

## Innovation Genesis: Assessing the Impact of the Hydrogen Economy

**Client:** Fortune 500 producer of commercial vehicles, power equipment and internal combustion engines.

**Challenge:** Concerned with increasing discussion in the popular press about alternative fuels and the imminent advent of fuel cell technology, the client approached Product Genesis to determine the likelihood, timing and potential impact of a broad-based hydrogen economy on their core businesses. Specifically, they wanted a more detailed understanding of potential opportunities and threats and what should be done tactically to prepare for them in the near-term, and strategically to plan for them in the long-term.

**Diagnosis:** With recent advances in hydrogen-based fuel-cell technology having garnered national press, industry as a whole had noticed the potential impact of alternative fuels. During initial visits to the client site, the excitement surrounding fuel cells was palpable. The client had already committed to exploratory investments in fuel cells and there was a significant constituency that was lobbying for very aggressive expansion of fuel cell development funding.

**Methodology:** The process of evaluating the likelihood and nature of a hydrogen economy started with the identification of a series of underlying conditions and drivers thought to spur the adoption of alternative fuels.

The identification of these drivers and research about each was completed using existing literature as well as interviews conducted with industry experts.

Factors that were identified as drivers of the hydrogen economy included: public policy initiatives, economic and environmental imperatives, power plant technology, fuel storage technology, infrastructure technology, primary energy source cost and availability, environmental impact, and the interests/behavior of key industry stakeholders (e.g. automotive companies, energy extraction companies, energy distribution companies, etc.)

A probabilistic model (Scenario Model) was developed to assess the likelihood of several scenarios that could result from the interplay of the identified drivers. These scenarios

characterized in detail the environment in which the client could be operating by the end of the planning horizon.

A detailed model (Application Model) was developed to indicate which power plant (fuel cell, hybrid-electric, and internal combustion, etc.) and fuel (gasoline, natural gas, hydrogen, etc.) combinations were best suited to a comprehensive set of power equipment applications under each of the potential scenarios. Suitability was determined by correlating the attributes of various power plant/fuel combinations with the critical requirements of the applications under consideration.

The combined model (Market Opportunity Model) generated a forecast of the potential for each technology combination over the planning period. This allowed the customer to prioritize and scale technology investments accordingly. An intuitive interface allowed the client to periodically update the forecast based on new information or events.

**Results:** The scenario model indicated that a ubiquitous hydrogen infrastructure (i.e. for passenger vehicles) is unlikely to develop within the client's planning horizon. This was because no single combination of technology and infrastructure was projected to deliver the level of cost-effectiveness, greenhouse gas reduction and energy independence sufficient to justify the huge investment in a nationwide hydrogen fuel infrastructure.

The model did indicate that certain specialized off-road applications would benefit from key attributes of fuel cells and alternative power plant configurations in the near-term. Based on these findings the client made appropriate investments in programs to develop new power plant architectures to enhance existing product lines and penetrate new opportunities.

The client employs this toolset to continually reassess the trajectory of alternative power plant adoption based on currently available data.

Using the Innovation Genesis methodology, the client avoided an uncritical rush into a large fuel cell investment. Instead they have identified a sequence of more modest investments that simultaneously offer near-term return and preparedness for new power technologies.

