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On behalf of:

Federal Ministry
for the Environment, Nature Conservation
and Nuclear Safety

of the Federal Republic of Germany

Building Partnerships for a ENVIRONMENTAL PROTECTION made in Germany Sustainable Infrastructure

Factsheet series:

Fuel cells for distributed power supply

Part 1: Mobile telecommunications

Status: February 2021

Brief summary

Stationary fuel cell systems enable lasting and reliable energy provision on site. This climate-friendly alternative is particularly interesting for emerging and developing countries because mains power supply is to a large extent, neither stable nor available in all parts of the country. Instead of fuel cells (FC), backup generators with fossil fuels like diesel and petrol are currently used to power areas with poor grid access or to ensure uninterruptible power supply.

Using diesel causes:

- High transport costs
- High maintenance costs
- Price uncertainty
- High level of emissions (CO_2, NO_x, VOC, particulate matter and noise)
- High risk of diesel and equipment theft
- Deterioration of stored diesel and wax formation at cold temperatures

Stationary fuel cells offer:

- Alternative fuels and simplified logistics
- Relatively high efficiency
- High level of operational reliability and low maintenance costs
- Small unit size
- Zero local emissions (depending on the fuel zero CO_2 emissions)
- Low noise emission

References: [1-4]

Using fuel cells in mobile telecommunications

An expanding network of mobile telecommunications towers connects billions of people and enables them to seize the economic opportunities offered by the internet. In order to guarantee the range and stability of the mobile network, mobile telecommunications towers must be supplied with electricity around the clock. This poses a particular challenge as they are often located in remote areas either without or with unreliable access to the electrical grid ('off-grid' or 'bad-grid'). Typically these towers are equipped with diesel-generators to ensure their power supply, however fuel cell systems represent an attractive alternative.

Status quo

Significant potential to reduce greenhouse gas emissions

7Mt
of CO_2 emitted by diesel generators for the energy supply of mobile telecommunications towers in 2020[6].

110Mt
of CO_2 are emitted by the operation of the global mobile communications network every year. This represents approx. 0.2% of global CO_2 emissions[5].

Billions of users need mobile telecommunications towers

5.3 billion
people had access to mobile networks at the end of 2019, representing 67% of the world's population[7].

5 million
mobile telecommunications towers are operational worldwide. In 2014, there were 4 million[6].

Increasing demand for renewable energy

29
mobile telecommunications providers (corresponding to 30% of mobile phone connections worldwide) have specific CO_2 reduction targets since 2020[6].

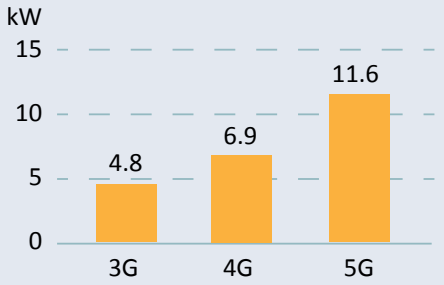
ABC mini-grid models
(Anchor Business Community) have not yet become established, but continue to be considered an option by TowerCos[6].

Market potential for hydrogen applications in the mobile telecommunications sector

Market outlook

- 600 million new mobile phone subscribers are expected by 2025 – highest growth in India, China, Pakistan and Nigeria.
- Smartphone penetration will increase to 80% in 2025[7]
- The typical maximum power consumption of a single mobile telecommunications tower is increasing because of 5G expansion (see image)[8]

Typical maximum power consumption of a single mobile telecommunications tower[8]



Technical requirements

Requirements for network reinforcement or uninterruptible power supply of mobile telecommunications towers:

- Guaranteeing power supply for 24-72 hours (depending on regulation and other factors specific to the location)
- Guaranteeing speedy response times often combined with restricted space availability.
- Fuel cell power rating <20 kW: approx. 6 kW is required for one mobile operator, with up to 12kW capacity needed for up to three operators at a single mobile telecommunications towers.

Technical solutions

- Different fuel cell technologies such as Polymer Exchange Membrane (PEM) and Direct Methanol Fuel Cell (DMFC) can be used.
- Consequently, propane, methanol, and methane can be considered as fuels. Depending on the choice of fuel cell technology, electrolysis is not necessarily required, but would enable self-sufficiency.

Transfer potential

- Worldwide there are at least 350,000 off-/bad-grid locations. Of these, 88% are powered by diesel generators[9].
- These systems can be the seeds of expanding island networks to supply nearby residents with power ("ABC mini-grid model"). For this purpose, local demand must be evaluated and local business models developed.

Case study: mobile telecommunications in India

India is the second-largest telecommunications market in the world, with 1.2 billion customer contracts and a growth rate of 3.4% CAGR (2015-20)[10].

The framework conditions create an attractive market environment

The power supply situation in India: 70% of mobile telecommunications towers suffer an 8-hour power cut every day.

Approx. 90%
of the 606,300 mobile telecommunications towers installed (2020) are operated as a hybrid system (power grid, battery and diesel generator)[10].

Approx. 2.5 million
litres of diesel are consumed annually in India in mobile communications – this corresponds to approx. 6.6Mt CO_2[12].

High costs of security of supply using diesel generators

25 %
of the OPEX of Indian network operators are energy costs[12].

732m US$
are required to supply mobile telecommunications towers with diesel annually[12].

The fuel cell in the Indian mobile communications market

Pilot projects with fuel cells showed:

- Improvement in power availability in mobile telecommunications
- 18% reduction in fuel consumption within six months[1]
- India's largest telecommunications company, Infratel, was already operating 15,594 diesel-free locations in 2020. Four new fuel cells were newly installed as a pilot project[13].

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