Regulatory and Market Effects of New Technologies

MID-AMERICA REGULATORY CONFERENCE

JUNE 2, 2014

PAUL J. MITCHELL
PRESIDENT AND CEO
ENERGY SYSTEMS NETWORK
Building an Energy Ecosystem
# ESN Board of Directors

<table>
<thead>
<tr>
<th>Board of Director</th>
<th>Title and Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>John Bear</td>
<td>President and CEO, MISO</td>
</tr>
<tr>
<td>Mitchell E. Daniels, Jr.</td>
<td>President, Purdue University</td>
</tr>
<tr>
<td>David Johnson</td>
<td>President and CEO, Central Indiana Corporate Partnership and BioCrossroads</td>
</tr>
<tr>
<td>Eizo Kobayashi</td>
<td>Chairman, ITOCHU Corporation</td>
</tr>
<tr>
<td>Tom Linebarger</td>
<td>Chairman and CEO, Cummins</td>
</tr>
<tr>
<td>Jeffrey Owens</td>
<td>Chief Technology Officer, Delphi</td>
</tr>
<tr>
<td>Jim Rogers</td>
<td>Chairman, Duke Energy</td>
</tr>
<tr>
<td>Tom Snyder (Chairman)</td>
<td>President, Ivy Tech Community College</td>
</tr>
<tr>
<td>Hisao Tanaka</td>
<td>President and CEO, Toshiba</td>
</tr>
<tr>
<td>Carl Chapman</td>
<td>Chairman and CEO, Vectren Corporation</td>
</tr>
<tr>
<td>Amory Lovins (Emeritus member)</td>
<td>Co-Founder, Chairman &amp; Chief Scientist, Rocky Mountain Institute</td>
</tr>
</tbody>
</table>
ESN Commercialization Projects

CURRENT PROJECT PORTFOLIO
Project Plug-IN

- Since project launch in 2009, Indianapolis has become one of most electrified cities in the US with more than $60M invested in electrification
- Attracted international partners to launch technology pilots and PEV business ventures in the state (i.e. Toyota, Toshiba, Bolloré Group)
- Mayor Greg Ballard was first in nation to announce conversion of municipal (non-police) fleet to all plug-ins by 2025
Toyota PHEV Plug-In Project

- Most advanced real-world vehicle to grid communication demonstration in the world.
- Includes testing of virtual rates to validate system for multiple utility markets.
- Extensive quantitative and qualitative data gathered including customer surveys.
- Toyota will use demo to develop system for 2015 model year Prius.

Definition:
- EVSE (Electric Vehicle Supply Equipment): a charging station that supplies electric energy for the recharging of PHEV
- SEP (Smart Energy Profile): standard for energy information and control, recommended by NIST (National Institute of Standards and Technology)
- DR (demand response): a mechanism to manage the consumption of electricity in response to supply conditions
- SoC (State of Charge): the state of charge of the batteries used in PHEV
- TOYOTA Smart Center: a system that links homes, vehicles, electric power companies and users, and enables integrated control of energy consumption
Plug-In Ecosystem Site

Major system components:
- 75 kW / 48 kWh system capacity
- Toshiba lithium titanate battery
- 10 kW roof-mounted solar
- Eaton 50 kW, 2 Siemens 6.6 kW PEV charging stations

Interconnection:
- Behind a commercial meter (customer sited)
- Interconnected at 120/208V, 3-phase transformer
- Located in the parking lot of Clay Terrace Mall

System attributes
- Installed 3Q 2012, in service 4Q 2012
- Designed to manage and optimize the combined energy profile of solar, PEV charging, and storage.
- Identifying pros and cons of a customer-sited system behind the meter.

Applications being tested

1 – active management of combined solar, storage and PEV charging
   a) testing energy management system and sizing of a behind-the-meter system

2 – energy shifting

3 – customer-sited installation aspects

Duke Energy Proprietary
Indianapolis ‘BlueIndy’ EV Car Share System

- French multinational conglomerate Bolloré currently operates the Autolib EV car share system in Paris, which is the largest in the world with 4,200 charging stations and 1,700 cars.

- In June Bolloré announced a MOU with the City of Indianapolis to invest $35M in the largest US EV car share service in Indianapolis with 1,200 charging stations and 500 cars across 200 sites.

- ESN has been working closely with the City of Indianapolis, IPL, State of Indiana to explore how IPL could recover costs for the expanded electrical service needed to support the car share service. A regulatory filing was made in the spring of 2014.
Battery Innovation Center (BIC)

- $20 million state-of-the-art energy storage R&D and prototype manufacturing lab at Westgate Technology Park outside NSWC Crane
- Full spectrum of energy storage R&D, manufacturing, and testing up to 6MW systems, including 1MW test cells
- Access to high power environmental and abuse testing labs at NSWC Crane
- Affiliate Partner in Argonne Lab’s $150M battery hub initiative
- Designated US Department of Commerce National Proof of Concept Center
- Exploring partnership with UL to serve as their North American Battery Testing Center
Wholesale Grid Storage

ESN working in partnership ITOCHU Corporation and Toshiba launched a new business and technical model for advanced grid storage technology in the United States wholesale electric market.

The partners completed a detailed Feasibility Study as part of the due diligence process to evaluate the economic potential for energy storage in the MISO and PJM footprints, to understand how that energy storage is best utilized for both bulk storage and frequency regulation, and to identify any key regulatory barriers to market entry.

The Feasibility Study showed positive results in the PJM’s new fast response Frequency Regulation market that resulted from FERC order 755.

The partners filed an interconnection license with PJM for a 64MW grid storage system. Unfortunately the application was pulled when after a year of the PJM market operating the price settlement formula was changed and the project was no longer economically feasibly. Several other projects have dropped out of queue for the same reason.
ESN Commercialization Projects

FUTURE PROJECTS
In early 2013 the ESN Board of Directors suggested that ESN go through a strategic planning process in order to develop a new round of commercialization projects. The graphic below details a high level flow of how that project development process was executed.

**Project Portfolio Development Process**

| Research | • Investigation of major market trends and general opportunity areas, looking for innovative projects in the clean tech design space  
• Research what other clean tech clusters and companies like ESN are doing |
| Partner Surveys SME Interviews | • Survey partner companies to determine project interests as well as synergies between partner companies  
• Interviews of industry subject matter experts (SMEs) regarding current or planned innovative projects, as well as gap analysis and suggestions for ESN direction |
| Workshop Preparation | • Identification of SMEs and professional facilitators to participate in the innovation workshop  
• Development of the workshop pre-read through synthesis of research, surveys, and interviews  
• Collaboration with Herron School of Art and Design for workshop hosting and visual communications |
| Innovation Workshop | • Innovation workshop of Technical Advisory Committee members and world-class SMEs  
• Ideation, group discussion, and breakout groups for project definitions and overview development |
| BOD Preparation | • Data synthesis of all ideation sessions, break out group discussions, and plenary discussions of prioritization and voting  
• Creation of a workshop report summarizing the ideation and project overviews and definitions |
| BOD Meeting June 24th | • Review of current project statuses, workshop results, and potential project opportunities  
• Discussion, prioritization and selection of projects to pursue |
| Next Steps | • Begin project planning for identified project opportunities  
• Potentially hold further innovation workshops to launch new projects |
Technical Workshop Participants – Bringing Together Different Expertise and Viewpoints for Innovative Results

ESN engaged a wide range of energy and sustainability experts in an Innovation Workshop to validate and refine new project concepts.

ESN Technical Advisory Council
- Dr. Richard Buckius, Purdue University
- Paul Choe, ITOCHU Corporation
- Dr. Hideki Hayashi, Toshiba Corporation
- Alec Proudfoot, Proudfoot Design
- Mike Thomas, Automotive Insight
- Dr. John Wall, Cummins (TAC Chairman)
- John Waters, Waters & Associates
- Dr. Bill Wylam, International Energy

Facilitation and Visual Documentation
- Ashley Bailey, Herron School of Art & Design
- Michael Brylawski, LITA Advisors
- Nate Cooper, ESN
- Martin Coveney, ESN
- Ashley Davis, Herron School of Art & Design
- Youngbok Hong, Herron School of Art & Design
- Stephanie Johns, Waters & Associates
- Maria Ramirez-Millan, ESN
- Melissa Roberts, ESN
- Allison Schultz, Herron School of Art & Design
- Emily Stump, Herron School of Art & Design
- Dr. Joel Swisher, Stanford University

Subject Matter Experts
- Alec Brooks, AeroVironment
- Marian Chertow, Yale University
- Hugh Donnell, Cummins
- Duane Embree, Ivy Tech Community College
- John Formisano, FedEx
- Bob Koester, Ball State University
- Joe Krkoska, Dow Agrosciences
- AJ Lasley, Delphi
- Paul Mitchell, ESN
- David Mohler, Duke Energy
- Herve Muller, Bolloré Group
- Sue Payton, Department of Defense
- General Gene Renuart, Department of Defense
- Mike Rowand, Duke Energy
- Joao Saraiva e Silva, Carlyle Group
- Wayne Schug, MISO
- David Trout, Dow Agrosciences
- Joan Wills, Cummins
- Walt Yeager, MISO
# ESN Proposed Projects

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>OVERVIEW</th>
<th>POTENTIAL PARTNERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. MILITARY BASE MICROGRID</td>
<td>Develop a zero waste, highly efficient microgrid that is grid connected, islandable, and commercially scalable.</td>
<td>State of Indiana, MISO, Duke Energy, Vectren, Cummins, ITOCHU, Toshiba, Purdue University</td>
</tr>
<tr>
<td>2. DATA CENTER BACK-UP POWER</td>
<td>Develop integrated clean energy backup power solution for data centers.</td>
<td>Cummins, Duke Energy, Toshiba, ITOCHU, MISO</td>
</tr>
<tr>
<td>3. NATURAL GAS FLEET LOGISTICS</td>
<td>Implement a best-of-class pilot of Class-8 compressed natural gas fueled vehicles.</td>
<td>Cummins, Vectren, ITOCHU, Love’s, Blu LNG, Fleet operators, fleet customers</td>
</tr>
<tr>
<td>4. PROJECT PLUG-IN 2.0</td>
<td>Demonstrate value of PEVs to consumers, government and commercial fleet operators through continued deployment of Smart Charging technology and successful EV car sharing roll out.</td>
<td>Duke Energy, Bolloré, AeroVironment, IPL, ITOCHU, Toshiba, City of Indianapolis, Toyota, SAE/Standards Groups, other OEMs</td>
</tr>
<tr>
<td>5. SMART POLE LED LIGHTING</td>
<td>Increase LED market penetration by providing an integrated lighting solutions package with communication and roadway sensor options to increase ROI.</td>
<td>Toshiba, Duke Energy, Simon Property Group, City of Indianapolis, Purdue University,</td>
</tr>
</tbody>
</table>