# Energy Management in Upstream O&G Operations

## Geothermal Energy and Waste Heat to Power: Utilizing Oil and Gas Plays

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# Agenda − Energy Efficiency in Upstream

*Some Challenges, Many Opportunities*

1. Energy Use in Oil and Gas Operations
2. Upstream Energy Efficiency and Waste Heat Utilization Challenges
3. Upstream Energy Efficiency Opportunities

# Key Messages

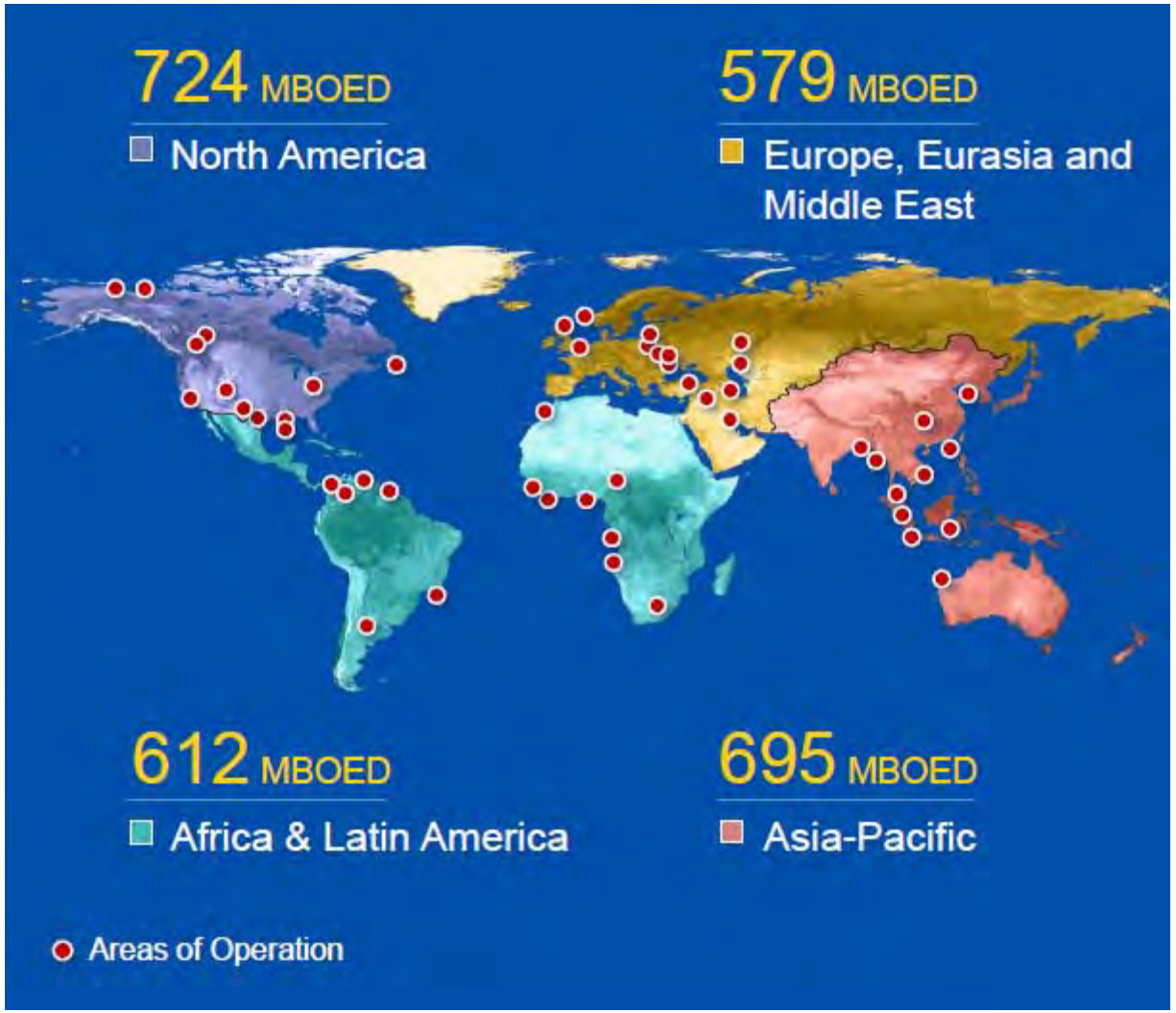
In Oil and Gas fields,

- There are competing, often more economic uses of waste heat than generating power
- Energy efficiency and power generation projects must compete on equal basis with larger, higher impact projects

**Under certain conditions waste heat to power may be viable:**

- **Need for incremental power**
- **High power costs**
- **Available “quality” waste heat**

# Chevron's Upstream Operations



# Life Cycle Energy Footprint for Petroleum Crudes

*Extraction and Conversion of Crudes to Product Is Relatively Efficient*

**Upstream**
(Exploration & Production)

Uses < 5% of a BOE*

**0.05 BOE**

**Midstream & Downstream**
(Transportation & Processing)

Uses ~5%–15% of a BOE*

**0.1 BOE**


**Net 0.85 BOE**

**End-Use**
(Distribution & Combustion)

Remaining 80%–90% of a BOE used in engines, turbines, burners, …

* BOE = Barrel Oil Equivalent of energy ~ 6MMBTU/barrel. Data sources: IPIECA 2012, OGP 2011, GREET 2011.

** For conventional oil and gas used for combustion. Unconventional resources such as heavy oil, thermal enhanced oil recovery, LNG and GTL have higher energy intensities. Petrochemical and other petroleum crude uses are not shown.

# Energy Management Challenges in Upstream

*Focus Has Been on Downstream, Not Upstream*

- Strong energy efficiency efforts in Downstream operations:
  - High energy intensity
  - Narrow margins
- Historically, less focus on energy efficiency in Upstream operations:
  - Competition with other projects for resources (money, time, people)
  - Primary focus on production and safety
  - Environmental and other compliance priorities
  - Reliability assurance
- No industry standard efficiency benchmarking for Upstream

# Energy Management Challenges in Upstream (cont'd)

*Energy Efficiency Projects Must Compete on an Equal Basis*

- Traditional economic benchmarks undervalue long term, low risk savings
- Even with favorable economics, other projects may yield larger absolute returns, e.g., asset expansion
- Concern over potential reliability and other operational impacts
- Resistance to change

# Challenges for Waste Heat to Power in Oil and Gas Fields

- More economic uses for waste heat
- Limited high quality waste heat sources
- On-site incremental power needs often limited
- Low value of excess power
- Integration constraints
- Permitting hurdles
- High capital cost of Organic Rankine Cycle (ORC) Systems

# Increasing Energy Efficiency Focus in Upstream

*Key Drivers*

- Higher cost of power
- Increasing energy intensity in Upstream operations
- Growing power demand to support Upstream asset expansions
- Remote operations, challenging physical environments
- Growing demand for clean energy, baseload power (emerging markets)
- Legislation and regulations on greenhouse gas and criteria pollutant emissions and energy efficiency
- Stringent environmental life cycle concerns
- Social responsibility

# Energy Management Opportunities for Existing Operations

*Thermal Applications*

- Optimizing steam distribution for thermal enhanced oil recovery
- Minimizing energy losses in production flow systems
- Re-using waste heat
- Increasing steam generation efficiency
- Improving water quality
- Converting flare gas to power or steam
- Optimizing subsurface (reservoir) heat management
- Renewable heat or steam: solar, biomass/biogas, EGS, heat pumps

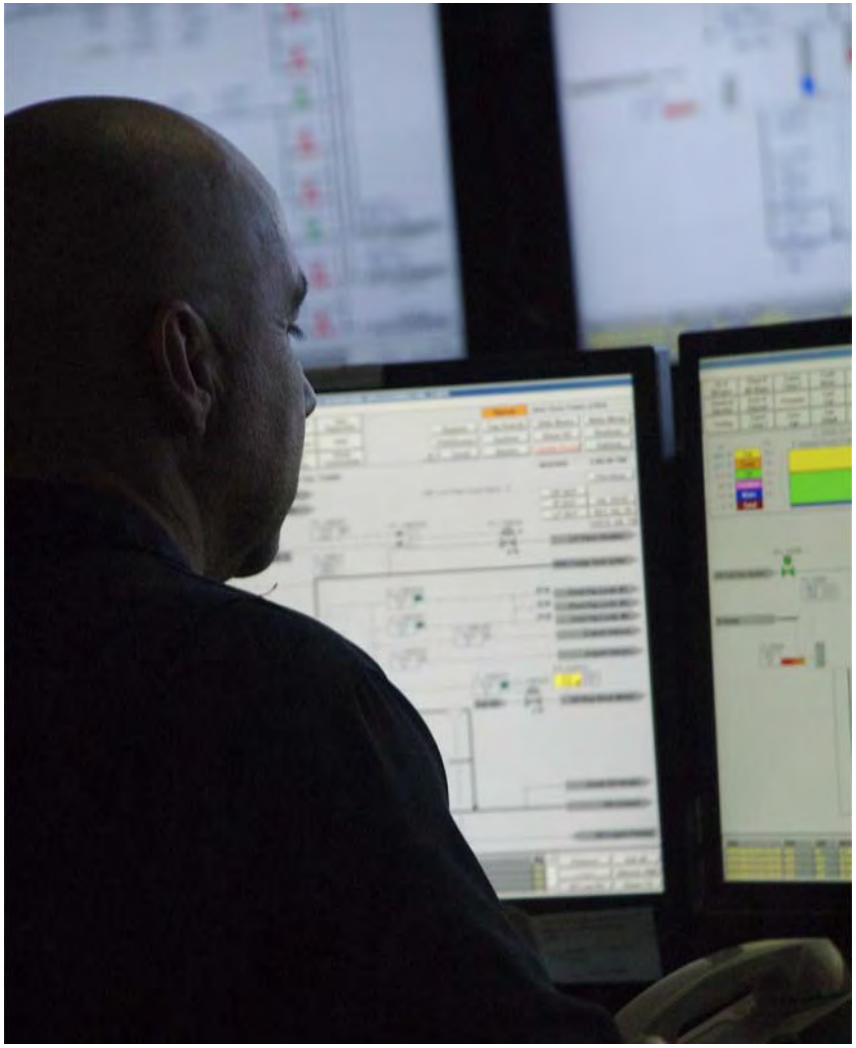
# Energy Management Opportunities for Existing Operations

*Electro-Mechanical Applications*

- Rotating equipment optimization (pumps, compressors, fans, motors)
- Ensuring system reliability
- Load-shifting, energy storage, power quality enhancement
- LED lighting
- Renewables: solar PV, solar pumping units, bioenergy, wind
- Energy Management References (e.g., IPIECA: ISO 50001, Saving Energy)

# Upstream Opportunities for Waste Heat Reuse

- Use waste heat to meet process heating (or cooling) demands, instead of power generation
- Replace electric loads with waste heat (e.g., absorption chilling, space heating)
- Find special opportunities where drivers align
- Develop lower (installed) cost, higher efficiency ORC systems
- Subsea ORCs for offshore operations



# Questions Welcomed!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