Demonstration of μCHP in Light Commercial Hot Water Applications

2015 Building Technologies Office Peer Review

Kris L. Jorgensen, kjorgensen@aosmith.com
A. O. Smith Corporation
Project Summary

**Timeline:**
- Start date: October 1, 2014
- Planned end date: September 30, 2017

**Key Milestones:**
1. T2M Plan – draft: 02/28/15
2. Identification of Potential Sites: 03/31/15
3. EPA Certification: 09/30/15

**Budget:**
- Total DOE $ to date: $45,241
- Total future DOE $: $629,759

**Target Market/Audience:**
- Domestic Hot Water (Multifamily Housing, Lodging, Foodservice, Healthcare/fitness)
- Space Heating

**Key Partners:**
- YANMAR America
- Briggs & Stratton
- Oak Ridge National Lab
- DOE-Office of Energy Efficiency and Renewable Energy (EERE)
- MicroCogen Partners

**Project Goal:**
Provide stake-holders with the information needed to build a sustainable market. Specifically:
1. Verify value proposition of a three year installed cost payback
2. Identify and simplify installation and maintenance
3. Create effective training for installation & maintenance personnel
Purpose and Objectives

Problem Statement:

- Commission eight field demonstration sites across specified target markets and geographic regions in North America to address the following market barriers:
  1. Lack of value proposition – payback longer than product life
  2. Complexity of system/sale – customer, installer, distributor
  3. Complex end market interface – lack of a trained installer base
  4. Lack of States’ regulatory consistency – net metering and FIT

Target Market and Audience:

- **Light commercial buildings with high hot water demand**: Full service restaurants, hotels & lodging, multifamily housing (75+ units), inpatient healthcare, education, fitness, car washes & laundromats. More than 370,000 potential buildings in NA in 2012, growing at 1% CAGR\(^1\).
- **Geographic regions with favorable μCHP criteria**: North-East, Mid-West and CA
- **Stakeholders**: Distributors, building contractors, building owners, specifying engineers and contracting installers.

\(^1\) Micro-CHP: Light Commercial Market Opportunity Analysis in NA, BRG, Sept. 2013
Purpose and Objectives

Impact of Project:

- Provide stakeholders with the information they need in order to make informed decisions regarding deployment of this technology. Specifically:
  - verifying the value proposition of <3 year installed cost payback
  - identifying and simplifying installation and maintenance/service issues
  - creating effective training programs for both installation and service personnel

- Technology to Market Plan laying out likely commercialization approach and anticipated time to commercialization (SOP late 2016)

- Total primary energy savings potential: 0.54 quads/yr
Approach

Approach:

- Install eight (8) μCHP field demonstration systems in four target markets with high daily hot water demands (>3000 GPD):
  - restaurants (full service)
  - small chain hotels (<200 rooms)
  - multi-apartment housing (>75 apartments)
  - inpatient healthcare/fitness

- ... and in three geographic regions with favorable μCHP criteria:
  - Northeast (favorable spark spread, inter-connectivity, grid issues)
  - Midwest (favorable spark spread, inter-connectivity)
  - California (progressive energy policy, rigorous emissions regulations, grid issues).
Approach

Key Issues:
- Identification of appropriate demonstration sites
- EPA emission certification on engines (required to progress to demonstrations phase of project)
- Reliability/noise
- Lack of suitable space in retrofit applications

Distinctive Characteristics:
- Development with two different well-established engine partners
  - Product features, voice of the customer for NA incorporated from the start
- Turnkey ‘plug and play’ system solution to reduce unnecessary costs
- Develop a “best practices” approach for reducing installation and maintenance costs
- Working closely with gas utilities to solicit feedback on best approach to market
Progress and Accomplishments

Lessons Learned:
- Additional marketing questionnaire highlighted the same two concerns already known: first cost and an unproven technology
  - However, technology itself seemed well understood and overall efficiency liked

Accomplishments:
- Most activity focused on finding eight suitable sites:
  - Kept the natural gas industry, multiple utilities and others informed of our progress via webinars and presentations -> huge interest
  - Resulted in 12 committed potential sites and five interested sites plus numerous others looking for sites
- Engine suppliers seeking EPA approval for engines
- Preliminary cost estimates remain within targets

Market Impact:
- Based on testing in the AO Smith lab with the chosen engines, using real water draw profiles, the project is on track to meet performance and cost targets
  - 3 year installed cost payback without incentives for our target markets
Project Integration and Collaboration

Project Integration:
- Two engine suppliers are each supplying four engines plus controls and providing cost share. One of these (YANMAR) is a leading supplier of μCHP systems in Japan
- There is also direct utility engagement, state/regional agencies, industry trade group outreach

Partners, Subcontractors, and Collaborators:
- YANMAR America/Briggs & Stratton: engine suppliers, engine controls
- Oak Ridge National Lab: field test measurement and verification
- Microcogen Partners: consulting; identification of sites

Communications:
- Webinars describing the project presented to natural gas utilities and utility trade groups
Verification of Performance in Lab

[Image of a lab setting with equipment and a person]

[Graph showing kBTU/hr over hours, with legend indicating μCHP, Backup Heater, μCHP Elec, and Draw (GPM)]
Target Regions and Demonstration Site Plans

Favorable States in Blue

Committed sites

Interested sites

Territory of groups (utilities, trade groups, state/local agencies) cooperating with site selection and market analysis
Next Steps and Future Plans

Next Steps and Future Plans (to complete Yr. 1):

- Complete all site evaluations by 5/15/15
- Finalize site selection by 5/31/15; all contracts in place by 6/30/15
- Site baseline testing June through installation: ORNL
- Receive EPA approval for engines by 8/31/15
- Assemble all needed hardware for all 8 sites by 9/15/15
- Installation of 8 sites (October 2015 through March 2016)
REFERENCE SLIDES
Project Budget

Project Budget: $1,538,300 ($675,000 DOE, $863,300 Cost Share)

Variances: None

Cost to Date: $90,482

Additional Funding: None

### Budget History

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<thead>
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<th>October 1, 2014– FY2015 (current)</th>
<th>FY2016 (planned)</th>
<th>FY2017 – September 30, 2017 (planned)</th>
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<tbody>
<tr>
<td>DOE $300,847</td>
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<tr>
<td>Cost-share $300,847</td>
<td>Cost-share $445,851</td>
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## Project Plan and Schedule

### Project Schedule

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<thead>
<tr>
<th>Project Start: October 1, 2014</th>
<th>[Completed Work]</th>
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<tr>
<td>Projected End: September 30, 2017</td>
<td>[Active Task (in progress work)]</td>
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- Milestone/Deliverable (Originally Planned) *use for missed*
- Milestone/Deliverable (Actual) *use when met on time*

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<tr>
<th>FY2015</th>
<th>FY2016</th>
<th>FY2017</th>
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### Current/Future Work

- **Q1 Milestone: Draft Technology to Market Plan**
- **Q3 Milestone: Site Selection**
- **Q4 Milestone: EPA Certification Go/No-go**
- **Q2 Milestone: Installation**
- **Q1 Milestone: Monitoring**
- **Q2 Milestone: Annual Service**
- **Q4 Milestone: Report**