ORC Technologies
Field Installations and Future Potential

Geothermal Energy Generation In Oil & Gas Settings
March 13-14, 2006

Halley K. Dickey
Sales Manager
Stationary Products
Overview of Today’s Agenda

• Review UTC Power

• Review PureCycle™ ORC Technology

• Field Installations Data / Experience

• Future Demonstrations / Applications
UTC Power Overview

UTC leadership spans many markets and industries…

UTC Fire & Security
Security & Fire Protection

Pratt & Whitney
Aircraft Engines, Gas Turbines & Space Propulsion

Carrier
Heating, Cooling & Refrigeration

Otis
Elevators, Escalators & People Moving Systems

UTC Research Center
– Technology Advancement

UTC Fuel Cells
On-site & Transportation

Hamilton Sundstrand
Aerospace & Industrial

Sikorsky
Helicopters
UTC Power Overview

Within those companies, a unique synergy was achieved...

Carrier
Heating, Cooling & Refrigeration

UTC Fuel Cells
On-site & Transportation
Within those companies, a unique synergy was achieved... which led to the formation of UTC Power...
UTC Power Overview

Within those companies, a unique synergy was achieved...

which led to the formation of UTC Power...

and the introduction of New CHP Technology Solutions...
On-Site Power CHP Portfolio

... unsurpassed in breadth and capability.

Combined Cooling, Heating, and Power

PureComfort 240M

PureComfort 300M

PureComfort 360M

PureCycle
Fuel Free Power, Zero Emissions

PureCell
Reliable, Durable, Ultra Low Emissions
## Sustainable Energy Value Proposition

### Avoided Emissions Per 1.0 MW application

<table>
<thead>
<tr>
<th>Product</th>
<th>Tons</th>
<th>Equivalent acres of forest*</th>
<th>Tons</th>
<th>Equivalent number of cars**</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 x PureCell™ 200</td>
<td>3500</td>
<td>750</td>
<td>4.8</td>
<td>247</td>
</tr>
<tr>
<td>3 x PureComfort™ 360M</td>
<td>3000</td>
<td>650</td>
<td>9.5</td>
<td>487</td>
</tr>
<tr>
<td>5 x PureCycle™ 200</td>
<td>7000</td>
<td>1500</td>
<td>20.5</td>
<td>1000</td>
</tr>
</tbody>
</table>

*Each acre of forest assumed to absorb 1.3 tons Carbon/acre/year (Ref: International Panel on Climate Change)
**Each car assumed to generate 38 lbm/NOx/year (Ref: US EPA)
Organic Rankine Cycle Solutions

PureCycle™ - Heat to Power Systems

Efficient, Clean, Fuel Free Power Solutions

- 200 kW + Net Power output
- Zero fuel costs
  - Works on waste heat: gas or liquid
  - *Net effective heat rate reducer*
- Zero emissions
  - Fuel free means emission free
  - *Net effective emissions reducer*
- Extended high performance
  - Year round payback
- Multiple Configurations

Developed in partnership with the DOE Office of Distributed Energy
Modular Carrier Components

Turbine Generator – Carrier 19XR2™

Vapor Compression Cycle (VCC)

- Condenser
- Expansion Valve
- Evaporator/Cooler
- Diffuser
- Impeller
- Motor
- Comp
- Pump
- INLET
- EXIT

19 XR225 Centrifugal Compressor

Organic Rankine Cycle (ORC)

- Vapor Generator
- Condenser
- Turbine
- Generator
- Motor
- Oil Pump
- INLET
- EXIT

19 XR225 Radial Turbine

Required Modifications
- Nozzle
- Impeller
Modular Carrier Components

Turbine Generator – Carrier 19XR2™

Adaptation of Existing Hardware - Compressor versus Turbine Operation

Compressor Operation:
Cut-away Of Impeller (Spinning Clockwise) and Pipe Diffuser (Radial Outward Flow)

Turbine Operation:
Cut-away Of Impeller (Spinning Counter-clockwise) and Pipe Diffuser (Radial Inward Flow)

Impeller, nozzle and shroud – only changes to compressor
PureCycle™: Project Profiles

Past Field Installations:
• US Energy – IL

Present Installations and Demonstrations:
• Austin Energy – TX
• UTRC - CT
• Inland Empire Utilities Agency - CA
• Seneca Meadows, NY
• Chena Hot Springs – AK

Future Potential Applications:
• Geothermal
• Oil & Gas
• Offshore Platform
PureCycle™ 200 - Field Installations

- Over 7,000 Total Cumulative Hours @ 3 Sites
- Gather Durability, Reliability and Performance Data
- Test bed for product improvements – hard / soft
- Performance within +/- 3% of Predictions
UTC / UTRC / Field tested to:

- Gain operational experience
- Gather reliability and performance data
- Test product improvements:
  - Remote operation / management / diagnosis
  - Controller and software modifications evaluation
  - Heat management control
- PureCycle™ experience
  - Lessons learned
  - Field experience
PureCycle™: Project Profiles

Past Field Installations:
• US Energy – IL

Present Installations and Demonstrations:
• Austin Energy – TX
• UTRC - CT
• Inland Empire Utilities Agency - CA
• Seneca Meadows, NY
• Chena Hot Springs - AK

Future Potential Applications:
• Geothermal
• Oil & Gas
• Offshore Platform
US Energy / BioGas
Danville, IL (Landfill)
(3) J320 Jenbacher

- Commercial agreement - June 2003
  - US Energy
    - Secured permits and approvals
    - Provides on-site technician support
  - UTC Power provides turn-key installation via Carrier Service
- One (1) year field trial period
- Start-Up Q1, 2004
Landfill Reciprocating Engines – Danville, Illinois

- (3) 987KW Jenbacher’s
- Extensive exhaust ducting

• Drawbacks:
  – Initially design required all (3) engines operating to produce power.
  – Only (1) engine operating continuously
  – PureCycle’s availability – designed for (3) Jenbacher’s running.

• Lessons Learned:
  – Select sites with verified availability and capacity
### Economics

#### PureCycle™ – Air Cooled Condenser

**Annual Inflation-Adjusted Pre-Tax Cash Flow - 10 Years**

<table>
<thead>
<tr>
<th></th>
<th>Installation</th>
<th>Net Output kW</th>
<th>Income</th>
<th>Inflation Rate</th>
<th>Number of Units</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>$190,000</td>
<td>100</td>
<td></td>
<td>3.0%</td>
<td>1</td>
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</tbody>
</table>

**AIR EVAPORATOR - AIR COOLED CONDENSER**

<table>
<thead>
<tr>
<th></th>
<th>Equipment Price</th>
<th>Energy Credits</th>
<th>Annual Hours</th>
<th>Annual Income</th>
<th>Inflation Rate</th>
<th>Discount Rate</th>
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<tr>
<td></td>
<td>$240,000</td>
<td>$0</td>
<td>$0,000</td>
<td>$10,000</td>
<td>3.0%</td>
<td>8.0%</td>
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<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
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<td>$190,000</td>
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**Pre Tax Annual Savings:**

<table>
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<tr>
<th>Year</th>
<th>1</th>
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<th>3</th>
<th>4</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>$430,000</td>
<td>$76,690</td>
<td>$75,592</td>
<td>$81,053</td>
<td>$83,484</td>
<td>$85,089</td>
<td>$88,569</td>
<td>$91,220</td>
<td>$93,962</td>
<td>$96,781</td>
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**Cumulative Net PreTax Annual Savings:**

<table>
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<tr>
<th>Year</th>
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<th>4</th>
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<tbody>
<tr>
<td></td>
<td>$430,000</td>
<td>$87,690</td>
<td>$161,082</td>
<td>$236,145</td>
<td>$319,229</td>
<td>$404,418</td>
<td>$484,187</td>
<td>$585,515</td>
<td>$679,375</td>
<td>$776,156</td>
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</table>

**PRE-TAX FINANCIAL METRICS:**

<table>
<thead>
<tr>
<th></th>
<th>Cash Costs</th>
<th>NPV</th>
<th>Payback Period</th>
<th>IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$430,000</td>
<td>$146,831</td>
<td>4.9</td>
<td>14.7%</td>
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</tbody>
</table>

1. 10 Years, Discount Rate = Financing Rate.
2. Annual Energy Credit - replacing gas fired hot water heating: 500 gpm 25 deg F 8,000 hrs/yr = $475,000.
3. Energy Credit not adjusted for inflation.
4. This example includes scheduled and unscheduled maintenance, one (1) overhaul at 45,000 hours.
5. Tax Rate, Federal, State not included.
PureCycle™: Project Profiles

**Past Field Installations:**
- US Energy – IL

**Present Installations and Demonstrations:**
- Austin Energy – TX
- UTRC - CT
- Inland Empire Utilities Agency - CA
- Seneca Meadows, NY
- Chena Hot Springs - AK

**Future Potential Applications:**
- Geothermal
- Oil & Gas
- Offshore Platform
Landfill Flare – Austin, TX

Austin Energy
Austin, TX (Landfill)
Open Flare

- Municipal Solid Waste Facility
- Commercial agreement - June 2003
- Installation/design - third-party engineers - Sept 2003
- Start-Up Q1, 2004
- Unattended operation began late March 2004
- Still operating today …
Landfill Flare – Austin, TX

Austin Energy
Austin, TX (Landfill)
Open Flare

• Attached to a candle flare
• Separate Heat Recovery System (HRS) required
• Drawbacks:
  – Flare instability delayed completion… hampers current operation

• Lesson Learned - Know your heat source
## Landfill Flare – Austin, TX

<table>
<thead>
<tr>
<th>Period</th>
<th>Average Power Index</th>
<th>Average Heat Index</th>
<th>Average Ambient Temp</th>
<th>Max Net Power</th>
<th>Operating Hours</th>
<th>Heat Source Availability</th>
<th>Run Time Availability</th>
<th>Gross Availability</th>
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<tbody>
<tr>
<td>28-31, July 05</td>
<td>1.03</td>
<td>0.70</td>
<td>82°F</td>
<td>164.7 KW</td>
<td>68.1</td>
<td>1.0</td>
<td>0.95</td>
<td>0.95</td>
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<tr>
<td>09 - 14, August 05</td>
<td>1.02</td>
<td>0.78</td>
<td>83°F</td>
<td>203.7 KW</td>
<td>126</td>
<td>0.98</td>
<td>1.00</td>
<td>0.97</td>
</tr>
</tbody>
</table>
IEUA
Chino, CA
Anaerobic Digester Gas Reciprocating Engines

- Commercial agreement - June 2005
- Startup September 06
- Scope:
  - IEUA
    - Secures permits and approvals
    - Installation and interconnection
  - UTC Power
    - Equipment and support

- LEED Platinum Facility (1 of 3)
- Largest manure digester in the world
- Premium CHP technology showcase:
  - ORC
  - ADG Reciprocating engines
  - ADG Microturbines
  - Absorption waste heat cooling
  - Sterling engine
  - ADG Fuel cells (future)
Inland Empire Utilities Agency – Chino, CA

- ADG Reciprocating Engine Exhaust - (2) CAT G3608’s
- Waste heat at ~ 850°F
- ~ 200 KW Output
- Using Waste Heat from Water Cooled Condenser:
  - Providing hot water to laundry customer
  - Raise 500 GPM - 25°F
w/o CHP - Condenser Water Heat Recovery – 25°F Delta T

- Recover waste heat from engines…

- Offset retail electric rates … produce Clean Power
  - At $0.14/kWh and 8,000 hr / yr = $200,000 Annual Savings.

*Net Annual Savings Over $ 200,000.*

- Potential for: Renewable energy credits / State incentives
# Inland Empire Utilities Agency – Chino, CA

**w/o Condenser Water Heat Recovery – 25°F Delta T**

## Annual Inflation-Adjusted Pre-Tax Cash Flow - 10 Years

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
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</thead>
<tbody>
<tr>
<td><strong>Net Output kWh</strong></td>
<td>180</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Equipment Price</strong></td>
<td>$240,000</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td><strong>Government Incentive</strong></td>
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<tr>
<td><strong>Net Instal Capital</strong></td>
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</tbody>
</table>

**Energy Cost Savings**

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<th>7</th>
<th>8</th>
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<th>10</th>
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</thead>
<tbody>
<tr>
<td><strong>Energy Costs</strong></td>
<td>201,969</td>
<td>202,648</td>
<td>231,177</td>
<td>229,955</td>
<td>230,710</td>
<td>240,721</td>
<td>247,943</td>
<td>253,005</td>
<td>254,801</td>
<td>263,042</td>
</tr>
</tbody>
</table>

**Energy Offset for Heating Water**

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy Offset</strong></td>
<td>369,909</td>
<td>390,000</td>
<td>390,000</td>
<td>380,000</td>
<td>380,000</td>
<td>380,000</td>
<td>380,000</td>
<td>380,000</td>
<td>380,000</td>
<td>380,000</td>
</tr>
</tbody>
</table>

**Maintenance Price**

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<th>7</th>
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<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maintenance</strong></td>
<td>16,000</td>
<td>16,485</td>
<td>16,974</td>
<td>18,08</td>
<td>19,54</td>
<td>18,10</td>
<td>19,97</td>
<td>18,678</td>
<td>20,54</td>
<td>20,485</td>
</tr>
</tbody>
</table>

**Pre Tax Annual Savings**

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
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<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-Tax Annual Savings</strong></td>
<td>340,909</td>
<td>565,609</td>
<td>571,168</td>
<td>576,993</td>
<td>582,810</td>
<td>588,894</td>
<td>595,161</td>
<td>601,616</td>
<td>608,265</td>
<td>615,113</td>
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</table>

**Cumulative Net PreTax Annual Savings**

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cumulative Net Pre-Tax Annual Savings</strong></td>
<td>340,909</td>
<td>565,609</td>
<td>1,137,944</td>
<td>1,713,071</td>
<td>2,305,641</td>
<td>2,898,766</td>
<td>3,480,937</td>
<td>4,082,052</td>
<td>4,600,418</td>
<td>5,205,580</td>
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**PRE-TAX FINANCIAL METRICS**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
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<tbody>
<tr>
<td><strong>Cash Costs</strong></td>
<td>$340,000</td>
</tr>
<tr>
<td><strong>Payback Period</strong></td>
<td>0.6</td>
</tr>
</tbody>
</table>

**NPV**

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<th>7</th>
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<tbody>
<tr>
<td><strong>NPV</strong></td>
<td>$3,611,136</td>
<td></td>
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</table>

**Avg Savings**

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<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<th>7</th>
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<tbody>
<tr>
<td><strong>Avg Savings</strong></td>
<td>$552,770</td>
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**IRR**

<table>
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<th>Year</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
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<tbody>
<tr>
<td><strong>IRR</strong></td>
<td>20.6%</td>
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</tbody>
</table>

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1. 10 Years, Discount Rate = Financing Rate.
2. Annual Energy Credit: replacing gas fired hot water heating. 500 gpm 25 deg F 9,000 hrs/yr = $475,600.
3. Energy Credit not adjusted for inflation.
4. This pro forma includes scheduled and unscheduled maintenance, one (1) overhaul at 40,000 hours.
5. Tax Rate, Federal, State not included.

---

Inland Empire Utilities Agency – Chino, CA

Clean, inexpensive, plentiful water
Inland Empire Utilities Agency – Chino, CA

CHP - Condenser Water Heat Recovery – 25°F Delta T

• Recover waste heat

• Offset gas consumption… produce Hot Water
  – Temp increase: 25°F - 500 gpm = 6.25 MMBtu/hr
  – At $8/MMBtu and 8,000 hr / yr  = $380,000 Annual Savings.

• Offset retail electric rates … produce Clean Power
  – At $0.14/kWh and 8,000 hr / yr  = $200,000 Annual Savings.

  Net Annual Savings Over $ 580,000.

• Potential for: Renewable energy credits / State incentives
# Condenser Water Heat Recovery – 25°F Delta T

## Annual Inflation-Adjusted Pre-Tax Cash Flow - 10 Years

<table>
<thead>
<tr>
<th>Year</th>
<th>Inflation Multiplier</th>
<th>1.00</th>
<th>1.03</th>
<th>1.06</th>
<th>1.09</th>
<th>1.13</th>
<th>1.16</th>
<th>1.19</th>
<th>1.23</th>
<th>1.27</th>
<th>1.30</th>
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### INLAND EMPIRE UTILITIES AGENCY: RP-5 - ORC

- **Installation**: $100,000
- **Equipment Price**: $240,000
- **Government Incentive**: $47,000
- **Net Inst/Capital**: $135,000

### PureCycle 200

- **Number of Units**: 1
- **Inflation Rate**: 3.9%
- **Sales Tax Rate**: 8.25%
- **Tax Exempt**: True

### Pre-Tax Annual Savings

- **Energy Cost Savings**: $200,480
- **Electric Cost Savings**: $212,689
- **Energy Costs**: $219,070
- **Maintenance Costs**: $225,042
- **Overhaul Costs**: $232,411
- **Total Annual Savings**: $250,000

### Cumulative Net PreTax Annual Savings

- **Year 1**: $654,751
- **Year 2**: $1,314,902
- **Year 3**: $2,652,011
- **Year 4**: $4,012,763
- **Year 5**: $5,356,406
- **Year 6**: $6,161,109
- **Year 7**: $6,816,644

### PRE-TAX FINANCIAL METRICS

- **Cash Costs**: $340,000
- **NPV**: $4,204,433
- **IRR**: 19.3%
- **Payback Period**: 2.5 years
- **Avg Savings**: $851,064
- **ROI**: 20.2%

---

**Notes:**
1. 10 Years, Discount Rate = Financing Rate, CA has 8.25% State Sales Tax.
2. Annual Energy Credit: replacing gas-fired hot water heating 509 gpm 25 deg F, 8,600 hrs/yr = $475,000.
3. Energy Credit not adjusted for inflation.
4. This pro forma includes: scheduled and unscheduled maintenance, one (1) overhaul at 40,000 hours.
5. Tax Rate includes Federal, State, and Local tax rates combined.
Seneca Meadows, NY
Reciprocating Engines
Tomato Hot House

- Ship Q3, 2006

- **Integrated Combined Heat Power**
  - Utilizing the ORC Heat Rejection
  - Heating Tomato Hot House

Reciprocating Engine Integration
Seneca Meadows, NY
>20MW
Chena Hot Springs, AK
Geothermal Resource

- Ship April 15, 2006
- Lowest Geothermal Temperature Application of ORC in the World
- Premium CHP technology showcase:
  - ORC
  - Aqueous Ammonia Absorption
  - Biomass
  - Hydrogen

- Geothermal Temp: 165°F
- Cooling Temp: 38°F
- Working Fluid: R134a
Chena Hot Springs – AK

* 90% Carrier COTS
Greater than 200 kW net power...

Power consumed by pump before generation.

...even though cold water is ~10F warmer than Chena.
Chena Hot Springs – AK
Chena Hot Springs – AK
### Chena Hot Springs – AK

**Offsetting diesel powered generation costs ~ $0.30 / kwh**

![Image](image-url)

#### Annual Inflation-Adjusted Pre-Tax Cash Flow - 10 Years

<table>
<thead>
<tr>
<th>Year</th>
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</thead>
<tbody>
<tr>
<td>Inflation Multiplier</td>
<td>1.00</td>
<td>1.00</td>
<td>1.03</td>
<td>1.09</td>
<td>1.13</td>
<td>1.19</td>
<td>1.22</td>
<td>1.27</td>
<td>1.30</td>
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<tr>
<td>Energy Cost Savings</td>
<td>$540,000</td>
<td>$556,200</td>
<td>$572,895</td>
<td>$590,675</td>
<td>$609,775</td>
<td>$626,008</td>
<td>$644,788</td>
<td>$664,132</td>
<td>$684,056</td>
<td>$704,578</td>
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<tr>
<td>Energy Cost savings for Heating Water: 500 GPM 25 deg F</td>
<td>$40,000</td>
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<tr>
<td>Maintenance Price</td>
<td>$18,000</td>
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<td>Overhaul Price</td>
<td>$0</td>
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<tr>
<td>Pre-Tax Annual Savings</td>
<td>$522,800</td>
<td>$537,600</td>
<td>$553,790</td>
<td>$576,403</td>
<td>$587,816</td>
<td>$605,141</td>
<td>$623,205</td>
<td>$641,994</td>
<td>$661,254</td>
<td>$681,992</td>
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<tr>
<td>Cumulative Net Pre-Tax Annual Savings</td>
<td>$522,800</td>
<td>$1,059,400</td>
<td>$1,613,690</td>
<td>$2,183,533</td>
<td>$2,771,348</td>
<td>$3,370,215</td>
<td>$4,041,995</td>
<td>$4,703,254</td>
<td>$5,304,008</td>
<td>$5,984,145</td>
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<td>PRE-TAX FINANCIAL METRICS:</td>
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<tr>
<td>Cash Costs</td>
<td>$382,000</td>
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<td>Payback Period</td>
<td>0.5</td>
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<td>NPV</td>
<td>$3,593,870</td>
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<td>IRR</td>
<td>15.4%</td>
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<td>Avg Savings</td>
<td>$596,415</td>
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<tr>
<td>ROI</td>
<td>15.4%</td>
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3. Energy Credit not adjusted for inflation.
4. Annual Energy Credit: replacing gas fired hot water heating, 500 gpm 25 deg F, 8,000 hrs/y = $475,000.
5. This pro forma includes scheduled and unscheduled maintenance, one (1) overhaul at 40,000 hours.
6. Tax Rate, Federal, State not included.
PureCycle™: Project Profiles

Past Field Installations:
• US Energy – IL

Present Installations and Demonstrations:
• Austin Energy – TX
• UTRC - CT
• Inland Empire Utilities Agency - CA
• Seneca Meadows, NY
• Chena Hot Springs - AK

Future Potential Applications:
• Geothermal
• Oil & Gas
• Offshore Platform
Geothermal and Oil & Gas Markets

Geothermal

- Small Binary plant for low to med temp
- Deployed on a distributed basis
- Develop resource - positive cash flow
- Could be well head - or centralized
- Abandon/capped: 200-250$^0$ F

Oil & Gas Locations

- Small Binary plant for low to med temp
- Deployed on a distributed basis
- Develop resource - positive cash flow
- Could be well head - or centralized
- Abandon/capped: 200-250$^0$ F
Offshore Oil & Gas Platform

Offshore Platforms
ORC Power Generation
Hot Liquid Resource

• Utilizing hot liquid resource
  – Hot oil
  – Hot water
  – Enhanced production

• Utilizing seawater for condensing - at or below thermocline
  – Increased ORC cycle efficiency
  – Utilize lower temperature resources (thermocline: \(53^0\text{F} @ 500’, 43^0\text{F} @ 1000’\))
  – Offset platform base load electrical energy requirements
  – Utilize the ORC Heat Rejection for on-platform heating
Plan of Action – what’s next?

*Near-term focus: demonstrate reliability on geothermal resource*

- Pick fruit off the ground…
  - Existing oil & gas wells w/ water injection
  - Pumping hot liquid: 200 – 250 – 300+ °F
  - Pumping wells with diesel power
  - Customer side of the meter: $0.17 - $0.30 (payback @ < 1.0 year)
Plan of Action – what’s next?

Near-term focus: demonstrate reliability on geothermal resource

• Pick fruit off the ground…
  – Existing oil & gas wells w/ water injection
  – Pumping hot liquid: 200 – 250 – 300+ °F
  – Pumping wells with diesel power
  – Customer side of the meter: $0.17 - $0.30 (payback @ < 1.0 year)

• Pick low hanging fruit…
  – All power consumed on site
  – Pumping hot liquid: 200 – 250 – 300+ °F
  – Customer side of the meter: $0.08 - $0.12 (payback @ < 3.0 years)
Plan of Action – what’s next?

*Near-term focus: demonstrate reliability on geothermal resource*

- **Pick fruit off the ground…**
  - Existing water injection
  - Pumping hot liquid: 200 – 250 – 300+ °F
  - Pumping wells with diesel power
  - Customer side of the meter: $0.17 - $0.30 (payback @ < 1.0 year)

- **Pick low hanging fruit…**
  - All power consumed on site
  - Pumping hot liquid: 200 – 250 – 300+ °F
  - Customer side of the meter: $0.08 - $0.12 (payback @ < 3.0 years)

- **Get a short ladder…**
  - Export to the grid
  - Pumping hot liquid: 200 – 250 – 300+ °F
  - Utility wholesale purchase: $0.06 - $0.07 (payback @ < 5.0 years)
Thank you.

Geothermal Energy Generation In Oil & Gas Settings

Department of Geological Sciences - Southern Methodist University

UTC Power
A United Technologies Company

Halley.Dickey@utcpower.com
(909) 838-6235