



Freedom Motors Top Market Opportunities

As the world moves towards renewable fuels and battery storage technologies, more emphasis has been placed on technologies to efficiently use fuel and charge battery systems. This renaissance is solely attributable to global warming and the threat to our environment and ultimately to humankind.

Freedom Motors (FM) has developed its engine technology that is solely focused on taking these threats head on and mitigating carbon, NOx and methane emissions. FM's strategy is to provide the consumer

1. Best "Power to Weight Ratio" (3.3 HP per pound weight of engine). Compact size (a 2 & 3 wheeler FM Rotapower® engine is comparable to the size of a grapefruit)
2. Fewer moving parts means longer life and significantly lower direct and indirect costs
3. Reduced fuel consumption (a comparable 4 stroke engine has 32 moving parts versus 2 for Rotapower® engine)
4. Very low emission levels (undetectable with methanol, ethanol and natural gas, zero emissions with hydrogen)
5. Proven multi-fuel performer
6. Extremely low vibration levels
7. Instantaneous torque characteristics

Industries where the Internal Combustion engines are poised to have CAGR gain are

1. Advanced Air Mobility (AAM)
2. EV Range extender
3. Industrial
4. Construction
5. Marine
6. Agricultural
7. Gardening
8. Generators
9. Motorcycles
10. Recreational Products
11. Automobiles/Trucks
12. Military

FM is focused on the small engines market which is expected to witness a global CAGR of more than 4% during the forecast period of 2022-2027. The majority of the growth is attributable to India, China and the Asia Pacific (APAC) markets.

TOP MARKET OPPORTUNITIES IN THE INDIAN MARKET

1. 2 & 3 wheeler market
2. Automobile/Trucks (hydrogen and renewable fuels)
3. Generator market
4. AAM market
5. Others (Agriculture, Industrial, Construction, Marine, Gardening, and Military)

Significant factors for market growth

1. According to the Indian government's estimate, the country needs an investment of about USD \$4.5 trillion to build sustainable infrastructure by 2040
2. The Union Budget 2022-23 of India highlights a 35.4% increase in public capital investment
3. The rise in CAPEX has increased from by nearly 50% from 2021-22 to the 2022-23 budget
4. Increase in industrialization and urbanization
5. A report released by People Research on India's Consumer Economy (PRICE), the share of the middle class in the total population rose from 14 per cent in 2004-05 to 31 per cent in 2021-22. By 2047 1 in 3 Indians will belong to the middle class. The number of "super-rich", on the other hand, has risen from 98,000 in 1994-95 to 1.8 million in 2020-21.
6. India is facing its worst electricity shortage in more than six years and early onset of summer and coal shortage has pushed up the demand to record levels
7. India's generator market is set to increase at 9.4% CAGR between 2021 (\$816.0 million) and 2030 (\$1.83 billion).
 - a. Systems ranging between 5 KW and 75 KW in power rating are the most popular in the in India as they witness a high demand from residential facilities, small industries, commercial complexes, restaurants, and telecom towers.
 - b. Residential applications have been the most productive for market players in the country till now because of the increasing incidence of power cuts and growing housing construction
8. Morgan Stanley predicts the global AAM (or Urban Air Mobility) market to reach \$1.5 trillion by 2040 and \$9 trillion by 2050
9. Developing countries like India, China and the rest of the APAC will play a significant role in the AAM market growth.

10. India is the world's largest 2 and 3 wheeler market. The market size in 2022 is \$16 billion and is forecasted to reach \$26 billion by 2028. There is a growing demand for hybrid models to stay independent of the power grid.
11. The Indian Electric Vehicle Market was valued at USD 5 billion in 2020, and it is expected to reach USD 47 billion by 2026, registering a CAGR of above 44% during the forecast period (2021-2026).
 - a. As per a MarketWatch report, India would need around 400,000 charging stations to accommodate the demand for 2 million EVs on the roads by 2026. Currently, the country has 1,800 charging stations as of March 2021. An independent study by CEEW Centre for Energy Finance indicates that it would need around 2.9 million public charging stations by 2030 to support EV adoption under the base case target of NITI Aayog. Of these, about 2.1 million (71 percent) of chargers would be low capacity chargers used for supporting two-wheelers and three-wheelers. Besides setting up more charging stations, the lack of space is also a hurdle since people need a place to charge their EVs.
 - b. Lack of support for grid development to cater to the increased load is another major problem. As per an industry analysis, increased use of EVs by 2030 will shoot up the electricity demand by 100 TWh.
 - c. The demand and significant growth in the EV market can be sustained by implementing range extenders to the EVs so they can be independent of the power grid. Using renewable and clean fuels to drive the range extender to charge the batteries will meet India's goals appropriately.
 - d. Introducing mobile charging stations using renewable and clean fuels will significantly reduce the demand for land and space for permanent charging stations and also avoid costs for upgrading the power grid elements.
12. India plans to produce 5 million tons of green hydrogen by 2030 to reduce the demand on the dependency of oil. The implementation of hydrogen as fuel will dominate the power production, industrial and commercial transport segments.
 - a. The demand for hydrogen fuel will also increase the demand for hydrogen fuel cells to generate power to charge batteries.
 - b. The production cost of hydrogen fuel cells are significantly higher and requires rare earth metals. The rare earth metal market is controlled by China.
 - c. The cost effective, efficient, longer life and compact size alternative to a hydrogen fuel cells are Rotapower® engines

TOP MARKET OPPORTUNITIES IN THE APAC MARKET

1. 2 & 3 wheeler market
2. Automobile/Trucks (hydrogen and renewable fuels)
3. Generator market
4. AAM market
5. Others (Agriculture, Industrial, Construction, Marine, Gardening, and Military)

The APAC market is exactly similar to the India market at a little smaller scale. All significant market growth factors also remain the same. The only exception is that the Marine (Outboard engine market) is expected to grow significantly at 8% CAGR from 2021 (\$1.18 billion) to 2028 (\$2.02 billion)

TOP MARKET OPPORTUNITIES IN THE NORTH AMERICAN MARKET

1. AAM market
2. Automobile/Trucks (hydrogen and renewable fuels, range extender)
3. Outboard engine market (Marine)
4. Generator market
5. Military
6. Others (Agriculture, Industrial, Construction, and Gardening)

Significant factors for market growth

1. Morgan Stanley predicts the global AAM (or Urban Air Mobility) market to reach \$1.5 trillion by 2040 and \$9 trillion by 2050
2. Approximately 10 million metric tons of hydrogen is produced in the U.S. annually, equivalent to just over 1 quadrillion BTUs per year (1 percent of U.S. energy consumption). Currently, over 95 percent of U.S. hydrogen production is grey.
 - a. Adaptation of hydrogen as fuel will significantly occur in commercial transportation and industrial sectors.
 - b. The demand for hydrogen fuel will also increase the demand for hydrogen fuel cells to generate power to charge batteries.
 - c. The production cost of hydrogen fuel cells are significantly higher and requires rare earth metals. The rare earth metal market is controlled by China.
 - d. The cost effective, efficient, longer life and compact size alternative to a hydrogen fuel cells are Rotapower® engines
3. North America Outboard Engines Market size was over USD 5.92 billion in 2021 and is expected to witness 4% CAGR from 2022 to 2028 (\$8.1 billion). The growth in the market would come from

rising consumer spending on recreational activities and an increasing fleet of commercial boats in the region.

4. The US generator market size was \$4.68 billion in 2020. The U.S. generator sales market is projected to grow from \$4.89 billion in 2021 to \$6.94 billion in 2028 at a CAGR of 5.13% in forecast period, 2021-2028.
 - a. FM to focus on the small and portable generator market
 - b. Generators based on FM Rotapower® engines
 - c. North America Portable Generators Market worth \$3.1 billion by 2028 and is anticipated to witness over 6.5% CAGR between 2022 and 2028 due to increasing demand for uninterrupted power supply along with the flourishing residential sector
 - d. The end-use domination will come from residential, commercial, and construction sectors
 - e. Producing generators that can operate on renewable and clean fuels will dominate the market
5. The use cases that are focused for military are
 - a. Compact (about 5 lbs weight) size generators for ground forces
 - b. Small and medium size generators
 - c. Range extenders for electric vehicles
 - d. APUs for aircraft, tanks and other military equipment
 - e. Micro-grid applications
 - f. AAM aircraft