HEAT IS POWER...
LET’S CAPTURE IT.

Organic Flash Cycle (“OFC”)

C2M Team
Andrew Collier, MBA 2013
Christian Di Sanzo, PhD Nuclear Eng. 2013
Amir Khan, MBA 2013
Paul Maa, MBA 2013
Min Ting, PhD Mechanical Eng. 2015

Scientist
Tony Ho, PhD Mechanical Eng. 2012
A Massive Opportunity in Heat-to-Power

2,000,000 GWh / Year in U.S. Alone

60% of Waste Heat is Low Temperature

= 2,000,000 GWh / Year in U.S. Alone
Global Markets Served By Organic Rankine Cycle

1+ GW of ORC technology installed by multiple players across multiple markets

- **Geothermal**: 55%
- **Waste Heat**: 22%
- **Biomass**: 22%
- **Solar**: 1%

Note: Team Estimates. Global Market Share, by Total Power
Incumbent Technology: Organic Rankine Cycle

- Condenser-Recuperator
- Heat Input
- Electric cubicles
- Electric generator
- Preheater
- Evaporator
- ORC turbine
- Feed Pump
- 1 MWe modular ORC unit
- Traditional 1 MW Organic Rankine Cycle
Technology Overview: Our Technology OFC

Organic Rankine Cycle

- Heater
- Turbine
- Condenser
- Pump

OFC

- Gas
- Liquid

- Flash Evaporator
- 2-Stage Turbine
- Throttling Valve
- Mixer
- Pump
- Condenser
Technology Overview: Our Technology OFC

The OFC is 10% more efficient, 5% cheaper, and all the components are readily available.
Market Assessment

<table>
<thead>
<tr>
<th>Market Appetite</th>
<th>Technological Complexity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>High</td>
<td>High</td>
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</tbody>
</table>

- **Waste Heat**
  - Remote waste heat (pipeline compression)
  - Simple cycle
  - Land transportation
  - Landfill gas
  - Marine transport
  - Refineries & chemical plants
  - Glass & ceramics fabrication

- **Generation**
  - Geothermal
  - Food & beverage
  - Metals manufacturing
  - Solar
  - Wood biomass
  - Geothermal
  - Marine transport
## Market Attractiveness

<table>
<thead>
<tr>
<th>Market Segment</th>
<th>Projected Growth</th>
<th>Competitive Pressure</th>
<th>Available Incentives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geothermal</td>
<td>9.5% CAGR</td>
<td>&gt;50 Installations</td>
<td>US Federal &amp; EU Incentives</td>
</tr>
<tr>
<td>Metals Manufacturing</td>
<td>&lt;5.5% CAGR</td>
<td>&lt;15 Installations</td>
<td>US State-by-State &amp; EU Incentives</td>
</tr>
<tr>
<td>Food &amp; Beverage</td>
<td>3.5% CAGR</td>
<td>&lt;15 Installations</td>
<td>US State-by-State &amp; EU Incentives</td>
</tr>
</tbody>
</table>

**Attractiveness**

- Low
- Medium
- High

**Sources:**
- Emerging Energy Research (EER)
- Global Metal Industry 2012-2017
- EPA CHP Partnership
- Websites of ORC Vendors
- DSIRE
- Bloomberg New Energy Finance
Path to Market

Range of Available Options

Team OFC Today

- No Patent
- Patent
  - Inventor Buys License
  - Incumbent Buys License
  - Start Company
  - License IP
    - Suspend All Activity
    - Open Source Consulting
## Prospective Partners for Licensing

<table>
<thead>
<tr>
<th></th>
<th>GE</th>
<th>ORMAT®</th>
<th>TAS®</th>
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<tbody>
<tr>
<td><strong>Licensing Appetite</strong></td>
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<tr>
<td><strong>Dedicated Group for Transition</strong></td>
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<tr>
<td><strong>Degree of Overlap with Identified Markets</strong></td>
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<tr>
<td><strong>Company Growth Prospects</strong></td>
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Having detailed conversations with these potential partners post C2M.
<table>
<thead>
<tr>
<th>Risk</th>
<th>Description</th>
<th>Mitigant</th>
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<tbody>
<tr>
<td>Technology Development</td>
<td>Technology is not proven yet</td>
<td>Reliability of the physical model used</td>
</tr>
<tr>
<td>Incumbent Technology</td>
<td>Competitors to OFC are under development</td>
<td>No new components, quick development</td>
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<tr>
<td>Lifecycle Costs</td>
<td>O&amp;M costs are potentially higher for OFC</td>
<td>Increase, but moderate</td>
</tr>
<tr>
<td>Sales Cycle</td>
<td>Organic Rankine Cycle useful life is 20+ years</td>
<td>In U.S., only 7% of market is exploited</td>
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## Proposed Timeline

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<tr>
<td>Jan</td>
<td>Feb</td>
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<td>Apr</td>
<td>May</td>
<td>Jun</td>
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<tr>
<td>Arrange Licensing Process</td>
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<td>Initiate Funding Application</td>
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<td>Prototype Testing</td>
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<td>Market Testing</td>
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- **LBNL/Scientists**: LBNL/Scientists
- **Licensee Company**: LBNL/Scientists
Key Takeaways

Compared to a 1MW Organic Rankine Cycle system, the OFC is:

❖ Cheaper by 5%

❖ 10% more efficient

❖ Comprised of readily available components

Heat is Power...Let’s Capture It!
Thank You!

Q&A