Case Study: General Motors’ use of wireless controls to achieve significant energy savings
Speakers

General Motors

• **Steve Townsend** – Senior Electrical Systems Engineer
• **Tom Quinn** – Energy Conservation Engineer, GM Spring Hill

Light Corp + Kanepi

• **Craig Klem** – Director of Technology & Process
• **Chris Albertson** – Regional Sales Manager
• **Jeff Baxter** – Executive Director of Sales
This session will examine General Motors’ efforts to:

1. Define the opportunity within its Spring Hill facilities by examining infrastructure and software.

2. Select & implement an integrated wireless controls system in an automotive manufacturing environment

3. Commission the system and further optimize energy usage
Learning Objectives

1. How to translate annual energy reduction goals into specific, quantifiable projects.
2. Scaling & scoping projects around annual energy reduction mandates & rebates.
3. Integrating existing building management systems with new control technologies.
4. Pulling together a multidisciplinary team for effective decision making.
General Motors Spring Hill, TN
A Case Study in Energy Efficiency
Overview of GM Manufacturing – Energy

- Building 9 million vehicles per year = $1 billion in energy
- Enough electricity to power 1 million homes
- Carbon equivalent of 172 million trees for 10 years
- Enough water to fill 166 billion glasses or 30 million people per year
Global Energy, Carbon, Water Intensity Goals

10-20% of facility total energy use is lighting

1. Reduce energy intensity from facilities by 20 percent.*

20% Energy

2. Reduce carbon intensity from facilities by 20 percent.*

20% Carbon

3. Reduce carbon intensity from facilities by 20 percent.*

Includes all manufacturing and nonmanufacturing CO₂ in the Carbon Disclosure Project (CDP) Scope 1 & 2 categories normalized by vehicle production. This data includes data from some GM JVs.

4. Protect water quality and reduce water intensity by 15 percent.*

15% Water

Includes all manufacturing and nonmanufacturing facility water use (municipal, surface, well), normalized by vehicle production. This data includes data from some GM JVs.

2010 – 2013 Performance

Energy – 10%  GHG – 7%  Water – 9%
WE STRIVE TO REDUCE EMISSIONS AND PETROLEUM DEPENDENCE BY BEING MORE ENERGY EFFICIENT.

Energy & Carbon Intensity – 20% by 2020

REDUCE EMISSIONS AND PETROLEUM DEPENDENCE BY BEING MORE ENERGY EFFICIENT

Reduce Use

Renewable Energy

Reduce Emissions

CO₂ Emissions Reduction

28% From 2005–2010

3.34 M METRIC TONS GREENHOUSE GAS EMISSIONS AVOIDED

10% From 2010 – 2013

2013 AND 2014 EPA ENERGY STAR® PARTNER OF THE YEAR–SUSTAINED EXCELLENCE

EPA’s highest level of recognition for corporate energy management

63 PLANTS MET EPA CHALLENGE FOR INDUSTRY

- More than any other company
- Avoided $162 million in energy costs

Equal to emissions from 244,000 homes
GM Spring Hill Manufacturing

- 2,381 employees
- 4 business units
  - Stamping
  - Injection Molding
  - Powertrain
  - Vehicle Assembly
- 6.9 million sq. ft.
- 2,100 acres
Stamping

- Current operations
  - 4 Transfer presses
    (1 more in process)
  - Ship up to 200,000 parts/week to 7 plants
Components

- Ship 33 molded commodities daily for the Chevrolet Traverse
- New Corvette fascia
- Current operation
  - VIS: 15 injection molding machines
  - Polymers: 18 injection molding machines
  - 9 assembly machines
  - Fascia paint line
Powertrain Products

2.0L Turbo

2.4L ECOTEC®

2.5L ECOTEC® All-New
2.0L Turbo & 2.4L ECOTEC® Models

Buick Verano
Buick Regal
Buick Regal GS
Buick LaCrosse

Chevrolet Equinox
Chevrolet Malibu
Cadillac ATS
GMC Terrain

Opel Insignia
Opel Astra
Chevrolet Orlando (Korea)
Daewoo Alpheon (Korea)

Chevrolet Captiva (Mexico)
Chevrolet Cruze (Korea)
2.5L ECOTEC® Models

Chevrolet Malibu

Chevrolet Impala

Chevrolet Colorado

GMC Canyon
Vehicle Assembly

- Flexible assembly plant
- Production based on customer demand and manufacturing need
- $61 million investment for the Chevrolet Equinox
- $350 million additional investment for future midsize vehicle
- 1,800 created or retained jobs
Lighting System
Selection & Evaluation
Defining the Opportunity to Retrofit - Infrastructure

- Plant re-tooling plans in progress
- Existing HID lighting equipment was nearing end of life
- Corporate initiatives to reduce energy were put in place – 2010 to 2020
- Public utility rebates were available
Defining the Opportunity to Retrofit - Software

• GM researched wireless controls
• Found out ZigBee Based Systems worked well in large industrial environments
• Realized ZigBee worked well in automotive in Europe
• Uncovered ZigBee in the US for large open indoor spaces with Kanepi Wireless Controls.
Existing System

- 480V High Intensity Discharge
- Near end of useful life
- Hard wired circuits controlled manually – Large Circuits with breaker control and lighting contactors
- No common building management system in place utilizing lighting
Measurable Results

- **Parameters around project**
  - Rebate requirements
  - GM’s corporate payback requirements
  - Implementation timing – LGE ahead of equipment install

- **Flexibility requirements**
  - 30 FC required for powertrain, minimum at 15 FC
  - Remote serviceability

- **Common system integration**

- **Account for lumen depreciation maintenance**

- **Control functionality** – zoning, scheduling, sensing
Risk Factors

• Lighting & controls must be evaluated by GM lighting committee SME’s
• 480V – previous poor experiences
• Warranty terms – new technology
• Wireless performance & interference in automotive manufacturing concerns
Selection Process: Controls

- Control of circuits vs. individual fixtures
- Wireless vs. wired
- Ease of commissioning, continuous improvement, scalability.
- Compatible with existing EMS system
- ZigBee Based
3 Kanepi Controls Components

nodes

control panel touchscreen

myKanepi user interface
Controls Strategy Basics

- **Group** electrical assets
- **Multi-level schedules** customized to all area shifts, breaks, and usage.
- Occupancy and daylight harvesting **sensors**
- **Automatic response** at peak utility energy demand
- Detailed **energy reporting** with ongoing refinement
- Lamp/ballast/driver **fault detection**
Selection Process: Lighting

- Fluorescent vs. LED
- Light level requirements
- Integrated system - controls + lighting
- Ease & cost of installation
- Warranty
New System
Phase 1 Evaluation: Manufacturer

- Light Corporation
- Passed lighting committee’s evaluation
- Both performed well in a 480V setting
- Kanepi System proved more flexible, robust and secure.
- The ZigBee based system offered high performance and no wireless interference
- Energy reporting
- Warranty
- Integrated lighting & controls proved lower cost of shipment & installation with one warranty from one manufacturer.
LGE Test Retrofit – First Full Scale Installation Awarded to Light + Kanepi

- **Powertrain LGE lighting retrofit**: Upgraded all high bay lights from High Pressure Sodium (HPS) to T5 and T8 Fluorescent with wireless controls
- 700,000 Sq.ft. ~ 1000 fixtures
Fixture Installation – Light + Kanepi

- Complete fixture & controls install in one
- **Installed like no controls involved**
- No pre-mapped locations
  - Pallets of fixtures
  - Pick from any pallet
  - Pick in any order
- No install location tracking / reporting
Initial Power Up Validation
Test Install at LGE – Commissioning Lessons Learned

• Commissioned during plant operations
• Controls revisions code updates/patches
• Set up full override
• Realized extent of ZigBee reach
  • Initially set out with 2 gateways in LGE, but first tested 1 gateway and succeeded
Install Expands to Other Areas

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<th>LOC1</th>
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Commissioning Process
Pre-Commissioning

• **What does the controlled space look like?**
  – Campus layout
  – Partition decisions & network solutions

• **Are there existing building controls?**
  – Various manufacturers
  – BAS backbone
  – Measure current RF activity

• **Meet principles**
  – Users, managers, IT
  – CAD layout
Commissioning

• Discovery
  – 100-200 nodes per hour

• Mapping
  – Fixture type assignments
  – Sensor/Switch assignments

• Over-the Air Programming
  – Custom features applied
  – Calibration of sensors
  – Calibration of energy
  – Commissioning mode
  – Time-out setting
Further integration by Dwayne Herren, GM Controls Engineer.

GE Cimplicity for computer interface and HMI’s in Team Centers
Training of Facility Staff

• **Grouping**
  – Assign logical vs. physical circuits / zones
  – Custom machine overlays
  – Safety / Security zones

• **Event Programming**
  – Scheduled events
  – Reactive events
  – Manual events
myKanepi Demonstration
16,000  
(7% failed in place)

HPS & MH fixtures removed

8,316

Linear Fluorescent fixtures installed

6,570

with Kanepi Controls

1,746

with sensor or wired control
Annual Energy Results – Fixtures Only

- 16,000 fixture HID system Wattage: 6,960,864 watts
- 8,371 fixture LFL system Wattage: 2,254,093 watts
- Total wattage reduced: **4.7 million watts**
- Mercury displaced: **321 grams**
- Chilled water **reduced**: Over 5000 tons per year
- Ambient noise **reduced**: Over 10 decibels

Energy reduced from wattage reduction:

**34.5 million kWh/yr**

68%

*based on 6300 hours of operation per year
Annual Energy Results – Controls Only

• 6,570 new fixtures controlled by Kanepi
• Hours of operation – 6300 hours / year
• Energy use of the 6,570 new linear fluorescent lights without controls: **16.1 million kWh/yr**
• Actual consumption with controls: **7.3 million kWh/yr**

Energy reduced from controls alone: **8.8 million kWh/yr**
(in addition to the lighting retrofit)

*based on 6300 hours of operation per year*
April 2014 – General Assembly (scheduled events)

Energy Usage

- Scheduled Energy Use
- Additional Savings
- Scheduled Savings
- Occupant Sensors/Manual Events
- 100% Power Utilization
- Maximum Energy Used
April 2014 – LGE Powertrain (manual events)
April 2014 – LOC 3 (reactive events)
Annual Energy Results – Fixtures + Controls

• Previous HID system consumption: 48.7 million kWh/yr
• Consumption with new Light Corp + Kanepi Energy Management System: 5.3 million kWh/yr
• Covering over 4.7 million sq.ft.

Total Energy Savings at General Motors Spring Hill Complex:

43.3 million kWh/yr

89% *based on 6300 hours of operation per year
An annual environmental impact equal to:

24,498 acres of U.S. forest

*numbers calculated using the EPA.gov equivalency calculator
*Photo courtesy of latimes.com
Continuous Improvement

• **Further Light level optimization** based on production status: Production, Maintenance, Shutdown, Holiday

• **Improved interface with plant controls system**

• **Future LED strip retrofit** into existing Light Corp Linear Fluorescent fixture bodies
Questions?
The products installed at General Motors Spring Hill are showcased in Booth #8013
Please remember to complete the course evaluations. Thank you.