



DECARBONIZING OUR ENERGY ECOSYSTEM WITH GAS TURBINES

Dr. Jeffery Goldmeer, Emergent Technology Director – Decarbonization
GE Gas Power

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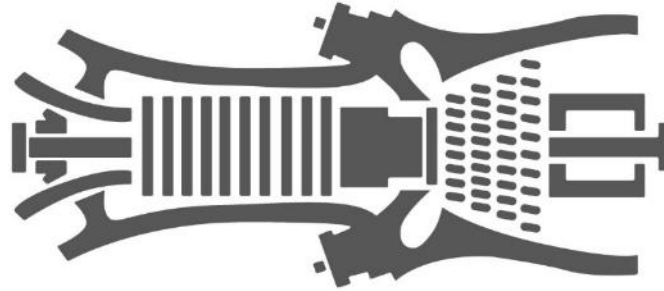


Decarbonizing gas power ... a range of options

Pre-combustion

Use a zero or carbon neutral fuel

- Hydrogen (blue, green, pink)
- Synthetic methane
- Renewable natural gas (RNG)
- Biofuels
- Ammonia (NH₃)



Post-combustion

Remove carbon from the plant exhaust

- Carbon capture (liquid solvents)
- Carbon capture (solid sorbents)
- Oxy-fuel cycles

Gas turbines offer multiple options to achieve lower or zero carbon emissions



Decarbonization option details

Hydrogen

- GE has 30+ years of experience with H₂ as a power generation fuel ... blends of 5% (by vol) up to 100%.

Renewable natural gas (RNG)

- RNG like natural gas is mainly composed of methane
- Concerns with RNG are potential contaminants from sources

Biofuels

- Biodiesel has been used in demonstration tests
- Ethanol is being used in aeroderivative gas turbines in commercial operation

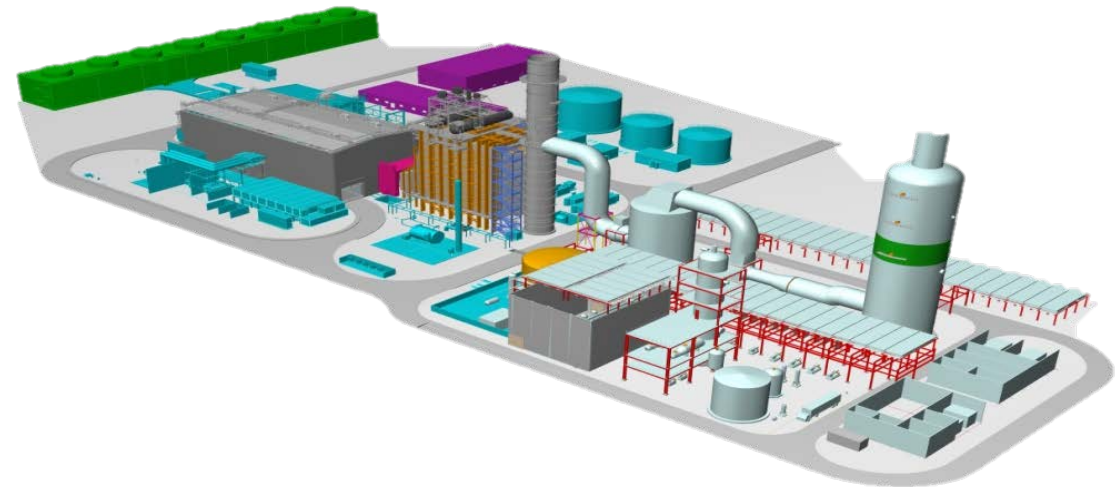
Ammonia

- In pure form can be corrosive and caustic
- Using as a fuel in a gas turbine without changes in technology, NO_x emissions may increase by 100-fold

Carbon capture

- Can be applied to existing power plants if there is sufficient space
- Technology exists today and has been applied to coal plants
- Requires offtake of CO₂

Combined Cycle Power Plant



Carbon Capture Plant



Impact of H₂ on new & existing power plant systems

Hydrogen transport
& storage

Gas turbine & plant
controls

NO_x emissions after
treatment

Gas turbine enclosure

Fuel accessory system

Gas turbine combustion system

Heavy-duty gas turbine combustion systems (F-class)

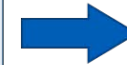
Today



Diffusion combustors
Max H₂ ~70-100%



Premixed combustors
Max H₂ ~5-20%



Future



Advanced premixer
Targeting 100% H₂

Aeroderivative gas turbine combustion systems

Today



Diffusion combustors
Max H₂ ~ 30-85%



Premixed combustors
Max H₂ ~ 10%



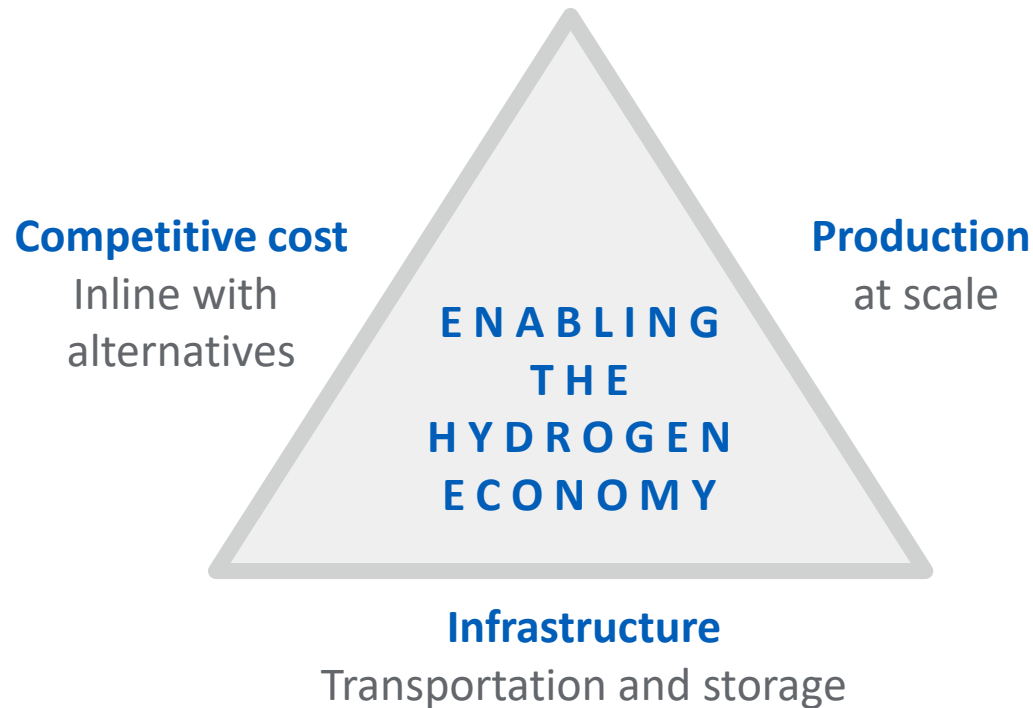
Future



Advanced premixer
Targeting 100% H₂



Considerations to make hydrogen a competitive power gen fuel



TODAY

70M tons of H₂ produced/year
> 99% is **grey** hydrogen

FUTURE

2050 forecast for **green** and **blue** hydrogen for power generation is ~3X more than all hydrogen produced today*

- **Grey:** Reforming natural gas
- **Blue:** Reforming natural gas + CCUS
- **Green:** Electrolysis of water with renewable power

Using hydrogen as a gas turbine fuel requires solving the trilemma of affordability, reliability, and sustainability

*bp Energy Outlook, Hydrogen, <https://www.bp.com/en/global/corporate/energy-economics/energy-outlook/demand-by-fuel/hydrogen.html>

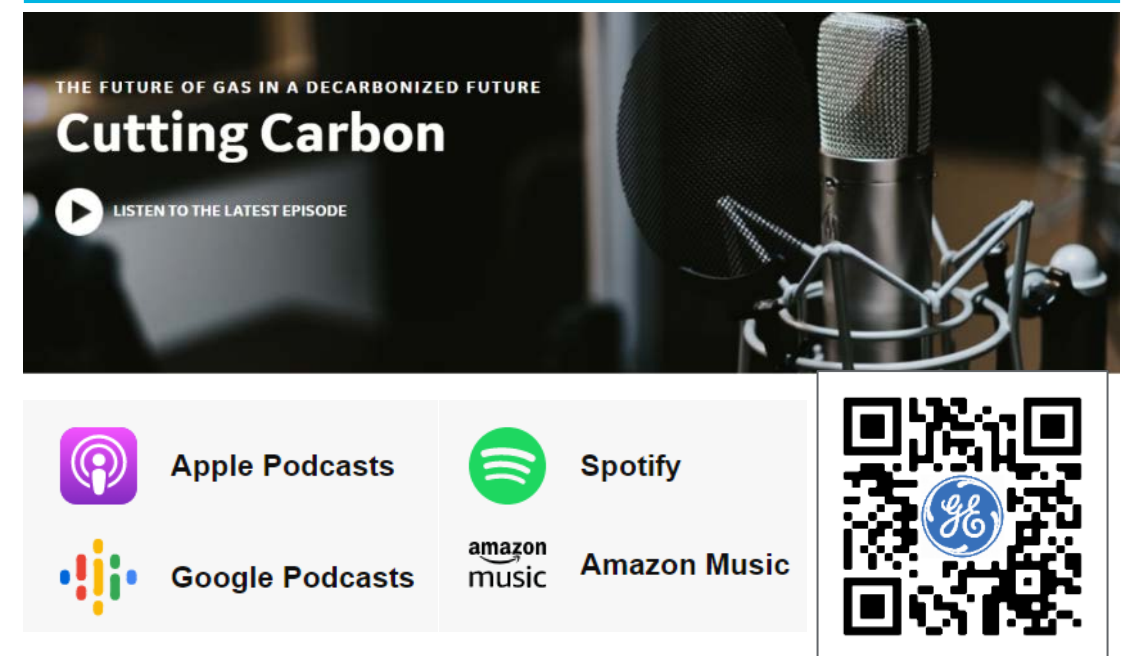


GE is excited about the future and the role that gas turbines will play in decarbonizing our society

The Future of Energy ... building a world that works



Cutting Carbon: a conversation about our energy future



[linkedin.com/in/jeffreygoldmeer](https://www.linkedin.com/in/jeffreygoldmeer)

