DSY Inc.

GTK-7 International Simulation Project

Taiwan Fuel Cell Scooter Proposal

DSY Incorporated
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Devolia Sweet, Chief Executive Officer (CEO)
Yasir Elamin, Chief Technology Officer, (CTO)

Proposal

In reference to your request for proposal, we are pleased to offer to you our recommendations for this joint venture in Taiwan. Our organization, **DSY** Incorporated, would be please to work in conjunction with TGTM to develop an environmentally conscious scooter for the benefit of the country. The proposal will include The Scooter and its technical specifications, the fuel cell, the cost of manufacturing 1000 scooters annually to supplement your production capabilities, and service and guarantee information regarding the product.

DSY is a contract manufacturer that specializes in the research, design, and manufacturing of transportation means utilizing alternative energy sources. We have three divisions, Military transportation, Commercial transportation, and Small Engine Replacement. Our organization is directed equally by our three officers, Ms. Devolia Sweet, Chief Executive Officer (CEO), Mr. Yasir Elamin, Chief Technology Officer (CTO), and Mr. Stephen White, Chief Operating Officer (COO). Our Small Engine replacement division develops, designs, and introduces fuel cell alternatives for motorcycles, scooters, lawn and garden equipment, and generators.

A fuel cell is an electrochemical engine that converts the chemical energy in a fuel directly into electricity and usable heat. While most scooters use two-stroke engines to provide power, a scooter powered by fuel cells offers a potentially environmentally cleaner option. The Growl scooter that is being proposed has the following specifications for a two-stroke engine:

The Growl 50cc Scooter
Engine – 2 stroke, single cylinder, air cooled
Compression Ration – 7.2:1
Displacement – 49.26 cc
Bore x Stroke – 40 x 39.2mm
Max Horsepower – 3.7hp/5500rpm
Max Torque – 0.57 kg-m/5500rpm
Maximum Speed – 62 km/hr
Fuel Consumption – 45 km/l
Ignition – Electronic CDI and variable timing

The retail cost of this existing scooter is approximately $**1400**. DSY is recommending the scooter be manufactured as a shell to *exclude* the two-stroke engine, exhaust system, fuel tank and battery. This would leave a retail base cost of approximately $**590** dollars before implementation of fuel cell system. As requested, DSY will fit the scooter with a Proton Exchange Membrane that produces water exhaust from

electrochemical electricity. This will be 5.9 kW fuel cell system with respective parts. The costs are described in the table below.

Fuel Cell Costed Bill of Materials

Part	Description	Cost
FC stack	DTI	$ 750.00
Starter battery	Yuasa-Exide	$ 10.00
Hydrogen storage	DTI metal hydride	$ 190.00
Heat Exchanger	Lytron M14-120	$ 60.00
Coolant pump	N/A	$ 10.00
Blower	AMETEK 116628-E (1 -2 psi)	$ 110.00
Plumbing	Water, Air pipes	$ 50.00
DC Brushless Motor	UQM SR121/1.5L	$ 125.00
Controller	UQM CD05-100A	$ 150.00
	Total-Fuel Cell Costs	**$ 1,455.00**
	Shell costs and assembly	$ 590.00
	Total-Fuel Cell Scooter	**$ 2,045.00**

Please be informed these prices are based on a minimum order of **1000** scooters annually, the prototype costs will be a higher. These prices can be achieved through long term mass production with potential of cost reductions on a regular basis. Below we will detail the costs of the infrastructure as well as the fuel costs in comparison to gasoline costs.

Fuel (Hydrogen) costs and infrastructure

The 5.9 kW pure fuel cell system with 250g of storage has a fuel economy of 0.527 km per gram oh hydrogen (334 mpg) under TMDC (Taipei Motorcycle driving cycle). Hydrogen in Taiwan would likely be produced by imported natural gas converted at local hydrogen filling stations using steam reformers.

A study by Ogden *et al.* calculated that hydrogen produced by on-site conventional steam reformers would cost 12-40 $/GJ based on a Los Angeles-area natural gas price of 2.8$/GJ. The range of cost is a function of how large each reforming station is.

Taiwan prices for natural gas are about 7.7 $/GJ, so the prices for hydrogen increased by 5 $/GJ to 17-45 $/GJ. At a smallest station size, an area of about 4,000 scooters running at 12,000 km per year could be serviced at a cost of 45 $/GJ. The fuel cost of operating a scooter is about $145 a year or 1.21¢/km. IF a larger plant capable of servicing an area of 72,000scooters was built, costs would drop to 17 $/GJ for a cost per vehicle per year of $78 and a driving cost of 0.65 ¢/km.

More advanced reformers would reduce the cost to 24 $/GJ for a 4,000 scooter Plant, but the larger stations would not be much cheaper. Note the raw natural gas cost is only 27% of the total delivered hydrogen cost; the rest is for labor, reformer construction, electricity, hydrogen storage and compressor.

Fuel cost summary

Below is a cost comparison of the existing gasoline and the 5.9kW fuel cell scooters.

	Gasoline	5.9kW pure FC
Refueling cost	**16.7 $/GJ (65.1¢/L)**	**24 $/GJ (0.34 ¢/g)**
On-vehicle mileage	**65 mpg**	**344 mpg**
Cost per distance	**1.5 ¢/km**	**0.65 ¢/km**
Annual cost	**$184**	**$78**
Present value of fuel Over 10-year lifetime	**$1130**	**$480**

Hydrogen production at the infrastructure level proposed, results in hydrogen costs that are less than half the price of gasoline, due to the high efficiency of the fuel cell scooter. The cost is low enough to make hydrogen fuel cell scooters a cheaper option to drive than gasoline-powered scooters.

Technology Transfer & Personnel Training

DSY has recently been involved in negotiations to purchase a manufacturing facility in Taipei. This move is contingent upon an agreement the venture. This facility will allow us to better service your operation and ensure an up close and personal relationship . This facility will have the capacity to manufacture a minimum of 1000 Fuel Cell Scooters. It will house staff functions such as R&D, Sales and Service, and engineering.

We will make the necessary commitments to properly train and develop the local workforce. We are pleased with the capital breakdown of the venture and feel it will allow great progress. Our Chief Technology Officer will oversee all technology transfer and engineering issues and our Chief Operating Officer will coordinate all operations for the new facility to include manufacturing, business & finance, and personnel. Our plan is to produce fully conforming Scooters within six (6) months of any agreement in which DSY and TGTM enters.

Conclusion

Again, we pleased to offer our services for this joint venture. The deliverables are to be **1000** fuel cell scooters annually at a price of $**2,045.00** per scooter. Confirmation of an agreement and subsequent purchase order will allow us to begin production. A prototype model will be delivered approximately **four** (**4**) weeks from receipt of purchase order for approval. **Eighty-five** (**85**) scooters are to be delivered **four** (**4**) weeks after approval of prototype and each month afterward.

Should you have any questions regarding our proposal, do not hesitate to contact any member of our executive offices at the following electronic mail addresses:

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Best regards,

Elamin, Sweet, & White

DSY, Incorporated