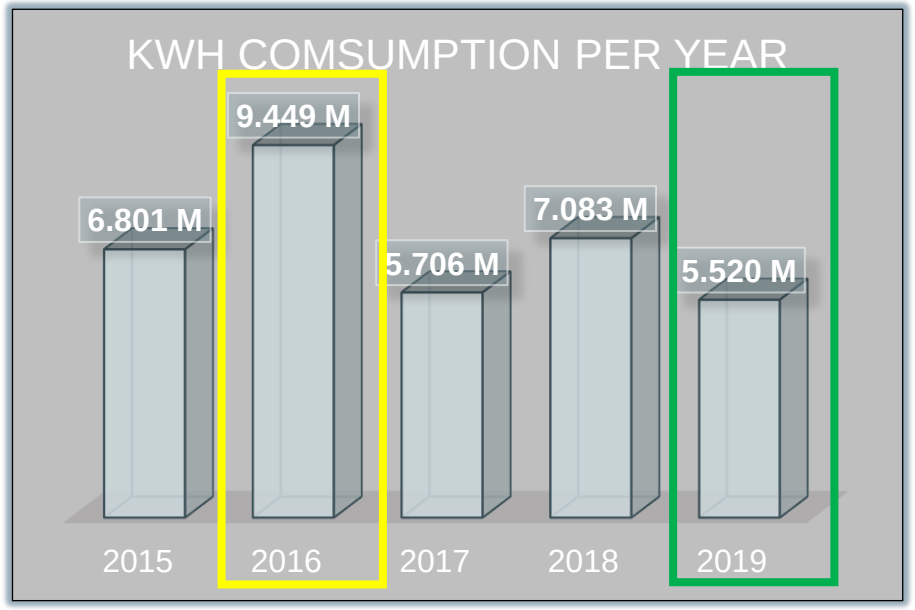
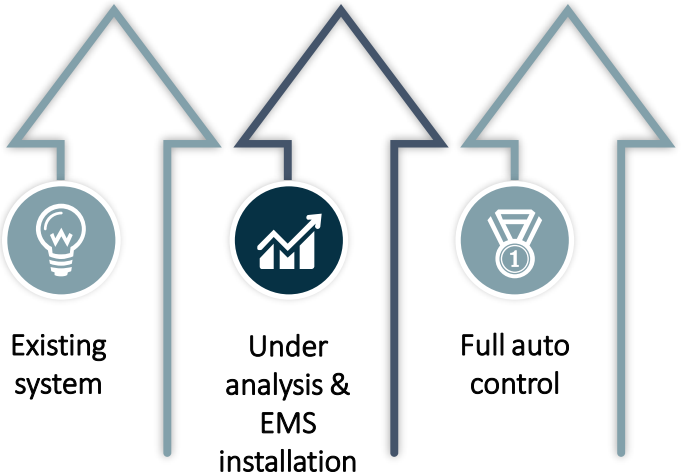


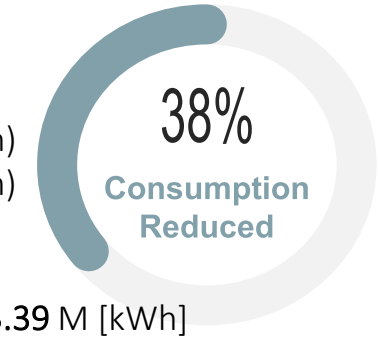




**Product per Energy consumption calculation**

Y2016 - 9,448,653(kWh) / 49,261 (Ton) = 191.8 (kWh/Ton)

Y2019 - 5,520,172(kWh) / 46,447 (Ton) = 118.8 (kWh/Ton)




**Cost Saving.**

[**191.8** (kWh/Ton)] - [**118.7** (kWh/Ton)] x **46,447** (Ton)] = **3.39** M [kWh]

*Electric tariff (Avg. **3.4** THB/kWh) = **11,521,490** THB/Year

**$CO_2$ Saving.**

*$CO_2$ Emission Reduction (Base 0.5642 $kgCO_2$/kWh) = **1,912,994** $kgCO_2$

# Success Stories – Vehicle part Manufacturer

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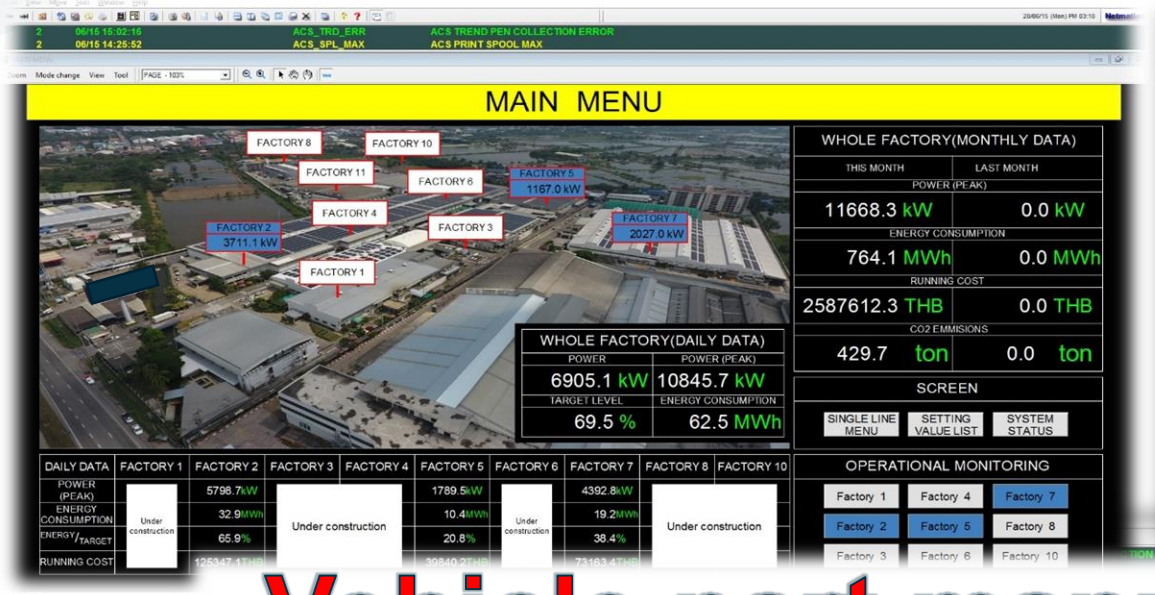
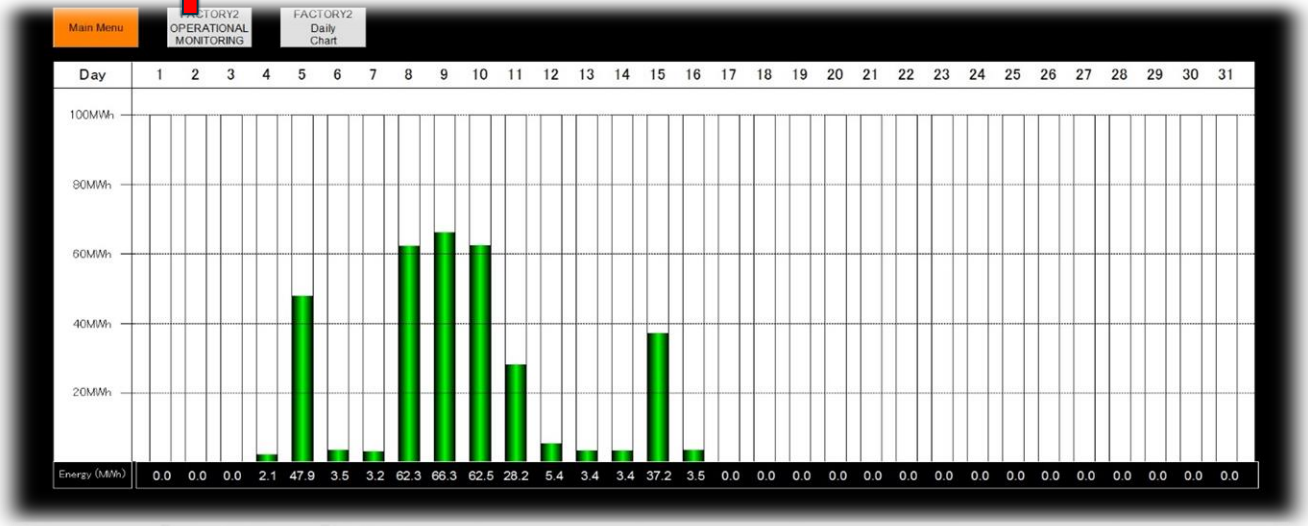




# Vehicle part manufacturer factory



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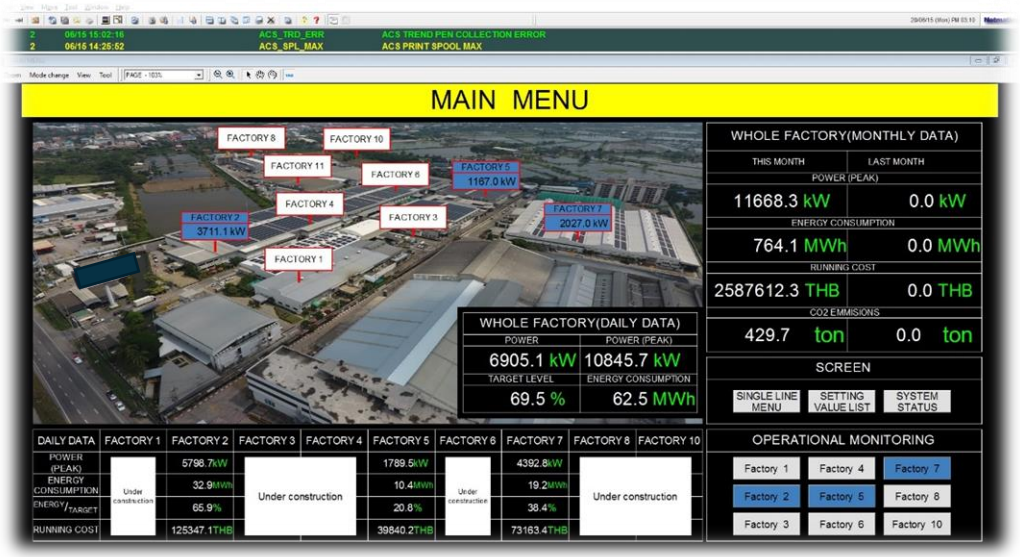


**04**

**Improvement of power monitoring (*Under designing*)**
- Include Plant#1, Plant#3, Plant#6 to EMS.

**02**

**Power monitoring system (June 2020)**
- Established EMS for power monitoring Plant#2, Plant#5, Plant#7

**03**

**New power meter installation (Apr 2021)**
- Installed Plant#1, Plant#3, Plant#6 power meters and cable wiring.

**01**

**Analysis for EMS (Nov 2019)**
- First step for EMS, plant by plant monitoring
- Focused on the most energy usage plant

# Success Stories – Tire Manufacturer

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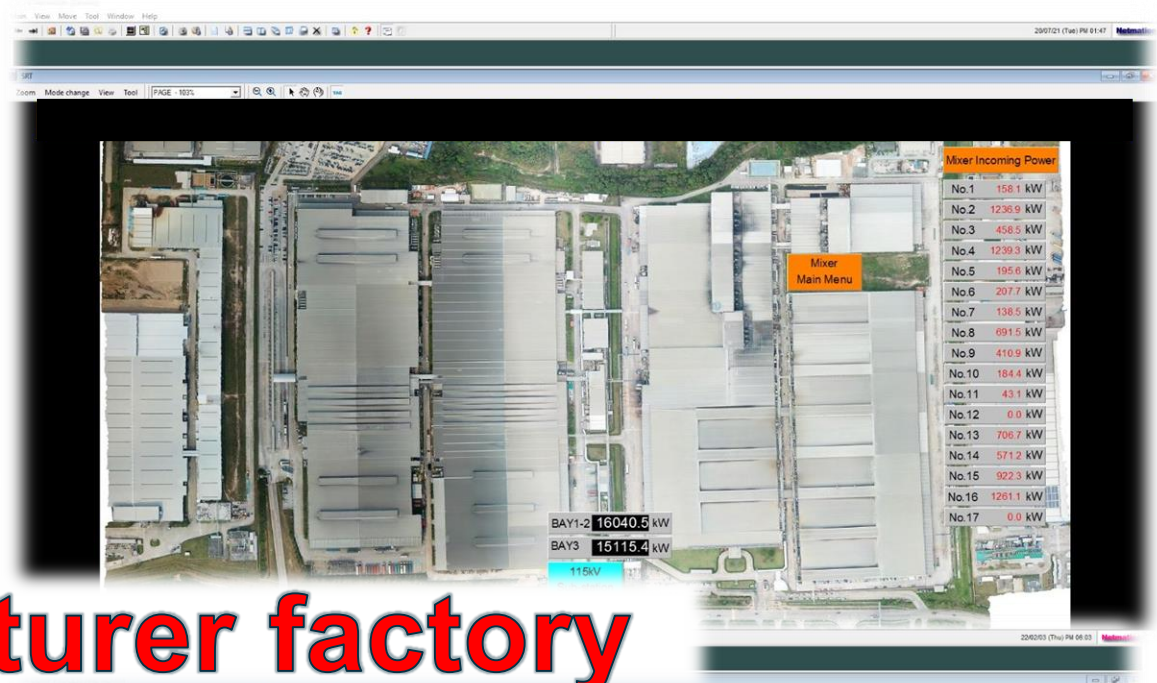
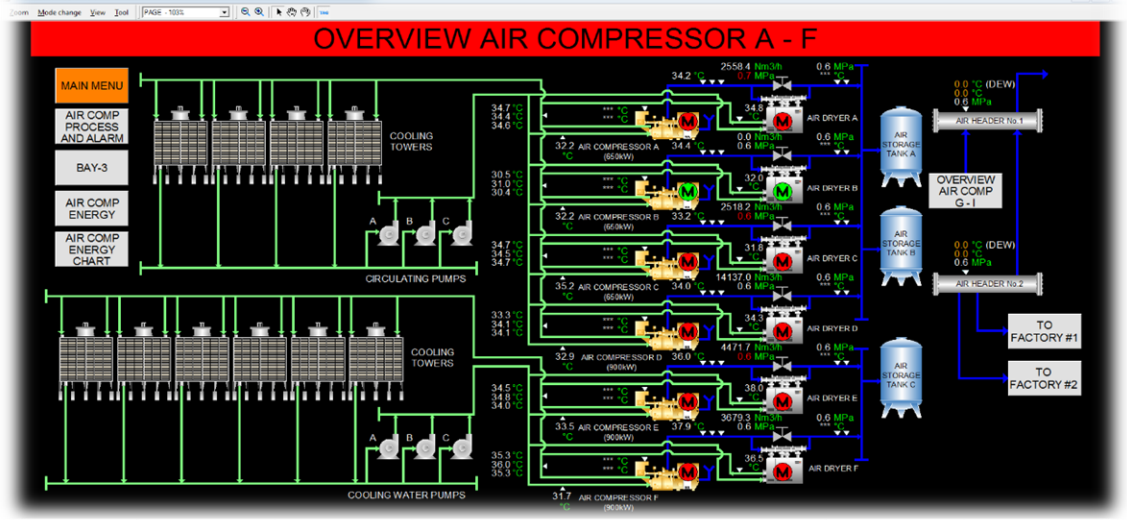
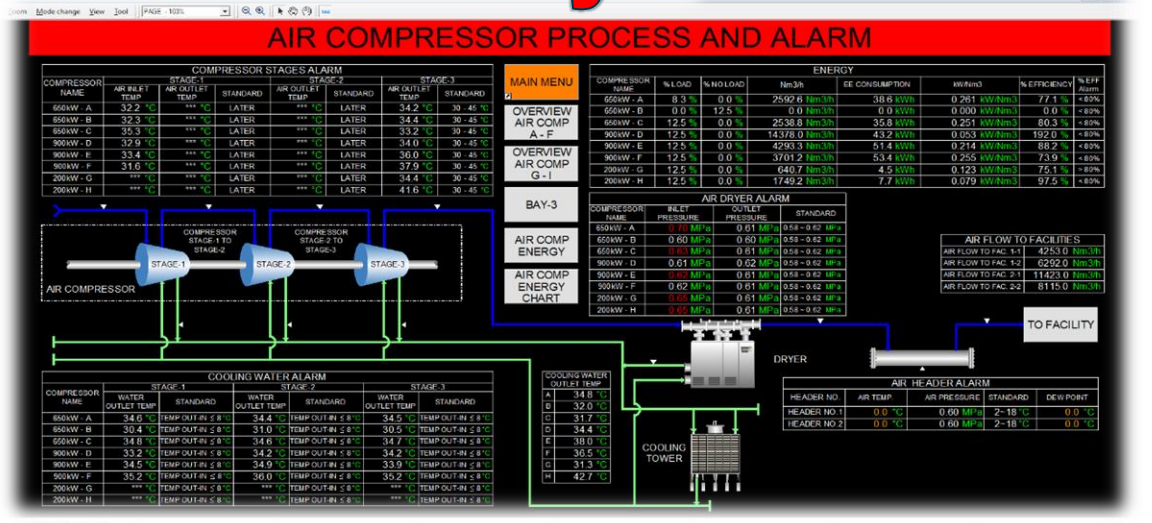



# Tire manufacturer factory



# Success Stories – Vehicle part Manufacturer

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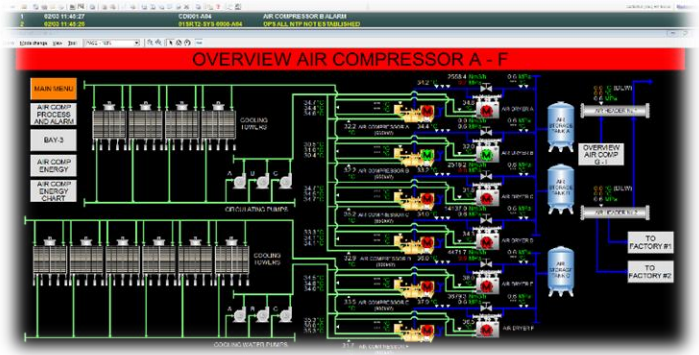
**04**

**Air compressor monitoring (Jan 2022)**
- Efficiency monitoring and reporting
- Cost monitoring and reporting




**03**

**Air compressor monitoring (Apr 2021)**
- Extended project for air compressor monitoring system

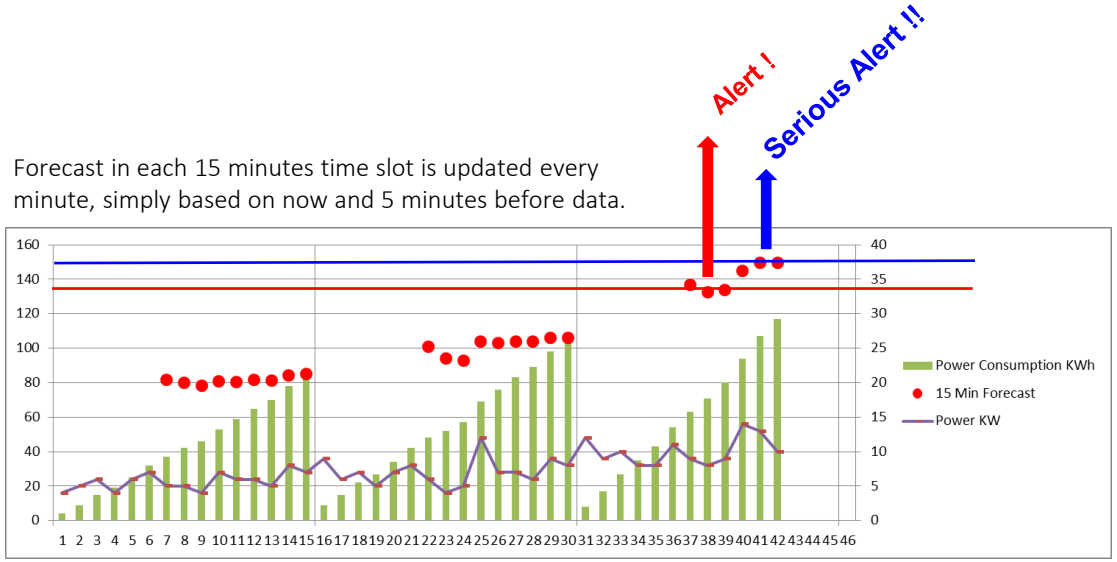
**02**

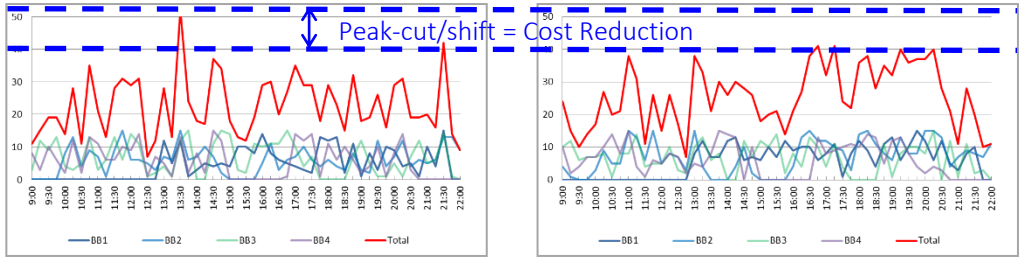
**Power monitoring system (Aug 2020)**
- Established EMS for power monitoring the most consumer machine such Mixer.
- Peak-cut function alarm.

**01**

**Analysis for EMS (2019)**
- First step for EMS, power monitoring for Mixer machine.
- Customer problem is the fee of peak power charge is too high.

Forecast in each 15 minutes time slot is updated every minute, simply based on now and 5 minutes before data.



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