

MOBILITY

INDUSTRY

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TREND DEEP DIVE

Alternative Fuels

H2 2019

FutureBridge



WHAT'S NEW?

H2 2019

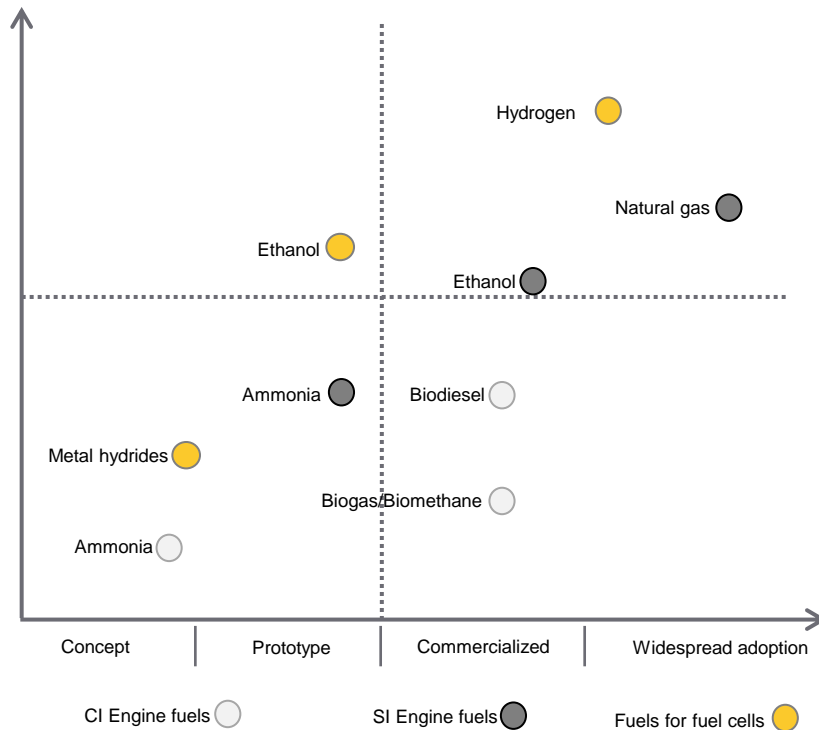
EXECUTIVE LENS

Summarized insights for Alternate Fuels w.r.t. trends in technology, market, and players



State of the Trend

A glimpse of the current landscape of the Alternative Fuels; innovation, investments and technology development.



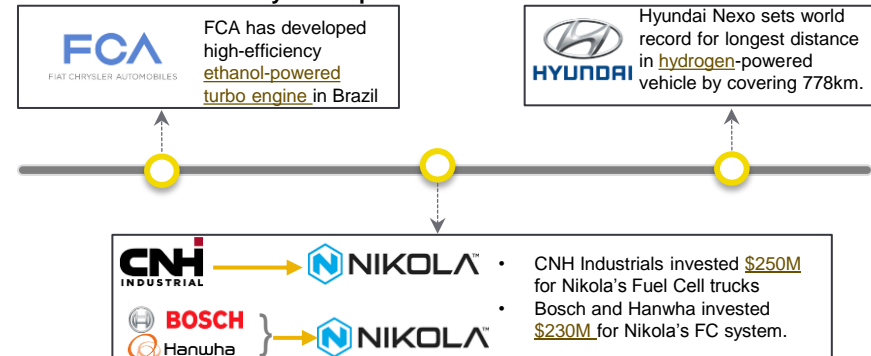
Read more in [Benchmarking section](#)

- Major OEM's such as Toyota, Hyundai and suppliers such as Shell ,Air Liquide are making collaborations for hydrogen mobility.
- Governments are providing subsidies and incentives to promote hydrogen worldwide.
- China is leading in hydrogen fuel cell adoption for transportation. Europe and US developing hydrogen infrastructure.

Hydrogen fuel cell

As world continues to explore various options for reducing carbon and other pollutants from its transportation needs, zero-emission hydrogen-powered fuel cell vehicles (FCVs) are increasingly being adopted to power cars, buses, trucks, trains, boats and everything in between.

Key developments in last 6 months



Emerging Trends

Continuous and sustained efforts by all the pertinent stake holders are shaping the Alternative Fuels landscape

- OEM's and suppliers are forming collaborations and joint ventures to promote hydrogen and fuel cell technology worldwide.
- Researchers are focusing on cost-efficient and sustainable hydrogen production methods.
- Collaborations between OEM's and suppliers are increasing for Biofuels. New inventions such as high efficiency flex-fuel engines and fuel from microalgae are increasing the growth scope of Biofuel adoption.

As Governments mandating emission regulations worldwide, the demand for zero-emissions and renewable alternate fuels increasing day by day.

Players are promoting biofuels through new inventions and collaborations


	<p>Joint venture between Bunge and BP for bioethanol production in Brazil >></p>
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	<p>Mazda and Japanese Universities are developing Biofuel from microalgae >></p>
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	<p>Praj and Dedini cooperation for ethanol production technologies in Brazilian market >></p>
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Read more in [Q3 2019 Pulse - AF](#)

Researchers working for cost efficient hydrogen production to provide non-battery alternative fuel choice


	<p>Researchers are using single enzyme biomineralization process to create photo catalyst for hydrogen >></p>
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	<p>Researchers develop large-scale, economical method to extract hydrogen from oil sands and oil fields >></p>
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	<p>Scientists are using microalgae and micro bacteria to boost hydrogen production >></p>
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Read more in [Q3 2019 Pulse - AF](#)

A strong drive for Hydrogen and Fuel Cells in Japan, EU and US in Q2'19

	<p>JV between Shell, Air Liquide, Linde, Total, Daimler and OMV to develop hydrogen infrastructure in Germany >></p>
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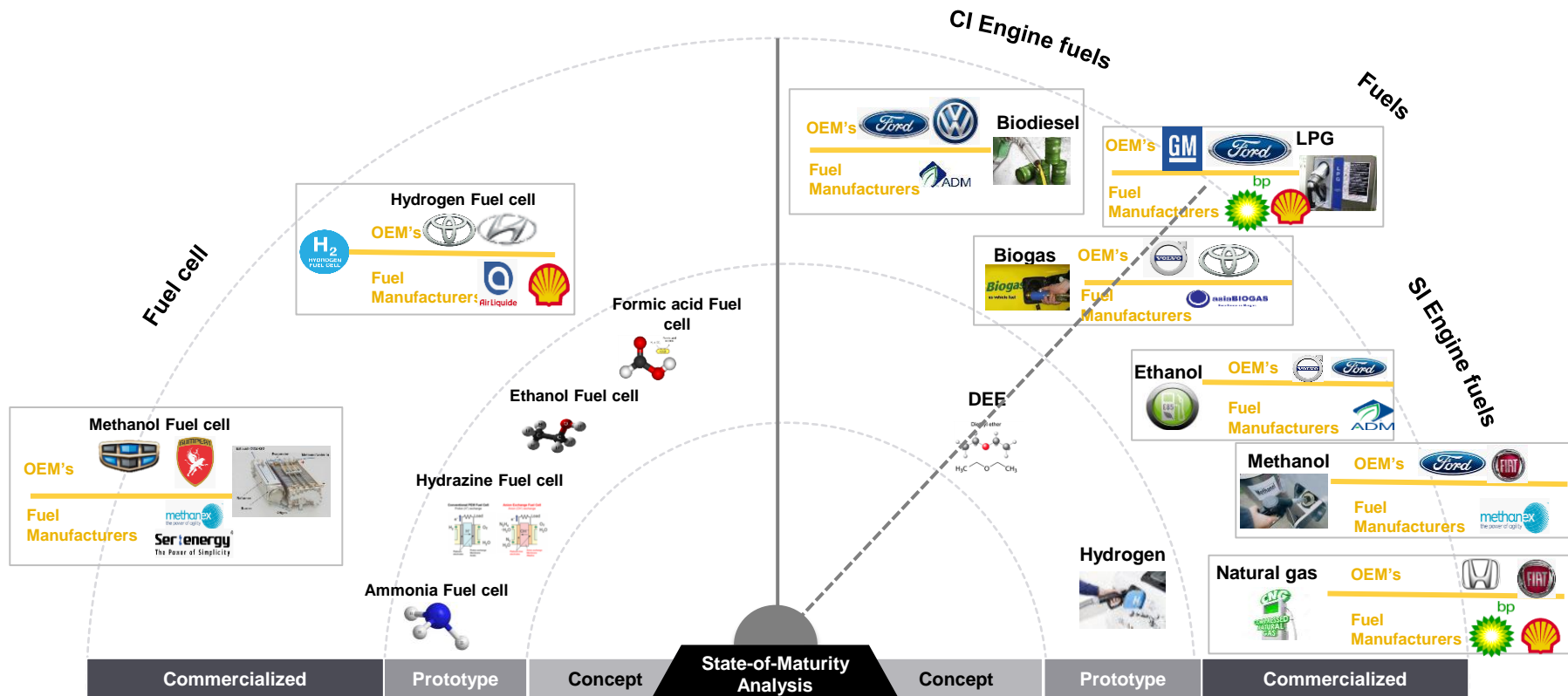
	<p>Shell and Toyota partnership developing hydrogen refueling network in USA >></p>
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	<p>Ballard Power System's H2PORTS project to facilitate hydrogen and fuel cells technology in European ports >></p>
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Read more in [Q2 2019 Pulse - AF](#)

State of Maturity

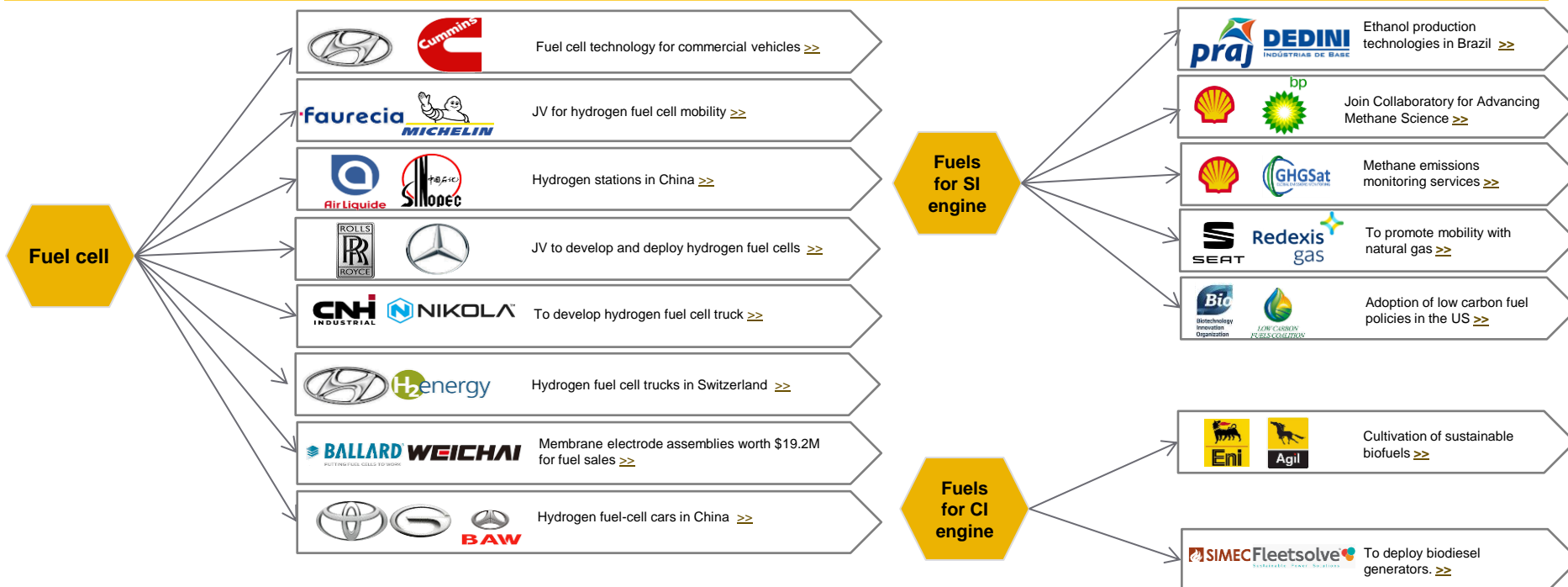
Players are researching more on different types of fuel cell. Government initiatives play a major role in adopting alternate fuels such as ethanol, methanol and hydrogen.



Collaborations

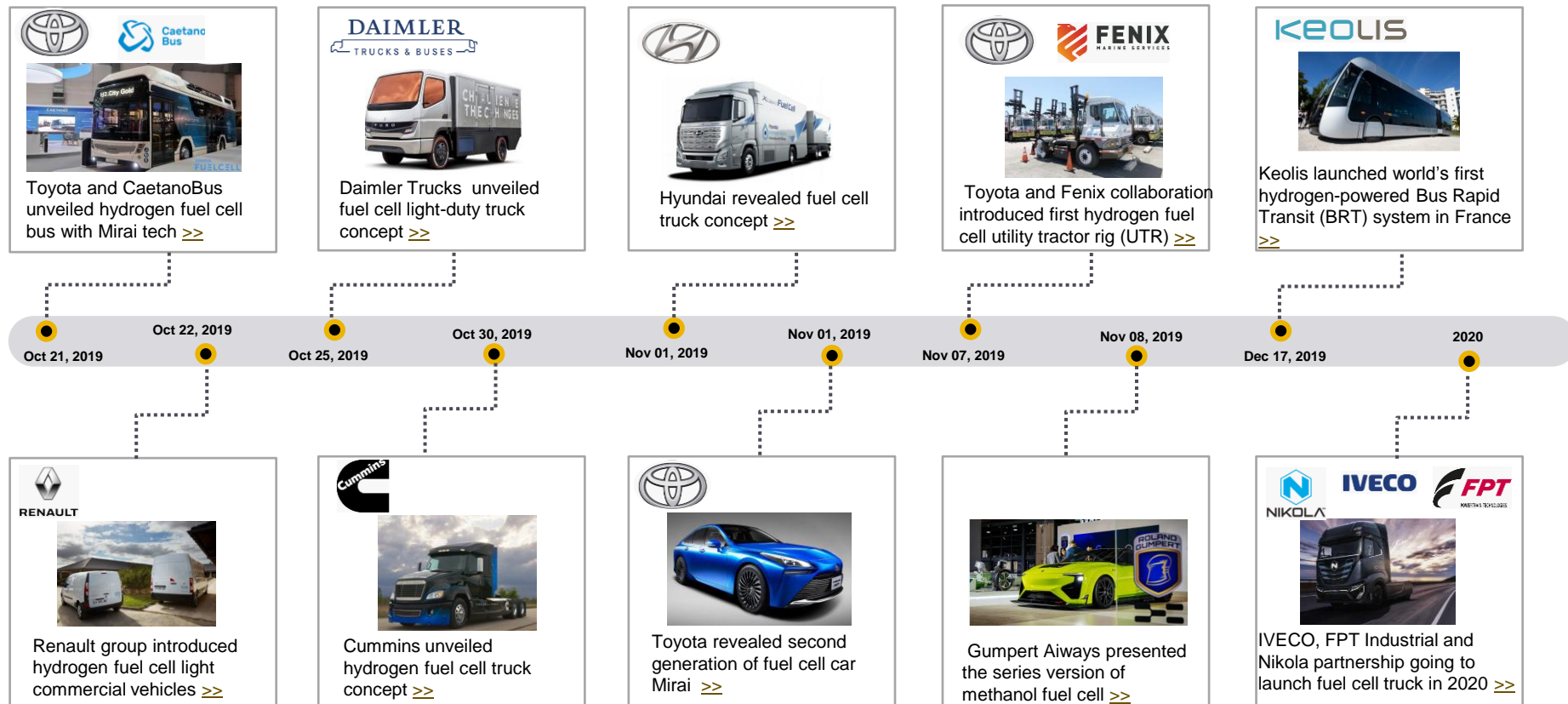
High activity observed in context to hydrogen, fuel cell and methanol.

- Major collaborations are focused towards Hydrogen fuel and fuel cells.
- Major OEM's like Toyota, Hyundai etc., and suppliers like Shell, Eni, BP etc., are focusing more on alternate fuel options .



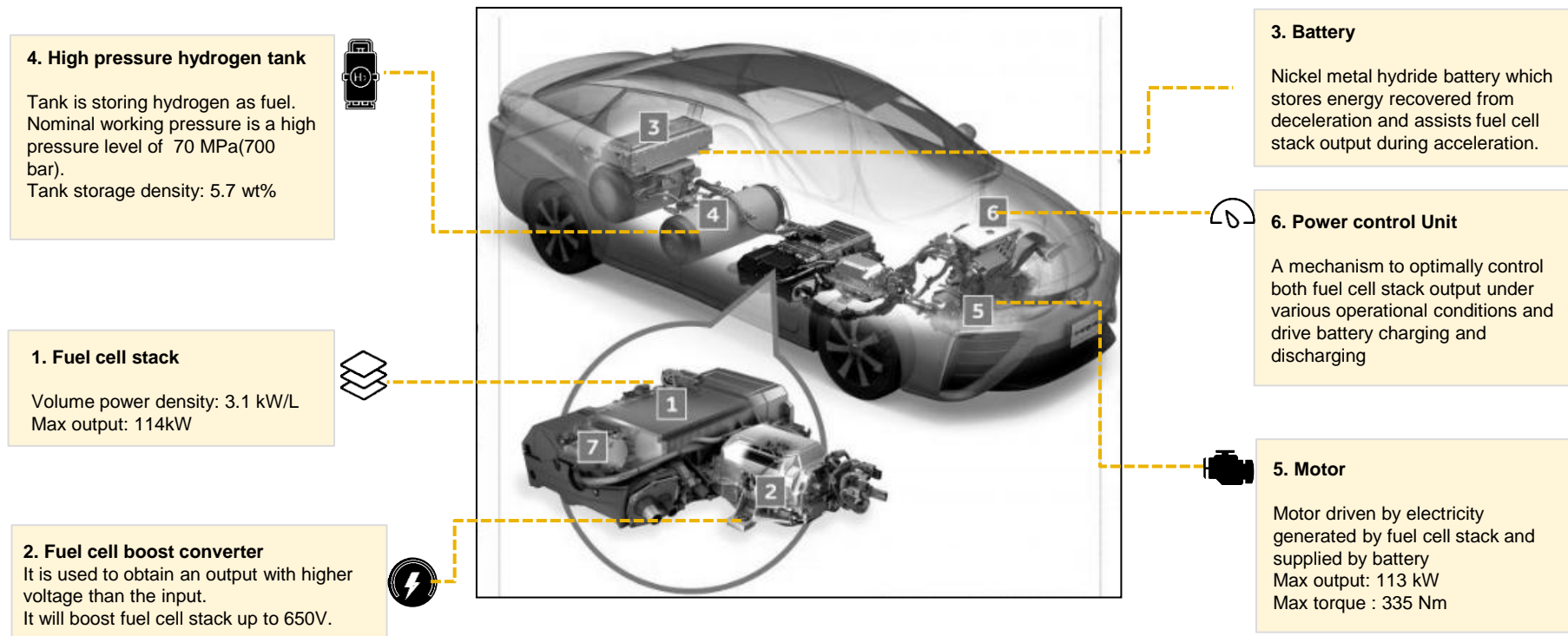
Launches

Major launches happened in H2 2019 vector. Includes fuel cell vehicles and concepts.



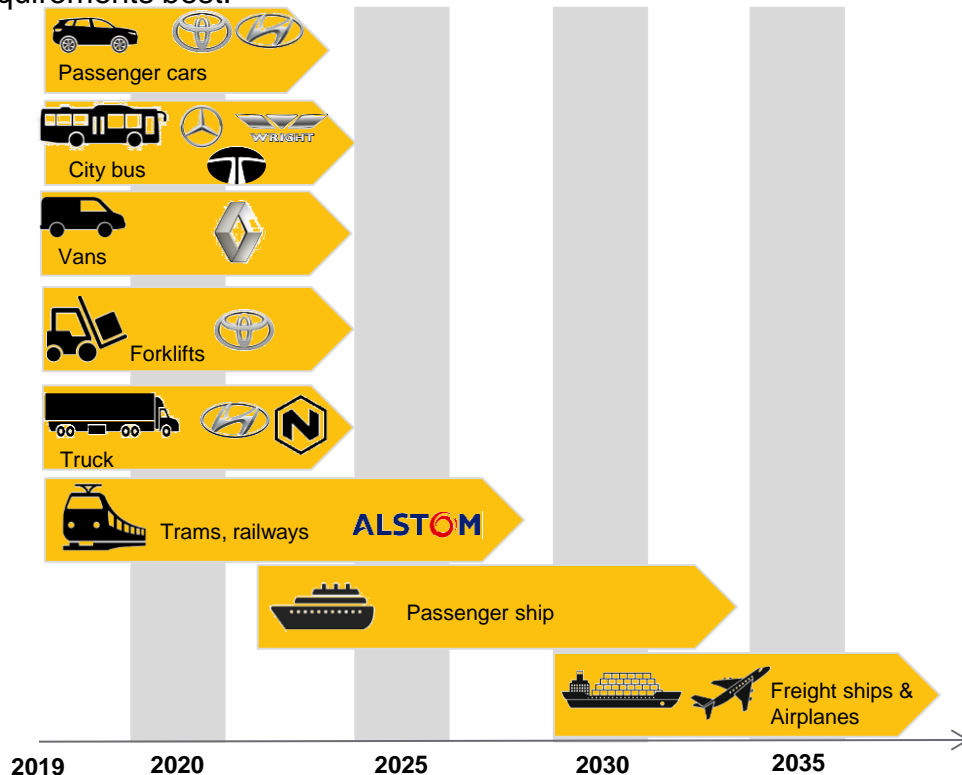
Hydrogen fuel cell vehicle : schematic diagram

Fuel cell system is a hybrid electric technology, with a hydrogen fuel cell stack taking the place of a petrol engine. The fuel cell produces electricity that powers the motor that drives the car, all with no emissions other than water.



Hydrogen fuel cell development forecast in transportation

Hydrogen-powered vehicles are commercially available now or will become available in the next five years in medium-sized and large cars, buses, trucks, vans, trains, and forklifts. In these segments, FCEVs meet the performance and convenience requirements best.



- The transition to hydrogen would also create opportunities for sustainable economic growth.
- As the technology reaches mass markets, it would create sustainable value chains that do not require further government support.
- Hydrogen fuel cell costs, which is the main barrier for global adoption of fuel cells, are likely to drop with scale, as researchers are focusing more on this.
- By 2030 larger world economies could be powered by Hydrogen and it will be using in heavy duty applications, trains and passenger ships.
- Beyond 2030, hydrogen will increasingly be used to create renewable synthetic fuels to decarbonize commercial aviation and freight shipping, which are harder to decarbonize using pure hydrogen and fuel cells.

2030 Milestones

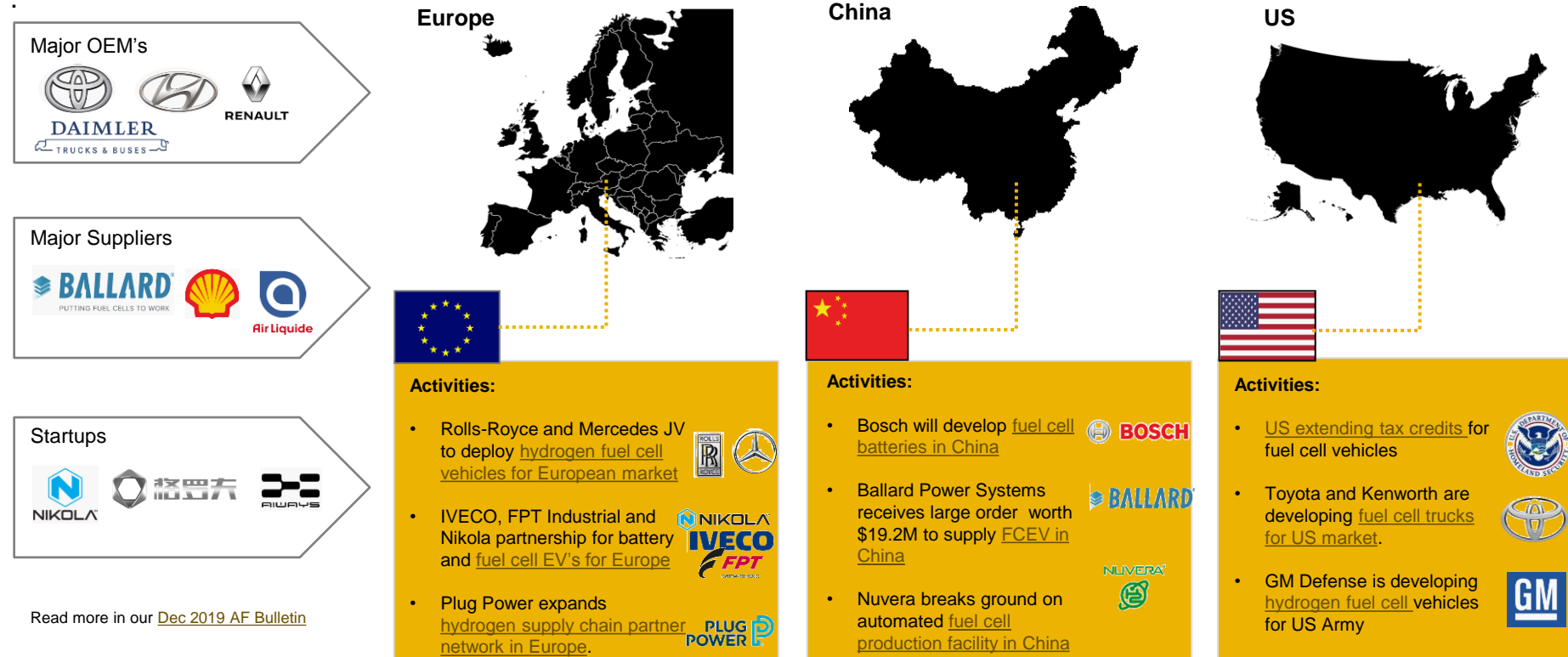
- 1 in 12 cars in Europe, US and Asia powered by Hydrogen
- Globally 10-15 M cars and 500,000 trucks powered by hydrogen
- Deployment of hydrogen powered ships and aero planes

2050 Target pictures

- 1 in 12 cars in Europe, US and Asia powered by Hydrogen
- Globally 10-15 M cars and 500,000 trucks powered by hydrogen
- Deployment of hydrogen powered ships and aero planes

Hydrogen & Fuel cell technology : region wise activities by players

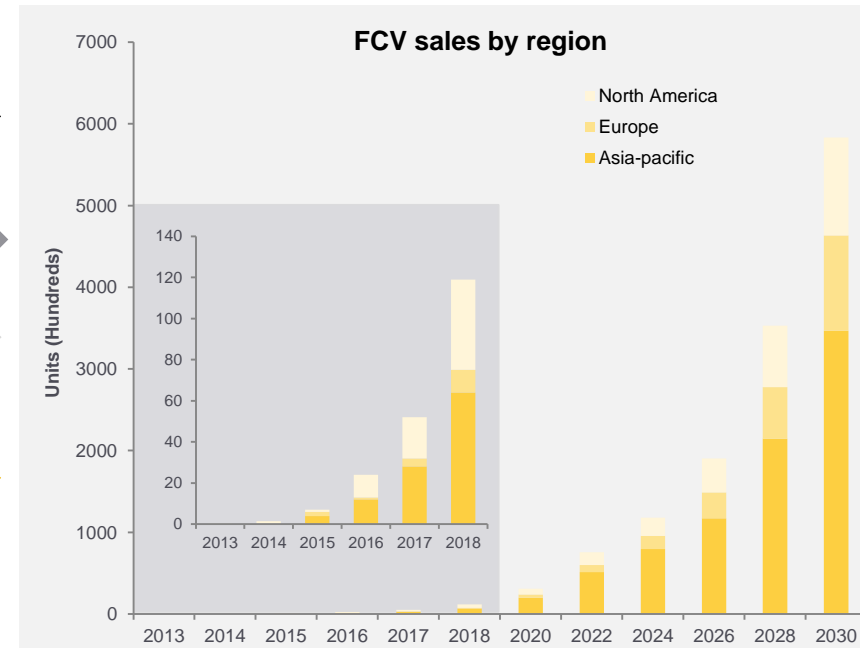
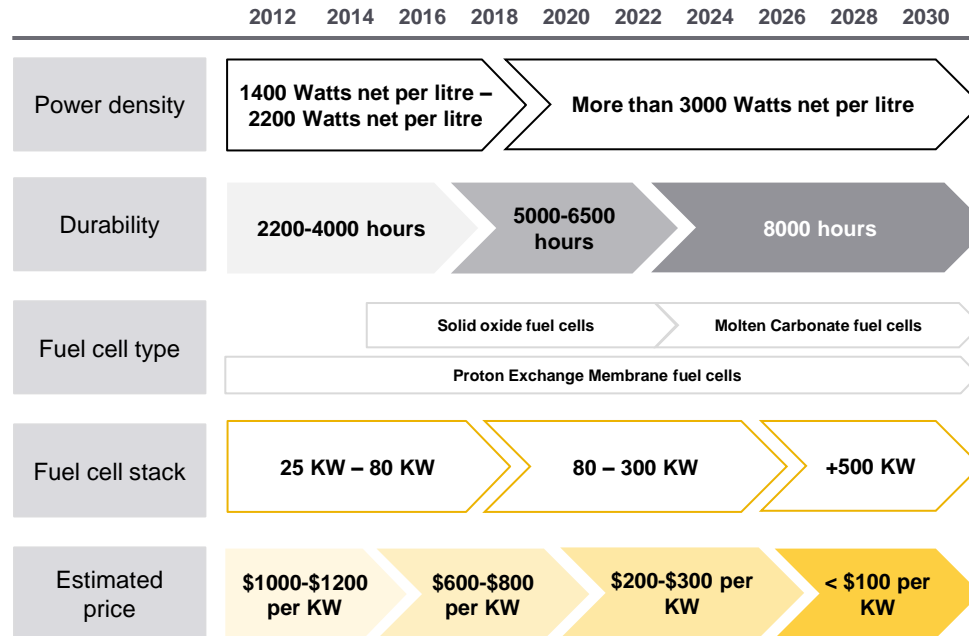
As part of China's plan, the government has put a strong focus on fuel-cell electric vehicles (FCEV) which can travel farther and are refueled in a similar way to diesel and petrol cars. Even though China is the global leader in fuel cell tech, Europe and US improving their competency by developing new FCEV's and hydrogen infrastructure.



Read more in our [Dec 2019 AF Bulletin](#)

Fuel cell passenger car global market scenario (2013-2030)

Technology roadmap and vehicle sales forecast



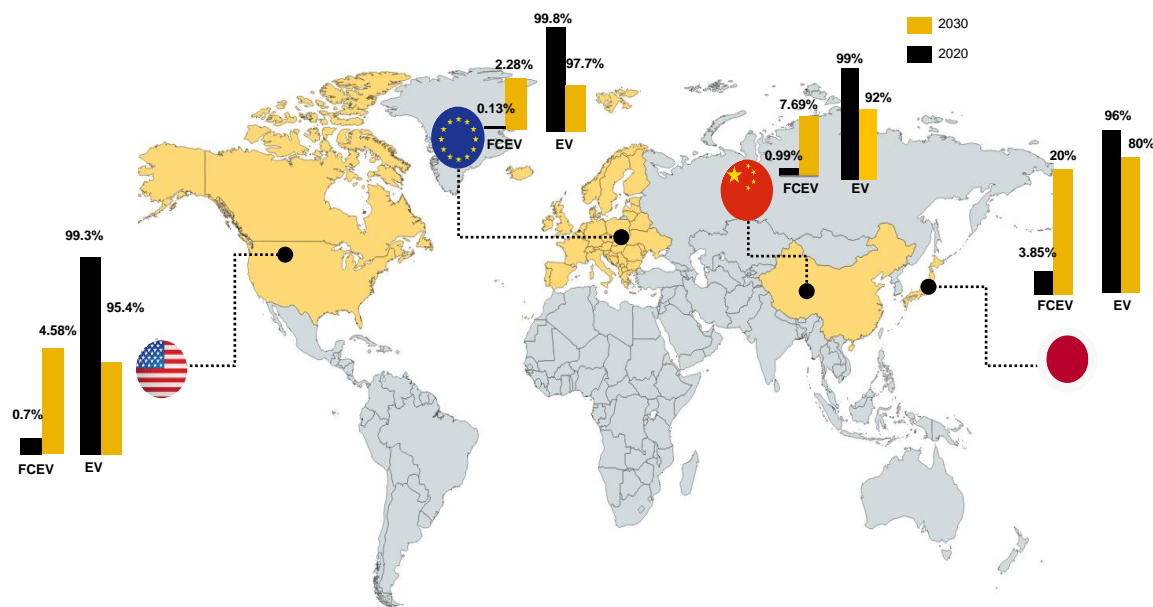
- Global adoption of FCEVs in emerging markets will be driven by strong incentives and government policies that will boost consumer acceptance and higher private investments by companies.
- Asian OEMs with a first mover advantage are expected to dominate the market. (unit sales of Toyota FCEVs are projected at 165,000 and Hyundai FCEVs at 148,000 by 2030)

Source: <https://www.openaccessgovernment.org/vehicle-technology/52116/>

Hydrogen fuel cell vehicle sales future forecast 2020-2030

Asia-pacific region(China and Japan) will have major share in FCEV market. Europe and US lags behind due to lack of refueling infrastructure

Electric vehicle v/s Fuel cell electric vehicles sales comparison forecast



- Market for hydrogen FCEVs is small but is expected to grow by 2030
- China and Japan will have major share in fuel cell electric vehicle sales since they promote hydrogen over EV.
- Well established network of hydrogen refueling stations will be a key factor in determining the future of hydrogen as a fuel.
- Comparing conventional fuel storage systems, Hydrogen Storage is expensive
- Low-cost materials /components and large-volume production methods will make hydrogen as more viable fuel.
- More research from OEM's and suppliers are focusing on this area.

Activities of major Energy players on Alternate fuels

Key players are enhancing their competency by developing alternate fuel options viz. hydrogen, natural gas, biofuels etc., from fossil fuels.



- Shell has constructed a hydrogen electrolysis plant in collaboration with ITM Power >>
- Shell and BP join Collaboratory for Advancing Methane Science >>
- GHGSat and Shell sign framework agreement for methane emissions monitoring services >>



- Bunge and BP team up for Brazil sugar and ethanol venture >>
- Shell and BP join Collaboratory for Advancing Methane Science >>
- BP strikes out CO2 and Natural gas in offshore oil exploration >>



Air Liquide



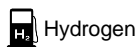
- Air Liquide and Sinopec sign MoU to accelerate hydrogen in China >>
- Air Liquide will invest \$270M in Air separation unit and will support Methanex for Methanol production >>
- Air Liquide planning to build new hydrogen production plant in Las Vegas >>



Eni



- Eni signs MoU to investigate castor cultivation for sustainable biofuels in Tunisia >>
- MIT and Eni renew low-carbon energy research collaboration >>
- Eni and PetroChina have bid in \$6Bn Pakistan LNG Tender >>



Hydrogen



Biofuel



Natural gas

For more data [2019 AF TDD ExL](#)

Hydrogen Infrastructure Development – Hydrogen distribution

Hydrogen refueling station roll-out started in Japan, Europe (Germany, UK) and USA(California and North Eastern States).



R&D and manufacturing

Hydrogen production

Hydrogen storage and buffering

Hydrogen distribution and retail

USA/California

- 2018 : 50 H₂ stations (CA)
- 2020 : 100 H₂ stations (CA, NY)



China

- 2018 : 14 H₂ stations
- 2030 : 1000 H₂ stations
- Large incentives for building H₂ stations



Japan

- 2018 : 100 H₂ stations
- 2025 : 800 H₂ stations
- 2030 : 1000 H₂ stations



Europe

- 2018 : 110 H₂ stations
- 2025 : ~800 H₂ stations
- 2030 : 3700 H₂ stations



South Korea

- 2018 : 15 H₂ stations
- 2030 : 1000 H₂ stations
- Hydrogen infrastructure initiative pending



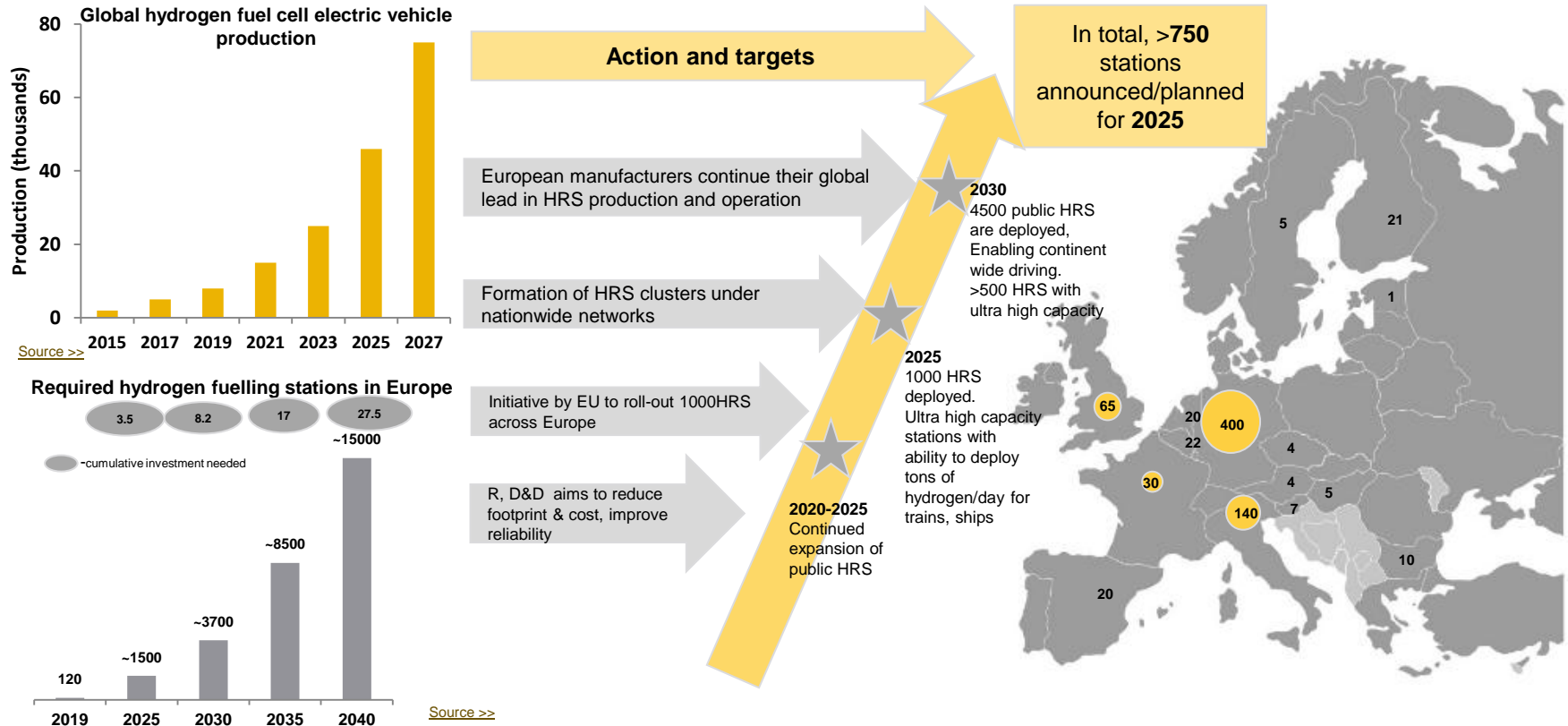
Hydrogen infrastructure networks continue to be developed in areas where vehicle manufacturers, hydrogen providers, and governments share an interest in paving the way for greater fuel cell vehicle deployment.

Infrastructure development necessitates rapid investment and coordination of many stakeholders including fuel and equipment providers.

Hydrogen fuel infrastructure forecast in European region

EU is in a transition phase towards hydrogen mobility. More hydrogen refueling stations are establishing across Europe.

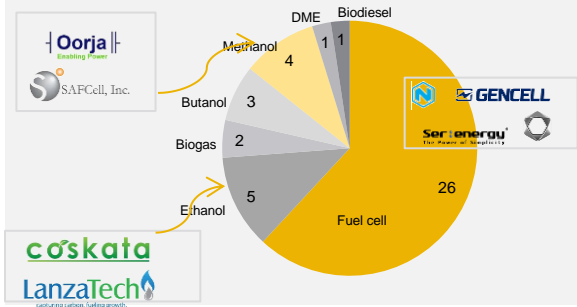
Hydrogen fuel infrastructure forecast in 2025



Startups Summary

- Majority startups work on Fuel cells, especially Hydrogen and *Out of 40 startups 15 are US based and 6 are Europe based*
- Methanol fuel cell technology and Solid oxide fuel cell technology is growing faster and the startups with these technologies are gaining more funding.

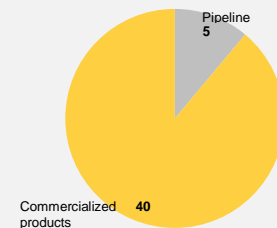
Startups in AF by technology



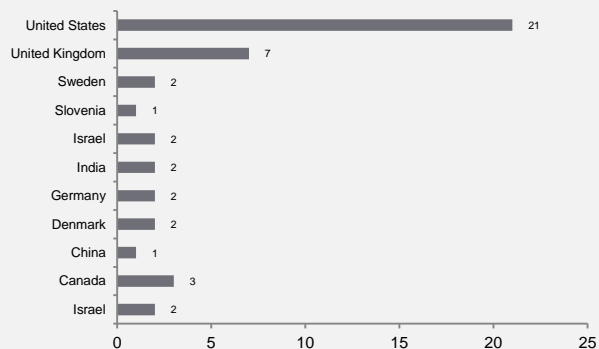
Some key startups active in H2 2019



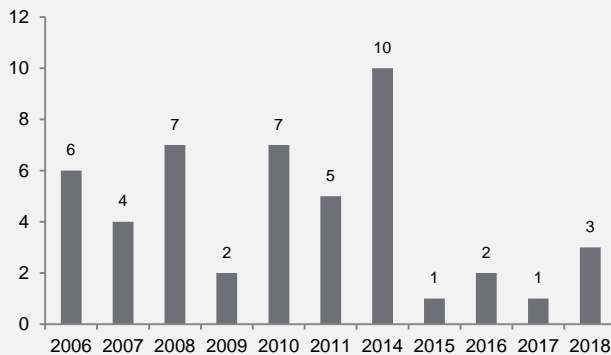
Startups by state of maturity of products



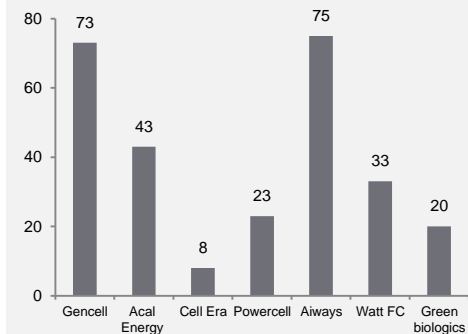
Startups by geography



Startup incorporation



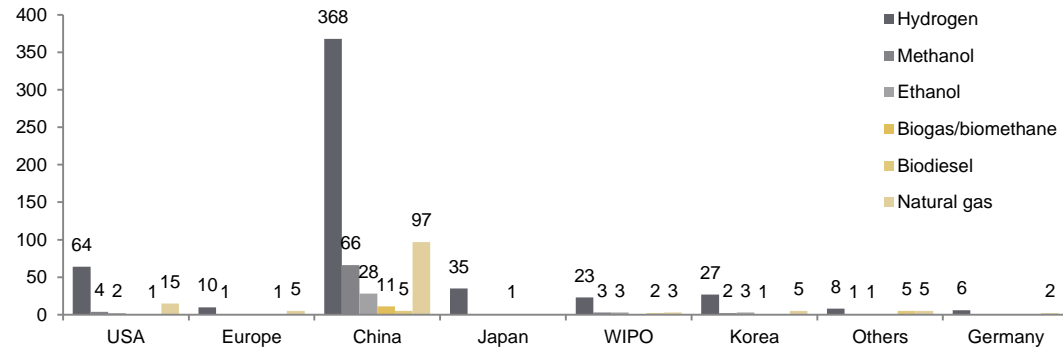
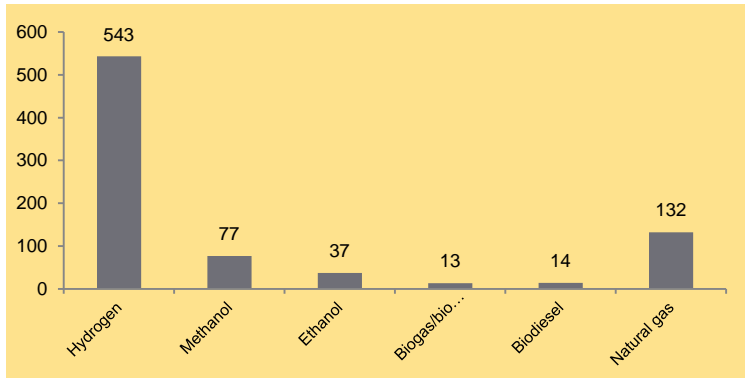
Number of patents by startup



See our [Startup tracker AF](#)
Strictly Confidential FutureBridge

Patent Summary

• Patent landscape scenario for Alternate fuels for the past Six months

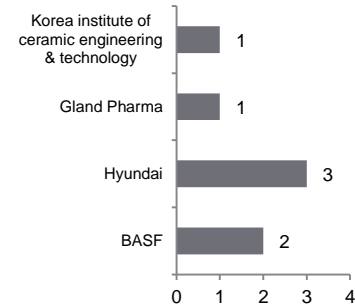
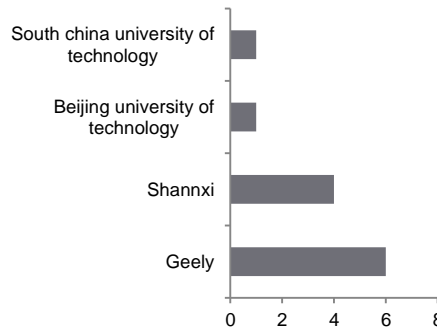
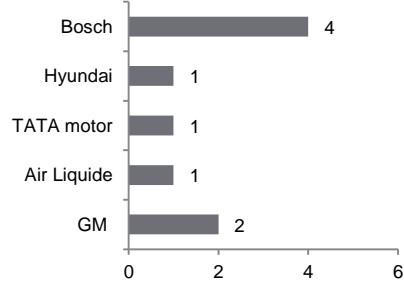
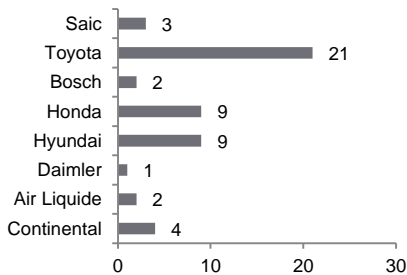


Hydrogen Fuel

Natural Gas

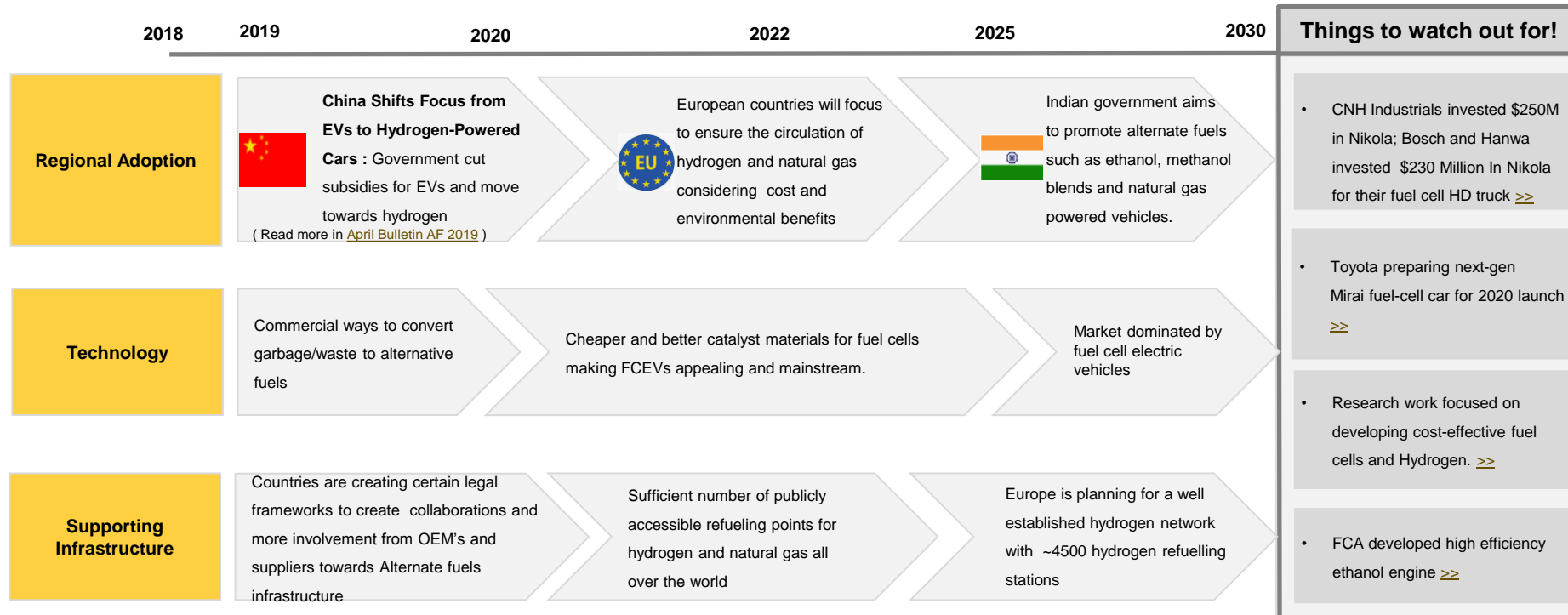
Methanol

Ethanol



Outlook

Countries across globe focusing on developing a cost effective robust ecosystem around the production, supply & consumption



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