

# ORMAT REGS

## EVALUATING A RECOVERED ENERGY GENERATION PROJECT

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2ND ANNUAL WASTE HEAT TO POWER WORKSHOP  
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# ORMAT TECHNOLOGIES, INC.

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- Vertically integrated alternative energy company
  - 40 Years of success
  - NYSE (ORA) listed
- Primarily engaged in geothermal and recovered energy project business
  - 800 MW of installed capacity worldwide
- Proprietary ORMAT technology
  - Binary organic Rankine cycle
- Flexible business model in the energy industry
  - Develop, design, build, own, operate
  - Turnkey
  - Equipment sales
  - Finance



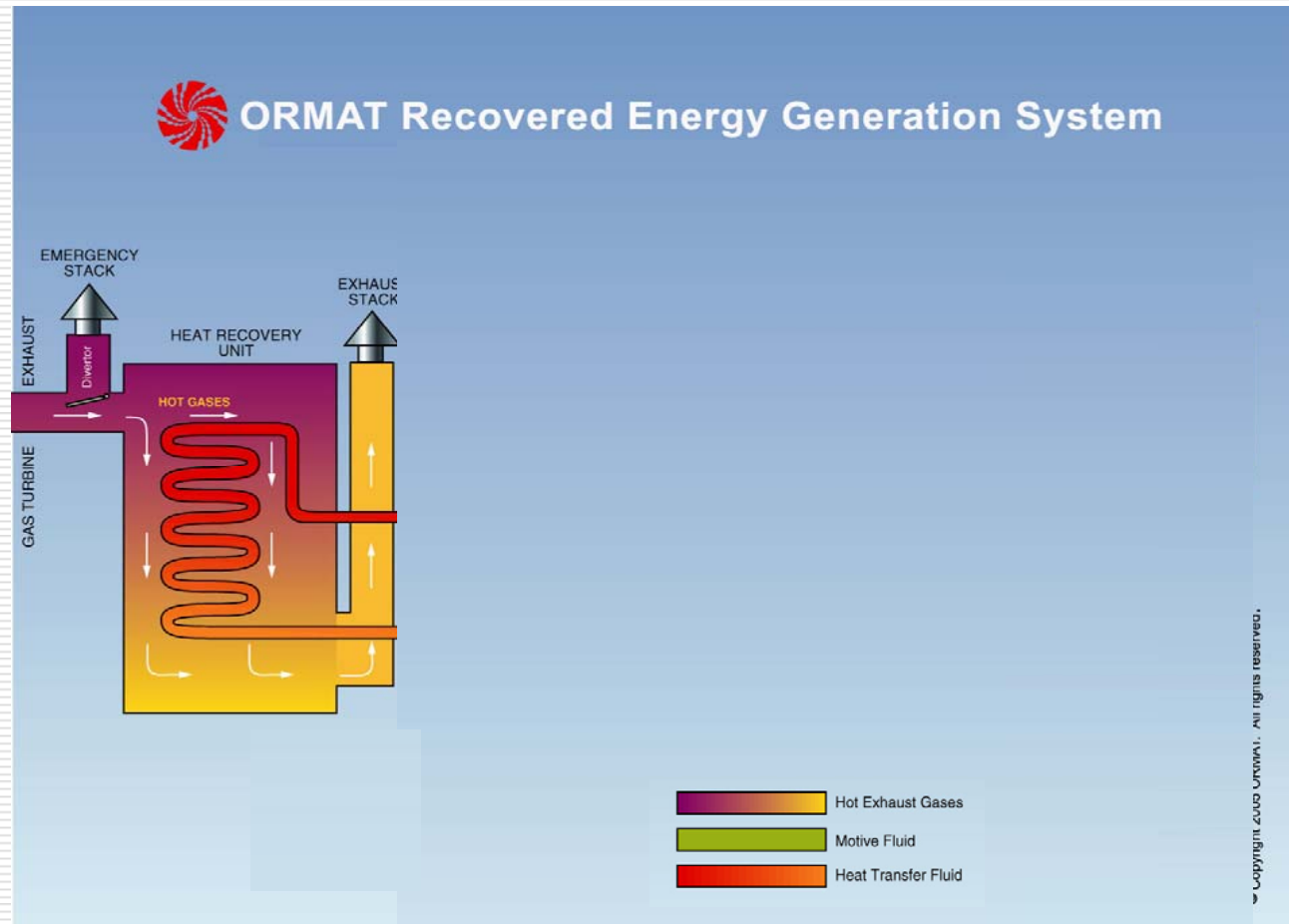
# ORMAT REGS

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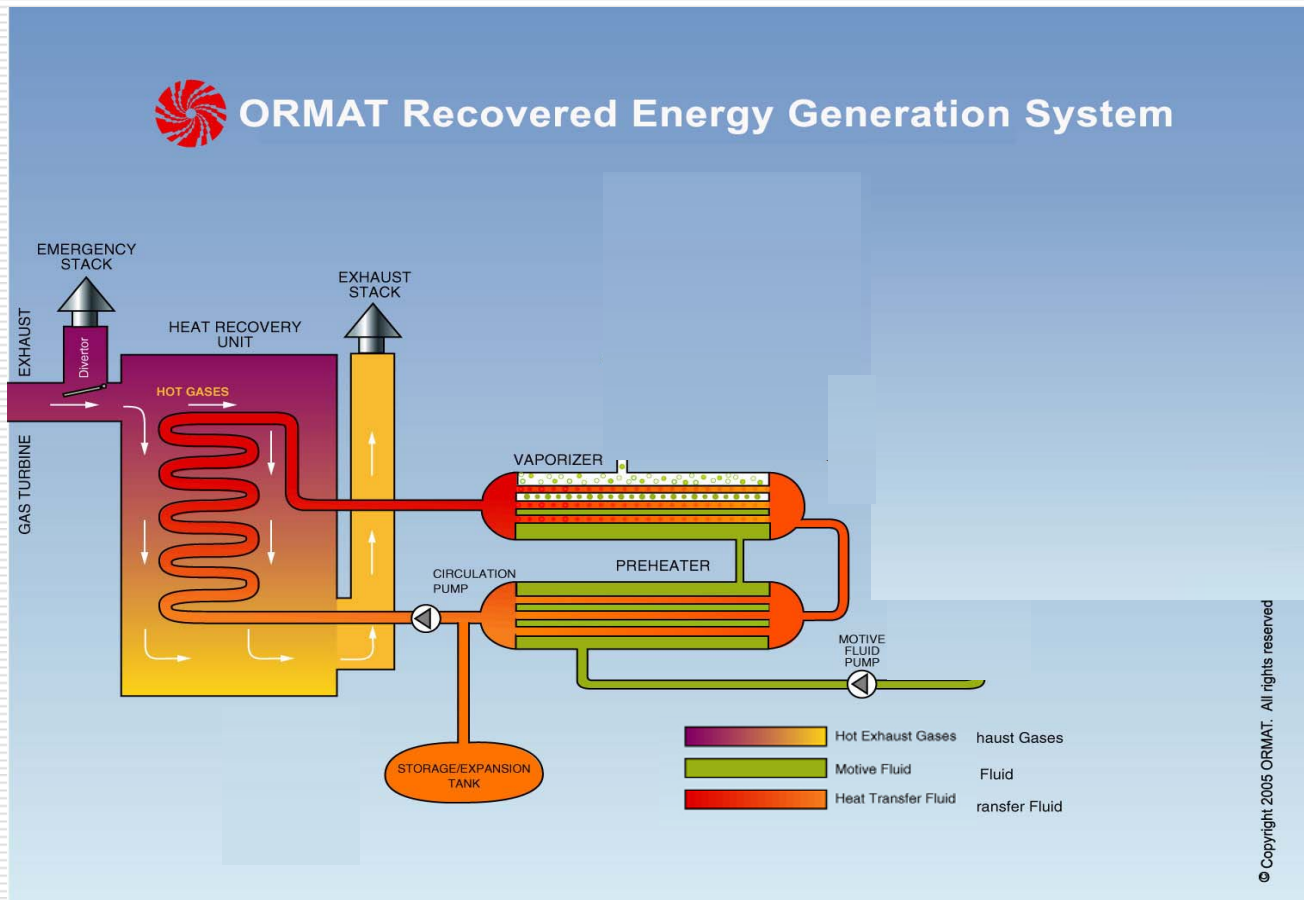
- What is it?
  - Recovered Energy Generation System
- Binary organic Rankine cycle
  - Closed
  - Use of organic motive fluid
  - Rankine cycle is the heart of the power plant
- Environmentally friendly
  - No discharges to the atmosphere
  - No water required
  - Offsets fossil fuel generated power
- How is it deployed?
  - Up to 10 MW modules
  - Gas turbine exhaust
  - Any industrial application with waste heat
- Competes more than favorably with steam turbine technology
- Energy cost competitive (\$/kWh) in today's marketplace



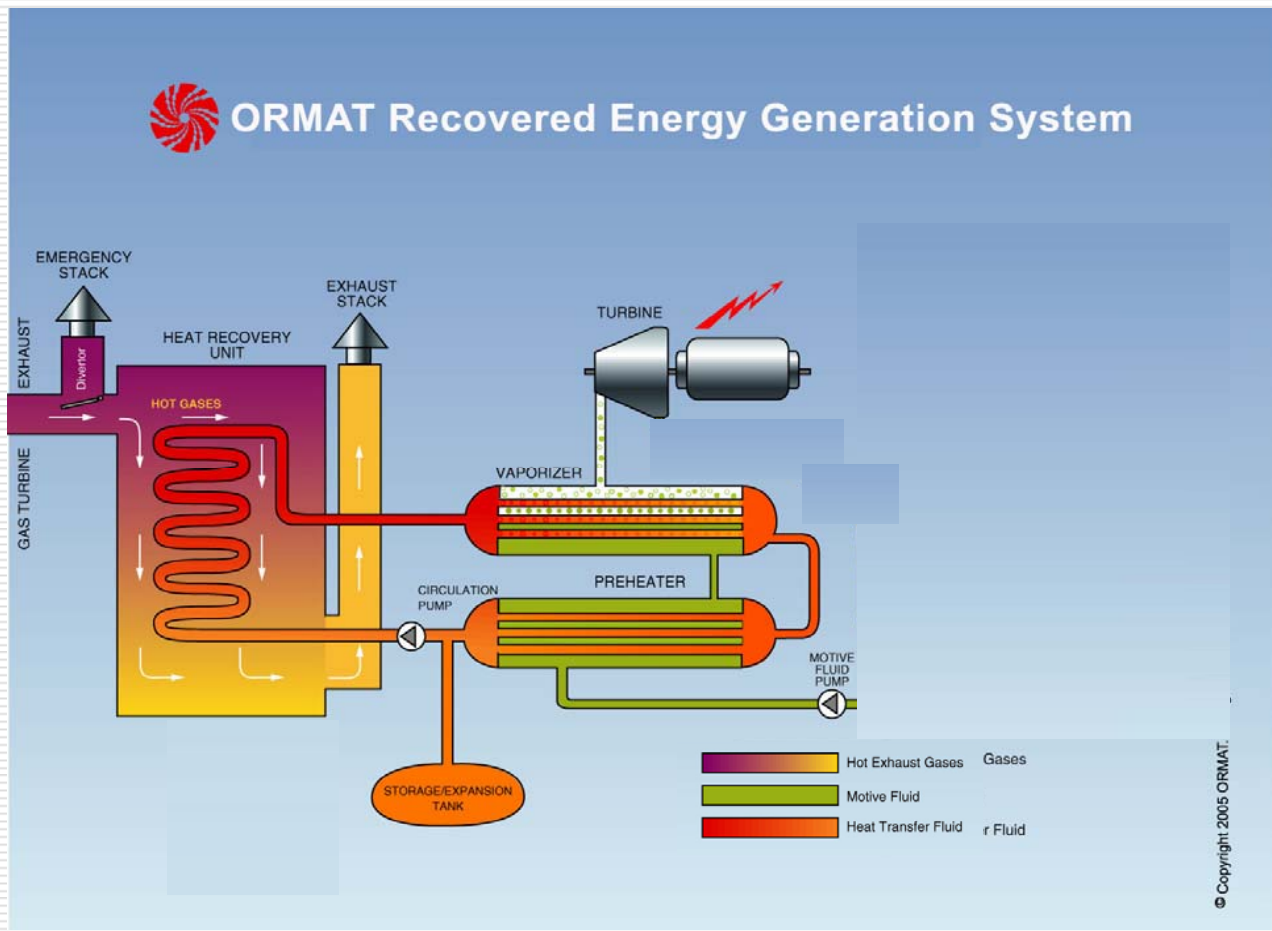
# REGS – Process Flow



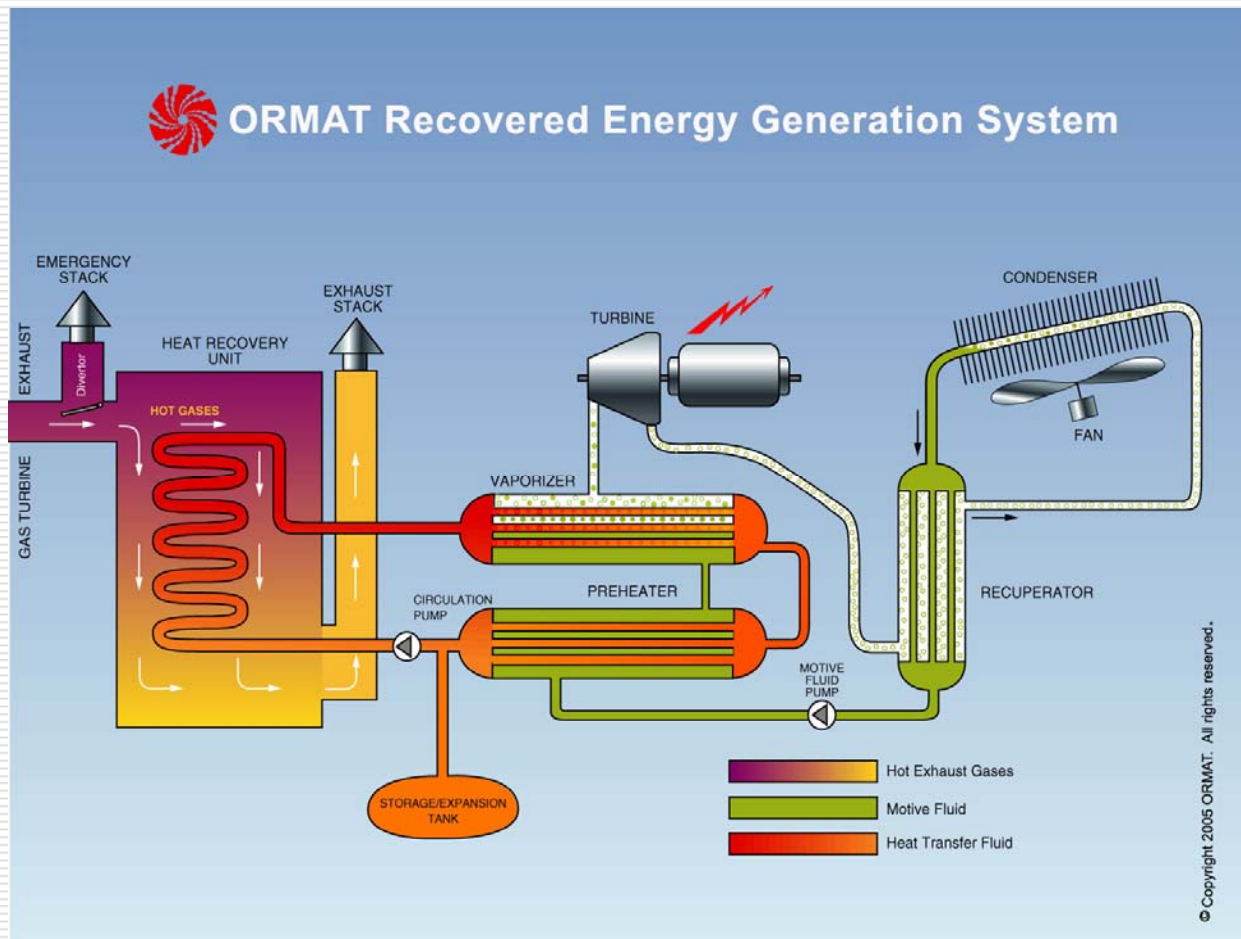
# REGS – Process Flow



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# REGS – Process Flow



# Enterprise – “Neptune” Gas Processing Station

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# Key Factors in Evaluating an Opportunity

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- Customer motivation
  - Energy costs are rising
  - Offset purchased energy (electric or fuel)
  - Need competitive edge
  - Need reliable energy due to grid failure (large ups)
- Application
  - Large quantity of hot gases “wasted” to atmosphere
    - The sweet spot
  - Runtime
  - Site and flow characteristics
- The questions
  - How much energy can be recovered?
  - How much does it cost vs. saving/making \$?
  - Is this a feasible project?



# Available Real Estate

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- REGS is a compact application
  - ½ acre or less needed
- Close to heat source
  - “Inside the fence”



# Permitting

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- ❑ REGS is environmentally friendly
- ❑ No new emission source
  - No fuel is combusted
  - No water supply or waste water disposal
  - Only construction permits and local approvals required
  - Organic fluid storage on site



# Operation

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- ❑ No “upstream” process impact
- ❑ Designed and built for unattended operations
- ❑ Simple start up and shut down
- ❑ Operator “buy in”
  - Operator friendly
  - Single switch operation – off or generate
  - Minimal system maintenance considerations



# Typical Project

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- Technical data
  - Rolls Royce RB211
  - Exhaust Temp at 910<sup>o</sup> Fahrenheit
  - Exhaust mass flow at 331 tons per hour
  - Sea level
  - 60F<sup>o</sup> ambient
  - Air cooling



# Typical Project

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- ❑ 5 MW of net power output using turbine exhaust
- ❑ Approximately 39.4 million kWh/year
- ❑ Budgetary capex \$9 million
- ❑ \$0.0015/kWh O&M
- ❑ Average west coast industrial rate of \$ 0.062/kWh
- ❑ Saving of approximately \$2,384,000 per year or a payback of around 3.5 years



# Conclusions

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- ❑ REGS economically attractive – even if energy costs stabilize
- ❑ REGS energy cost is almost flat over the project life
- ❑ REGS offers environmental attributes
- ❑ It can be used to offset RPS requirements in several states
- ❑ Market is responding



# Thank you

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