Making Something From Nothing:
"The Green Machine Turns Waste and Geothermal Heat Into Power"

GulfCoast GREEN ENERGY

Waste Heat
Making Something From Nothing

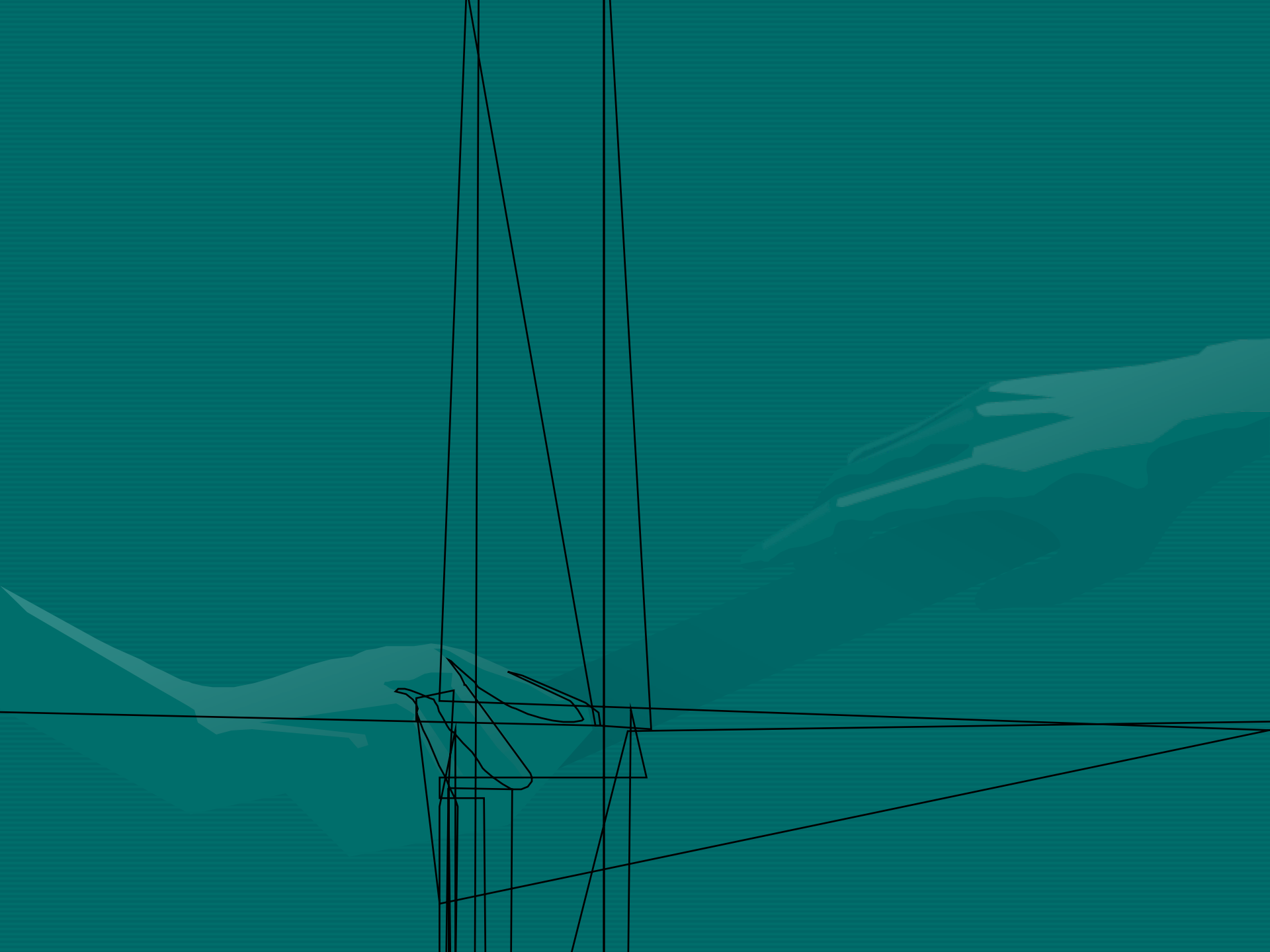
9 million megawatts

Assumes global average thermal efficiency of 40% X 14 terawatts total world energy consumption - Dr. Richard Smalley, Rice University, June 23 2003) Nobel prize winner

Waste Heat is Zero-Pollution Energy

Zero

Just 10% = 380,000 megawatts.
At $0.10 per kilowatt-hour



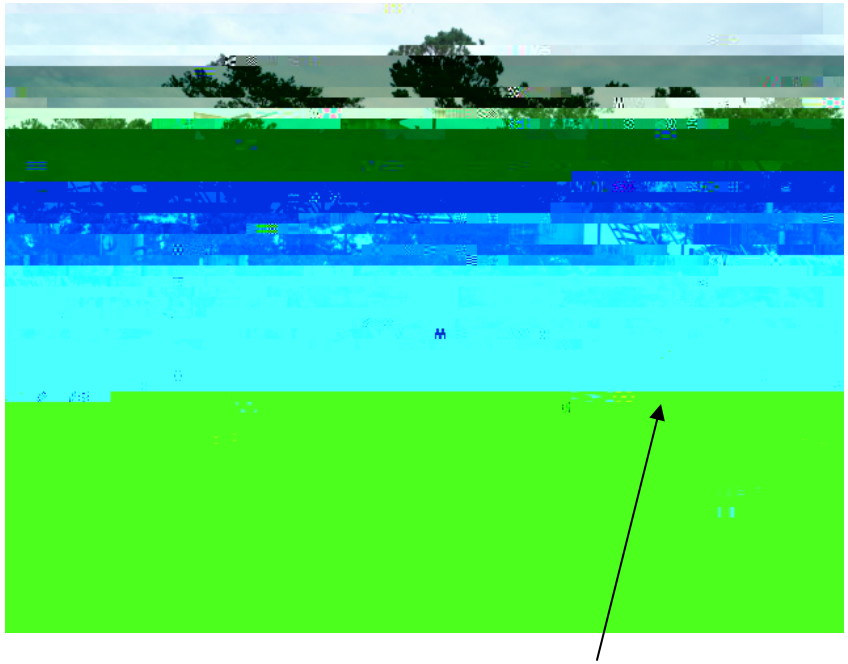
Denbury Resources Inc.
Green Machine at Summerland #22

Defining Denbury

Denbury - Summerland #22

- GCGE approached Denbury in December 2008 about participation in a study on power generation from high temperature wells.
- Summerland well #22 was identified as a suitable candidate for the Green Machine
- Summerland field is located in Jones County, Mississippi.
  - Well #22 produces from the Wash Fred formation at 9500 ft. under natural water drive.
  - The well produces 100 BOPD and 4000 BWPD on down hole ESP artificial lift.
  - The surface flowing temperature is 200 degrees F.
  - The well is not part of a CO2 flood.
  - Based on calculations from GCGE, the Green Machine can produce 30 KW or approximately 25% of the power needs of the ESP pump. About a 3 year payout.
- Power at the site is provided by Dixie Electric, a rural power cooperative.
  - Connection will be downstream of a primary meter. Offset $0.098/kwh vs. selling at $0.044/kwh.
  - Power companies are sensitive about unreliable [illegible] (

Summerland #22 Site

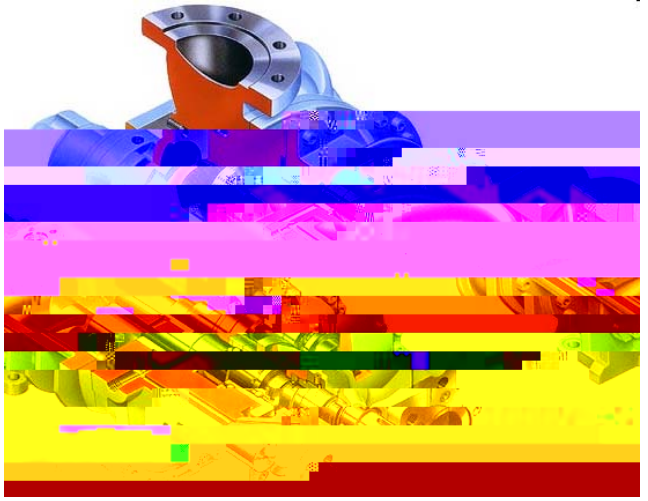


#22 Battery. Production Separator

Green Machine Location

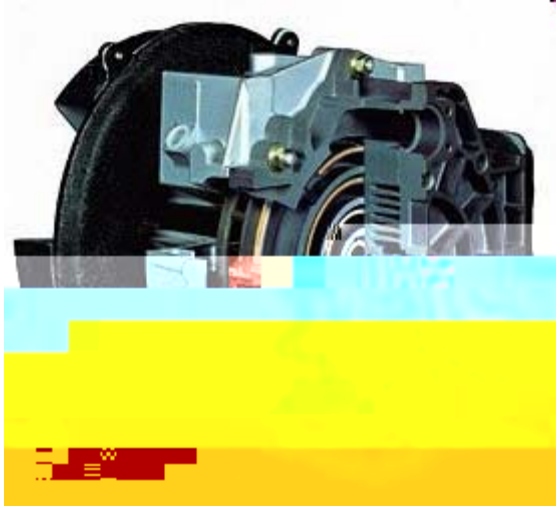
Twin Screw Rotors in a Casing

Turbo vs. Positive

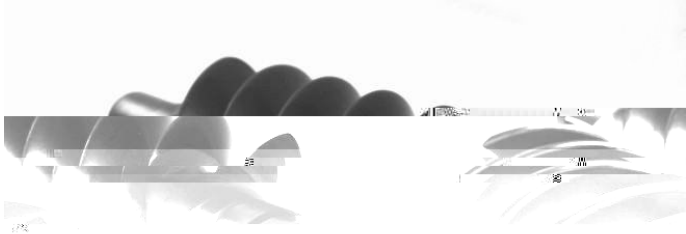


- Change of momentum imparted to the fluids
- Steady flow of fluids at high velocities

- Admitting a fixed mass of fluid into a working chamber where it is confined and then compressed or expanded and finally discharged



Screw vs. other Displacement



- Moving parts all rotate and hence can run at much higher speeds
- Contact forces within them are low
- Sealing lines of contact which define the boundaries of each cell chamber, decrease in length as the size of the working chamber decreases and the pressure within it rises
- Rolling motion discourages seizure

Expander advantages in small ORCs

- Wet inlet conditions are permissible
- Adiabatic efficiency can be very similar to turbines
- Improved rotor profiles mean greater efficiency
- Lower tip speeds, lower overall speed
- Mass produced
- Efficient with varying loads
- Long service life

Expander Optimization

- Large flow cross sectional area
- 8

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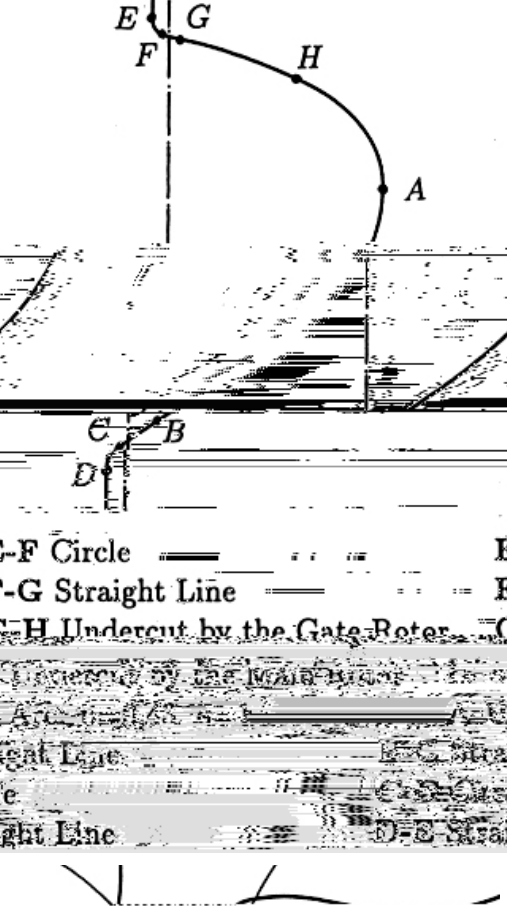
Main/Gate Configuration

- 3/5, dry applications, offers a high gear ratio
- 4/6, for both dry and oil-flooded
- 5 main rotor lobes are suitable for higher compressor pressure ratios
- 4/5, arrangement has emerged as the best combination for oil-flooded applications of moderate pressure ratios, permits the smallest overall dimension for the rotors
- Also, one less lobe in the gate rotor compared with the 4/6 combination can improve the efficiency of rotor manufacturing
- 6/7 for high pressure and large built-in volume ratio refrigeration applications



N Profile and More

- Full tightness, small blow-hole area, large displacement, short sealing lines, small confined volumes, involute rotor contact and proper gate rotor torque distribution together with high rotor mechanical rigidity
- Design also involves mathematical modeling to determine the optimum rotor size and speed, shape and position of the suction and discharge ports, taking into account of the limitations imposed by bearing and seal selection.
- Goal: Maximize endurance, efficiency, and reliability!

City University

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