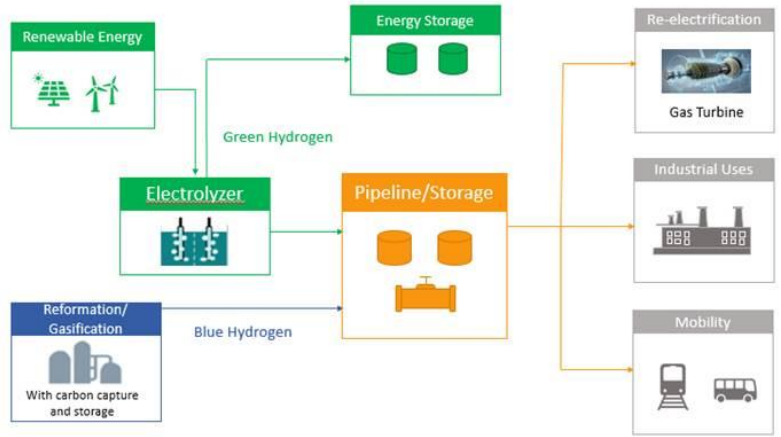
SS&A Power Consultancy

Hydrogen Business Survey Report



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Introduction

As the world is striving to achieve carbon neutrality, there has been a rapidly growing attention on hydrogen. Since it can be used as a feedstock or fuel in many applications and emits no CO2, hydrogen offers huge potential to decarbonise energy and industrial processes. Furthermore, by utilizing renewable energy, as in the case of green hydrogen, it presents an energy storage opportunity.
In the past year, there has been an exponential increase in the announcement of new hydrogen development and investment plans.

SS&A Power Consultancy launched this brief survey to our clients and network with particular focus on the key sectors with interest in hydrogen to provide a current view of companies' strategies and outlook on hydrogen. The participants included power companies, equipment suppliers, EPC contractors, investors, oil & gas companies and consultants.

This is only a snapshot and we look forward to continuing the dialogue and assisting our clients in evaluating the impact of hydrogen in the coming years.

Executive Summary

Companies Overview

- Most of the participants were utilities/power generators (37%), followed by equipment suppliers (21%), EPC contractors and consultants (11%) and investors (8%).
- Most were large companies, 47% with annual revenues over $1bn, 14% between $500M and $1bn and 11% between $100 and $500M.
- While most of the companies were headquartered in Europe (47%), North America and Asia were well represented, 27% and 19% respectively. Most companies had global operations.

Role of hydrogen in Strategy / Investments

- hydrogen had an important or very important role for 59% of the companies participating in the survey, with 34% of the respondents with a neutral view or saying that it had a less important role. 8% mentioned that it was not important.
- In terms of investment in hydrogen in the next 5 years, 60% responded that they were going to invest $25M or less, 24% between $25-100M and 9% between $500M and $1bn.
- The primary focus for most of the participants was power and energy storage, 74% and 54% respectively, followed by production, 38% and industrial applications, 36%.
- The great majority, 75% of the respondents, agreed that green hydrogen should be the priority for hydrogen technology development, followed by storage and blue hydrogen.

Power Application for hydrogen

- Most of the respondents felt that gas turbines are the best application of hydrogen in power generation (62%), while 32% stated fuel cells.
- Regarding the ability for gas turbines to burn hydrogen, none of respondents felt that, in the next five years, burning 100% H2 would be needed, with all responding that ability to burn a blend would be sufficient in the near term. In the next 10 years, 20% of the respondents stated that 100% H2 would be needed, while most still felt a blend would be the requirement.
- 45% of the gas turbine operators felt that they would need to retrofit their fleet for a hydrogen/natural gas blend in the next 10 years, while 21% mentioned that their GTs are already able to burn a hydrogen blend. 24% stated that they are not planning to use hydrogen in the next 10 years.
- Combustion stability was stated as the biggest challenge in using hydrogen for gas turbines, followed by controlling NOx emissions and safety issues.
- When asked about when hydrogen would be competitive for power generation without any incentives, about 62% felt that it would take at least 10 years, while 30% stated within the next 10 years. With that in mind, however, most felt that, in the long term, hydrogen was a very promising long duration storage option.

Views from Participants

“My current focus is on battery energy storage, however, I believe green hydrogen, as both a fuel and energy storage medium, provides the most long-term promise. The challenge, however, is that a hydrogen future requires parallel development of several industries/technologies: production, storage/compression, transmission/distribution, end users, etc.. Policies that incentivize and subsidize development will continue to be important.”

“A lot of work still to be done on both hydrogen production and gas turbine combustion hardware!”

“The next years it is important to bring H2 into "hard to abate" sectors, like industry or the transport sector. The power sector has the problem that it is extremely cost intensive to use green hydrogen in order to produce electricity. You have two times efficiency losses. However, the input energy cost of wind and solar is zero, so potentially efficiency questions will be non dominant in the future, if CAPEX of wind, solar and electrolysis are low enough.”

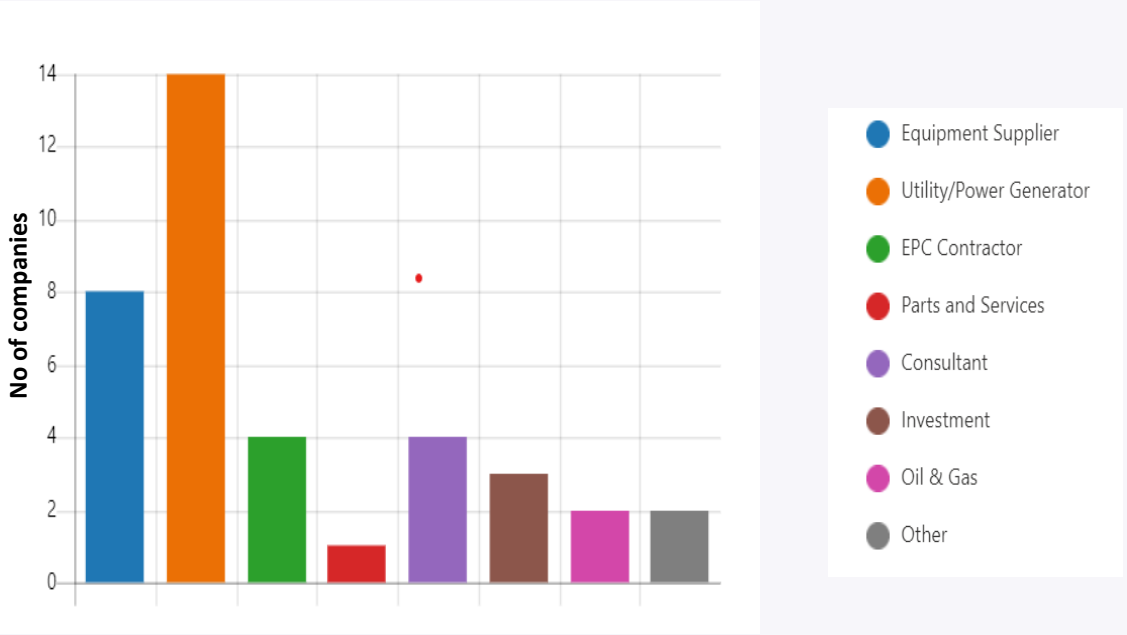
“hydrogen is likely to be a good alternative as fuel for the transport sector or to blend with methane for power generation to avoid too many hardware changes.”

“A lot more challenges like development of anti-hydrogen-embrittlement steel to achieve hydrogen society, it will take a long time to introduce hydrogen as a choice of fuel into our power generation from the standpoint of an owner of private power plants. In addition, nobody will use hydrogen unless the price after "carbon pricing" gets low enough to be competitive with LNG. In my view, hydrogen use will be focused mainly on fuel cells, not on GTCC, in terms of efficiency.”

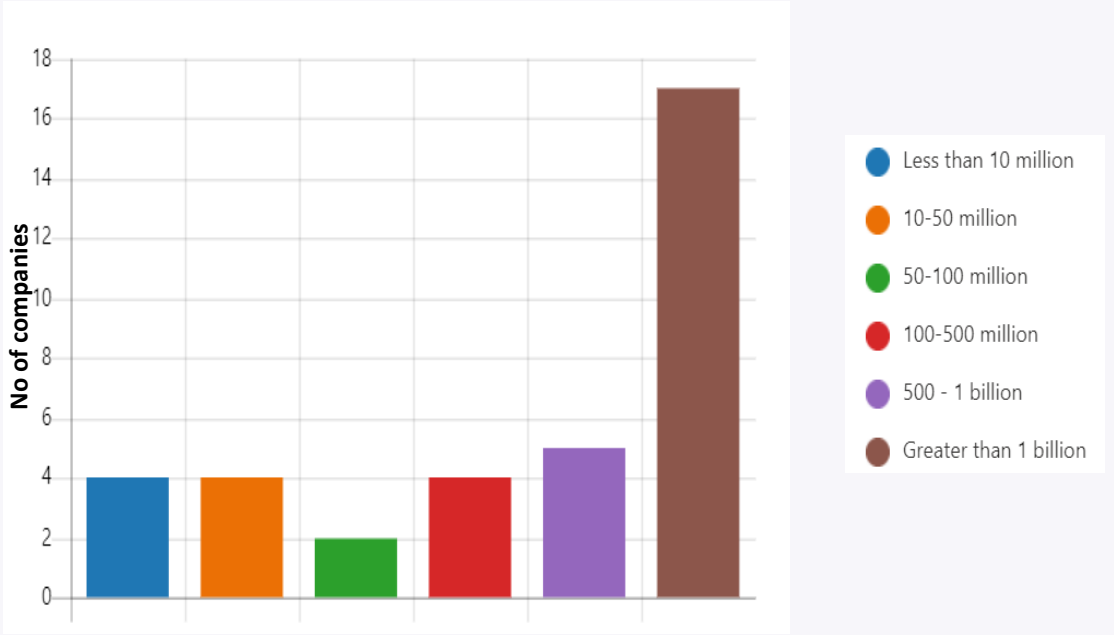
“I believe that green H2 will be critical for GTs to remain relevant for large grid scale power to balance the increasing use and volatility of renewables. The combustion technology to allow massive amounts of H2 consumption in GTs blended with natural gas, with low NOX emissions, is not the barrier to success or market entry, but rather the supply and storage side of H2 in such necessary large volumes. Price of carbon and subsidies, especially sun setting fossil production incentives and those for wind/solar as well be instrumental in driving the momentum behind this urgent energy transformation.”

Companies Overview

Type of Company

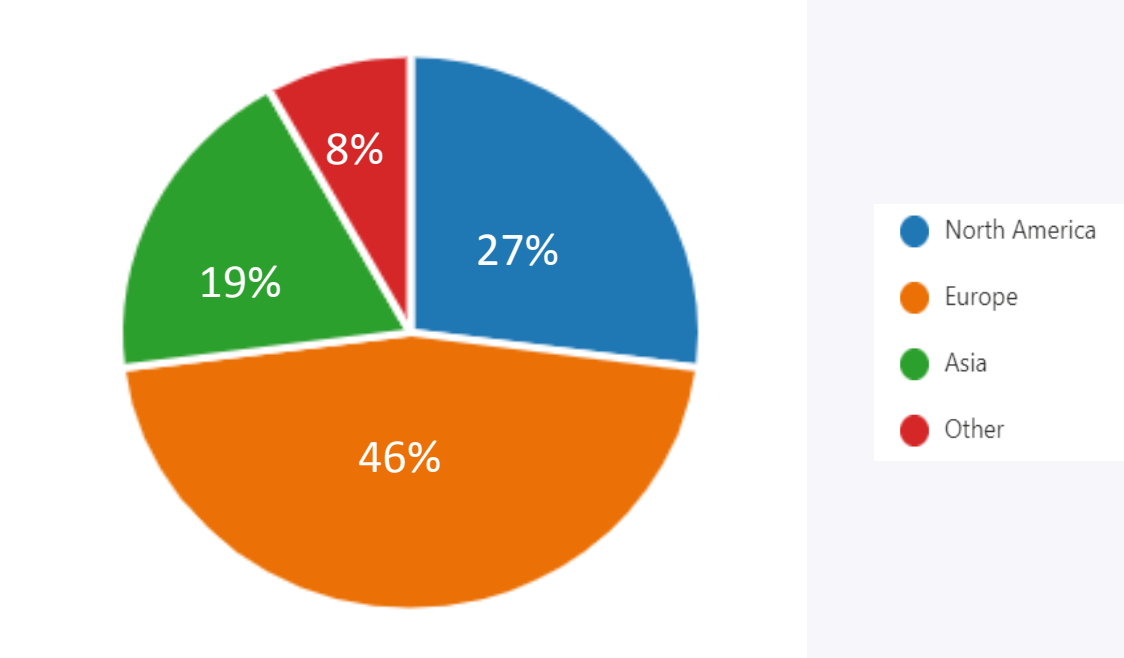


Revenues

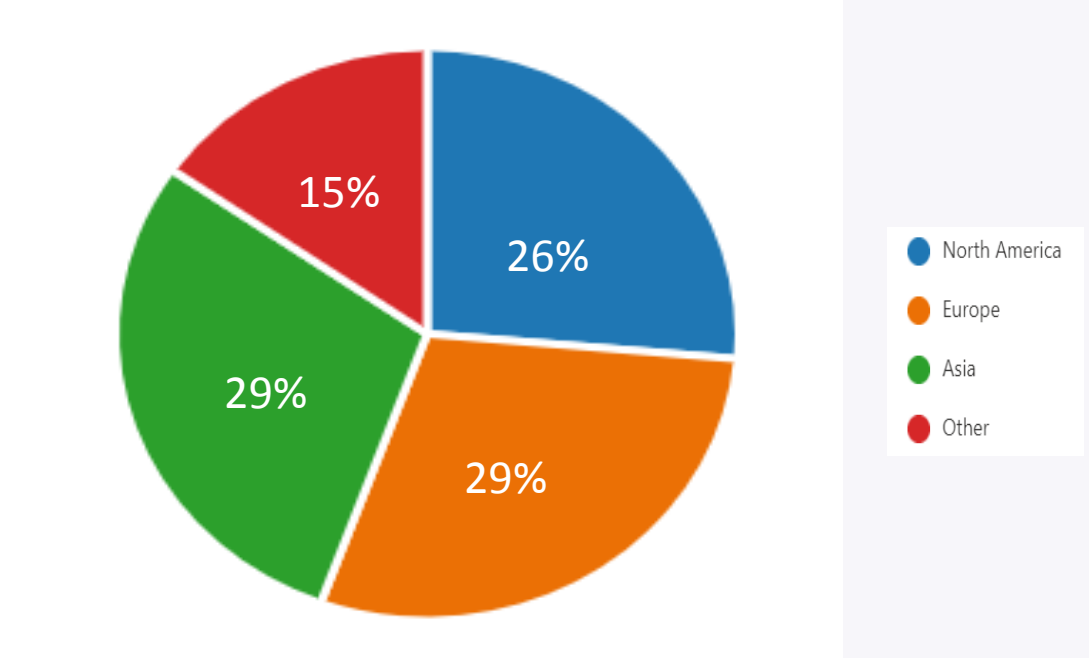


Companies Overview

Company HQ

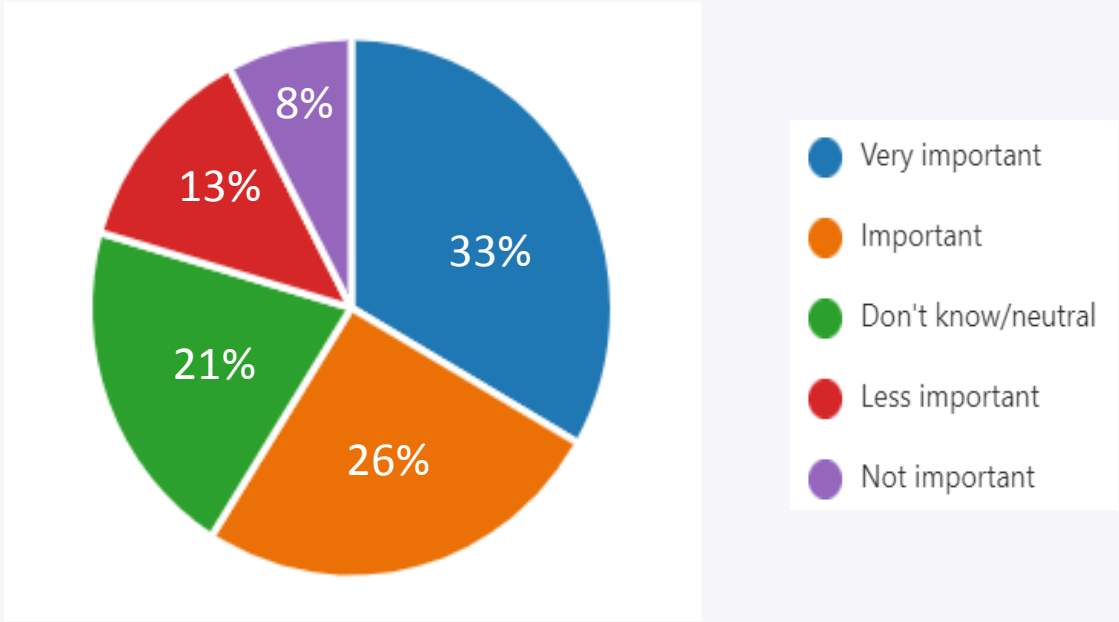


Operations

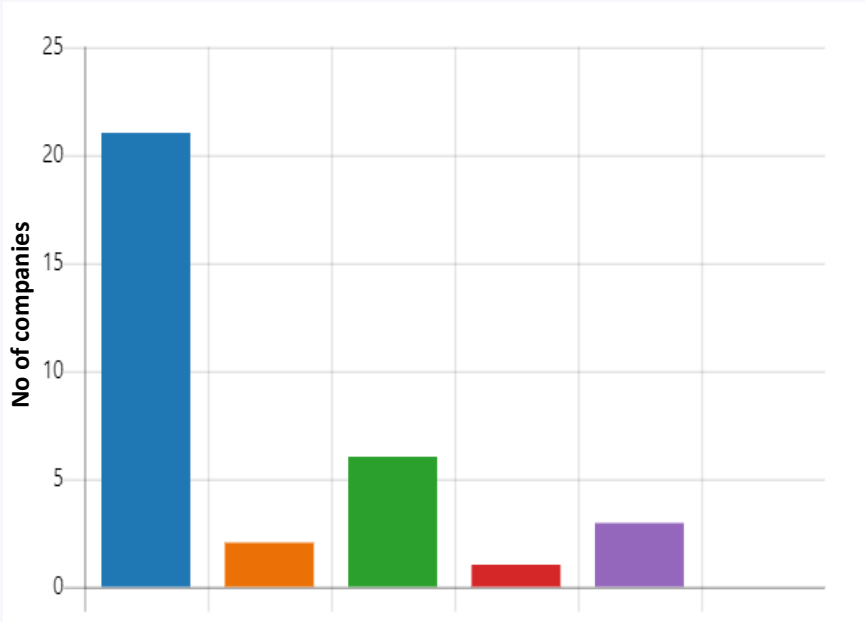


Role of hydrogen in Strategy/Investment

Importance of hydrogen in your strategy

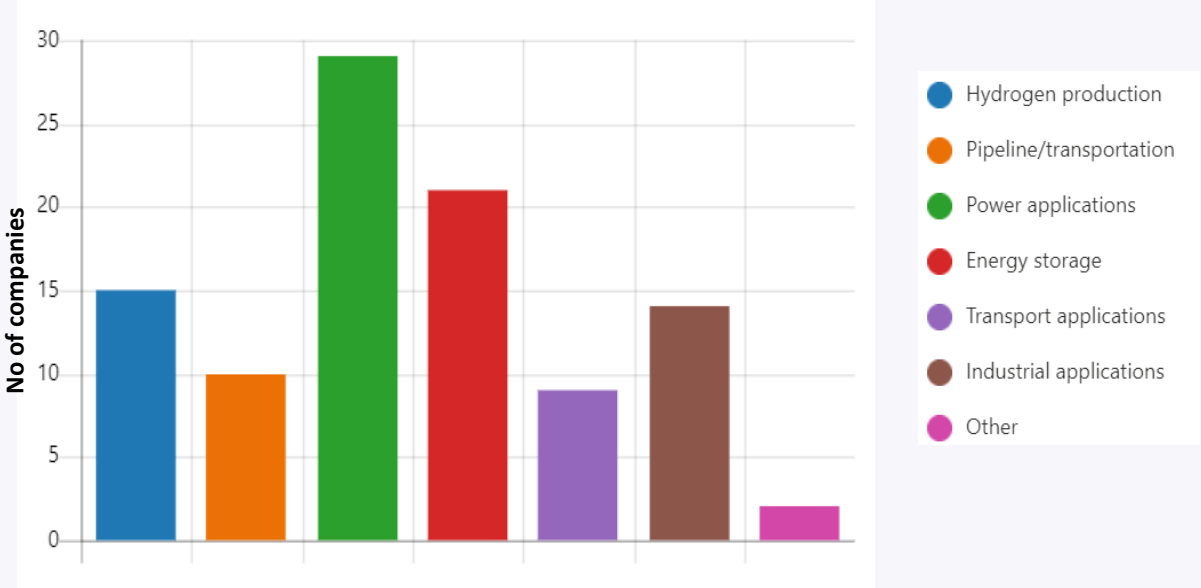


How much will your company invest in hydrogen in the next 5 years?

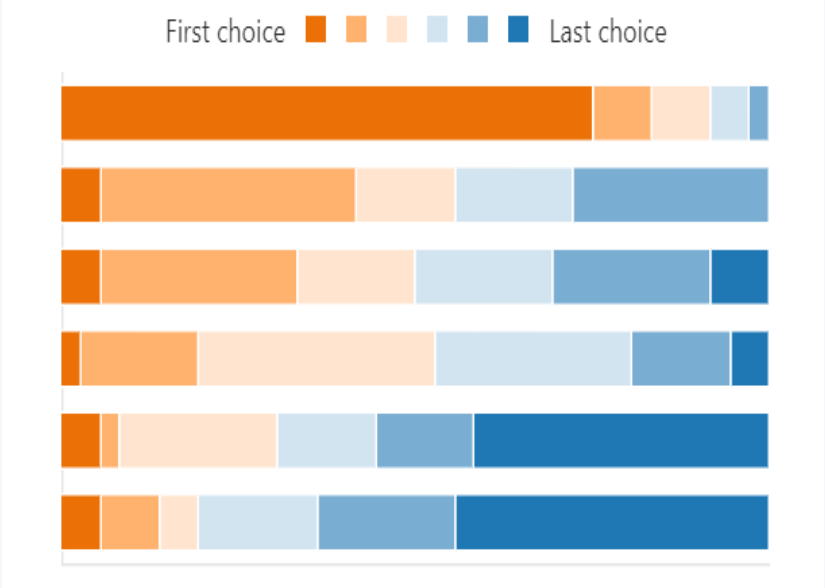


Role of hydrogen in Strategy/Investment

What is your primary focus in hydrogen?



Priority hydrogen technology development?

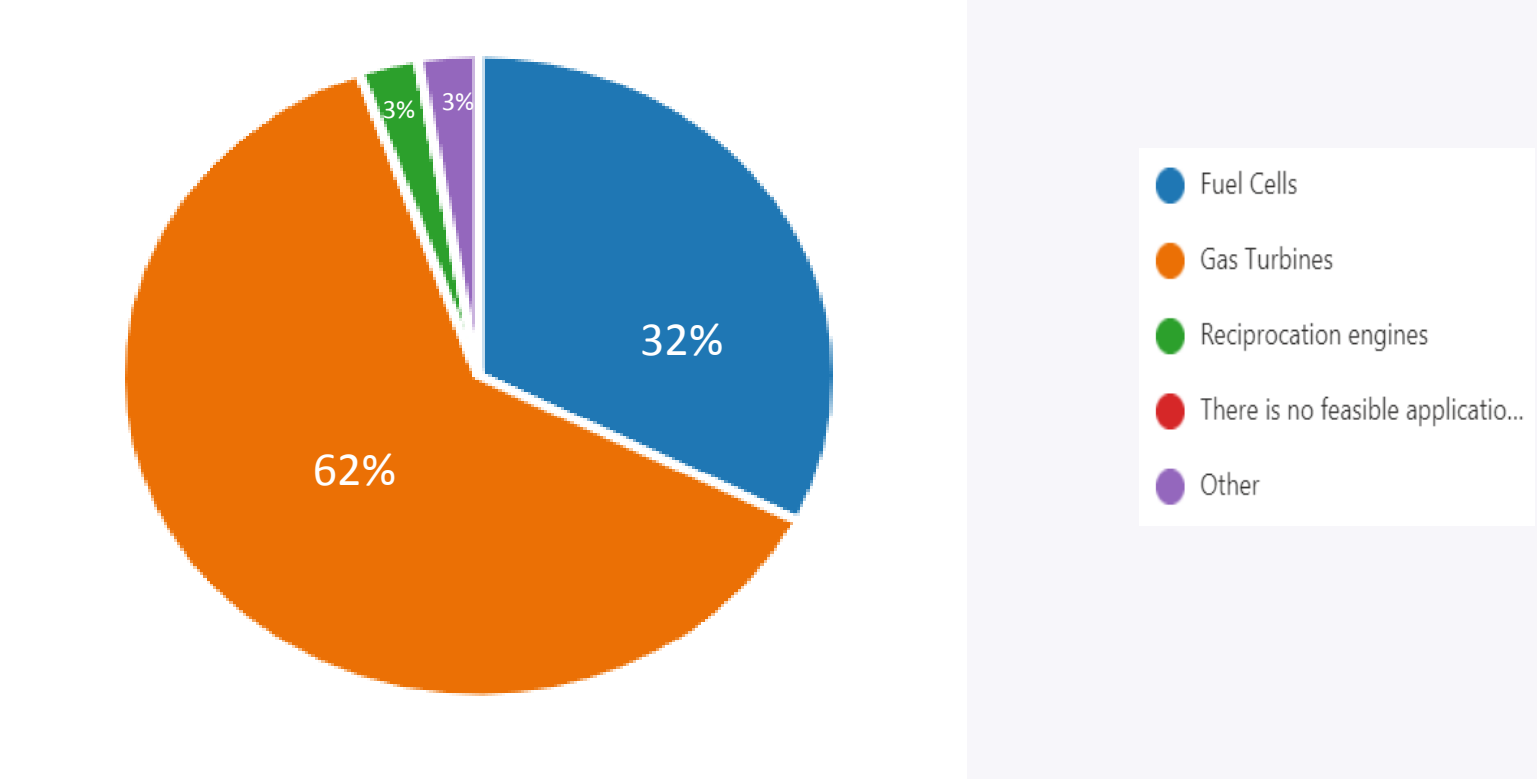


Ranking

1. Green hydrogen
2. Storage
3. Blue hydrogen
3. Pipeline/Transportation
4. Other hydrogen production
5. Long distance transportation in liquid form

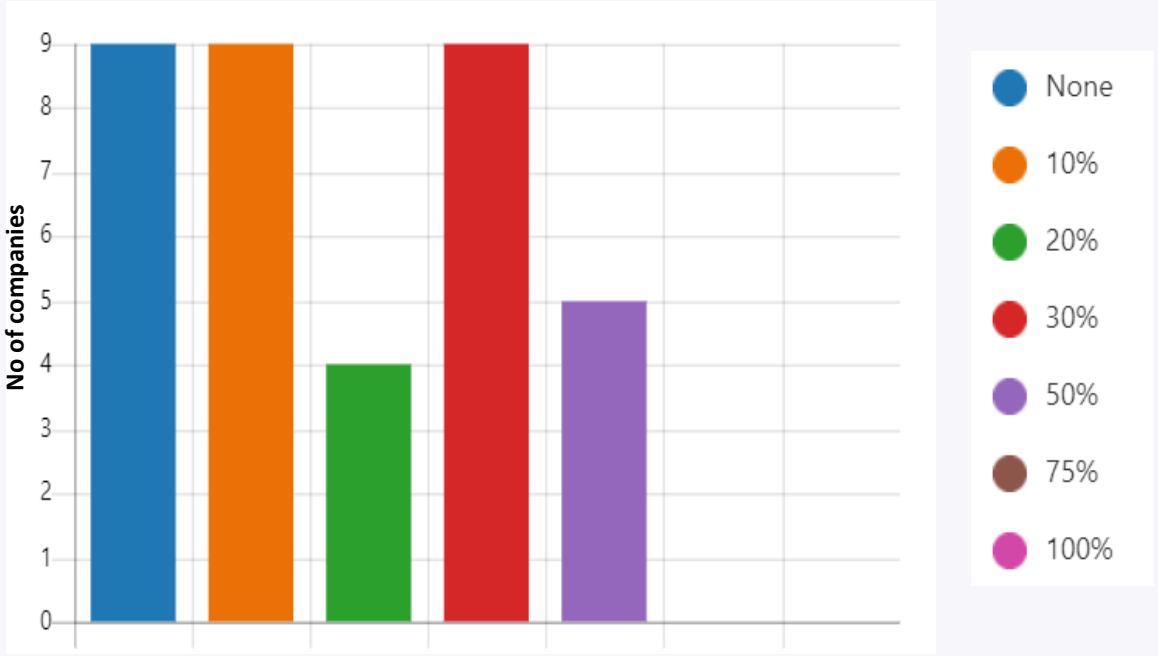
Power Application of hydrogen

What is the best application of hydrogen in power generation?

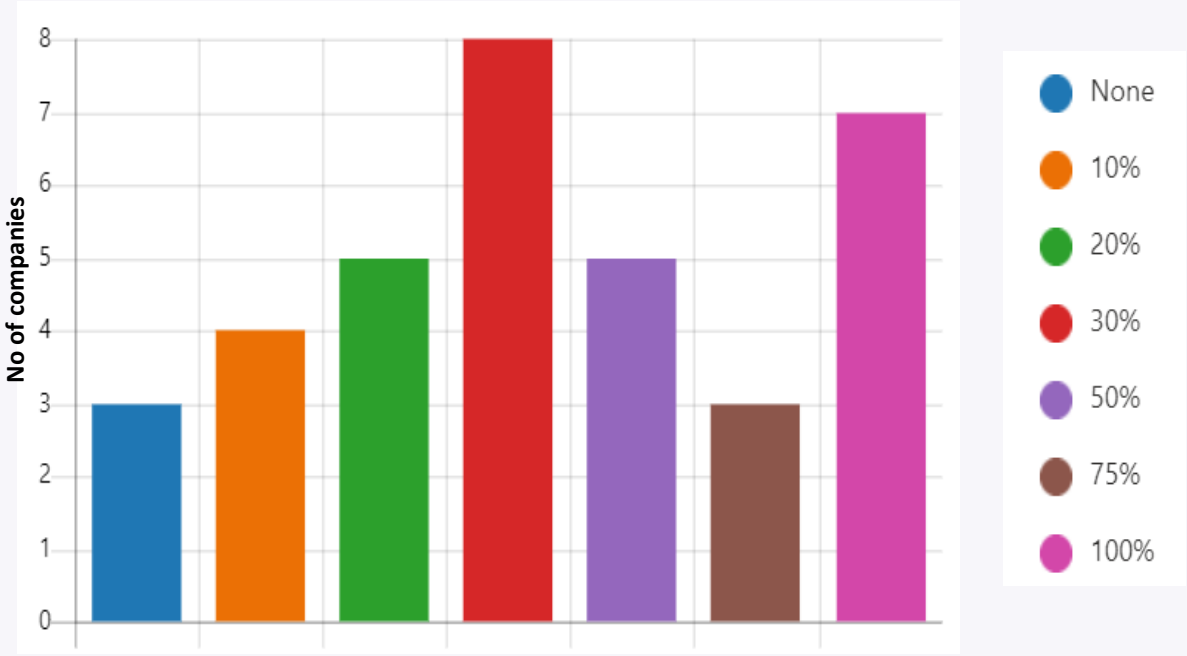


Role of hydrogen in Strategy/Investment

What hydrogen blend by volume will new gas turbines be required to burn in the next **5 years**?

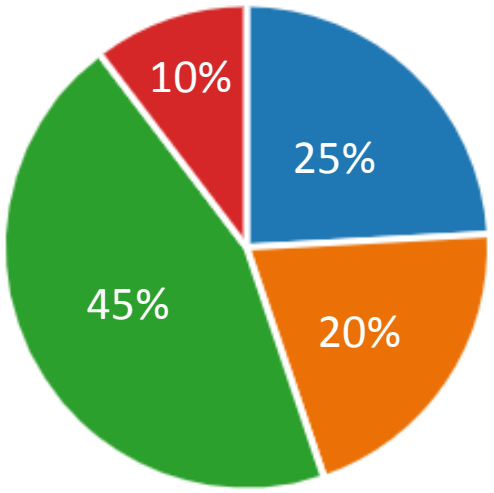


What hydrogen blend by volume will new gas turbines be required to burn in the next **10 years**?



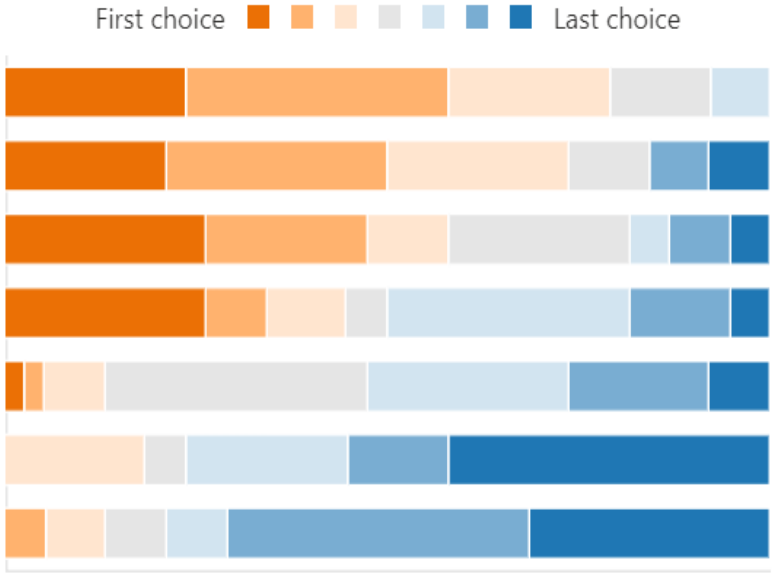
Role of hydrogen in Strategy/Investment

If your company operates gas turbines, do you expect they will be retrofitted to burn hydrogen in the next 10 years?



- No, hydrogen will not be used as a fuel for these units
- No, the existing hardware can tolerate some H2
- Yes, to burn a natural gas/H2 mix
- Other

What is the biggest challenge in using hydrogen in power

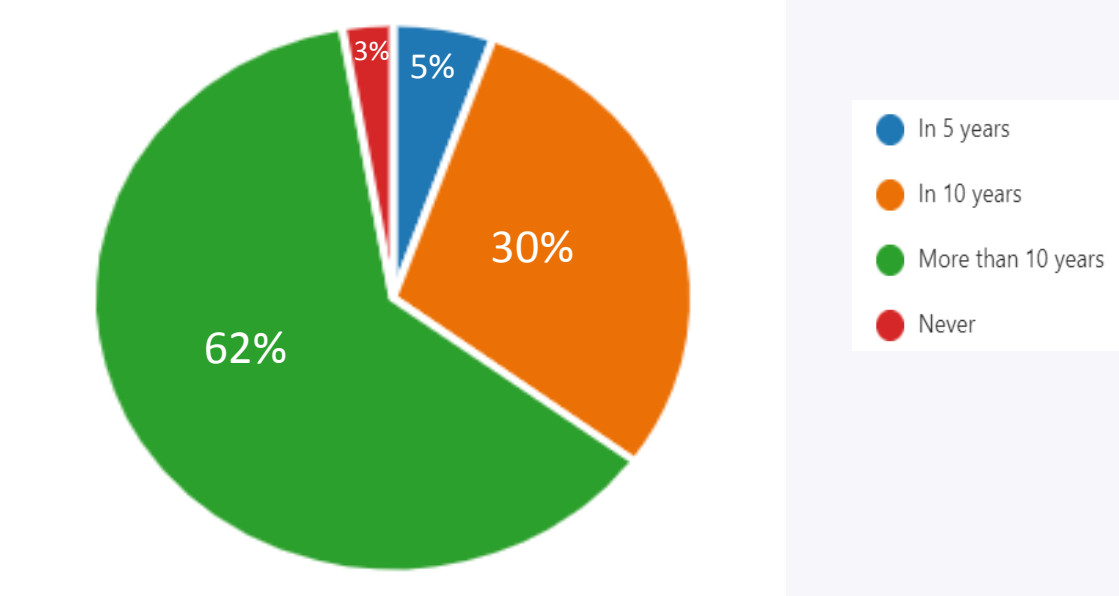


Ranking

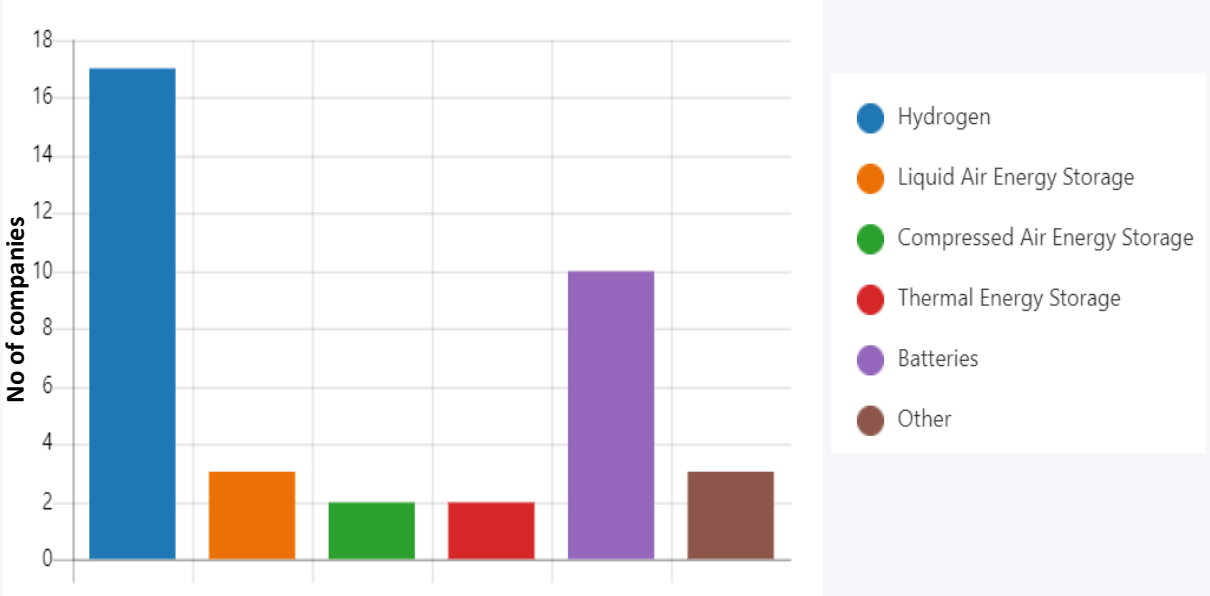
1. Combustion system stability/operation
2. NOx emissions
3. Safety
4. Transportation storage
5. Impact on auxiliary system
6. Reduce Parts Life
7. Compression

Role of hydrogen in Strategy/Investment

When will hydrogen production be cost competitive for power generation without incentives?



Which technology do you see as most promising for long duration energy storage?



Thank you

Contact

If you have any questions on this survey or if you would like to discuss your hydrogen strategy including possible retrofit of your gas turbine fleet, please contact us:

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