PRCI Compressor Station R&D

DOT R&D Forum

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Houston, TX

Bill Couch – El Paso Pipeline Group

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PRCI Focus

- **“Minimize the operating costs and capital requirements of compression and pump service while meeting market demands and all applicable environmental regulations.”**
- **PRCI scope is on driver-side, not compressor-side**
- **PRCI has two active programs**
  1) “Avoid mandated CapEx” (NOx reduction)
  2) “Reduce O&M costs”

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Program 1 – Avoid Mandated CapEx

- **Develop cost-effective reciprocating engine NOx retrofit options for expected 2010 NOx rules**
  - Avoid major replacements of older units with electric drives or new engines
    - Total replacement cost ~$13.5 Billion (9 MM HP)
    - Preserve capital for pipeline growth investments
- **Target 0.5 g NOx/bhp-hr at 1/6 cost of new unit**
  - No compromise on any other emissions, unit performance, reliability or fuel efficiency
  - Applicable to 80% of existing units
  - Multi-faceted challenge, many projects underway

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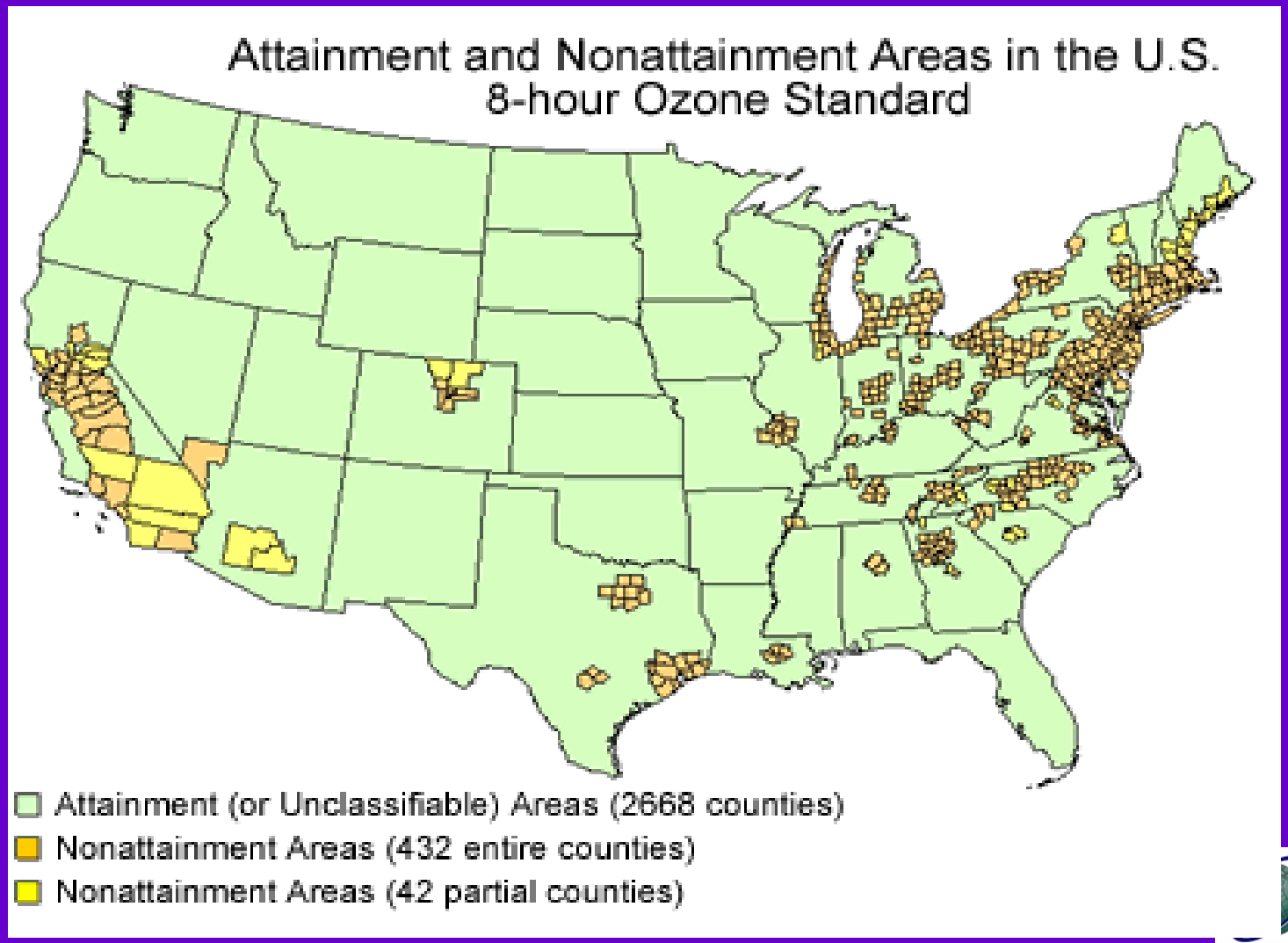
NOx Reprise: New Hot Spots Just Named



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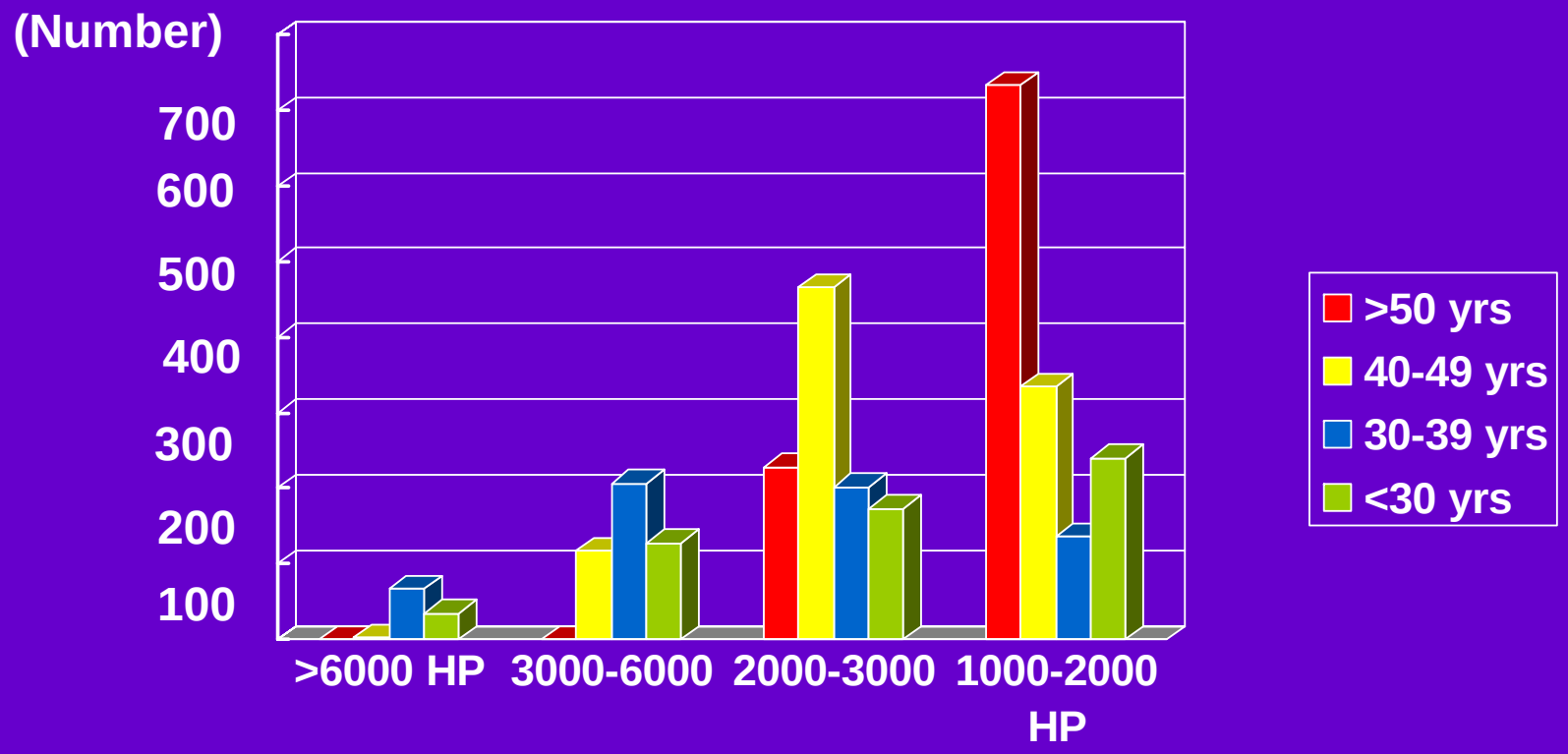
Age of Reciprocating Engine Fleet



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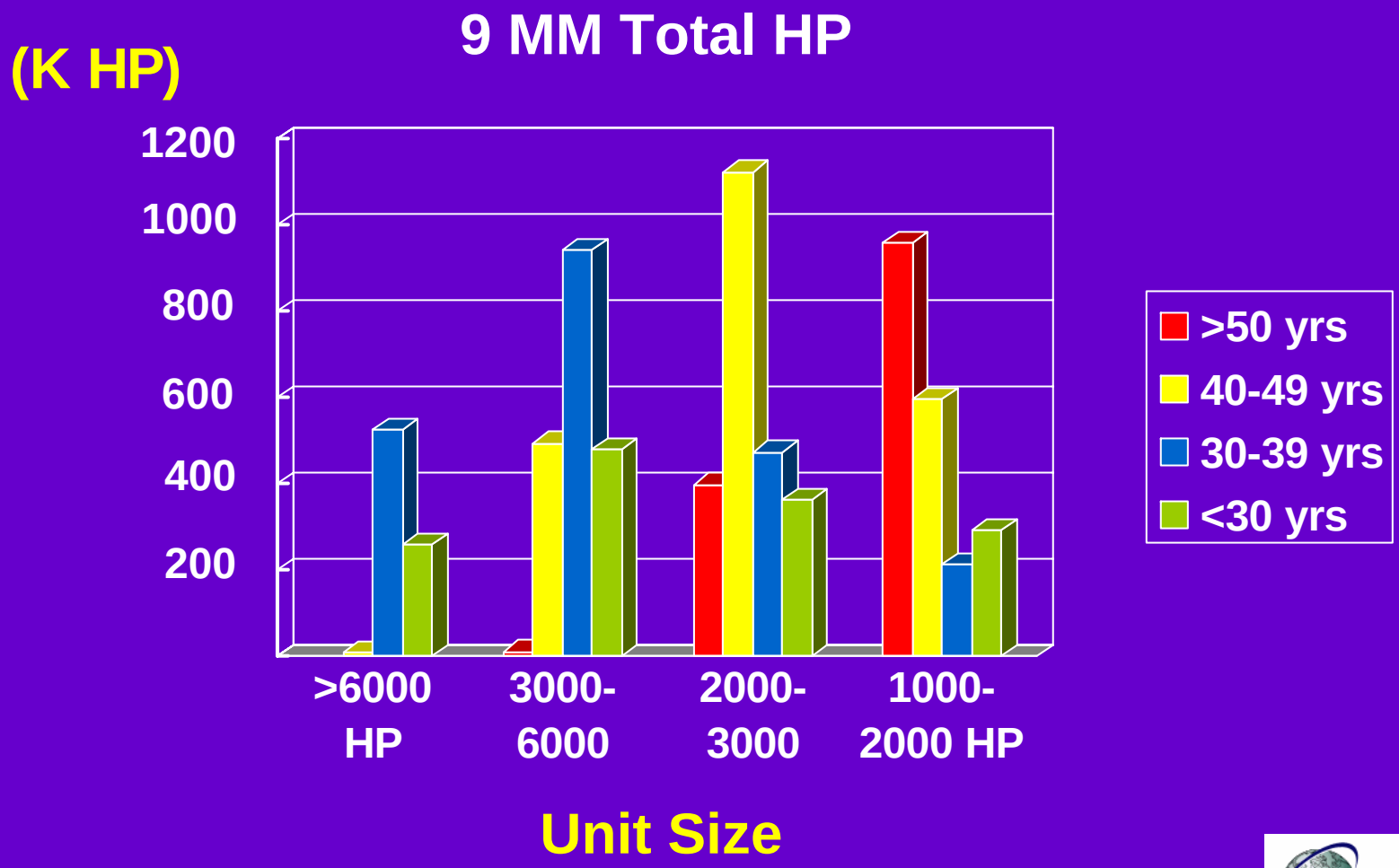

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NOx Reduction – Reciprocating Engines

- **Six Technical Dimensions for NOx control**
  - Ignition
  - In-cylinder air/fuel mixing (fuel injection)
  - Air management
  - Air supply
  - Engine Controls
  - Exhaust aftertreatment
- **Marginal returns from each dimension vary, and are not completely independent of the others**
- **Requires component integration & testing at scale**

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NOx Reduction – Reciprocating Engines

- **Ignition**
  - Laser-ignition system development at Colorado State U.
  - Micro-pilot ignition field testing ongoing (DOE cofunded)
  - Reduction of prechamber-generated NOx (future)
- **In-cylinder air/fuel mixing (fuel injection)**
  - Refinement of high-pressure fuel injection nozzles (completed)
- **Air management**
  - Port flow design to enhance scavenging of Worthington engines
  - Port flow coefficients for Clark, Cooper & Worthington engines
- **Air supply**
  - Turbocharger performance monitoring system
  - Standardized turbocharger testing guidelines (completed)
  - Turbocharger embedded flow sensor (completed)

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NOx Reduction – Reciprocating Engines

- **Exhaust after-treatment**
  - Assessment of non-thermal plasma exhaust treatment
  - Oxidation catalyst performance guidelines (completed)
  - Evaluate SOA performance of SCR
- **Engine controls**
  - Determine precise air/fuel ratio using automotive-based technology (ion sensing)
    - Potential closed-loop controller
  - Advanced two-cycle controls algorithms (completed)
- **Component integration via Lab and field work**
  - Clark TLA-6 installation at CSU engine testbed (DOE cofunded)
  - Investigate impact of gas composition on pipeline engines

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Program 1 – Avoid Mandated CapEx

- **Gas Turbines - Validate DLN performance**
  - Test DLN units at very low ambient temperatures
    - Solar-Mars 100S (TransCanada)
    - Solar-Centaur (Williams)
      - Proposed NSPS for gas turbines ~ 15 ppm
- **Gas Turbine emissions monitoring**
  - Gas turbine PEMS development
    - Alternative to expensive CEMS

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Program 2 – Reduce O&M Costs

- **Gas Turbine blade life characterization**
  - Rolls-Royce RB211-24G
    - Avoid needless blade replacement
- **Improve overall recip engine performance**
  - Reduce fuel use, maintenance cost, and emissions
  - SwRI project – Compressor Station Infrastructure Enhancement (DOE cofund)
    - Improve unit performance by capturing non-traditional engine parameters as control inputs
- **Improve liquid pump efficiency**
  - Expand the efficiency “sweet spot” of centrifugal pumps

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Summary of 2005 PRCI Program

	2005 Budget	Cofunding
Avoid Mandated CapEx	$ 838 K	$ 460 K
Reduce O&M Costs	$ 150 K	$ 175 K
Total	$ 988 K	$ 635 K

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