Introducing The Newark Biogas Program

The Age of Ultra Efficiency

The Language of Sustainability

The Resilient Society
Enter the Era of **Ultra Efficiency**

**Clean Energy Resources**
- Produce RNG from BioGas conversion
- Solar PV array for self sufficient power

**Efficiency/Optimization Measures**
- Waste Stream Capture/Conversion
- Clean Transportation (CNG/EV)
- Integrated Energy Storage systems

**Interoperate and **Optimize** Generation Machinery**
- Storage as the Energy Cache
- Smart Inverters and Solid State “Energy Routers”
- Emerging Standards driving synergies

**Economic Efficiency**
- Access to low cost and patient capital
- Hedge against tightening energy markets
- High efficiency externality cost recovery (ie price for Carbon)
Develop the *Language of Sustainability*

**Walk the Talk**
- RNG from Local Food Waste streams
- Create Clean Energy Urban Renewal Jobs

**Capture the Sun (even in leftovers)**
- Waste Stream Capture/Conversion
- Fuel Clean Transportation (CNG/EV)
- Store and Transfer Energy Smartly

**Spread the Word**
- Create a Caring and Nurturing Community
- Encourage Curiosity and Embrace Change
- Recognize and Reward Responsible Behavior

**Share Your Discoveries**
- Capture Results and Communicate Benefits
- Public Schools structured curriculum/internships
- Maintain a Transparent and Level playing field
- Mentor and Encourage Other Communities

**DEMONSTRATE**

**INNOVATE**

**MOTIVATE**

**COLLABORATE**
Bring Forth a Resilient Society

Rebuild the Economy
• Put displaced workers back into a productive labor market
• Create highly relevant educational opportunities

Prepare for and Recover from Emergencies
• Keep critical power and transportation needs met
• Mitigate collateral damage to community
• Assist the public utilities in restoration and grid balancing

Connect Society Smartly
• Priority “microgrid” Islanding and critical load management
• Provide Transport Fuel supply diversity
• Enable market participation to offset costs

Economic
• Harness low cost and patient clean energy capital
• Minimize waste in business models
• Hedge against tightening energy markets
• Lever to future Carbon offset markets
Utilize the *entire* Smart City lifecycle to ensure the vision is viable.
US Energy Mix is *dramatically* changing
- Coal abandonment is accelerating (political, scientific, economic reasons)
- Conversion / new build for Natural Gas electric generation

Solar and Wind Energy are growing exponentially

Biogas Generation is just beginning its growth period

Rejected Energy (Waste) at Generation remains high

Distributed Energy Resources gaining market acceptance
What in the World is Happening?

- Paris COP21 Agreements signed (80% reduction by 2050) – extreme storms and ocean rise already impacting/dislocating.
- Federal Clean Power Plan coming soon – States responding now
- Regulatory Models are Evolving (Fuel Shift to NG, RG, EE/DR, DER w/Storage)
- Bipartisan Federal Support growing for Energy Modernization

- Disruption to traditional industries in the Sharing economy
- Utility Sector losing workers, needs skills replenishment
- Restructuring of the US Education Sector on political agenda

Let’s look at the big picture through an interesting lens...

www.sankey-diagrams.com
Inserting Biogas into the Energy System

Where do these disruptions play out?

1. Distributed Electric Generation
2. Gas Pipeline Injection
3. CNG Vehicle Fleet
What Are the Trends over 3 Years?

Estimated U.S. Energy Use in 2014 ~98.3 Quads

+170%
Solar 0.427

+48%
Nuclear 8.33

+10.5%
Hydro 2.47

-9.2%
Wind 1.73

+8.0%
Geothermal 0.202

+10.5%
Natural Gas 27.5

-9.2%
Coal 17.9

+8.0%
Biomass 4.78

Petroleum 34.8

+1.1%
Net Electricity Imports 0.164

2011
2012
2013

Residential 11.8

Commercial 8.93

Industrial 24.7

Transportation 27.1

Energy Services 38.9

Source: LLNL 2015. Data is based on DOE/EIA-0035(2015-03), March, 2014. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant “heat rate.” The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 65% for the residential and commercial sectors, 80% for the industrial sector, and 21% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527
Coal is the Culprit

By Chris Mooney  April 19

Asked about the reason for the considerably more negative coal forecast, Timothy Hess, an analyst with the EIA’s Short Term Energy Outlook (STEO), responded by email:

The major contributor of lower coal production in the most recent STEO compared with a year ago is the increase in natural gas used in the electric power sector, mainly because of lower natural gas prices. In the April 2015 STEO EIA forecast natural gas price at Henry Hub to average $3.45 / million British thermal units in 2016. In the April 2016 STEO EIA forecast the natural gas price at Henry Hub to average $2.18 / million British thermal units in 2016. This drop in forecast price makes it more economic to run gas-fired generating units and reduced generation at some coal-fired units. The government issued striking figures showing how much coal production in the United States has declined in the space of just a few years.
Evolving Energy Mix (Shifting from Coal)

Estimated U.S. Energy Use in 2014: ~98.3 Quads

The sharp decline in U.S. coal production

<table>
<thead>
<tr>
<th>Year</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>999.7</td>
</tr>
<tr>
<td>2015</td>
<td>895.4</td>
</tr>
<tr>
<td>2016 (projected)</td>
<td>752.5</td>
</tr>
</tbody>
</table>

Figures are in million short tons.

Source: U.S. Energy Information Administration

THE WASHINGTON POST

Source: LLNL 2015. Data is based on DOE/EIA-0035(2015-03), March, 2014. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant “heat rate.” The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 65% for the residential and commercial sectors, 80% for the industrial sector, and 21% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527
Impact of Shifting From Coal

Withdrawal of rock steady baseload generation supply is causing ripple effect by...

- Opening market demand for:
  - New (cleaner) replacement generation
  - More flexible Distributed Energy Resource

- Driving higher levels of intermittency into T&D, which is...
  - Causing states/utilities to invest in grid modernization
  - Accelerating adoption of Microgrids and Energy Storage systems
  - Driving variable pricing and Demand charge structures

- Causing a rethinking of the traditional Utility Model
  - Encouraging public-private partnerships
  - Opening Regulatory reform to enable local balancing solutions
US Big Picture – Impact Points of (RNG)

Estimated U.S. Energy Use in 2014: ~98.3 Quads

Source: LLNL 2015. Data is based on DOE/EIA-0035(2015-03), March, 2014. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant "heat rate." The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 63% for the residential and commercial sectors, 85% for the industrial sector, and 21% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-ML-4109527
Engage with World Class Design, Build, O&M Teams
- Core Digester Waste Conversion.. Post Digester Gas Production
- Facilities and Energy Integration.. Process Modeling and Control

Inform and Engage Participants to Drive the 3 Pillars (E,S,R)
- Alignment of Private and Public stakeholders and capital
- Structured development and integration of curriculum “modules”

Design Facility for Flexible Operating Modes
- 30 day Buffer for Input Waste Streams
- Optimize Energy Output Mix
- Configure Microgrid Systems with Responsive “Islanding” Plan
A Word on MERIT Global

M.E.R.I.T., INC.
Formerly known as: “M.E.R.I.T., Investigative Services, Inc.”
Federally Certified SDVOSB, SDBE, MBE Firm

A Synergistic Approach to Construction, Security, IT and Safety

<table>
<thead>
<tr>
<th>Construction Services</th>
<th>Security Services</th>
<th>IT Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Management</td>
<td>Security Management</td>
<td>Software Development</td>
</tr>
<tr>
<td>Facility Management</td>
<td>Physical Security Assessment</td>
<td>Systems Integration</td>
</tr>
<tr>
<td>Construction Management</td>
<td>Personnel Security</td>
<td>Privacy Management</td>
</tr>
<tr>
<td>Design Build Capabilities</td>
<td>Training &amp; Certification</td>
<td>Identity &amp; Access Management</td>
</tr>
<tr>
<td>Post Construction Services</td>
<td>Security Guard Services</td>
<td>Data Center</td>
</tr>
<tr>
<td>Facility Maintenance Services</td>
<td>• Armed</td>
<td>Help Desk</td>
</tr>
<tr>
<td>OSHA Safety Training</td>
<td>• Unarmed</td>
<td>------------------------------</td>
</tr>
<tr>
<td>Scheduling and Quality Control</td>
<td>• CCTV Design &amp; Installation</td>
<td></td>
</tr>
<tr>
<td>Project Staffing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Project manager</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Superintendent</td>
<td></td>
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</tbody>
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info@meritoperations.com  www.meritsecurity.net  www.meritinc.us
Merit Global Energy

Jose L. Rodriguez
President of M.E.R.I.T., Inc.

Eleven years ago, Jose L. Rodriguez left behind a successful career in law enforcement to start his own business. The president of M.E.R.I.T., Inc., a Newark-based contracting company that provides its clients with construction and security services was named the U.S. Small Business Administration’s 2011 New Jersey Small Business Person of the Year. Mr. Rodriguez was selected for the award based on criteria that include: Staying Power; Growth in Number of Employees; Increase in Sales; Financial Strength of the Company; Innovation of Product or Service Offered; Response to Adversity and Contributions to Aid Community Oriented Projects.

The former Newark Police detective and retired captain from the Essex County Prosecutor’s Office took the experience he gained there and set off to start a company that provided security services. However, that all changed in 2003 when Joe turned to the SBA for assistance in becoming a certified SBA 8(a) company. The certification helps small disadvantaged businesses compete for contracts from the federal government. The combination of being an SBA 8(a) company and having Service Disabled Veteran status helped propel M.E.R.I.T., Inc. to the next level. Having familiarity with construction didn’t hurt either. Joe was confident in his ability and changed the focus of the company to construction-based services. That was the turning point and Joe hasn’t looked back since. Today, M.E.R.I.T., Inc. has grown to 40 employees with annual sales of over $9 million.
Anatomy of the Newark Biogas System
Risk Managing the End-to-End Process

MEGA's ORM Solution

- Operational Risk Management
- Enterprise Risk Management
- Regulatory Compliance
- Internal Control
- Internal Audit

- Alerts
- Workflows
- Dashboards
- Reports
- Assessments
- Risk Engine
- Confidentiality

COMMON REPOSITORY
Shared Enterprise Description and GRC Viewpoints

Powered by HOPEX

Wires & Pipe

Electric Generation monitoring and control, and coordination with electric utility and power markets

5.0 Gas Scrubbing
Metering, monitoring, and valve components

6.0 Gas Compression
Compressing it to specific levels of pressure

7.0 Electric Generation
Large scale energy storage system

8.0 CNG Carting/Dispensing

Further processed

CNG Vehicles

Finished gas product
## Major NBG Process Elements

<table>
<thead>
<tr>
<th>MAJOR PROCESS STEPS</th>
<th>COMMON POINTS FOR ALL PROCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 Food Waste Receiving</td>
<td>• All MUST be continuous (minimal batch)</td>
</tr>
<tr>
<td>2.0 Food Waste Sorting</td>
<td>• Fault Tolerant component designs required</td>
</tr>
<tr>
<td>3.0 Anaerobic Digesting</td>
<td>• Fully instrumented with critical sensors</td>
</tr>
<tr>
<td>4.0 Gas Production</td>
<td>• Data fusion and mining, secure cloud access</td>
</tr>
<tr>
<td>5.0 Gas Scrubbing</td>
<td>• Automated process optimization</td>
</tr>
<tr>
<td>6.0 Gas Injection</td>
<td>• Risk boundaries continuously monitored</td>
</tr>
<tr>
<td>7.0 Electric Generation</td>
<td>• Risk events and Market changes draws on flexibility of operational design</td>
</tr>
<tr>
<td>8.0 Energy Storage</td>
<td></td>
</tr>
<tr>
<td>9.0 CNG Dispensing</td>
<td></td>
</tr>
<tr>
<td>10.0 Waste Product Removal</td>
<td></td>
</tr>
</tbody>
</table>
Kiss + Cathcart, Architects, New York.

Kiss + Cathcart, Architects, New York.
toward productive buildings, 1984 - 2020

.... Oh, yeah..and make it *look* as good as it *works*!
Overview of the visualization from an AAT biogas plant in Charleston SC
Modeling Drives Information

- Holistic system architecture and design
- Integrated Process Model
- Risk Management Tools
- Curriculum Components

Graphic courtesy of Buildipedia.com
ECOVERSE (2.0 Sorting)
Anaerobic Digester (3.0 Digester)
Gas Production and Scrubbing (4.0, 5.0)

### Biogas upgrading steps

1. Bulk sulfur removal (4000 to < 100 ppm)
2. Biogas boosting and polishing sulfur (100 to < 1.5 ppm)
3. Biogas compression (4 to 232 psig)
4. DMT Carborex MS to remove CO₂ (96-97% CH₄ purity)

<table>
<thead>
<tr>
<th>Biogas IN</th>
<th>Gas OUT</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow maximum</td>
<td>1250</td>
<td>692</td>
</tr>
<tr>
<td>CH₄</td>
<td>55</td>
<td>96-97</td>
</tr>
<tr>
<td>Calorific value</td>
<td>&gt; 970</td>
<td>btu/ft³</td>
</tr>
<tr>
<td>CO₂</td>
<td>44</td>
<td>&lt; 2</td>
</tr>
<tr>
<td>H₂S</td>
<td>4000</td>
<td>&lt; 1.5</td>
</tr>
<tr>
<td>O₂</td>
<td>&lt; 0.2</td>
<td>&lt; 0.2</td>
</tr>
<tr>
<td>N₂</td>
<td>&lt; 1</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>H₂O</td>
<td>Sat.</td>
<td>dry</td>
</tr>
<tr>
<td>T</td>
<td>77-105</td>
<td>77-105</td>
</tr>
<tr>
<td>P</td>
<td>3-5</td>
<td>232</td>
</tr>
</tbody>
</table>

- Production of CNG in < 5 min to meet pipeline spec
- 98% methane recovery; 98% plant uptime
- 15+ DMT Carborex MS references
- 100+ DMT references in biogas upgrading projects
- No risk as long as it is designed for biogas inlet
Here’s how it works
Gas Injection (6.0)

Biomethane to Grid Injection Systems
Gas Quality Analysis System

- EnCal 3000 Biogas
- EnCal 3000 THT
- Moisture sensor

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Combined Heat & Power (CHP) (7.0)
CNG Production and Dispensing (8.0)

DISCOVER A SMARTER WAY TO FUEL YOUR FLEET.

Commercial vehicles around the world are saving as much as 30-50% on their fuel costs by choosing Compressed Natural Gas (CNG). It's easier than you think to convert your fleet and use a cleaner, more reliable domestic fuel.
A Word on Leidos Engineering

- Formerly part of SAIC
- Headquartered in Reston, VA
- $6.3 billion in revenue (approximate annual pro-rated revenue for FY ending January 31, 2013)
- Focus on National Security, Health, and Engineering
- 20,000 employees, with 4,000 dedicated to engineering
- 1 of every 4 FORTUNE 500 companies is a valued engineering client

LEIDOS' NATIONAL RANKINGS 2013
ENGINEERING NEWS-RECORD

#23 Top 25: **Power**

#6 Top 15: **Transmission & Distribution**

#8 Top 50: **Program Management**

#46 Top 100: **Design-Build Firms**

#34 Top 500: **Design Firms**

#8 Top 200: **Environmental Firms**
A Word on ABB

Energy Storage

MicroController

PowerStore
Renewable microgrid stability
Thank You!

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