



Sustainable Transportation Energy Pathways (STEPS)

Natural Gas as a Pathway to Alternative Low Carbon Fuels: Infrastructure Issues and Barriers

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Stylized Facts



State of the Natural Gas Market

- Shale Revolution has led to plentiful, cheap natural gas (NG)
- Relative to diesel fuel, NG is an inexpensive energy source
- Relative to diesel fuel, NG tailpipe emissions are lower, implying potential GHG benefits.

These conditions make natural gas appealing as an emerging alternative fuel source for transportation.

Infrastructure Issues and Barriers

Barriers

- Refueling infrastructure requirements are costly
- With cheap nat gas comes cheap oil
- Emission advantages of NG over diesel may be misunderstood
- Renewable Natural Gas (RNG) has limited commercial potential at current relative prices

Refueling infrastructure requirements are costly

Natural gas as an emerging long-distance fuel is competing against established incumbent diesel and gasoline distribution system

NG Requires:

- Large-scale liquefaction or compression plant
- New pipeline construction to plant
- Delivery by truck to retail location
- Construction of new distribution equipment and storage tanks at refueling station

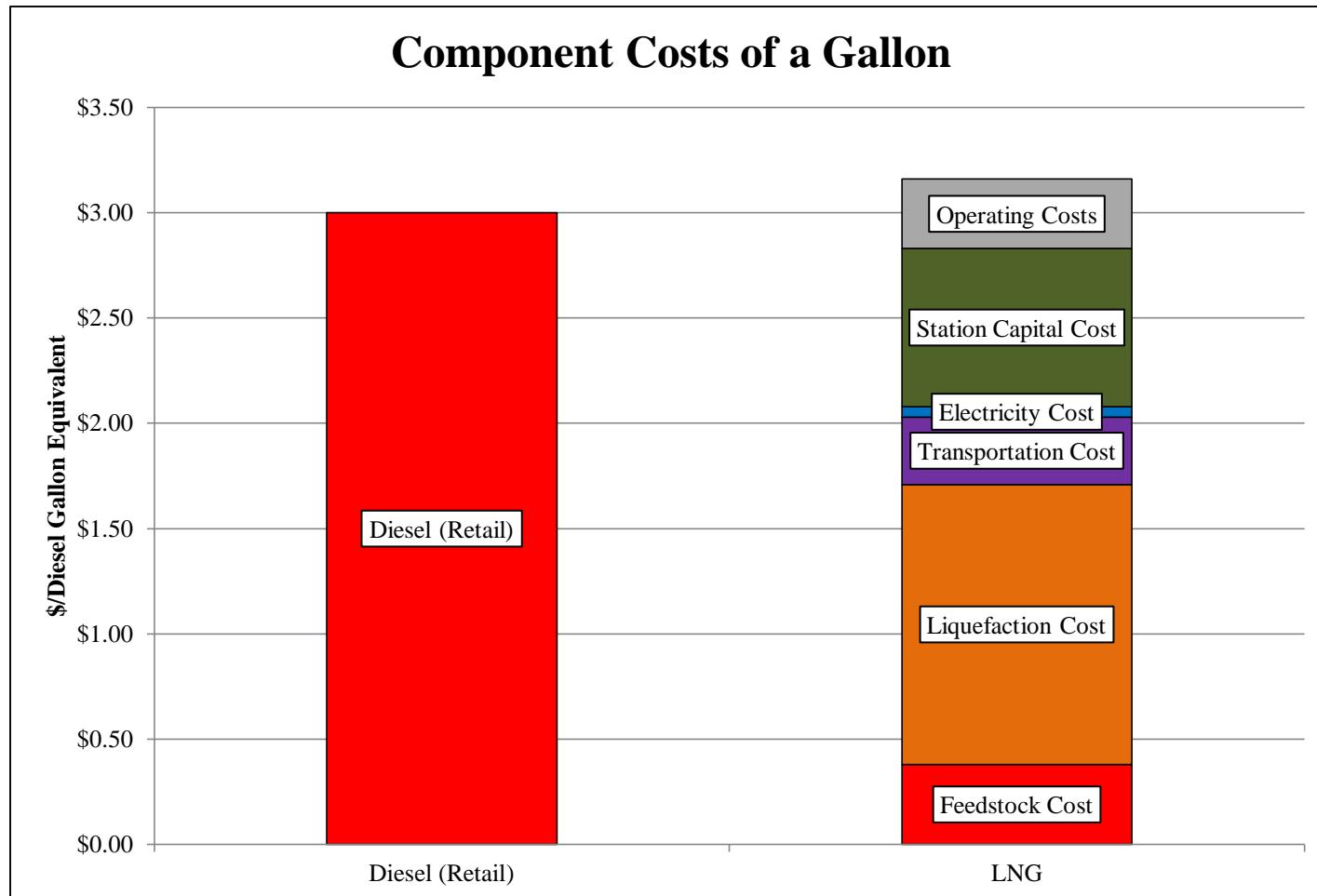
or

- New pipeline construction to Refueling station
- Small-scale compression or liquefaction equipment on-site
- Construction of new distribution equipment and storage tanks at refueling station

Infrastructure costs are sizeable and require high-volume sales before NG is profitable given the margin between NG and diesel.

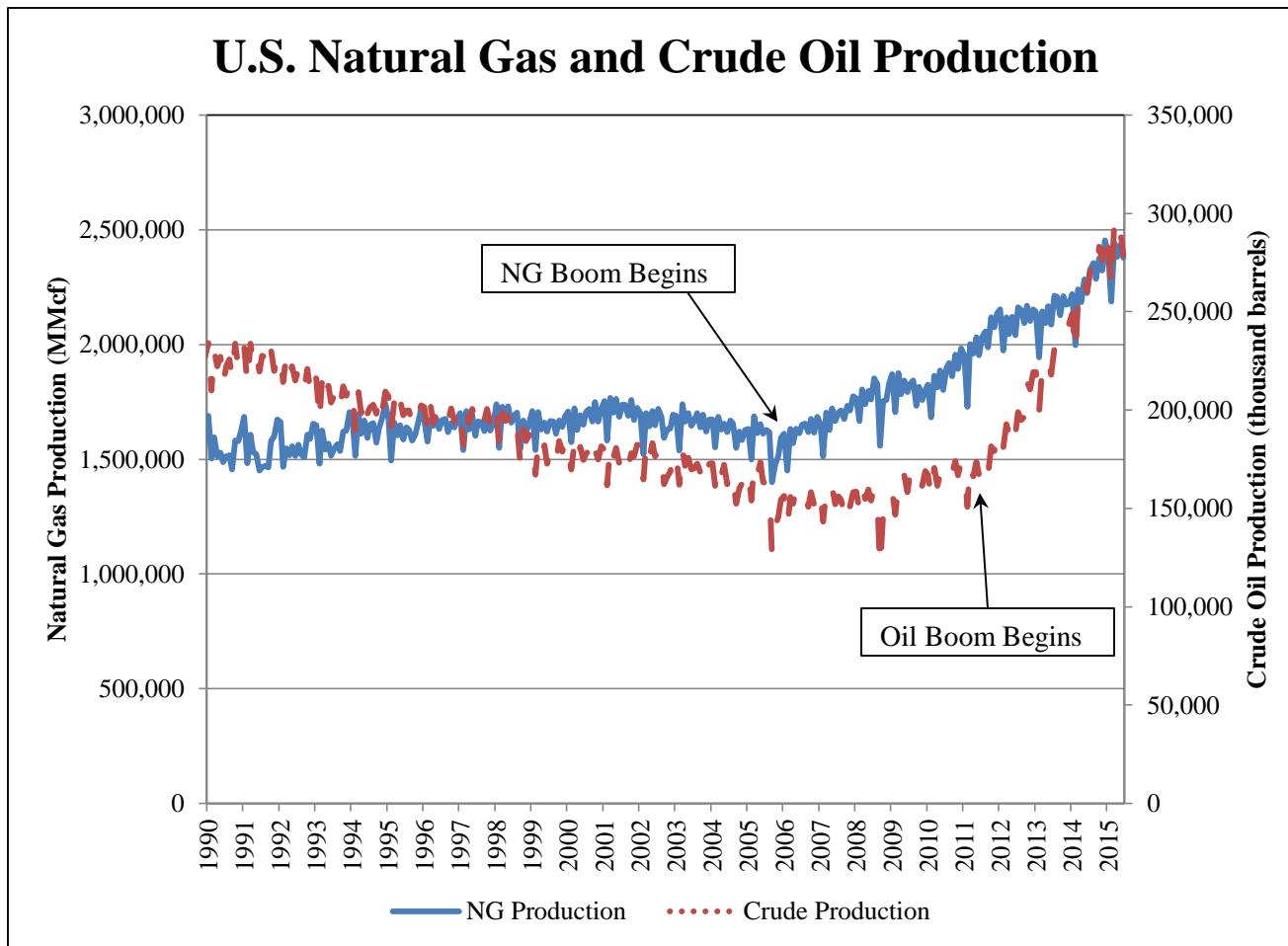
Infrastructure requirements are costly

Infrastructure costs can exceed margins between natural gas feedstock price and diesel retail price. Sufficient margin is required in every location to construct a natural gas network.



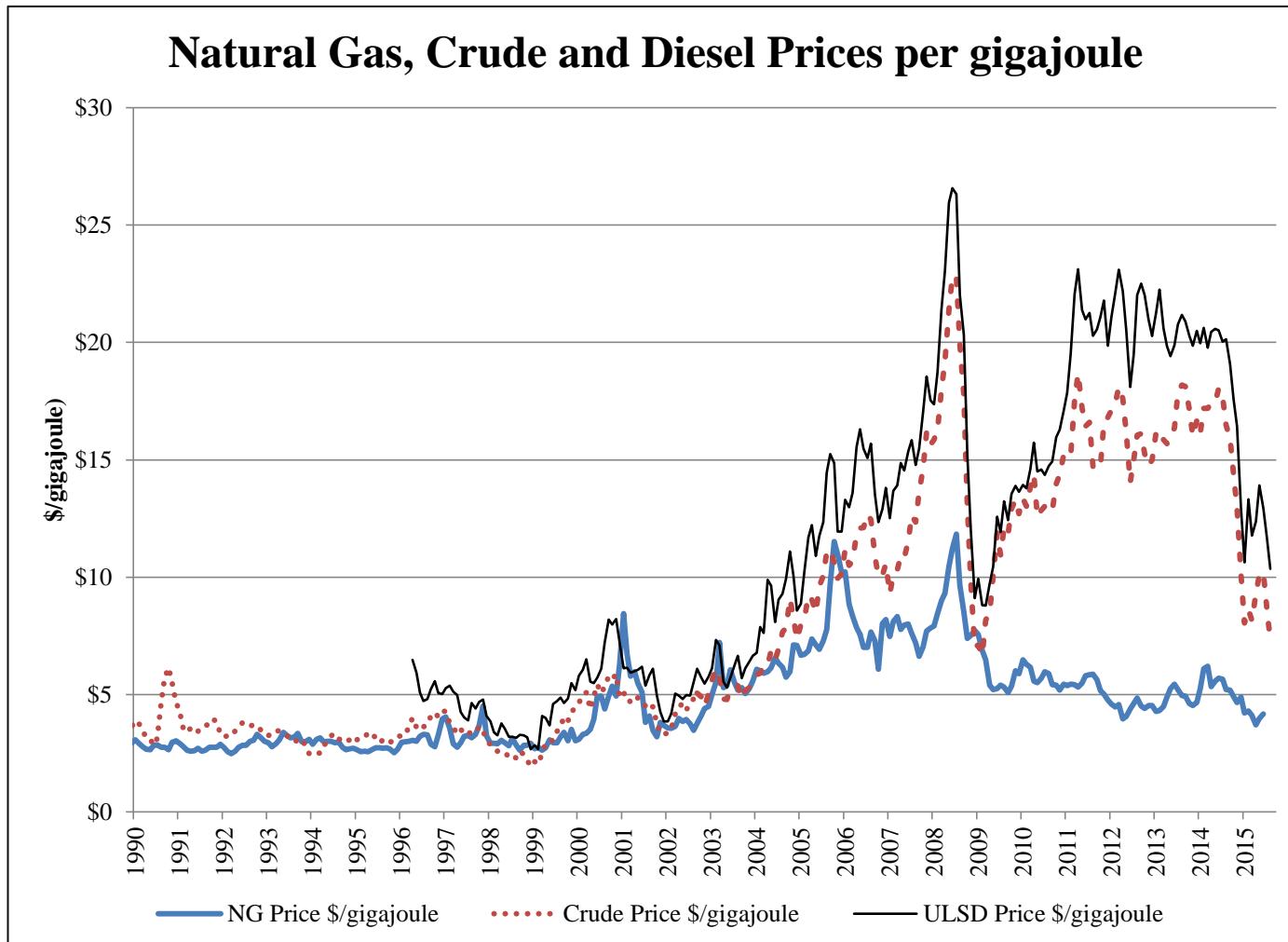
With cheap gas comes cheap oil

Production boom of crude oil lagged behind natural gas boom by five years



With cheap gas comes cheap oil

Previously large margins between NG and diesel are disappearing



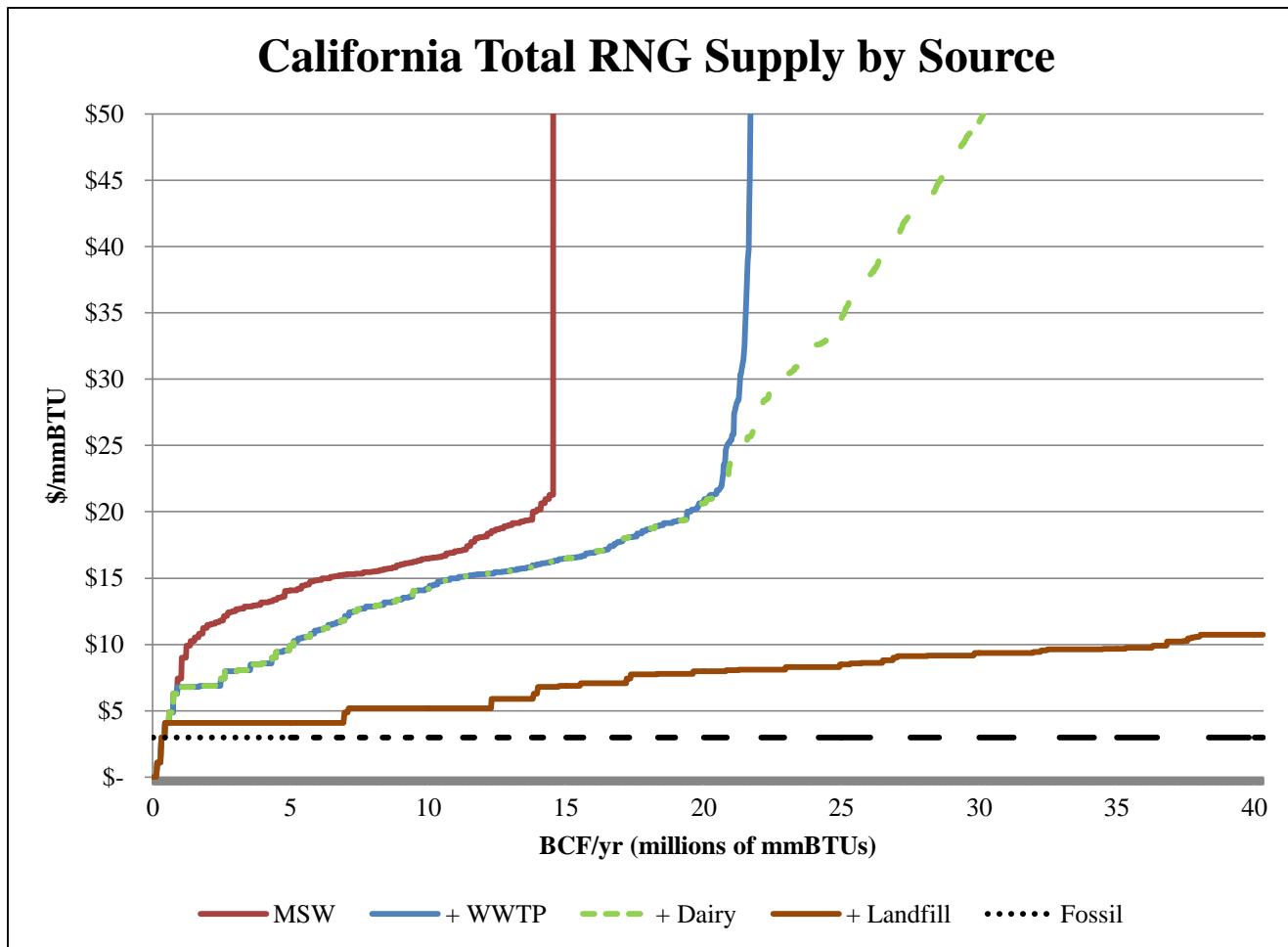
Source: U.S. Energy Information Administration

Emissions Advantage?

- Natural gas is promoted as being the cleanest burning alternative fuel with commercial viability.
- Tailpipe emissions are, in some cases, lower than diesel emissions.
- Upstream leakage in pipeline and production coupled with lower NG engine efficiencies potentially eliminate any GHG advantage of NG as a fuel.

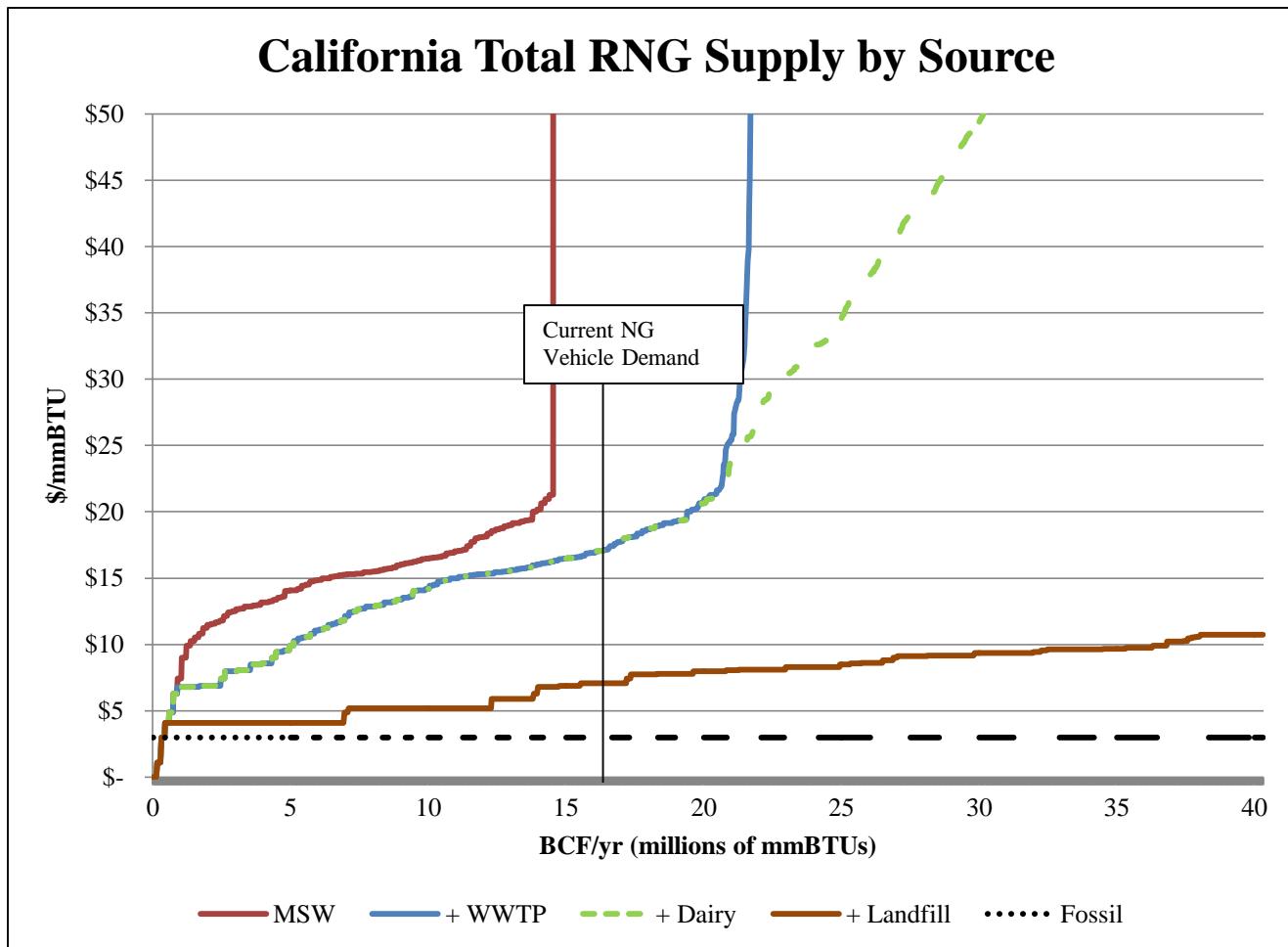
Emissions Advantage?

Is renewable natural gas the solution? Not at current prices.



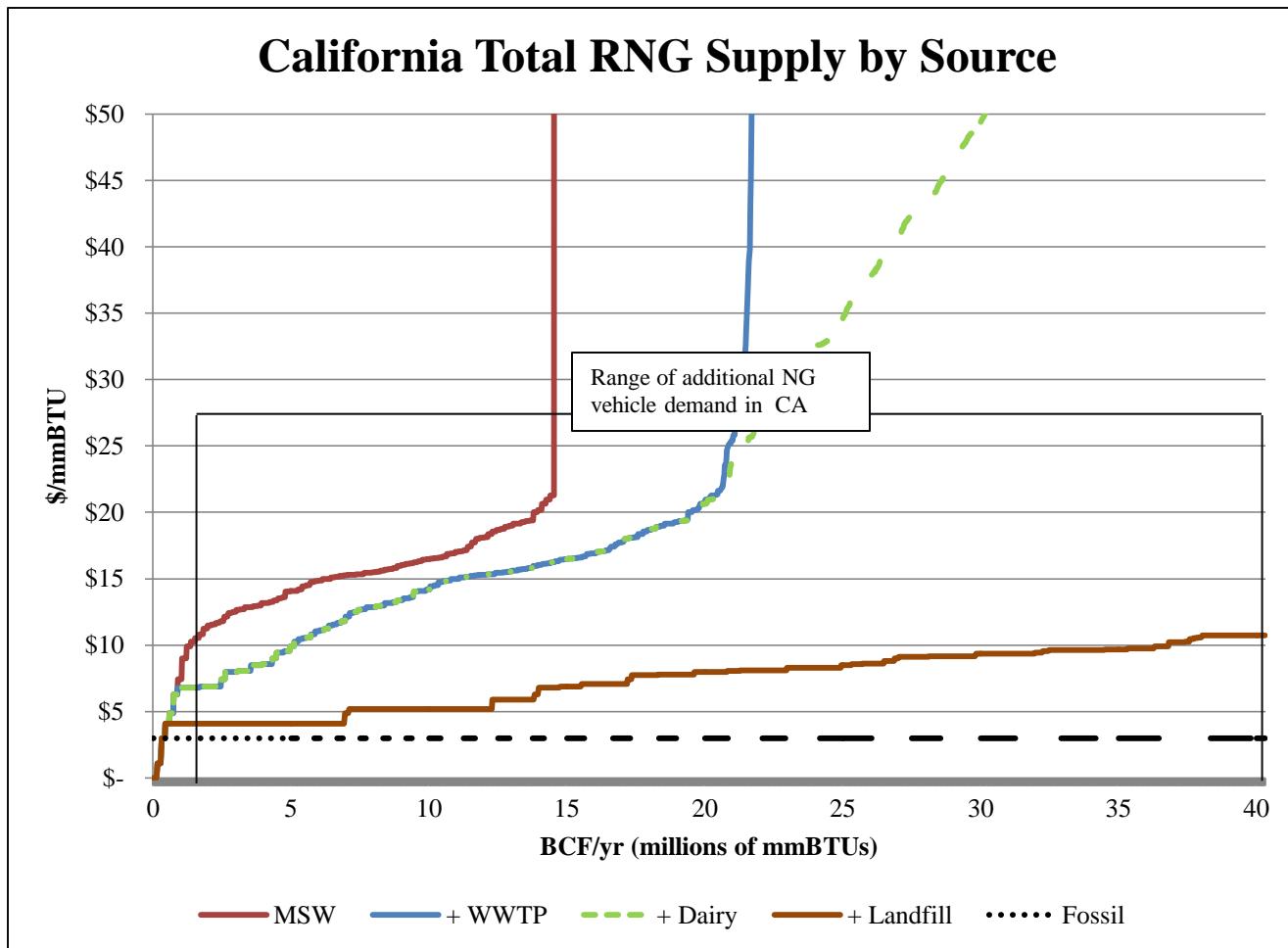
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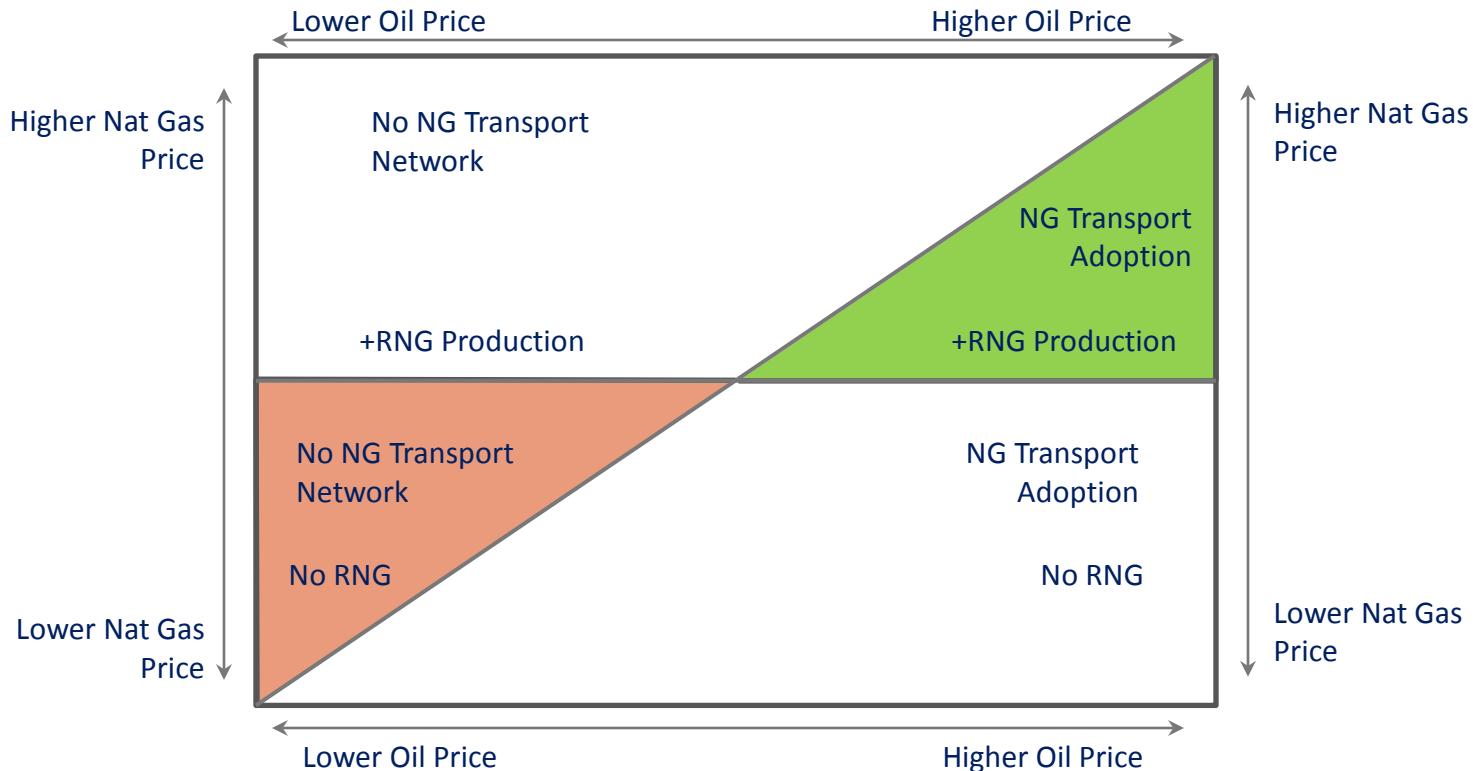
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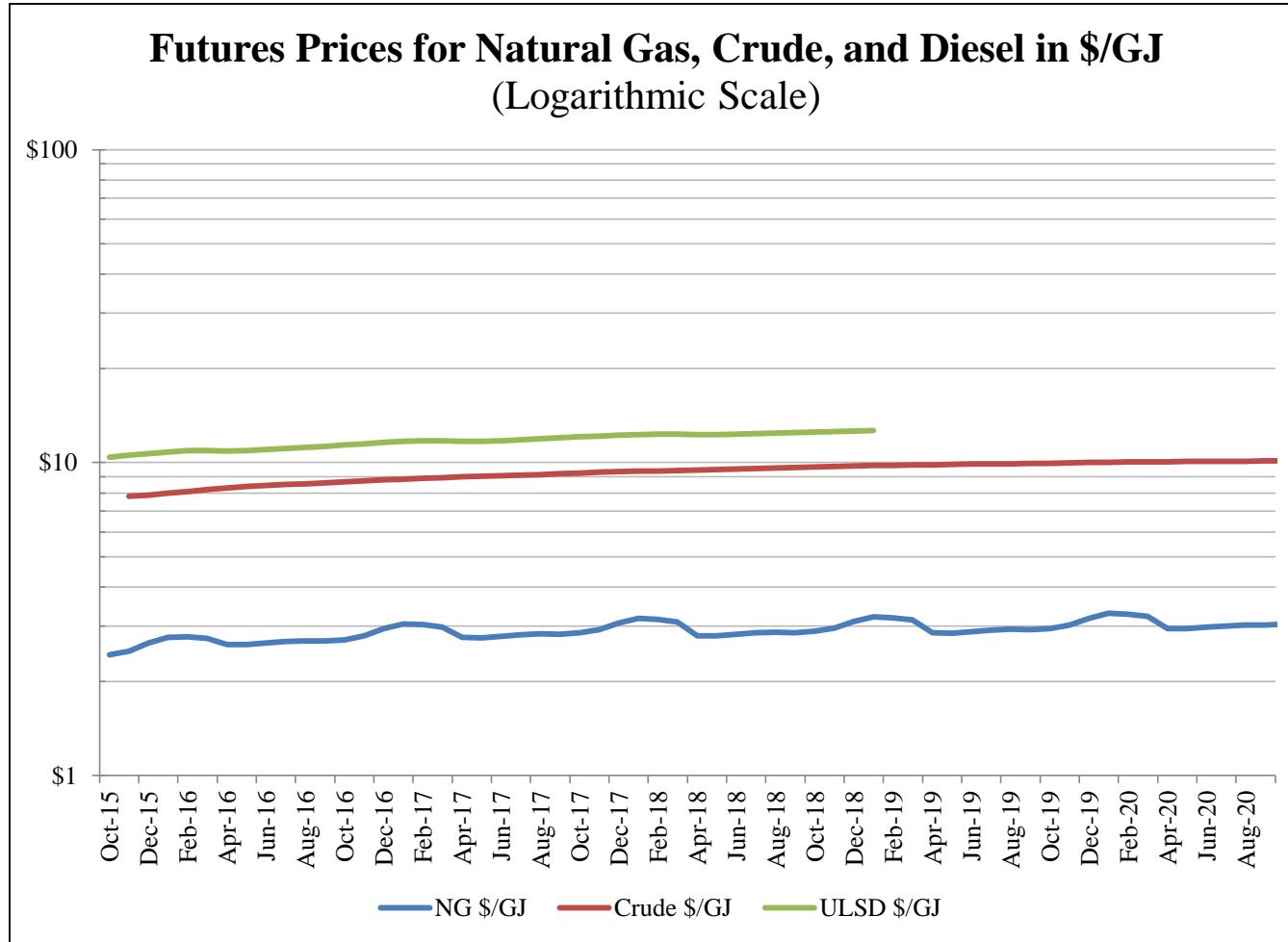
Emissions Advantage?

Conditions that promote wide natural gas adoption in the transportation sector not the same as conditions that promote a cleaner NG supply from renewable sources.



Emissions Advantage?

Futures prices indicate: margins expected to remain constant and prices unlikely to increase significantly



Source: CME Group