Technology to Market
GENSETS
GENerators for Small Electrical and Thermal Systems

John R Tuttle, Ph.D.
Senior Commercialization Advisor

November 3, 2015
Outline

- What is “Technology to Market” (and what it isn’t)

- What you will be doing in your T2M Program
  - Technoeconomic Analysis
  - Business strategy
  - Follow-on Funding
  - Messaging

- Summit preparation
About the Speaker

- **Senior Commercialization Advisor (“T2M”) – ARPA-E (2013-present)**
  - Program development and market-facing execution

- **Technologist**
  - ~30 yrs in semiconductors (including µ-electronics)
  - ~30 yrs in solar-PV (11 yrs @ NREL, 10 yrs as CTO) – CIGS Technology
  - ~7 yrs consulting to companies large and small
  - ~3 yrs focusing on Storage, (other) Distributed Gen, Efficiency

- **Serial Entrepreneur / Executive (~20 yrs)**
    - Built R&D, development and pilot-production facilities
    - 3rd pure-play solar company to go public (Nasdaq: DSTI)
  - Founded Skypoint Solar, Inc. - (2008)
    - $500M factory construction project / LOI’s for factories in China
  - Consulted for several early-stage startups
  - Worked with public & private sectors in Senegal, Ghana, Brasil & China
Innovative & Disruptive?
At what points does T2M engage?
Our GENSETS Performers

**Internal Combustion**
- Aerodyne Research
- MAHLE Powertrain
- Tour Engine, Inc.
- Wisconsin Engine Research Consultants
- West Virginia University

**Solid State**
- NanoConversion Technologies

**Microturbine**
- Mohawk Innovative Technology, Inc.
- Brayton Energy

**Stirling**
- Temple University
The Technology to Market ("T2M") program is complementary to the Awardee’s technical program.

Its primary purpose is to imprint market-facing elements to your technology development – whether your ready for market at the end or not.

What does “Success” look like?

- Sufficient technological advancement to ultimately enable product introduction and differentiation in the market
- Possible successful outcomes include:
  - New Company formation
  - New Investment into existing private entity
  - License to / funding from a Strategic Partner
  - Follow-on funding from another Govt agency
Basic Elements of Success

What are the elements necessary for attracting interested parties to your project?

- **Month 0:**
  - Technical plan that will produce results with metrics that are relevant
  - Commercialization (T2M) plan that is achievable / realistic for the technology sector in which your project competes

- **Month T-X** (T= length of project, X=3, 6, or 12 mos.)
  - Significant data set;
  - 1st prototype or demonstration;
  - Refined Commercialization plan;
  - Ongoing discussions with potential partners / investors / govt agencies;
  - Solid techno-economic analysis (TEA);

- **Project Completion**
  - An appropriate “hand-off” to the next phase of development
Role of T2M milestones

*T2M milestones reflect a philosophy that we are technologists engaged in product creation*

**T2M Plan Willingness to pay**

- Who is the customer?
- How is their need met now?
- What is performance of incumbent technology?
- What capabilities and resources are needed to get to the next stage of development?

**T-E Analysis Cost**

- Establish theoretical limits
- Identify Most Valuable Improvements
- Inform Potential Trade-offs, Targets, and Metrics
- Ultimately…Understand the Minimum Viable Pricing
Economic Modeling for Technology

Full Company Financial Model

Production Cost Model

- Determine resources required for at-scale production
- Tabulate material/component flow, labor & energy use, equipment, etc

Basic Materials & Process

- Bill of Materials (BOM) – list of “ingredients”
- Simple block diagram of production steps

Most early-stage companies begin with a basic form of “Production Cost Model”
Messaging: Market Engagement
Getting past the Standard Interaction

Hey check out my super-expensive, unreliable gadget that we cooked up in lab and have no idea what to do with!

Lab Researcher

What they hear:
Hey - check out my new Generator that can solve all your Problems!

What they really mean:
Interesting!

I’m trying to be polite. Actually, you haven’t told me enough to have any clue of how interesting this is for me.

Strategic Partner / Investor

What they hear:

Interesting!
Various Pathways to Follow-On Funding

Performers
- Universities (42%)
- FFRDC’s (8%)
- Non-Profit (4%)
- Small Companies (32%)
- Lg Co’s (14%)

Commercializing Entities
- NewCo’s
- Small Companies (Non-Alums)
- Lg Co’s (Non-Alums)
- Small Companies (Alums)
- Lg Co’s (Alums)

Pathways:
- Licensing + Entrepreneur + $$
- Govt Program $$
- Corporate Capital / Strategic Partnership
- Acquistion
- Equity Capital (VC, Angel, Crowd, etc.)
- Self-Funded
- Govt Program $$
- Internal $
What Does it Take to Attract Capital?

- Reasonable Risk / Reward Scenario
  - Staged development can lower risk while maintaining ROI
  - Don’t hide – highlight – potential risk

- A Differentiated Value Proposition
  - Your audience will have likely heard many undifferentiated pitches

- A Techno-Economic Analysis
  - Reasonable assumptions impress reasonable people

- Customer Conversations
  - No better way to illustrate Need

- Management Team
  - Someone on the Team needs to have been there before
Funding Challenges Unique to Clean Tech/Energy

- **Penetrating Energy Markets is a “Push” rather than “Pull” process**
  - Value proposition for cleaner, more distributed energy technologies is not as clear or sexy as a new smartphone or App.
  - Non-level playing field with traditional hydro-carbon energy markets (*no current monetization of carbon attributes*)
  - Regulatory barriers to changing legacy infrastructure

- **Energy technologies are not typically “capital light” as VC’s prefer**
  - Investing in manufacturing development is not cheap

- **Energy is a political issue**
  - Regulatory reform, policy changes to encourage clean energy are absent
Good News / Bad News

- World Clean Energy technology investments dropped 67% since 2008
  - Dropped from ~$12bn in 2008 to ~$4bn in 2013.
  - Led by Solar PV investment losses following Chinese product dumping

- Investments in Hardware have doubled since 2010
  - Hardware components commoditized & cheaper
  - Easier prototyping & manufacturing
Best Practices / Deliverables

- **Ongoing Effort**
  - Ideally, T2M lead is NOT the PI.
  - We are interested in supporting / reporting successes that may be outside Project goals

- **Quarterly Reviews**
  - Always begin with a high-level summary of project
  - Provide quarterly updates on T2M milestones (TEA, Pitch) even when there is no milestone deliverable

- **Milestones**
  - Provide draft versions to Advisor in time for discussion
  - Deliver Final versions to EPIC system & Advisor (for review)

- **Annual Summit**
  - Booth / Poster should reflect T2M focus of Event
Summit Programming of Interest

› Panel Discussions:
  – Summit will include multiple breakout sessions focused on current trends and best practices in technology commercialization

› Networking Sessions:
  – Government Agency Networking: Representatives from 15-20 federal offices will attend a structured networking session to discuss funding opportunities
  – General & Industry-Specific Networking Receptions: Multiple opportunities to network with investors, corporate executives and other attendees

› Student Program:
  – 100 selected graduate-level students will be invited to attend the Summit and participate in student programming. Application deadline is December 4.
Awardee Participation

Awardees contracted before **December 31, 2015** are required to attend the Summit. GENSETS performers are strongly encouraged to exhibit in the poster section.

Summit is a key part of ARPA-E’s Tech-to-Market approach

- Summit connects awardees with financial institutions, government agencies and companies looking for partnership opportunities

Engagement and learning opportunities at the Summit include:

- **Targeted networking receptions**
- **Panel discussions** on best practices in commercialization, trends in technology development
- **Corporate Acceleration Program** pairs investors with project teams
Key Responsibilities

**October – November**
Register for Tech Showcase with eventPower (not via public website). eventPower will contact you in late October / early November.

**November - December**
Register all members of your team participating and make travel, hotel accommodations; Plan your exhibit

**January - February**
Discuss best practices for exhibiting, pitching and networking with your Program Director, Tech-to-Market advisor

**Feb. 29 – Mar. 2, 2016**
Attend the Summit; Provide feedback to ARPA-E on your experience
HOW TO DELIVER AN EXTENDED “ELEVATOR PITCH”

ARPA-E UNIVERSITY

Dr. John R. Tuttle

Distributed Generation

- “The transformation occurring across the world’s electrical systems represents one of the greatest technological challenges industrialized societies have undertaken.”
  - The Resnick Institute

- “Each Year, U.S. utilities and factories send enough energy in the form of heat up their chimneys to power all of Japan.”
  - Pew Charitable Trust / Oak Ridge National Laboratory
Technology to Market

GENSETS
GENerators for Small Electrical and Thermal Systems

John R Tuttle, Ph.D.
Senior Commercialization Advisor

November 3, 2015
# Program Challenges

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
White Space in Small Power Generation

**Goal**

<table>
<thead>
<tr>
<th>Technology</th>
<th>Maintenance Intervals (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Turbine</td>
<td>4,000-8,000</td>
</tr>
<tr>
<td>Microturbine</td>
<td>5,000-8,000</td>
</tr>
<tr>
<td>Recip. Engine</td>
<td>1,000-2,000</td>
</tr>
<tr>
<td>Fuel Cells</td>
<td>20,000 – 40,000+</td>
</tr>
</tbody>
</table>

Can small size electrochemical devices help solve the problem?

Technology Gap - CHP

ICE data from W. Liss, ARPA-E Small Engine Workshop presentation
About the Speaker

- Senior Commercialization Advisor (“T2M”) – ARPA-E (2013-present)
  - Assist program awardees / performer in achieving their goals;

- Principal / CEO of Skypoint Solar, Inc. (2007-2013)
  - Initially focused on thin-film photovoltaics (PV) manufacturing technology;
  - Providing technology & business consulting services to the cleantech industry;

- Founder, CEO & Chairman of DayStar Technologies (1996-2007)
  - Pioneered thin-film photovoltaics on flexible media / under low concentration;
  - Raised ~ $45M in public equity (Nasdaq:DSTI) / ~$20M in incentives and grants;

  - Multiple World-Record device efficiencies;

- Board of Advisors – Cornell Energy Institute
Upgrading our Electricity Infrastructure

- Can Distributed Generation offset cost of T&D upgrade?
  - 20-45% rooftop PV penetration can offset costs of T&D upgrade and more efficient HC central generation

The Edison Foundation - 2008

<table>
<thead>
<tr>
<th>Table 1: Model Results Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Average Peak Load Growth Rate</td>
</tr>
<tr>
<td>New Capacity Through 2030</td>
</tr>
<tr>
<td>(in GW)</td>
</tr>
<tr>
<td>Renewables</td>
</tr>
<tr>
<td>Combustion Turbine</td>
</tr>
<tr>
<td>Nuclear</td>
</tr>
<tr>
<td>Conventional Combined Cycle</td>
</tr>
<tr>
<td>Coal</td>
</tr>
<tr>
<td>Total New Capacity (GW)</td>
</tr>
<tr>
<td>Capital Investment Through 2030</td>
</tr>
<tr>
<td>(rounded to nearest billion)</td>
</tr>
<tr>
<td>Generation</td>
</tr>
<tr>
<td>Transmission</td>
</tr>
<tr>
<td>AMI and EE/DR</td>
</tr>
<tr>
<td>Distribution</td>
</tr>
<tr>
<td>Total Capital Investment</td>
</tr>
</tbody>
</table>

*32 GW of EPRI Prism coal generation incorporates carbon capture and storage.