Factsheet:
Hydrogen and Fuel Cell Technology in India

India is one of the world's largest GHG (green house gases) emitters, and the trend is rising. As the country's economic growth increases, so does its demand for energy. The potential of renewable energies (RE) in India is great - both to electrify rural regions and to reduce the dependence on imported fuels. And this potential is now being exploited: 175 GW of capacity will be installed by March 2022. Such an increase in renewable energies requires suitable, scalable energy storage systems: hydrogen and fuel cell technologies could be the solution.

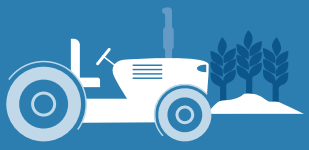
The use of hydrogen and fuel cell technologies in India can improve air quality and strengthen the economy. Against this background already in 2006 the government launched a first strategic measure: the National Hydrogen Energy Road Map of India. Since then different ministries support activities and demonstration projects. In particular the industry depending on fossile energy is interested in supporting hydrogen technology.

In the field of mobile communications and the decentralised energy supply, emissions can already be reduced quickly today. This is because 360,000 of the 450,000 mobile phone base stations are operated with diesel generators. In India, an amendment to the 'National Digital Communications Policy 2018' has therefore created broad support for the replacement of diesel generators, including the advancement of fuel cell systems.

The following analysis looks at the use of hydrogen/fuel cell technology in India in relation to the (energy) policy and economic situation, and identifies optimum areas of application.

Political and economic situation

1,35 billion
population (Nov. 2018)



Population predominantly active
in agriculture

46%
urban population

Due to the country's rapid economic growth and the ensuing increase in India's urban population, the infrastructure in urban centres is facing considerable challenges. This means that – despite the great successes in achieving the sustainability goals of the United Nations – problems such as the fght against poverty and access to clean and sustainable energy remain unresolved for large segments of the population. In view of these conditions, political stability is rated as considerably lower than in other regions.

Political stability

14.8 von 100
Score des World Government Index of the World Bank (as of 2018)

Economic growth

> 7% of GDP

High credit rating
(The Global Competitiveness Report 2017-2018) and the inclusion in various free trade agreements[1]

Rank 63 of 190
in the 'ease of doing business' index of the World Bank (as of 2020)

Investments and international energy partnerships
AHK* and GIZ**
as local partners

* AHK - German Chamber of Commerce
** GIZ - German Society for International Cooperation

Import restrictions make it difficult for SMEs to invest in India: For fuel cell systems, for example:
Additional costs of up to 30%.

Energy policy framework and existing activities

Energy policy in India is directly tied to the country's large energy needs

2000-2020
Doubling of energy demand (BP Energy Outlook 2018, India)

80%
fossil share of electricity

> 85%
total oil intensity

7%
of global emissions are attributable to India

A further doubling of energy demand is forecast by 2040 (IEA Report India, 2020)

India is dependent on fossil fuels

India is thus one of the largest GHG emitters

Furthermore, due to insufficient domestic reserves, these dependencies lead to substantial volumes of imports, making India the world's largest coal importer alongside China and Japan. Due to the planned further expansion of capacities, which are politically seen as a necessity for the security of supply and continued economic growth, a further increase in fossil energy consumption is to be anticipated in the coming years.

The expansion of renewables and the decommissioning of old coal-fired power plants that are being phased out should curb the overall increase in emissions. Renewable energies remain the fastest growing energy sources. Most recently, however, an amendment to the feed-in tariff and the introduction of protective tariffs on solar modules from China and Malaysia until July 2020 led to a significant decline in the growth of installed systems. Nevertheless, political support for renewable energies can still be expected in connection with the annually increasing import costs for oil and coal, and is particularly evident in the strong growth of decentralised PV systems:

Growth 2019
1.6 GW

Forecast 2021
12.9 GW
total installed capacity

[1] ASEAN-India Free Trade Agreement, South Asian Free Trade Agreement (SAFTA), Asia Pacific Trade Agreement (APTA), Global System of Trade Preferences among Developing Countries (GSTP)

Current energy supply

Besides other fossile energy sources:
140 GW
of diesel grids installed

These produce
940 million
tons of GHG

and provide
30%
of the electricity

84 GW
installed capacity
renewable energies

In many regions availability and theft of diesel lead to
> 8 hrs/day
without electricity

(Jain et al., 2018)

Further disadvantages

Dependence on imports, fuel transport, fluctuating fuel prices, GHG and noise emissions

Future energy supply

should be based more on
renewable energies
in order to reduce dependencies

Decarbonisation & stabilisation

of decentralised networks in rural areas with battery and fuel cell

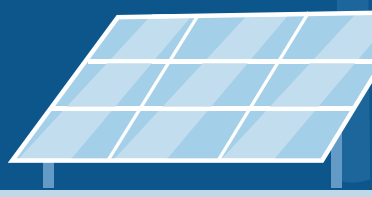
Of particular note in the current make-up of the energy supply is the high dependence on diesel generators. This is due to the instability of the networks. In some parts, diesel generators are also used to reduce so-called “brownouts” – partial power failures. Due to problems regarding the supply or theft of diesel, the availability and stability of the supply of electricity is a serious problem in many places. Consequently, the expansion of RE is in many respects an option to help reduce dependencies.

In the context of the possibility of electrification, especially in rural areas, the development of RE should be considered in isolation. Such electrification has been a top political priority in recent years and has made considerable progress. However, 100 million people are still without access to electricity (IEA World Energy Outlook 2018 / IEA India 2020 policy review). Here, renewable energies can make a significant contribution to advancing further electrification, decarbonising the grids, which are often supplied decentrally via diesel generators – without having to expand the grids at the same speed. At the same time, with a suitable mix of technologies with batteries or fuel cells, downtimes can be significantly reduced, which in many regions still amount to several hours a day.

So much is certain at this point: India’s energy requirements are already enormous and will continue to rise over the next 20 years. In order to cover the demand, every form of energy generation is being considered. Since the prices for RE have fallen sharply in recent years and are now cheaper than supplying energy via coal, the maximum amount of coal energy is foreseeable due to the considerable expansion of RE, despite a continued increase in coal-fired power. This is where hydrogen and fuel cell technology becomes more attractive again: On the one hand, large amounts of energy can be stored temporarily, and on the other hand, the grid can be stabilised through flexible operation.

Expansion target for renewable energies

Installed capacity of
175 GW
by March 2022



NOW
NOW-GMBH.DE

Lack of reliability of diesel networks, fluctuation of renewables, network stability and energy storage are among the central challenges of electrification and expansion of renewable energies (IEA Report India, 2020). In response, the Indian government has set up a comprehensive programme to test various technology options, including battery storage. An overview of projects already underway can be found at the India Energy Storage Alliance.

IESA
India Energy Storage Alliance

Potential of hydrogen and fuel cells in India

Hydrogen Stratgies

2006
National Hydrogen Energy Road Map of India

2018
Action Plan for Clean Fuel

2020
National Hydrogen Mission (working on)

Relevant political actors

MNRE
Ministry of New and Renewable Energy

DST
Ministry of Science and Technology

MoPNG
Ministry of Petroleum and Natural Gas

NITI Aayog
National Institution for Transforming India

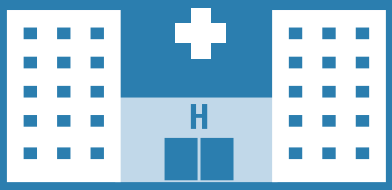
MoP
Ministry of Power

Next to national efforts India participates in international networks and is one of the founding member states of IPHE - International Partnership for Hydrogen and Fuel Cells in the Economy.

Among the applications of hydrogen and fuel cell technology (abbrev.: H2/ FC technology) already being implemented in India today, the decentralised and off-grid power supply of critical infrastructures is particularly noteworthy. The immense challenges of a constantly growing demand for energy, the guaranteed and reliable access to electricity coupled with the simultaneous development of new infrastructures such as the expansion of mobile communications, highlight the need for such a technology. The Indian government is showing great interest in utilising existing infrastructures and in encouraging zero-emission options in the expansion of new infrastructures. In the long term, the use of hydrogen in industrial applications is an interesting option. Against the backdrop of the potentials shown, international stakeholders – particularly those from Japan – are increasingly positioning themselves on the Indian market.

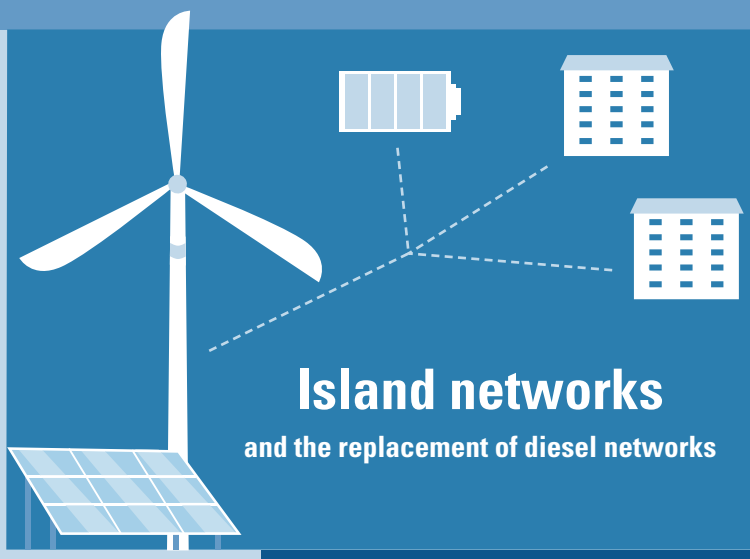
H2/FC in mobile communications and decentralised energy supply

Included among the key applications for H2/FC technology in India are also:



Emergency power supply

for critical infrastructures such as hospitals and mobile/ public authority radio masts



Island networks

and the replacement of diesel networks

Existing backup power systems consist almost exclusively of diesel generators and batteries. In addition to the disadvantages of diesel generators, the supply of electricity from batteries also poses specific challenges:

- Limited by restricted capacity
- Self-discharging
- High dependency on temperature

Given the proliferation of diesel generators, island networks and emergency power supply systems, H2/FC technologies potentially represent a significant alternative:

- **As an additional electrification option and for the stabilisation of critical networks and infrastructures**
- **For the reduction of GHG and noise emissions**
- **To reduce uncertainty through predictable costs to enhance self-sufficiency**
- **Potential for establishment of**

It is against this backdrop that H2/FC technologies are already explicitly included as options for energy storage in India's National Electricity Plan.

NOW-GMBH.DE

The demand for alternatives to diesel generators can be highlighted with an example:

Mobile phone base stations with fuel cells

India's telecommunications market is one of the fastest growing worldwide.

Telecommunications market of India:

450,000
mobile phone base stations

360,000
thereof dependent on diesel generators

> 58 million
tons of GHG emissions

Low availability of the mobile phone stations:

40%
under 12 h/day

15%
under 8 h/day

High costs

Fluctuating fuel & transport costs represent 30-34% of the total operating costs

As the growing demand and, of course, the declared path into the age of a 5G network present additional challenges, the Indian government set conditions early on to increase efficiency in the telecommunications sector. In 2018, an amendment to the 'National Digital Communications Policy 2018' created broad support for the replacement of diesel generators including the promotion of fuel cell systems. In the context of the fuel savings to be achieved, this will create a significant market for fuel cells: Not only for the conversion of existing systems, but primarily by the expansion to 5G.

Changeover of the mobile telecommunications market as a blueprint

Alternatives available:
Methanol FC - allowing leveraging of existing supply streams
Hydrogen FC - fully self-sufficient solution

Environmental benefits:
Reduction of fuel consumption and GHG and noise emissions.

Economic benefits: Reduced dependencies and greater local value creation

Demonstration projects of the Export Initiative for Environmental Technologies

Building Partnerships for a Sustainable Infrastructure
ENVIRONMENTAL PROTECTION made in Germany

The use of emergency power systems with fuel cells have been successfully demonstrated and established in Germany. With long and proven experience in this area German companies are joined in the network Clean Power Net. The Export Initiative Environmental Technologies supports the provision and dissemination of information on technology, planning and implementation of these systems and funds international demonstration projects. Besides the use of hydrogen and fuel cells in mobile communications and the decentralised supply of energy, applications in mobility and industry are also to be assessed more closely for India in the future. Test fleets and pilot projects in the mobility sector are in operation already. Oil, gas and coal companies expressed their interest in hydrogen technologies.

NOW NOW-GMBH.DE

Kontakt

Dr. Julius von der Ohe
Head of program international energy concepts
Phone: +49 (0)30-311 61 16-12
Email: julius.vonderohe@now-gmbh.de

May 2020