U.S. Environmental Protection Agency
Natural Gas STAR Program

Vapor Recovery

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Beliefs in O&G Industry

- ★Vent gas methane quantities are low
- ★Vent gas dollar value is low
- ★Too hard to measure vent gas flow rates
- ★Too hard to recover vent gas

New Facts

- ★Millions of BTUs per day are vented to the atmosphere
- ★Millions of dollars per day are lost
- ★Measurement of vent flow rates is easy
- ★Recovery of vent gases is easy

Past Vent Gas Determination Methods

- ★Vasquez-Beggs
- ★Computer simulations
- ★Pressurized oil sample to determine gas-to-oil ratio
- ★Direct measurement with orifice plate meter
- ★Educated Guess

New Facts

- ★ Vent Gas Volume are Large and Have Value
- ★ Actual Measurement
  - 150,000 SCFD (150 MSCFD)
  - 1850 BTU/SCF
  - $5.00/MMBTU
  - Yields: $506,438/year lost profit

Estimated Potential from O&G Facilities

Est. Gas Volume per Facility	100,000	SCF/day
Number of Facilities	1,500	
Vent Gas CH4 Content	65	Volume %
Volume of CH4 Per Facility	23,725,000	SCF/yr
Total Volume CH4 All Facilities	35,587,500,000	SCF/Yr
Annual Vent Gas Value	$273,750	facility
Annual Vent Gas Value	$410,625,000	facilities
Gas price = $5.00/MMBTU and BTU value of 1,500 BTU/scf		

Estimated Potential from O&G Facilities

Weight of CH_4 per Facility	501	tons/yr
CO_2 equivalent per Facility	10,517	tons/yr
Total CO_2 eq. all Facilities	15,774,934	tons/yr

Gas STAR Estimated Annual Methane by Sectors

- ★ Production = 89 bcf
- ★ Transmission and Storage = 96 bcf
- ★ Distribution = 77 bcf
- ★ Processing = 36 bcf

Production Sector Opportunities

- ★ Storage tanks
- ★ Separators and heater treaters
- ★ Glycol dehydration units flash tanks and still column vents
- ★ Low pressure vent systems

New Fact

- ★Vent gases can be measured easily using ultrasonic methods
- ★Measurement is critical to sizing vapor recovery unit properly to get total volume and variations in flow

Gas Measurement Types

- ★Ultrasonic transit-time meters
- ★Differential Pressure - orifice plate, pitot tube, annubars, venturi
- ★Turbine meters
- ★Thermal mass flow meters
- ★Vortex flow meters
- ★Acoustic meters for through-valve leaks

Ultrasonic Measurement

- Meter sends signals from transducers through pipe - velocity of signal increases with flow and decreases against flow. Differential time proportionable to velocity of gas in pipe.
- Known pipe diameter to calculate flow rate
- Independent of gas composition
- Speed of sound through air calibration check

New Fact

- Vent gases can be recovered using the Jet Pump (EVRU™) or mechanical vapor recovery unit (VRU)

Mechanical VRU Compressors

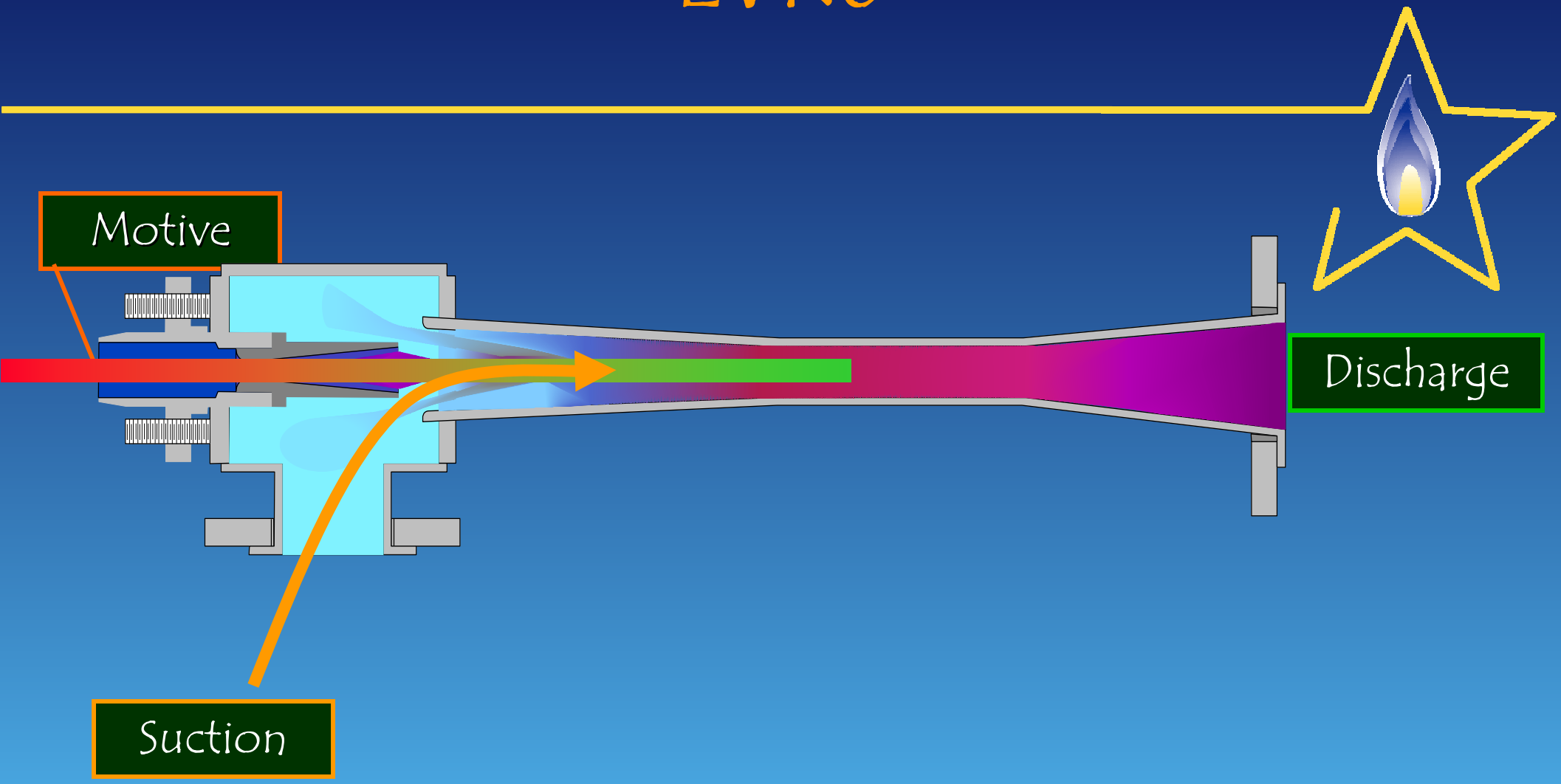
- ★ Reciprocating Compressors
- ★ Centrifugal Compressors
- ★ Screw Compressors
  - Wet
  - Dry
- ★ Rotary Vane

Non-Mechanical Compressors

- Jet Pump (Ejector Vapor Recovery Unit - EVRU™)
- see:

http://www.epa.gov/etv/verifications/vcenter3-10.html

EVRU



Summary

- ★Vent gases volumes can be large
- ★Recovery reduces VOC and GHG emissions
- ★Vent gases have value
- ★Vent gases can be measured accurately with ultrasonic methods
- ★Vent gases can be recovered