AIR POLLUTION – THE SILENT KILLER

Every year, around **7 MILLION DEATHS** are due to exposure from both outdoor and household air pollution.

Air pollution is a major environmental risk to health. By reducing air pollution levels, countries can reduce:

- **Stroke**
- **Heart disease**
- **Lung cancer, and both chronic and acute respiratory diseases, including asthma**

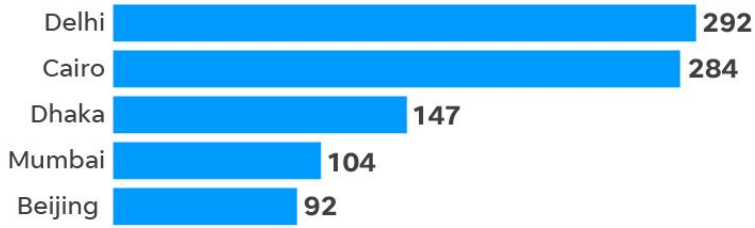
REGIONAL ESTIMATES ACCORDING TO WHO REGIONAL GROUPINGS:

- **Over 2 million** in South-East Asia Region
- **Over 2 million** in Western Pacific Region
- **Nearly 1 million** in Africa Region
- **About 500 000** deaths in Eastern Mediterranean Region
- **About 500 000** deaths in European Region
- **More than 300 000** in the Region of the Americas

CLEAN AIR FOR HEALTH #AirPollution World Health Organization

World's top 5 most polluted megacities

Based on the number of particles of pollution per cubic meter. Megacities are those with at least 14 million people.



SOURCE World Health Organization, 2010-2016
Frank Pompa/USA TODAY

Fourteen out of the world's most-polluted 20 cities are in India

City	*PM2.5	City	*PM2.5
Kanpur	173	Gurgaon	113
Faridabad	172	Jaipur	105
Varanasi	151	Patiala	101
Gaya	149	Jodhpur	98
Patna	144	Baoding	93
Delhi	143	Ulaanbaatar	92
Lucknow	138	Hengshui	87
Agra	131	Xingtai	87
Muzaffarpur	120	Anyang	86
Srinagar	113	Liaocheng	86

*(Annual mean, ug/m3)

Source: World Health Organization

BBC

NATIONAL GEOGRAPHIC

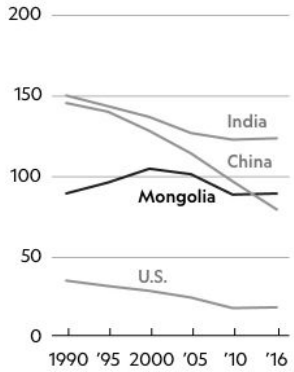
A two-year-old girl is treated for pneumonia in the intensive care unit of an Ulaanbaatar hospital. On her forehead is a smudge of coal ash applied by her mother to ward off evil spirits. It's air pollution from coal burning, however, that has caused the incidence of pneumonia and other respiratory illnesses to spike in the Mongolian capital, especially among children.

ENVIRONMENT | THE CITIES ISSUE

Kids suffer most in one of Earth's most polluted cities

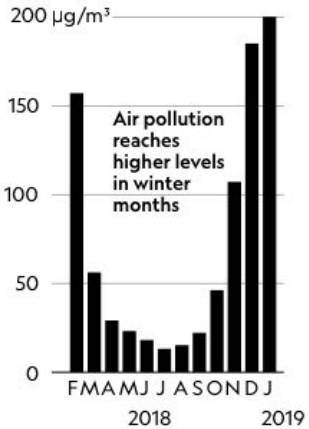
In winter, coal stoves and power plants choke Mongolia's capital, Ulaanbaatar, with smoke—and lung disease.

Death rate from air pollution
(per 100,000 people)



The 10 most polluted capitals in 2018
Annual average levels of PM2.5,
in micrograms per cubic meter (µg/m³)

Monthly PM2.5 in Ulaanbaatar



RYAN MORRIS, NGM STAFF
SOURCES: OPENAQ; IQAIR AIR VISUAL 2018 WORLD AIR QUALITY REPORT; MONGOLIA NATIONAL AGENCY FOR METEOROLOGY AND ENVIRONMENTAL MONITORING; U.S. EMBASSY IN ULAANBAATAR AIR QUALITY MONITORING PROGRAM; WORLD HEALTH ORGANIZATION; INSTITUTE FOR HEALTH METRICS AND EVALUATION

HYDROGEN

TRANSPORTATION FUEL FOR INDIA

Presented by:

NAMIT MUNSHI
DIRECTOR, NISHAL GROUP

NISHAL GROUP

Nishal is a diversified group that has evolved as dominant player across various business areas since three decades. Incorporated in 1979, we offer a range of products, solutions and services that meet the requirements of a diverse set of consumers across multiple industries. We are leading suppliers, distributors and service providers of high performance solutions for variety of industries based on years of experience and expertise.

CHEMICALS

FUEL CELLS

HYDROGEN

LNG

Head Office : Mumbai, India
Network : 4 Branch Offices and 1 Fabrication Facility

HYDROGEN GAS – PROPERTIES

- Hydrogen, or H_2, is the lightest of all gases and the most abundant element in the universe
- Colorless, odorless, tasteless and non-toxic
- Hydrogen has the highest specific energy content per unit mass among known fuels with 120.7 MJ/kg (Methane - 50 MJ/kg; Petrol - 43 MJ/kg)
- Hydrogen is lighter than air and diffuses rapidly - it rises 2 times faster than helium and 6 times faster than natural gas

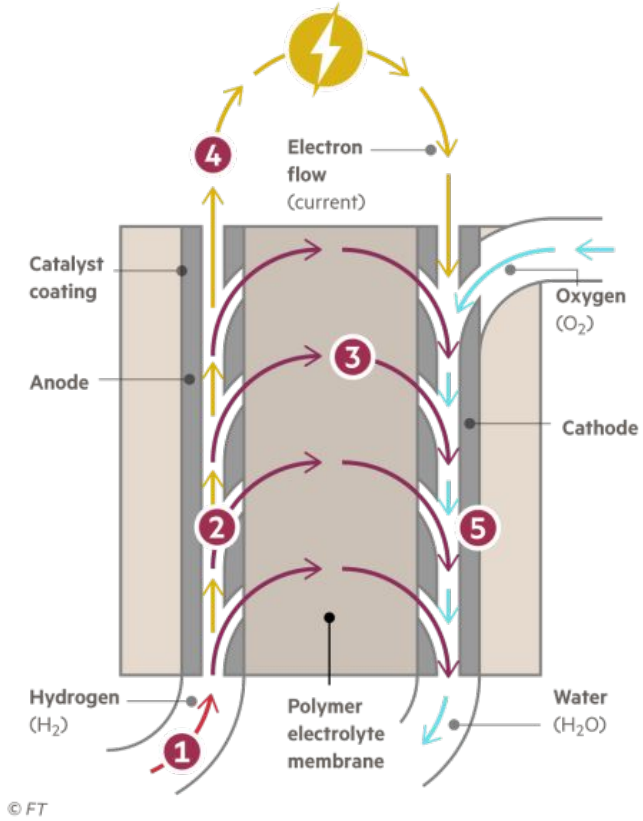
HYDROGEN GAS – SAFETY DATA

Hydrogen car (L), gasoline car (R) - Photo from a video that compares fires from an intentionally ignited hydrogen tank release to a small gasoline fuel line leak.

- At the time of this photo (60 seconds after ignition), the hydrogen flame has begun to subside, while the gasoline fire is intensifying
- After 100 seconds, all of the hydrogen was gone and the car's interior was undamaged. (The maximum temperature inside the back window was only 67°F). The gasoline car continued to burn for several minutes and was completely destroyed.

Photo/Text: Dr. Swain, University of Miami

WHAT IS A FUEL CELL?

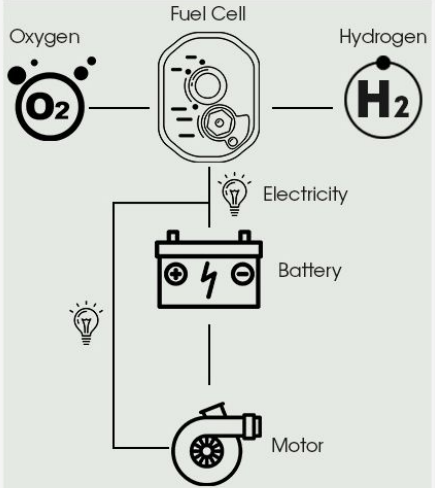


1. Hydrogen gas enters the anode side of the fuel cell
2. It reacts with the platinum catalyst coating the anode, which strips the hydrogen of its electrons
3. The hydrogen ions pass through an electrolyte membrane to the cathode
4. The electrons cannot pass through the membrane so flow around it in an electrical circuit, generating the driving power
5. At the cathode, the catalyst causes the ions and electrons to bond with oxygen from the air to form water vapour – the only byproduct of the process

HYDROGEN EV vs BATTERY EV

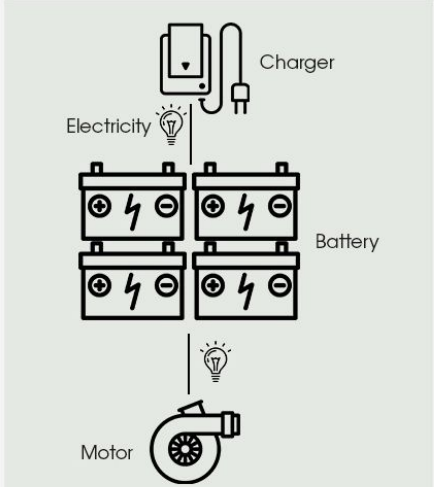
hydrogen

Hydrogen & oxygen are sent to the FC stack.
A chemical reaction produces electricity & water.
Electricity is sent to the motor.



electric

Electric cars get power from rechargeable batteries, which then power the motor.



HYDROGEN EV vs BATTERY EV

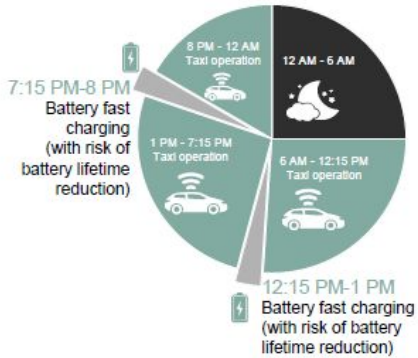
NISHAL™

FASTER REFILLING TIME

Example: airport shuttle

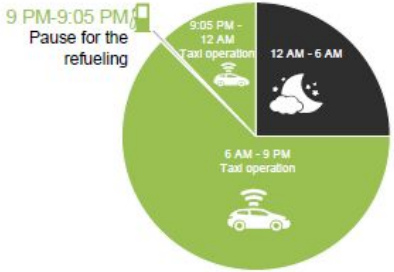
Recharging time required for BEV

60 to 90 minutes per day[1]



Refueling time required for FCEV

~5 minutes per day



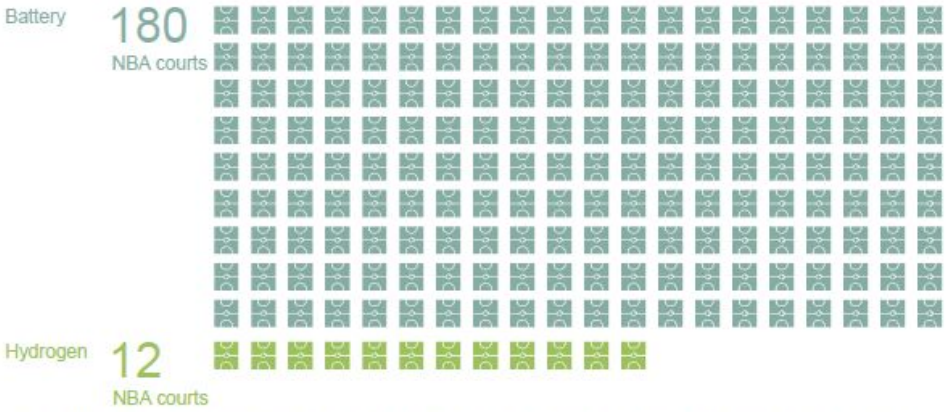
1 Depending on availability of fast charging infrastructure

9 BEV with 18 kWh/100 km consumption and average speed of 30 km/h, equaling a consumption of 5.4 kWh per hour; 2 kW additional consumption from level 5 technology would increase the consumption by 35 percent.
Source: Bloomberg; expert interviews; Wired

LOWER FOOTPRINT

Example: New York City cabs[1]

Charging stations for all NYC cabs would take up space equal to …



1 Number of taxis and cabs: ~74,000; annual mileage per taxi 70,000 miles; refueling times FCEVs 0.02 minutes/mile, BEVs 0.26 minutes/mile; area for one fueling station 30 m²; size of NBA court (436 m²; 26.7 x 15.2 m)

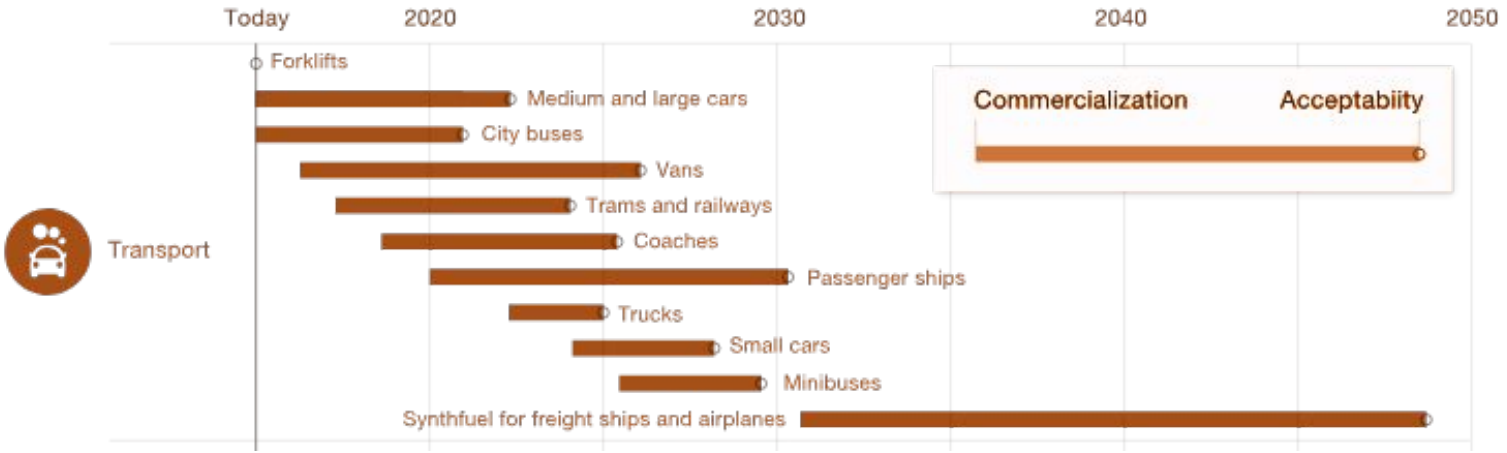
SOURCE: EPA; Curbed New York; NBA; New York City Taxi and Limousine Commission; Tesla

H_2 AS A TRANSPORT FUEL

NISHAL™

Hydrogen adoption could start with passenger cars and buses.

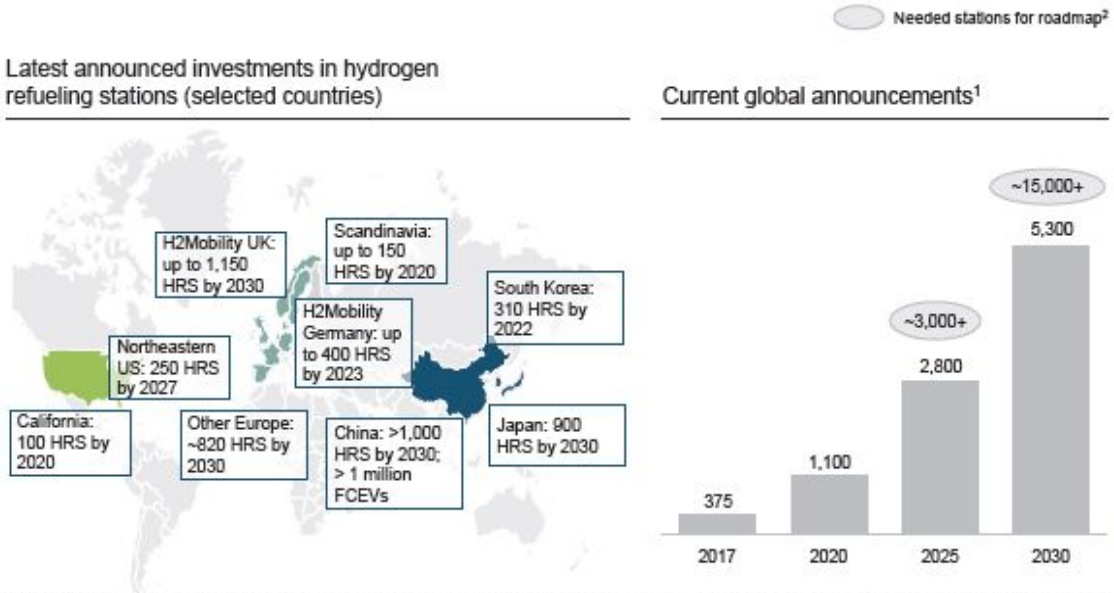
Hydrogen use from initial commercialization to mass-market acceptability, years



Source: https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/hydrogen-the-next-wave-for-electric-vehicles

HYDROGEN REFUELING STATION (HRS) - DEVELOPMENTS

More than 5,000 hydrogen refueling stations have been announced



1 Announcements for shaded countries/regions: California, Northeastern US, Germany, Denmark, France, Netherlands, Norway, Spain, Sweden, UK; Dubai; China, Japan, South Korea
2 Equivalent number of large stations (1,000 kg daily capacity)

SOURCE: Air Liquide; Honda; Hydrogen Mobility Europe; H2Mobility; E4tech; NREL; web search

Source: http://hydrogencouncil.com/wp-content/uploads/2017/11/Hydrogen-scaling-up-Hydrogen-Council.pdf


Hyundai Fuel Cell Electric Truck


CREATING A ZERO-EMISSIONS WORLD


U.S. XPRESS
NIKOLA ONE

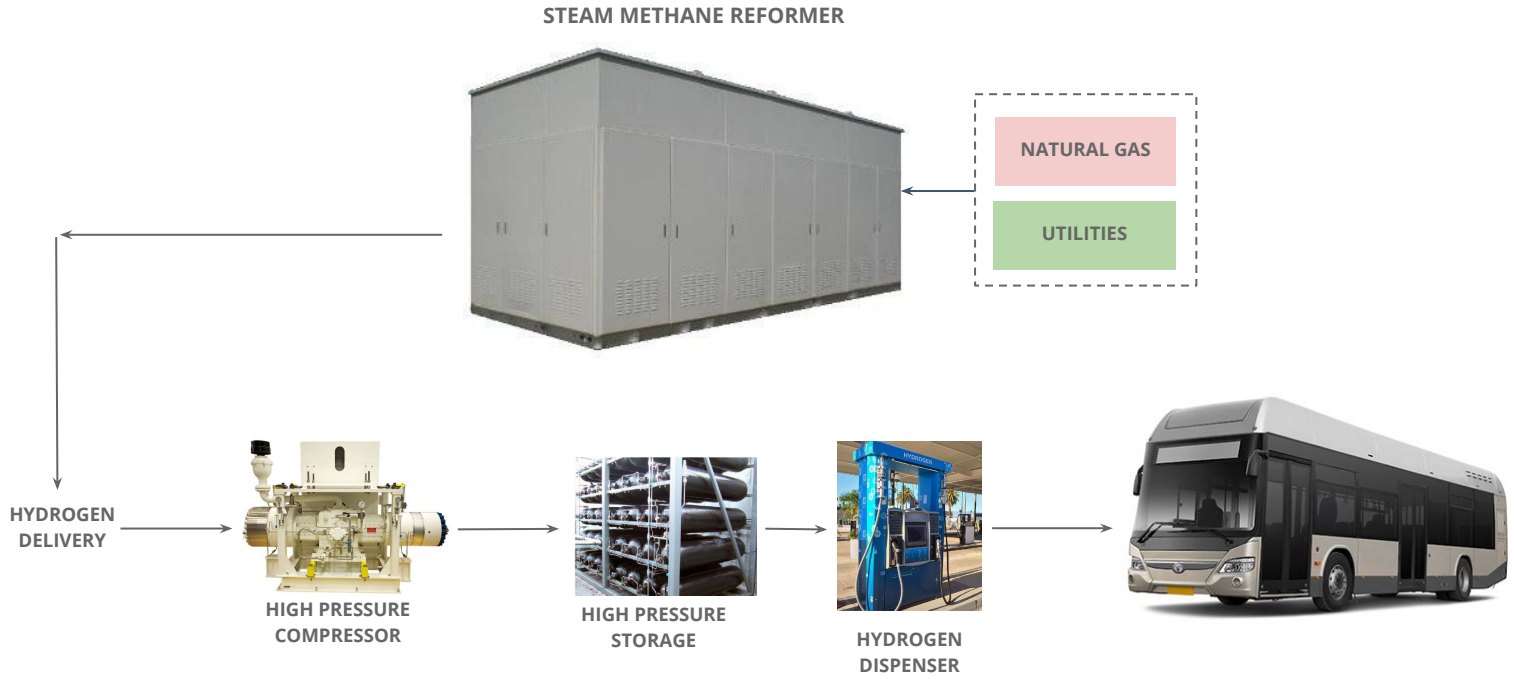

F-CELL


Fuel Cell Bus
Mercedes-Benz
CITARO

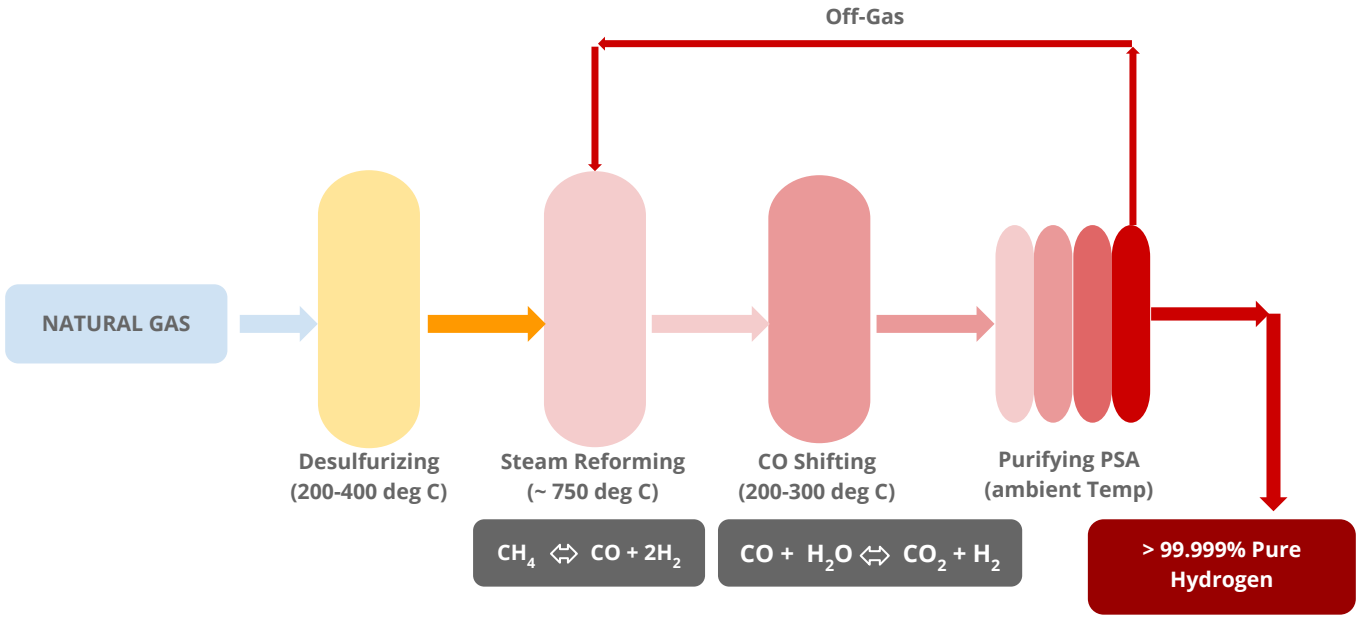

HYUNDAI HYDROGEN POWER
FUEL CELL


FUEL CELL BUS
TOYOTA

HYDROGEN REFUELING STATION (HRS)



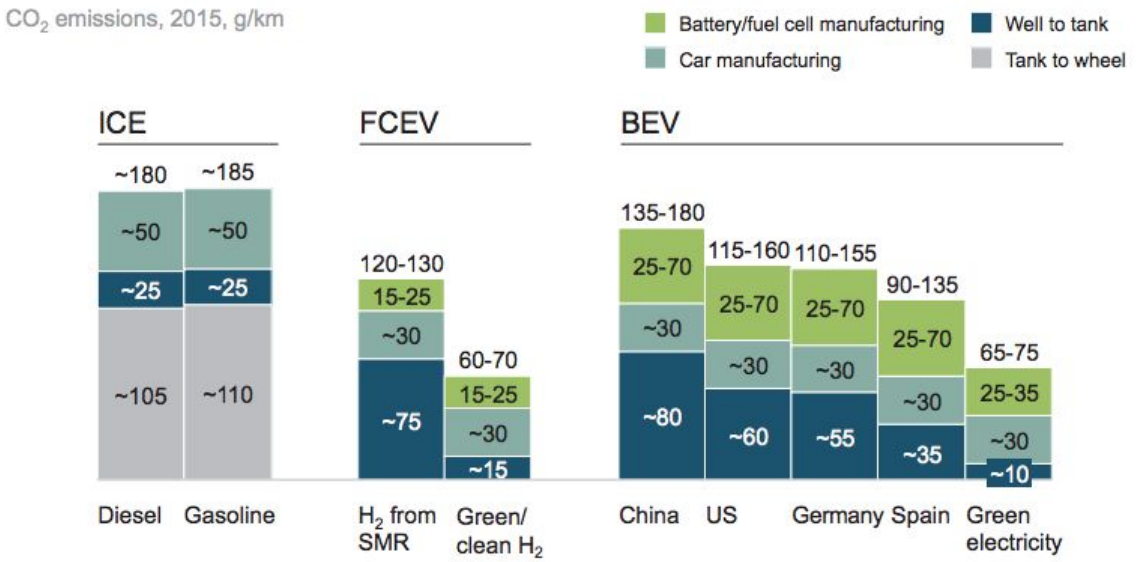
STEAM METHANE REFORMER (SMR)



LIFECYCLE EMISSIONS

NISHAL™

FCEVs can achieve very low CO_2 emissions if the whole lifecycle is considered



Assumption: compact car (C-segment) as reference vehicle (4.1 l/100 km diesel; 4.8 l/100 km gasoline; 35.6 kWh battery), 120,000 km lifetime average grid emissions in China, Germany, Spain in 2015; EV manufacturing (excl. fuel cell and battery) 40% less energy-intensive than ICE manufacturing; 10 kg CO_2/kg H_2 from SMR; 0.76 kg H_2/100 km; 13 kWh/100 km

SOURCE: EPA; A Portfolio of Powertrains for Europe (2010); Toyota Mirai LCA; IVL; Enerdata; expert interviews

Source: http://hydrogencouncil.com/wp-content/uploads/2017/11/Hydrogen-scaling-up-Hydrogen-Council.pdf

EMISSIONS - SMR vs ELECTROLYZER (EU)

NISHAL™

GWP and non-renewable PED for natural gas supply and H_2 at an HRS with on-site SMR incl. compression

Country / Technology (reference year 2013)	Natural gas / bio-methane supply GWP (g CO_2-eq./kg gas)	Natural gas /bio-methane supply Non ren. PED (MJ/kg gas)	H_2 production incl. compression GWP (kg CO_2-eq./kg H2)	H_2 production incl. compression Non ren. PED (MJ/kg H_2)
EU-28	518	50.6	13.2	211
BE	220	44.7	11.3	197
DE	458	48.7	13.6	204
ES	656	51.9	13.1	199
UK	232	48.2	12.4	201
IT	722	52.3	13.9	212
LV	758	56.0	14.7	216
NO	85	47.9	10.1	167
EU-28: biomethane mix + conv. electricity mix for compression	1,129	6.0	5.4 (without compression: 3.7)	49.4 (without compression: 19.8)
EU-28: biomethane mix + electricity from EU hydropower for compression	1,129	6.0	3.7 (without compression: 3.7)	19.9 (without compression: 19.8)

Table 6 - GWP and non-ren. PED for natural gas supply and H_2 at an HRS with on-site SMR incl. compression (simplified: 4 kWh/kg H_2 for compression), calculated using thinkstep's GaBi software and LCA databases 2016 [GaBi]

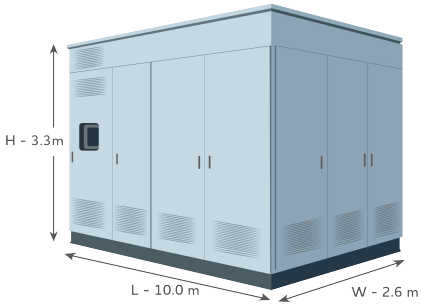
GWP and non-renewable PED for electricity generation and for H_2 at HRS with on-site electrolysis incl. compression

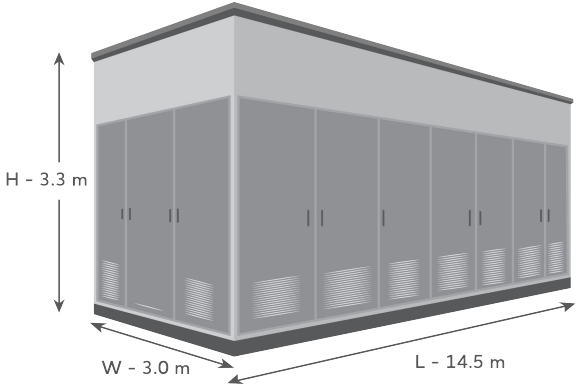
Country / Technology (reference year 2013)	Electricity generation GWP (g CO_2-eq./kWh)	Electricity generation Non ren. PED (MJ/MJ)	H_2 production incl. compression GWP (kg CO_2-eq./kg H2)	H_2 production incl. compression Non ren. PED (MJ/kg H_2)
EU-28	423	2.06	26.2	459
BE	214	2.17	13.3	484
DE	595	2.09	36.9	467
ES	317	1.62	19.7	361
UK	496	2.28	30.8	508
IT	429	1.67	26.6	373
LV	631	2.16	39.1	481
NO	36	0.13	2.2	30
EU-28: hydropower	6	0.01	0.4	2
EU-28: photovoltaic	31	0.13	1.9	30
EU-28: wind power	9	0.03	0.5	7

Table 5 - GWP and non-renewable PED for electricity generation and for H_2 at HRS with on-site electrolysis (simplified: 58 kWh electricity/kg H_2 for production and 4 kWh electricity/kg H_2 for compression), calculated using thinkstep's GaBi software and LCA databases 2017 [GaBi]

Source: http://newbusfuel.eu/wp-content/uploads/2015/09/NBF_GuidanceDoc_download.pdf

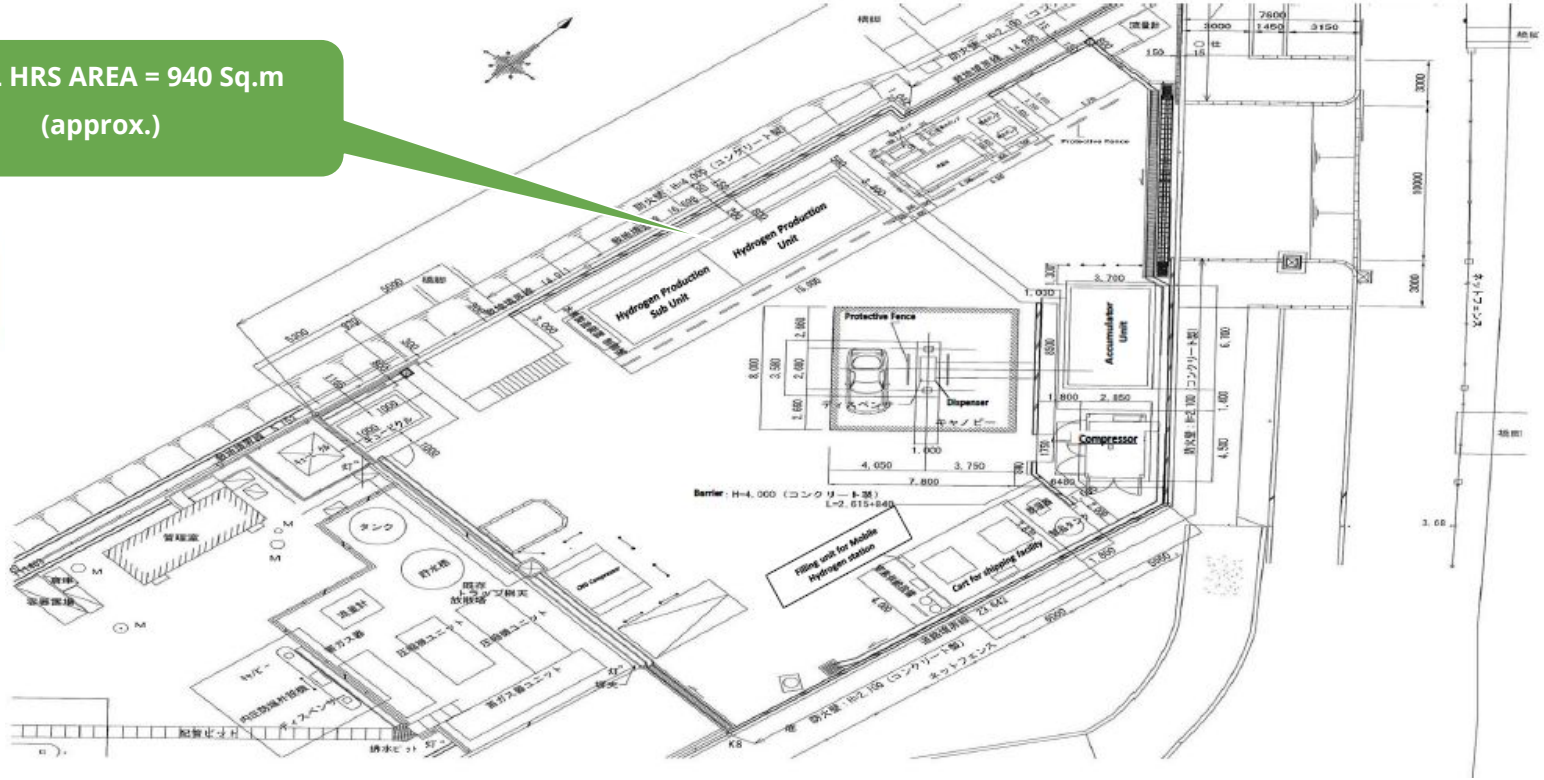
HRS INSTALLATION





HRS - AREA LAYOUT

TOTAL HRS AREA = 940 Sq.m (approx.)

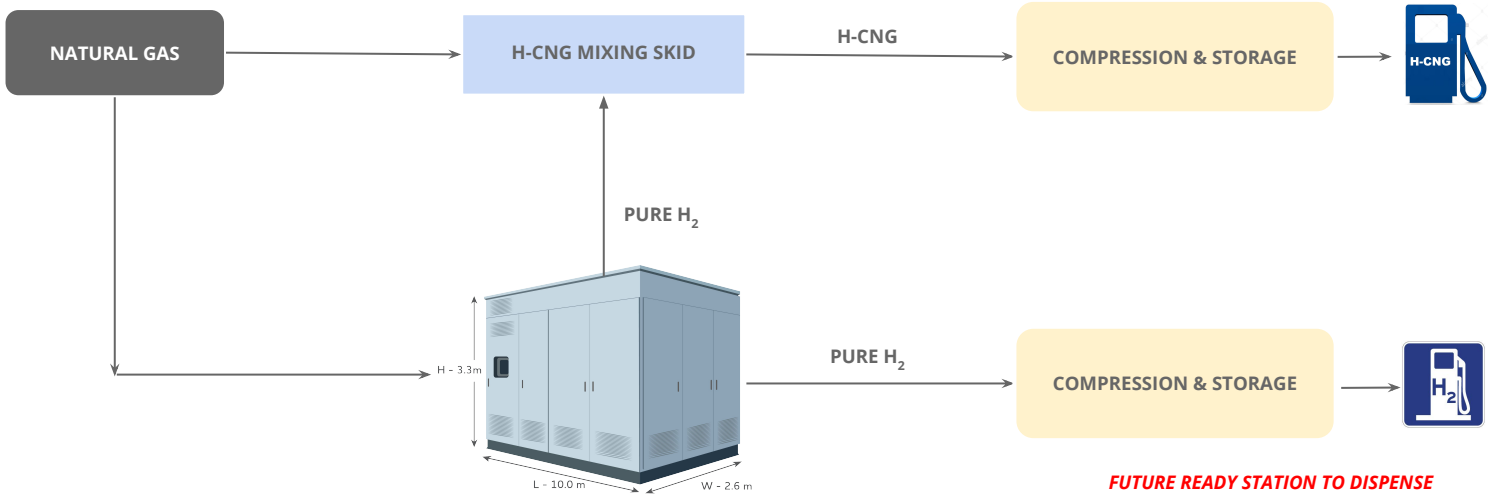


H-CNG PRODUCTION SCHEME

NISHAL™

H-CNG STATION USING NISHAL SMR

(ESTIMATED H-CNG CAPACITY – 9.3 Tons/Day) ~ 100 Buses/ Day @ 90 KG/Bus



COMPACT SMR (100 Nm^3/h)
FUEL CELL GRADE H_2

FUTURE READY STATION TO DISPENSE HYDROGEN FOR FCEVs

MoU - NISHAL-INDRAPRASTHA GAS LTD

Nishal and Indraprastha Gas Limited (IGL), engaged in refueling CNG to World's largest fleet of buses, signed an MoU to help IGL in setting up a Hydrogen & H-CNG station in Delhi-NCR. Nishal will help IGL in deploying innovative, on-site hydrogen & H-CNG generation technology


THANK YOU!
NAMIT MUNSHI
namit.munshi@nishalgroup.com
+91 9819808909