Energy Management System and Energy Conservation Initiatives
General Motors Experience and Commitment – Road to 2050
Our Vision

We see a world with:

- Zero crashes
- Zero emissions
- Zero congestion

and our people are the driving force behind making this a reality.
**Energy Group Vision:** Contribute to GM Vision in achieving Zero Emissions

**Mission:** 100% of GM Energy Matrix provided by Renewable Sources until 2050
Since 2003, General Motors has been developing its energy management system at GM S. America, aligned to the global standard and pursuing the reduction of energy and water use per vehicle, as well as the reduction of carbon emissions;

Through ABRACE, GM participated in every initiative that had a potential to enhance energy efficiency and contribute to the company efforts in sustainability, reducing impact to the environment and to the community around our operations;

Seeking continuous improvement, GM participated in the Energy Conservation Center Japan initiative with CNI/ABRACE in order to enhance its knowledge regarding energy management system;

**Major Objectives:**

- Share experiences and knowledge related to energy management and efficiency;
- Be part and contribute to the development of Energy Efficiency Policies for Industry
General Motors South America

10 Plants:
- 6 Assembly
- 1 Stamping
- 3 Powertrain
- 6 ISO 50.001 certified
• General Motors South America – Energy Control since 2003:

GMSA Energy per vehicle

- At the same level of production (2003;2016) the reduction was of 48%

CHALLENGE
How can we perform better in a more difficult environment?
No more “hanging fruits”
Great opportunity to understand the Japanese culture and experiences regarding energy consumption and efficiency;
Based on the experience exchange between GM and ECCJ during visits to GM Brazil headquarters and Workshop held in Japan, some actions related to Energy Management improvement were identified:

- Most of the gaps had already been identified before but the interactions with Japanese Experts have reinforced those requirements

1. Energy Policy thorough implementation at the region;
2. Metering automation;
3. Energy KPI deployment to individual shops;
4. Alignment between KPI’s and annual budget;
5. Enhance Regional Energy Group;
6. Analysis through process losses;
The Energy Policy reflects the company leadership commitment to approve and support initiatives that results in efficient use of energy and natural resources;

Most significant requirement to achieve the ISO 50.001 certification;

The policy is being implemented for all GMSA Plants according to ISO 50.001 master plan.

During GM and ECCJ partnership there were 5 plants that received ISO 50.001 certification:

- SCS Plant
- ROS Assembly Plant
- ROS Powertrain Plant
- Gravatai Plant
- Ecuador Plant
GM understands that a comprehensive metering system is essential to leverage its current Energy Management System;

Key Factors:
- Eliminate human errors;
- Identify hidden opportunities;
- Enables individual shops analysis;

Current GM Data Management Structure

GM Supervisory System
- Data Consolidation and analysis.
- Data Library and source for Energy KPIs.
FMS:

• Metering Automation
• GM Energy OnStar:
• GM 2100:

on Friday 23 February 2018 we processed 84 new bills.
Total value R$11,447,005
Electricity: R$10,059,958
Gas: R$2,373,467
Water Services: R$1,013,600

Electricity, Energy Analysis Report
Week 07 - Jan 2018
Report generated on 29 February 2018 13:35:29 UTC. By 15196

"Creating places you want to be"
With an automated system – GM can develop current individual performance metric to each shop that composes the vehicle manufacturing complex:

- Powertrain;
- Plastic Injection – Bumpers;
- Press Shop;
- Body Shop;
- Paint Shop;
- General Assembly;
- Support Areas;
- Non Manufacturing Operations.

Current Structure does not consider all shops;

Deployment is ongoing;
Energy KPI Deployment

- Current KPI Analysis:
  - Target Development – Based on forecasted scenarios and according Production variation features;
  - Monthly Analysis – Through Plant individual performance:

<table>
<thead>
<tr>
<th>Actual</th>
<th>Total Energy (MWh)</th>
<th>Monthly Energy/vehicle</th>
<th>Monthly Target</th>
<th>Total Energy /vehicle</th>
<th>Target YTD</th>
<th>Total Water (m³)</th>
<th>Monthly Water/vehicle</th>
<th>Monthly Target</th>
<th>Total Water /vehicle</th>
<th>Target YTD</th>
<th>Production (vehicle)</th>
<th>Production (Forecast)</th>
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Energy KPI Deployment

- Current KPI Analysis:
  - PPR (Plan Performance Review) – Action Plans to revert initial bad performance
  - Based on PDCA Cycle (ISO 50.001)

### PPR - Plan Performance Review - 2018

<table>
<thead>
<tr>
<th>Date</th>
<th>Ref</th>
<th>Results</th>
<th>Root Cause</th>
<th>Action (Countermeasure)</th>
<th>Timing</th>
<th>Responsible</th>
<th>Status</th>
<th>Support / Comments</th>
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<td>Target</td>
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**São Caetano do Sul**

### Energy

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<tr>
<th>Date</th>
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<th>Action (Countermeasure)</th>
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### Water

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<tr>
<th>Date</th>
<th>Ref</th>
<th>Results</th>
<th>Root Cause</th>
<th>Action (Countermeasure)</th>
<th>Timing</th>
<th>Responsible</th>
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</table>
GMSA Energy Group understands that it has become difficult to approve projects (higher complexity) without identifying exactly the impact on approved budget.

- Drives Energy Consumption Reduction provided by initiatives and projects;
- Manage the risks of each project based only in consumption.

- Variable not controlled by Energy Efficiency projects specialists;
- Costs management has to be considered as it impacts future scenarios.
Alignment with Annual Budget

- **GMSA Regional Energy Group Mission** – Provides guidance, support and knowledge to plant operations with an objective to have them achieve their objectives of energy consumption;

- **Current Structure** – Each Plant Director has the role of achieving the target of energy consumption and the responsibility is directed until the Plant Energy Coordinator.

- **The Energy Regional Manager and its team are responsible for give support to Plant Energy Coordinator in accomplish those targets.**
**Enhance Regional Energy Group**

- Tools to leverage All Energy Group Relationship:

**Regional Face to Face Meetings** – the last was held in November 2017

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**Routine and Standardization process**

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### Utility Efficiency Projects

<table>
<thead>
<tr>
<th>Plant</th>
<th>São Caetano do Sul</th>
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</thead>
<tbody>
<tr>
<td>Project Type</td>
<td>Development Level</td>
</tr>
<tr>
<td>Replacement of ADM and Tech Center buildings cooling system</td>
<td>Medium</td>
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<tr>
<td>Installation of ATLAS compressor management system</td>
<td>High</td>
</tr>
<tr>
<td>Replacement of motors by high efficiency models (ETE e CF)</td>
<td>High</td>
</tr>
<tr>
<td>Replacement of common lighting by LED lighting (external lighting)</td>
<td>High</td>
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<tr>
<td>Install a drinking water line to maintain supply of the Tech Center through the Main Plant</td>
<td>Low</td>
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<tr>
<td>Install a Reverse Osmosis system + Ultra filtration system in Powerhouse II (Boilers and Cooling Towers)</td>
<td>Low</td>
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<tr>
<td>Reverse Osmosis system installation + Ultra filtration system in Paint Shop</td>
<td>Low</td>
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<tr>
<td>Reforming the clarifier tank to store rainwater</td>
<td>Medium</td>
</tr>
</tbody>
</table>
Enhance Regional Energy Group

• Tools to leverage All Energy Group Relationship:

  Sharing External Programs to all group

Strong Communication Program
GM understands that this could be the most significant contribution that ECCJ provided in this partnership.

ECCJ team has provided General Motors with some analysis that are based not only on consumption but through some other factors such as:

- Raw Material;
- Losses though the entire process flow;
- Different production indicators;

GMSA has considered these features in its vision of energy management and it is already considered as a plan that depends on the initiatives described before:

- Metering Automation
- KPI Deployment;
There is a master plan to have all those initiatives concluded by 2020:

<table>
<thead>
<tr>
<th>Initiative</th>
<th>Status</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
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<tbody>
<tr>
<td>Energy Policy</td>
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<tr>
<td>Metering Automation</td>
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<td>Energy KPI to Individual Shops</td>
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<tr>
<td>Alignment with Annual Budget</td>
<td>On Going</td>
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<tr>
<td>Enhance Regional Group</td>
<td>On Going</td>
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<td>Analysis through process losses</td>
<td>Not Started</td>
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</table>

**ECCJ Experience** – Major contribution of this partnership (GM view) was not only regarding technical initiatives that could be used in the operations but how the company in South America can look at its energy consumption pattern and change the behavior and culture to be even better in its standards related to energy management.
GMSA Major Achievements – 2016–2018

• Full LED project initiative:
  • Have 100% of manufacturing operation lighting provided by LED technology – until 2020;
    • 2016 – 20% Concluded;
    • 2017 – 45% Concluded;
    • 2018 – 100% Concluded.
  • Estimated Savings of R$1,0 Mi per year;
• Energy Efficiency Workshops in each plant:
  • 2016 – Gravataí;
  • 2017 – São José dos Campos;
  • 2017 – São Caetano do Sul – Aliança Program;
  • 2018 – Rosario Plant

(More than 100 initiatives were raised and at least 20% were implemented – R$ 250.000 / per year);
(Gravataí has achieved its energy annual target after this workshop);
THANK YOU

Sustainable Workplaces

“Creating places you want to be”