Opportunities for Industrial Efficiency in the Commonwealth

Virginia Energy Efficiency Council
The Alliance for Industrial Efficiency
Siemens
WGL Energy

February 28, 2017
Who is VAESEC?

A broad coalition of businesses, utilities, local governments, universities, and nonprofits working to assess and support programs, innovation, best practices and policies that advance energy efficiency in Virginia while providing a forum for stakeholder interaction.
David Steiner
President, D+R International
Board Chair, Virginia Energy Efficiency Council

David Steiner serves as Chair of the Virginia Energy Efficiency Council. He is President of D+R International, Ltd., which has been instrumental in the support of innovative program design for energy efficiency adoption over its 30-year history. The company focuses on high quality data that brings greater understanding of energy efficiency opportunities and ultimately capture of energy savings. David also serves on the Town of Vienna’s Community Enhancement Commission.
Speakers

Jennifer Kefer
Vice President, David Gardiner & Associates
Executive Director, Alliance for Industrial Efficiency

Dalia El Tawy
Senior Marketing & Business Development Manager,
Siemens

Charles Miller
Manager, Distributed Generation Asset Development,
WGL Energy
Agenda

➔ Overview of CHP/WHP
  ◆ Importance of the industrial sector
  ◆ Benefits of CHP
  ◆ Scale of the opportunity and state of the market

➔ Examples of CHP/WHP

➔ Virginia: programs and barriers

➔ Examples of CHP elsewhere

➔ What more needs to be done to get CHP/WHP in Virginia
The Alliance for Industrial Efficiency promotes state and federal policies to support U.S. manufacturing competitiveness through enhanced industrial efficiency. Our diverse coalition of businesses, labor groups, and non-profits work to improve energy efficiency in America’s industrial sector. The Alliance is a project of David Gardiner & Associates.
Agenda

➔ Importance of the industrial sector

➔ Benefits of CHP

➔ Scale of the opportunity and state of the market
Virginia Energy Use by Sector

- Transportation, 29.6%
- Residential, 26.4%
- Industrial, 18.6%
- Commercial, 25.3%

Source: EIA 2016
Energy Efficiency Keeps Bills Down

Source: ACEEE 2014
Industrial Efficiency Is the Cheapest Source of Efficiency

Source: Aden et al. 2013
CHP Is an Efficient Way to Produce Power

- 60% Waste Heat
- 7% Line Loss
- 100% Fuel
- 33% Delivered Electricity
CHP Benefits:
1. Manufacturers
2. The Public
3. Utilities
Current CHP Projects

Source: DOE CHP Installation Database, March 2014
ArcelorMittal (Indiana)

- 90 MW energy recovery and reuse 504 boiler project
- $63.2 million total project cost
- $31.6 million DOE grant
- $20 million in annual energy savings
- Payback (with DOE grant): 1.58 years
- Provides 20% of energy needs
Hood Dairy (Winchester, VA)

- 15-MW microgrid, including CHP
- 4 year payback period (ongoing)
- 30% emissions reduction
- Expanding to provide refrigeration
CHP Generating Capacity in the Mid-Atlantic

Source: DOE CHP Installation Database, December 2015
U.S CHP Technical Potential

Current: 82 GW
Potential: 149 GW

Source: DOE 2016
CHP Technical Potential (Virginia)

Source: DOE 2016

Current: 1,689 MW
Potential: 4,308 MW
VA CHP Technical Potential vs. Deployment

Source: DOE 2016
Investing in CHP and Industrial Efficiency Can...

- Save Virginia businesses $4.1 billion (2016-2030) in avoided electricity costs;
- Save 6.6-million megawatt-hours of electricity in 2030;
- Reduce annual CO$_2$ emissions in the state by 2.6-million tons in 2030; and
- Achieve about 31% of Virginia’s emission reductions called for under EPA’s Clean Power Plan (CPP).
Dalia El Tawy
Senior Marketing & Business Development Manager
Siemens
A Comprehensive Portfolio of Advanced Technologies for CHP Applications

<table>
<thead>
<tr>
<th>Technology Type</th>
<th>Model</th>
<th>Power (kW)</th>
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<tbody>
<tr>
<td>Guascor Reciprocating Engines</td>
<td></td>
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<tr>
<td>Aeroderivative Gas Turbines</td>
<td></td>
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<tr>
<td>Industrial Gas Turbines</td>
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<tr>
<td>Small Steam Turbines</td>
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</tbody>
</table>

- **DR Guascor Rich Burn**: 280kW / 870kW
- **DR Guascor Lean Burn**: 250kW / 1300kW
- **DR Guascor CHP Systems**: 250kW / 1300kW
- **DR KG2**: 2MW
- **Industrial 501**: 4, 5, 6MW
- **SGT-100**: 5MW
- **SGT-200**: 7MW
- **SGT-300**: 8MW
- **SGT-400**: 13/15MW
- **SGT-500**: 17MW
- **SGT-600**: 25MW
- **Industrial RB211**: 27/30/32MW
- **SGT-700**: 31MW
- **SGT-750**: 37MW
- **SGT-800**: 47/50/53MW
- **Industrial Trent 60**: 54/62/63/66MW
- **SST-100**: 8.5MW
- **SST-150**: 20MW
- **SST-200**: 10MW
- **SST-300**: 50MW
- **SST-400**: 65MW
- **SST-500**: 100MW
- **SST-600**: 150MW
- **SST-700**: 175MW
- **SST-800**: 150MW
- **SST-900**: 250MW

**Colors and Legends**
- Orange: Dresser-Rand Reciprocating Gas Engines / Turbines
- Teal: Siemens Gas Turbines
- Blue: Siemens Aeroderivative Gas Turbines
- Green: Siemens Steam Turbines
CHP Projects: Key Selection Criteria

- Meeting thermal and power load requirements
- Reducing energy costs
- Availability and reliability
- Lower emissions
- Fuel flexibility
- Enhanced control
- Financing solutions
- Life-cycle support

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Examples & case-studies

CHP projects: applications & technologies
CHP projects in industrial applications
Pulp & paper - example 1

Wisaforest pulp & paper mill
Pietarsaari, Finland CHP plant

- One of largest 100% biomass-fired power plants in the world
- Supplies electricity and process steam to the mill’s operations
- Also, provides district heating to the surrounding town of Pietarsaari
- Prime mover: SST-800 steam turbine
- Power output: 143 MW
Klabin pulp & paper factory
Ortigueria, Brazil CHP Plant

- Two of the largest steam turbines used in the pulp and paper industry worldwide
- Highly specific steam turbines integrated into a customized process cycle
- Uniquely flexible plant due to 2 production lines and ability to produce 2 types of fiber simultaneously
- Prime mover: 2 SST-800 steam turbines
- Power output: 270 MW
- 150 MW fed into the national power grid
CHP projects in industrial applications
Breweries and distilleries

CHP plant at a brewery in London, Canada
Industrial 501-KB7 Aeroderivative Gas Turbine
4.0 – 6.6 MW(e)

CHP plant installed in a distillery in Scotland, UK
SGT-100 Industrial Gas Turbine
5.1 - 5.4 MW (e)
CHP projects in industrial applications
Chemicals and waste-water treatment

CHP project at a chemical plant in Infracor Marl, Germany
1 x SGT-800 Gas Turbine & 1 x SST-300 Steam Turbine 60 MW(e)

CHP project installed in a wastewater treatment facility in Psyttalia, Greece
SGT-400 Gas Turbine 12.9 MW(e)
CHP in Virginia:
current status and areas for improvement
CHP in Virginia
Current status and areas for improvement

- CHP incentives
  - Need for additional state policies/programs that provide incentives for CHP deployment

- Energy savings from CHP
  - State policies designed to acquire energy savings from CHP, similar to other efficiency resources, could help in encouraging additional CHP installations

- Interconnection standards
  - Additional specifics with regards to fuels and technologies could enhance the standards and support CHP deployment
Charles Miller
Manager, Distributed Generation Asset Development
WLG Energy
Examples of Where CHP Programs are Working

PON 2568 CHP Program

Description

The Combined Heat and Power (CHP) Program provides incentives for the installation of grid-connected CHP systems up to 3 MW at customer sites that pay the System Benefits Charge (SBC) on their electric bill.

The CHP Program supports an accelerated procurement process where customers select from a set of pre-engineered CHP modules supplied by approved CHP vendors (the Catalog Approach) or the more traditional design/build procurement process specifically for larger CHP systems where requirements are not adequately met by the Catalog Approach (the Custom Approach).

Under the Catalog Approach, approved CHP vendors act as a single point of responsibility for the entire project and provide a minimum 5-year maintenance/warranty agreement on the CHP system. Under this approach, NYSERDA will only accept applications from, and will only contract with, approved CHP vendors.
Efforts in WGL Territory

In February 2016 WGL Petitioned for a rate case that would support deployment of CHP in the District of Columbia.

Outcome of petition is expected in March or April.

Allows Negotiated rates for firm and interruptible service.

1. Floor of Firm = Tariff rate for interruptible
2. Interruptible Rate has no floor
3. Would not require commission approval of negotiated rates
4. Ultimately may lead to a published CHP tariff rate
Maryland has published rate and policy for gas fired generation stations but this is more directed to commercial generation

Restriction is greater than 373KW in size and does not include grid protection

This effectively limits application to “In Front of the Meter” applications

BGE has petitioned to incorporate “Micro-grid Solutions” into a rate base.

Concerns with this approach may limit effective competition for the rate base
1) Third Party Ownership and PPA
2) Public Micro-grid innovation
3) Technology evolution
Efforts in WGL Territory

Virginia currently enjoys extremely competitive pricing for both gas and electric

Electric service is exceptionally low comparative to surrounding states

Creates significant challenges for CHP deployment

Will most likely require state programs that affect the “Public Good” such as the NYSERDA program in NY

Based on already reduced costs, Gas utilities may have difficulty differentiating between Large Commercial applications and CHP installations

Current WGL Tariff rates in VA can theoretically support CHP applications however project is extremely sensitive to commodity fluctuations
VA Modular CHP System

System ensures facility resiliency through black start capability and redundant heating and cooling systems

Overall reduction in carbon footprint by nearly 50% from grid electric

Reduced life cycle cost of operations with significant efficiency improvement over DX

Ability to predict operations cost and incorporate strategies to mitigate any fuel risk

Allows for secure operations during system outages – Designate as place of refuge

System benefits reminder
Representative Project: Commodity Comparison

<table>
<thead>
<tr>
<th>Projected Commodity DX</th>
<th>$1,250</th>
<th>$1,288</th>
<th>$1,326</th>
<th>$1,366</th>
<th>$1,407</th>
<th>$1,449</th>
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<tr>
<td>Equipment Charge</td>
<td>$440</td>
<td>$893</td>
<td>$920</td>
<td>$947</td>
<td>$976</td>
<td>$1,005</td>
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<td>Gas Charge</td>
<td>$427</td>
<td>$431</td>
<td>$435</td>
<td>$439</td>
<td>$444</td>
<td>$448</td>
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<td><strong>Scenario 1</strong></td>
<td>$867</td>
<td>$1,324</td>
<td>$1,355</td>
<td>$1,386</td>
<td>$1,420</td>
<td>$1,453</td>
</tr>
</tbody>
</table>

| Equipment Charge       | $594   | $1,206 | $1,242 | $1,312 | $1,357 | $1,398 |
| Gas Charge             | $427   | $431   | $435   | $439   | $444   | $448   |
| **Scenario 2**         | $1,021 | $1,637 | $1,677 | $1,751 | $1,801 | $1,846 |

| Equipment Charge       | $776   | $1,576 | $1,623 | $1,672 | $1,773 | $1,827 |
| Gas Charge             | $427   | $431   | $435   | $439   | $444   | $448   |
| **Scenario 3**         | $1,203 | $2,007 | $2,058 | $2,111 | $2,217 | $2,275 |

DX Commodity Cost escalated at 3% per year
WGL Commodity Operations cost escalated at 3% per year
WGL CHP Commodity gas escalated at 1% per year
All electric escalated at 3% per year
Hood Dairy represents an alternative approach that overcomes the traditional limitations of CHP deployment by focusing on “Value Stacking” outside of only thermal and electric costs/savings.

By incorporating market dynamics into the overall value equation for either a direct owner or for a third party ownership model, additional value can be obtained and monetized to overcome the low commodity savings challenge in the region.

ZF Energy and Rockwell Automation have teamed together for the Hood Dairy Project to validate the value stacking approach.
Questions & Answers

Type your questions by clicking the “Ask a Question” button located on the top left-hand side of the screen.
Contact information

Jennifer Kefer
jennifer@dgardiner.com

Dalia El Tawy
dalia.el_tawy@siemens.com

Charles Miller
charles.miller@wglenergy.com

Annie Suttle
annie@vaeec.org
ADDITIONAL SLIDES
Mid-Atlantic Industrial CHP Technical Potential
(8,348 MW @ 5,943 sites)

Source: DOE March 2016
Mid-Atlantic **Commercial** CHP Technical Potential

(9,884 MW @ 22,868 sites)

Source: DOE March 2016
Commercial & Industrial CHP Potential (Virginia)

Source: DOE 2016