

# IPRO 351

## SOLAR/BATTERY HYBRID THREE WHEELER RICKSHAW FOR INDIA

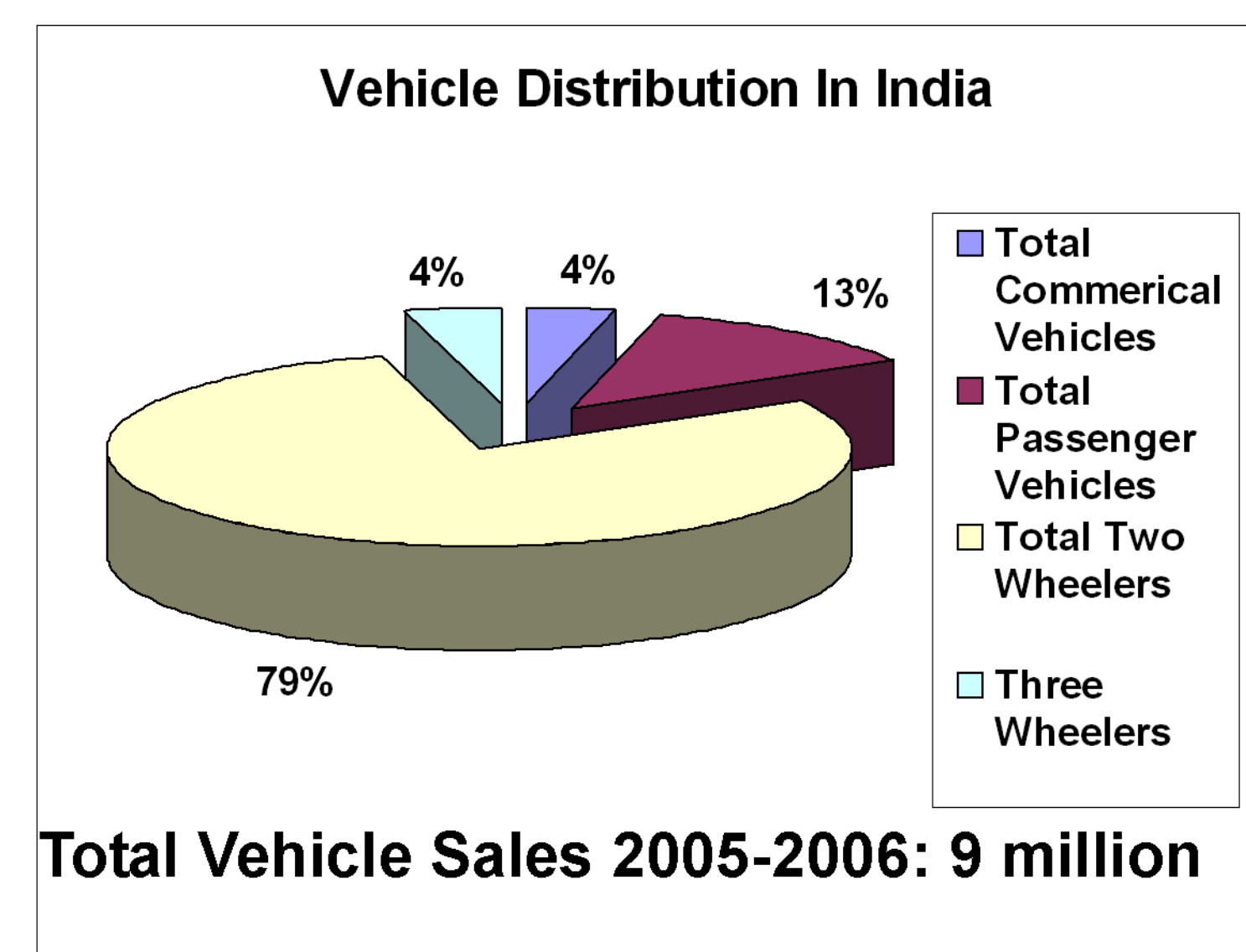
### MISSION STATEMENT

Our mission is to investigate the feasibility of introducing solar/ battery powered auto rickshaws into India's transportation industry.

### AUTO RICKSHAWS

An auto-rickshaw is a three wheeled vehicle widely used for public and goods transportation. It is one of the chief modes of transport in India, Pakistan, Nepal, Bangladesh and Sri Lanka.

Rickshaws are currently available in gasoline, diesel, compressed natural gas (CNG) and liquefied petroleum gas (LPG)



### SUSTAINABILITY PROBLEMS



#### INDIA'S OIL DEPENDENCE

India imports more than 60% of its annual oil needs.

This amounts to slightly more than 1.4 million barrels per day.

This figure is likely to increase by 5 million barrels per day in 2020.

In 15 years India will have to import close to 90% of its petroleum needs.

#### INDIA'S AIR POLLUTION CRISIS

"Of the 3 million premature deaths in the world that occur each year due to outdoor and indoor air pollution, the highest number are assessed to occur in India."



### INDIA'S COMMITMENT TO ALTERNATIVE ENERGY

. A commission recommended the complete ban of two stroke three wheelers, which was endorsed by the government.

. Natural gas prices are controlled by the Indian government. The cost of CNG is heavily subsidized.

. A new fare structure that benefits the CNG three-wheelers relative to petroleum vehicles was put in place.

. Government supports favorable financing terms for the purchase of environmentally friendly three wheelers.

"The government will support those companies which will achieve substantial reduction in energy consumption and at the same time look for use of alternative fuels including hybrids."

Source: Minister of Heavy Industries and Public Enterprise

### THE KATHMANDU EXPERIENCE

In 1996 in Kathmandu, Nepal, a development project was initiated by USAID to put a small fleet of battery powered Tempo auto rickshaws into the city.

These became known as Safa Tempos. The vehicles have been well received and the project has found private investment as well as good support from both the local and national government.

It has been seen that passengers prefer to travel in Safa Tempos, often letting a standard vehicle which pass.

They are also willing to pay a 25% premium for the Safa Tempos.

They claim the benefits are a smoother and quieter ride.

### WHY THE SOLAR /ELECTRIC RICKSHAW

. The supply of CNG rickshaws is limited to major cities because of a lack of pipeline infrastructure in rural areas.

. Electricity is affordable since it is subsidized by the government

. Electricity is also widely available across the country

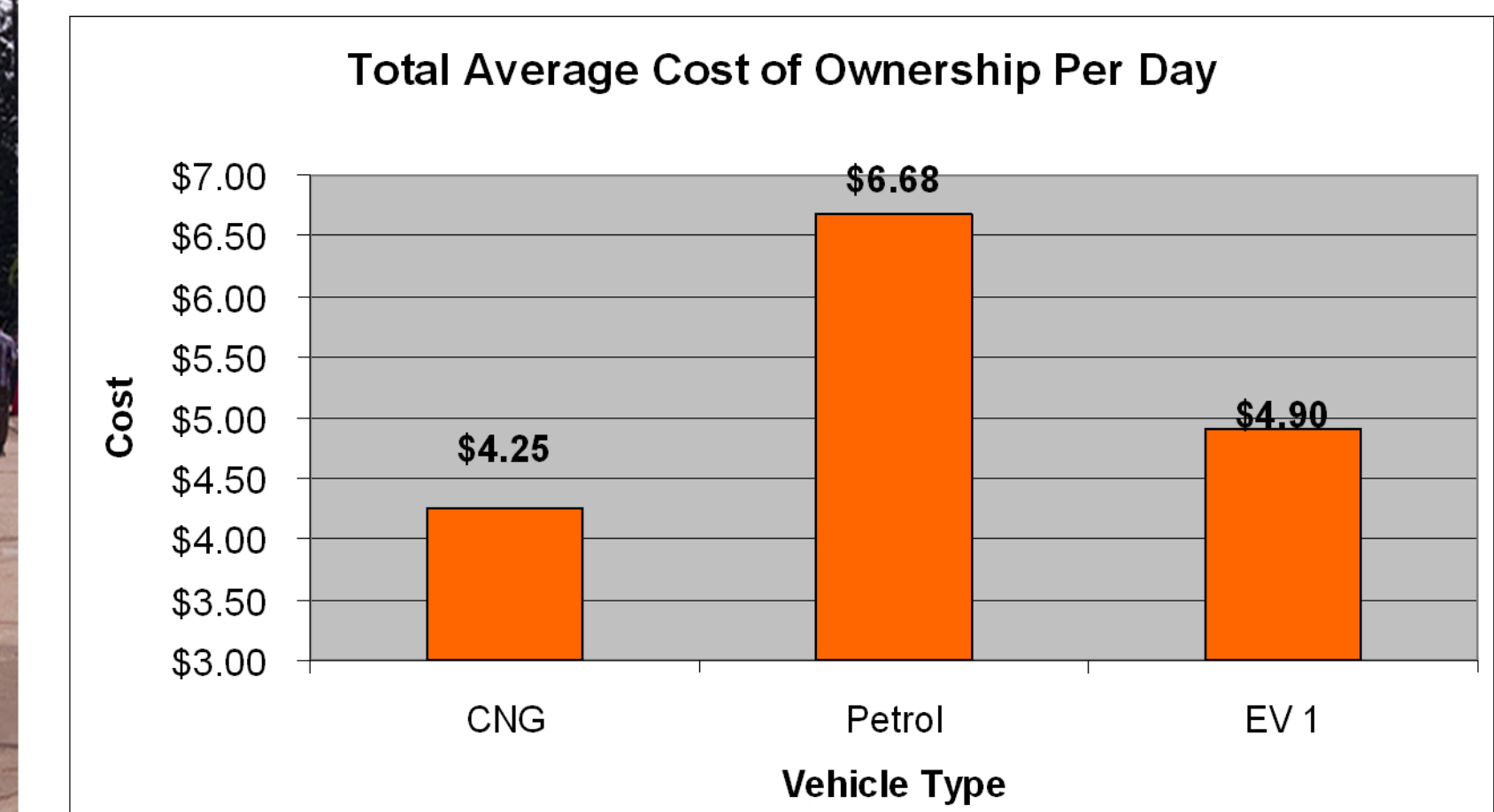
. India has an ideal climate for solar technology

. India is almost entirely self sufficient in producing electricity thus reducing foreign energy dependency

### BUSINESS OPPORTUNITY

2.3 Million three wheelers on the road, 250,000 new vehicles produced per annum

Source: Hindu Business Line



### ECONOMIC EVALUATION

Costs Per Kilometer (Rupees)	EV 1	Petrol	CNG
Financing	0.66	0.46	0.43
Taxes, Fees, Insurance	0.16	0.13	0.10
Battery	0.86	0.11	0.11
Fuel	0.15	1.81	0.66
Maintenance	0.36	0.48	0.60
Total Rupees Per Kilometer	2.19	2.99	1.90
Rupees Per day	219.18	298.72	189.76
\$USD/day	\$ 4.90	\$ 6.68	\$ 4.25

### PATH FORWARD

In order to promote EV's the Indian Government needs to create subsidies and policies similar to the what was done with CNGs.

We need to design a solar electric rickshaw that is competitive with the operating cost of a CNG Rickshaw.

We need to calculate the cost of the solar components and also determine an implementation strategy.