

DOCKETED

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Document Title:	Miguel Sierra Aznar - Gas Plant Retrofits
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ZERO CARBON, FLEXIBLE, AND
EFFICIENT POWER

noble
thermodynamics

POTENTIAL NATURAL GAS RETROFITS



Fuel:

Natural gas, Hydrogen

Efficiency/Heat rate:

55-60% / 6200-5700 Btu/kWh

Feature:

Retrofittable

GHG emissions:

100% CO₂ Capture

Air pollutants:

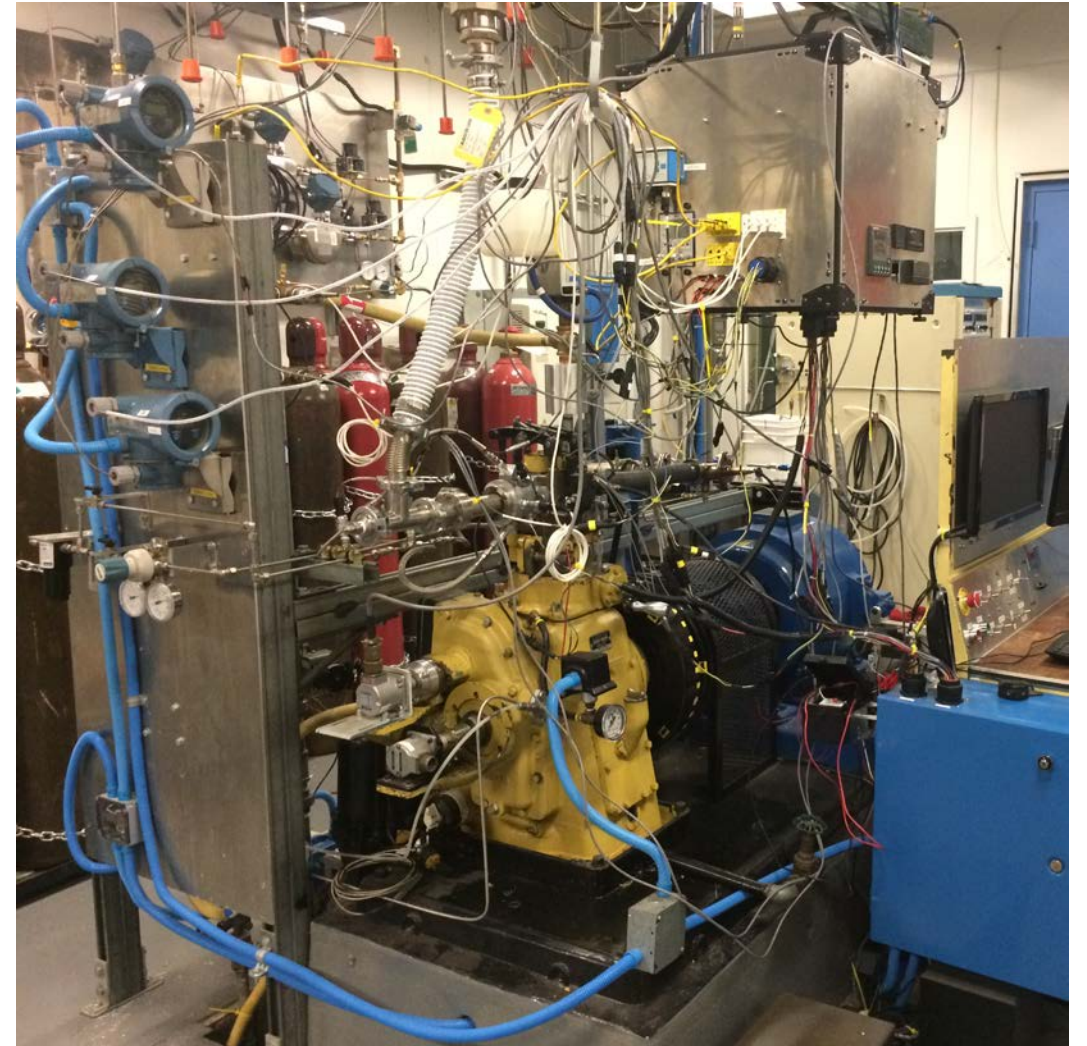
Zero NO_x

Scale:

1-100th MWs

LCOE:

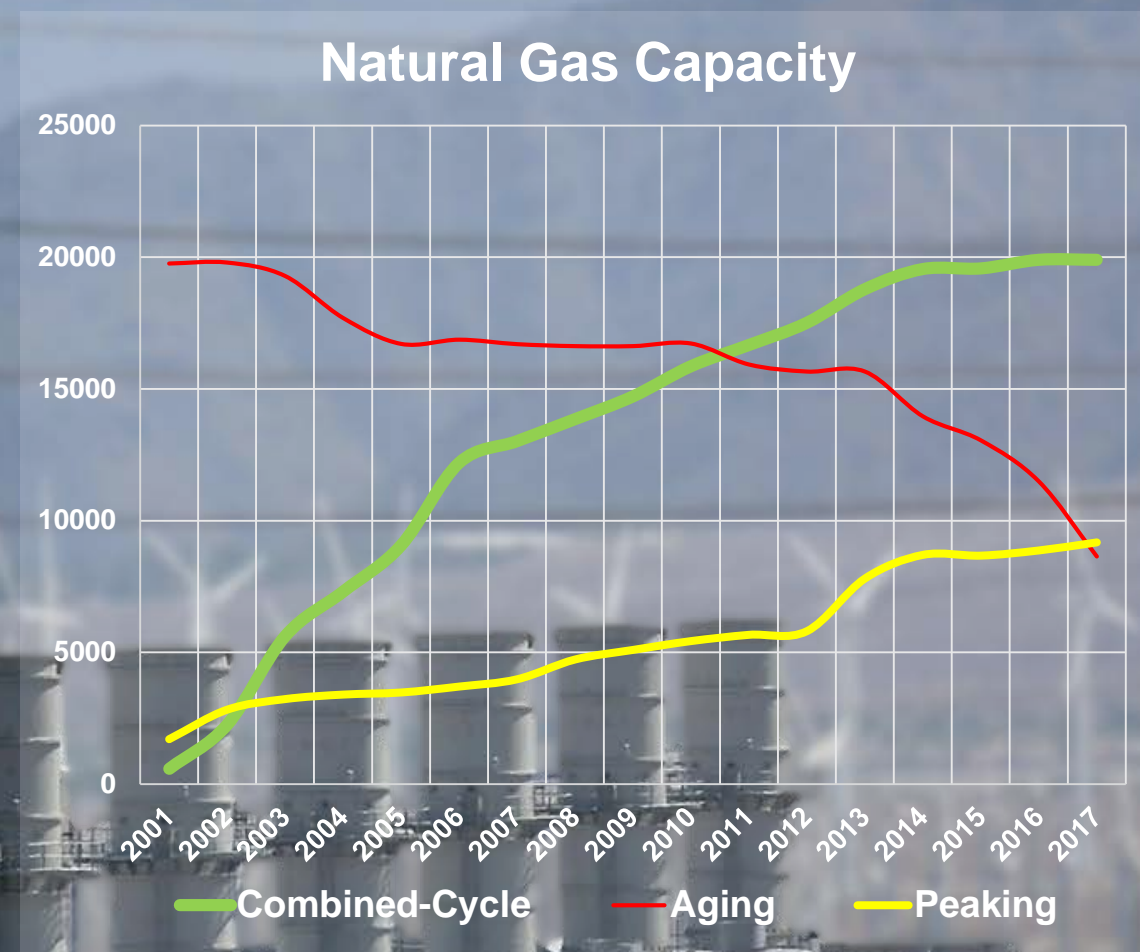
**60-140 \$/MWh
@ 90-30% CF**



Current California market / Potential

California NG by the number (2018)

- **90,691 GWh** power generated
- **46%** of total in state generation
- **40 MMtCO₂e** Emissions (NG)
- **3-5\$/MMBtu** fuel cost
- **44 GW** Capacity
- **36%** Capacity factor
- **43%** Overall fleet Efficiency
- **200 miles** of NG infrastructure



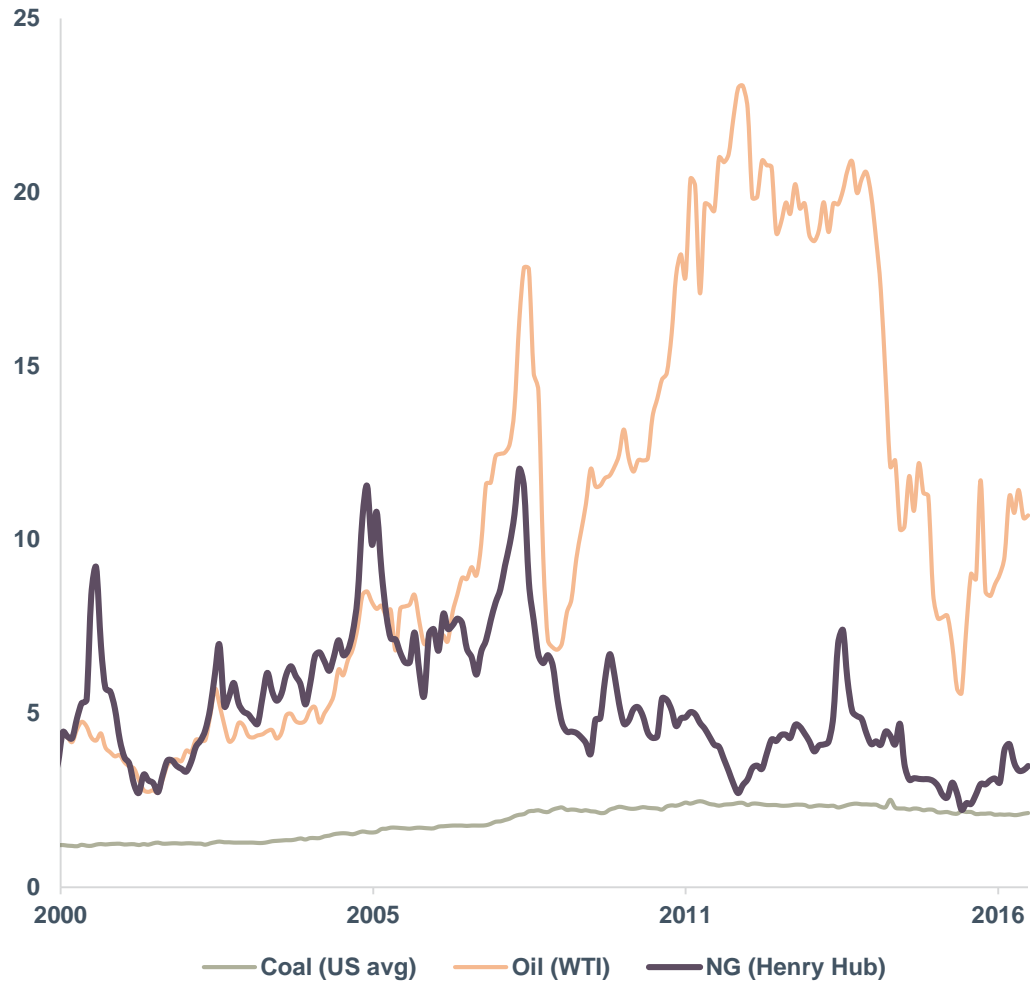


Simultaneously!

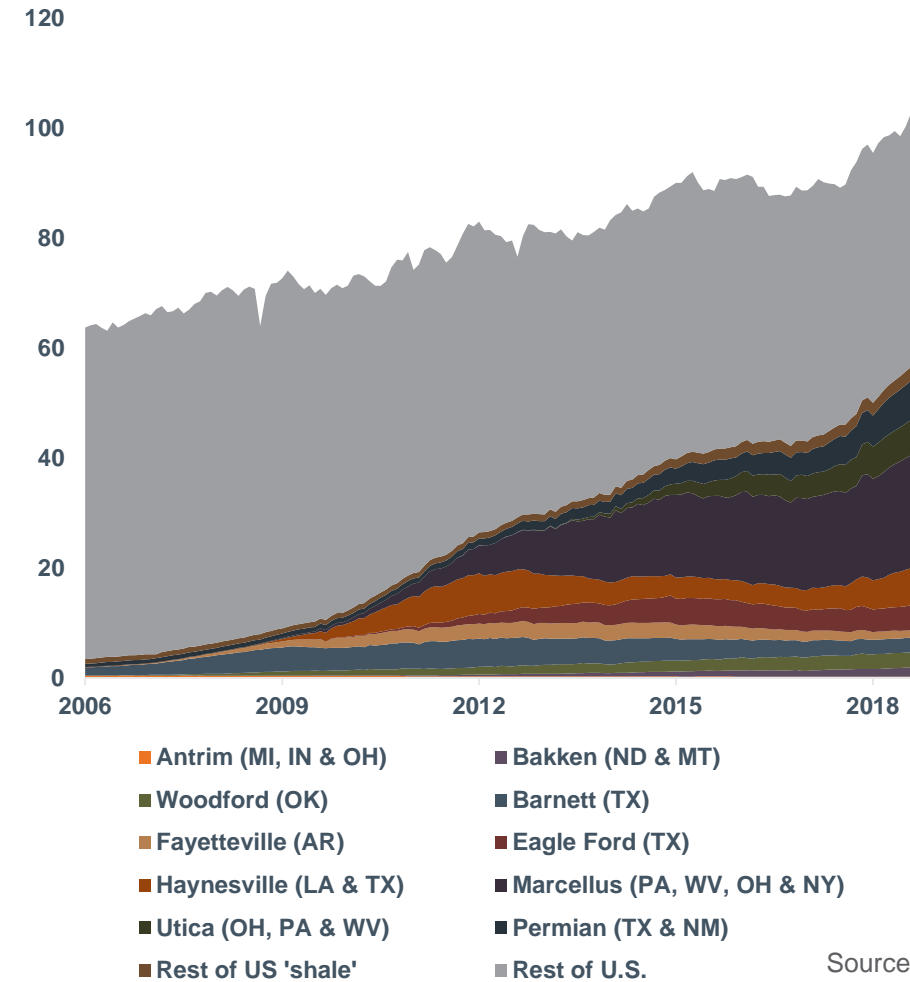
NATURAL GAS COAT TRENDS



U.S. Fuel Prices (USD/MBtu)



U.S. Shale Gas Production (Bcfd)

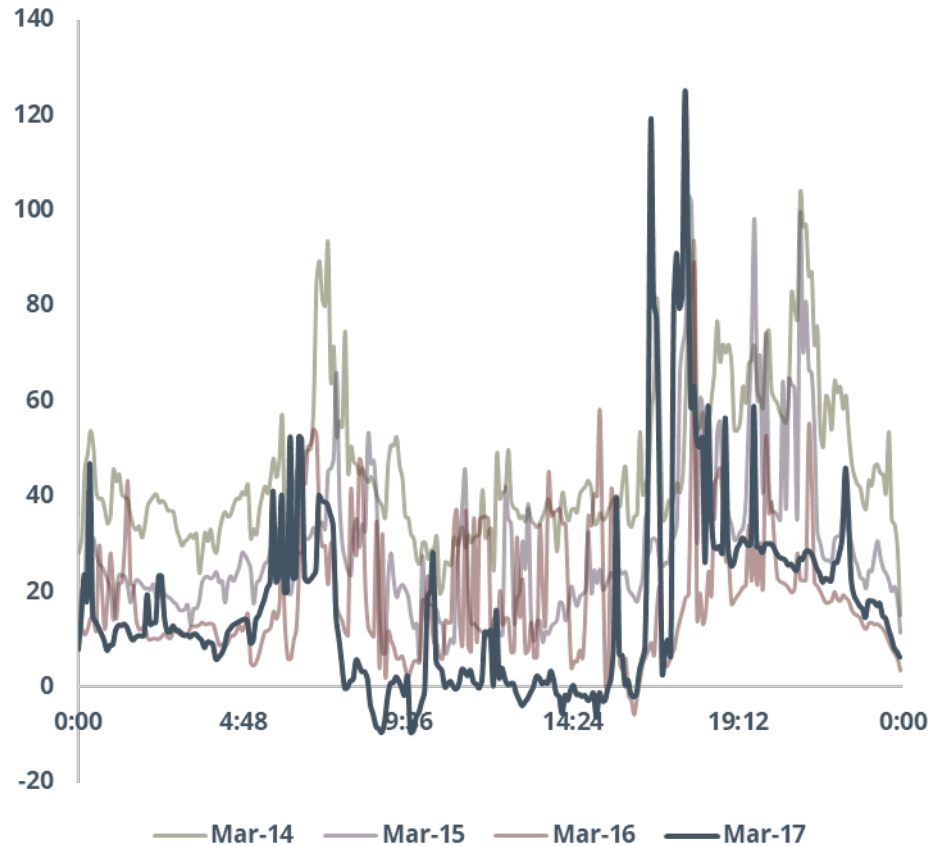


Source: EIA 2018

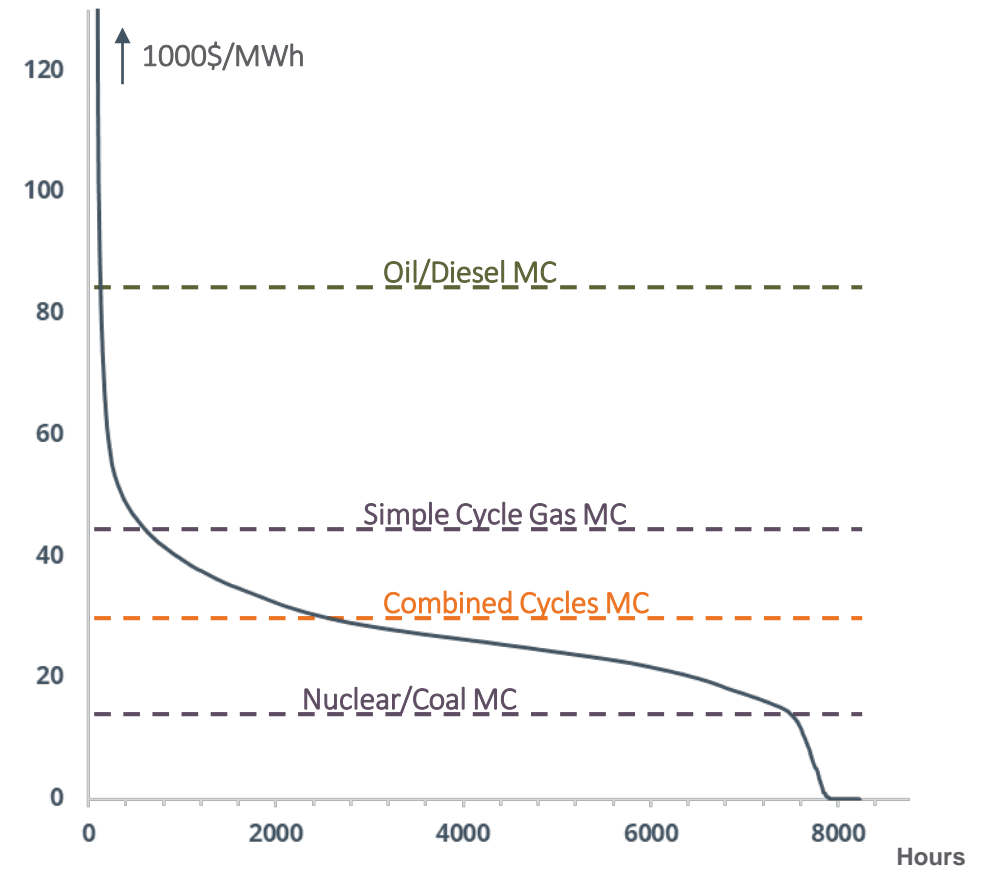
BARRIER TO ENTRY IN A NUTSHELL



5 min wholesale price (\$/MWh)



Electricity Price distribution (\$/MWh)



Source: CAISO 2018