# Solar/Battery Hybrid Three Wheeled Rickshaw for India

IPRO 351

# Our Team Mission

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

# Background

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)

Cinematographer: Michael Coggins

On Location: Thane, India

July 2006


Oil Dependency
& Pollution

# Government Objectives & Policies

**"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."**

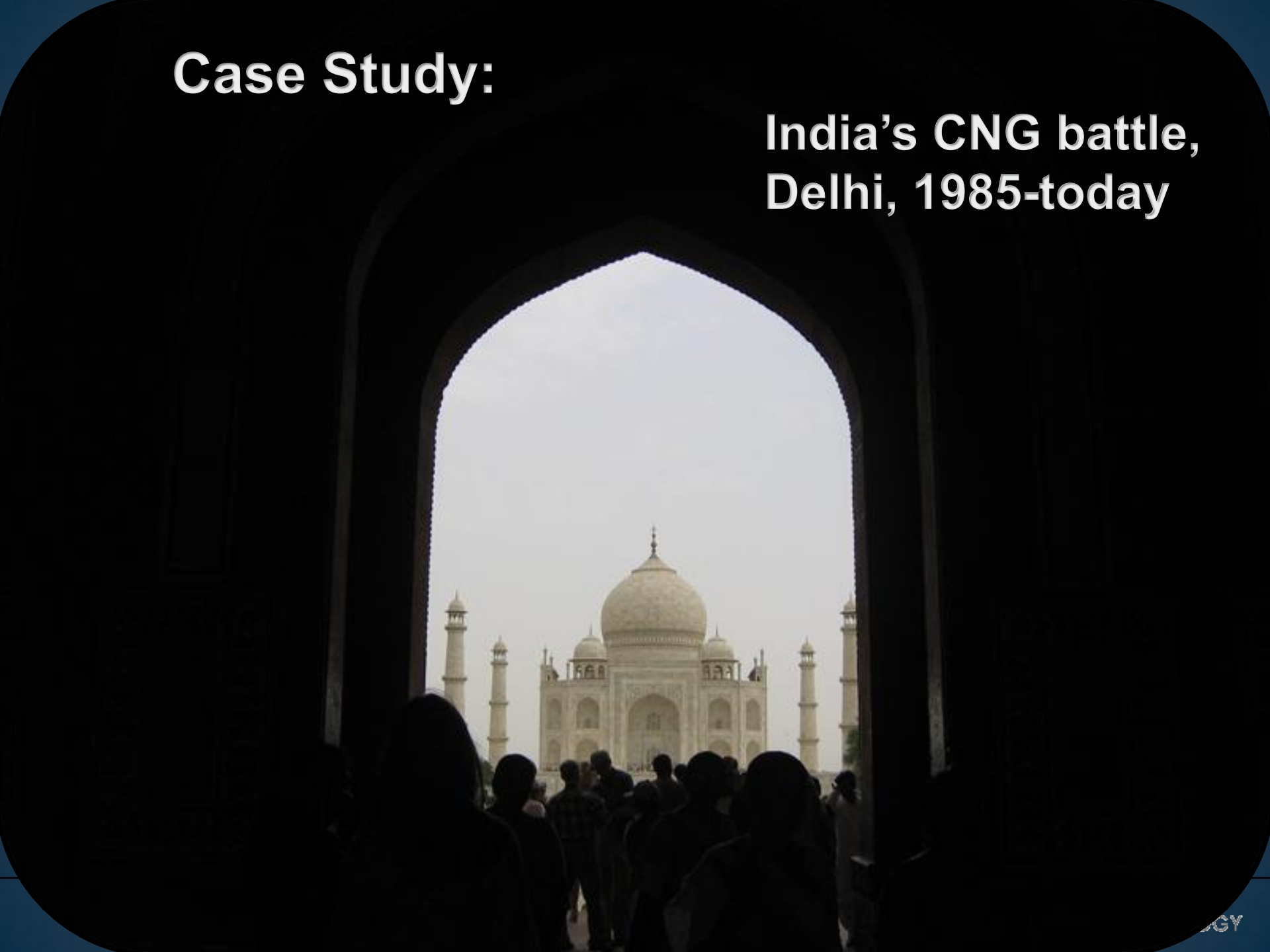
*Source: Ministry of Heavy Industries and Public Enterprise*

# Transportation Industry Structure

- Bajaj Auto Ltd.—77% of 3-Wheeler Market
- Current Problems
- Barriers to Entry
- Critical Success Factors for New Technologies

# Case Study:

## India's CNG battle, Delhi, 1985-today



# CNG Timeline

**1985-1995**

Pollution

**1996-2001**

Solution?

**2002-2006**

Corrective Action, Progress Forward


# Lessons Learned

## What They Did **Not** Do

- Range in short, medium, and long-term solutions
- Only remove vehicles that you can replace
- Offer incentives
- Keep public aware and involved

# The Technology

# ICE Vehicle Systems

**Ignition**
**Cooling**
**Exhaust**
**Fueling**
**Mechanical/Lubricating**
**Drive Starting**

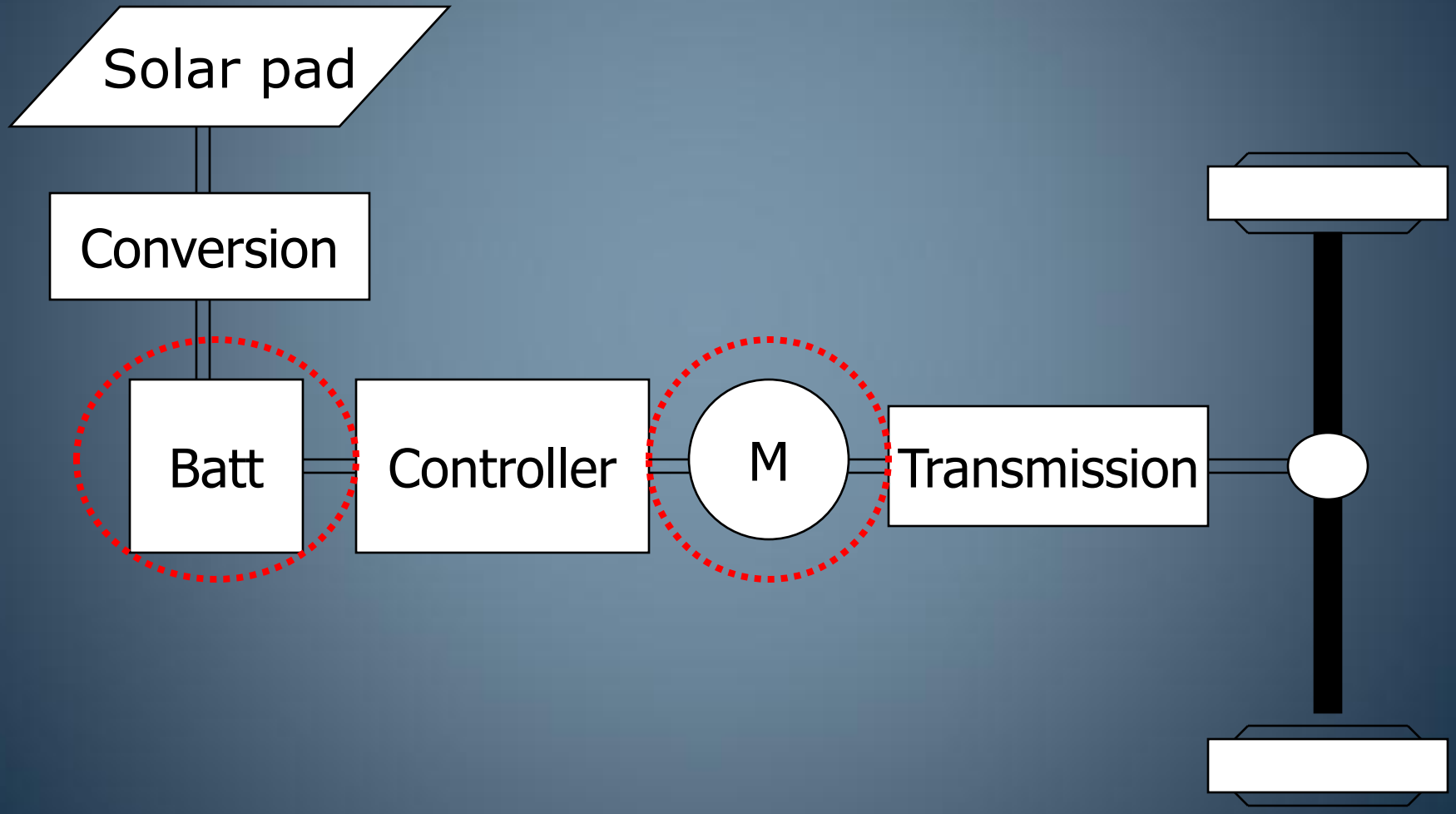
*These systems all require periodic maintenance and replacement*

# Solar/Electric Vehicle Systems

**Fueling**
**Electrical**
**Drive**

*Most of which is little or no maintenance and requires infrequent replacement*

# Simplified Vehicle Diagram



# Batteries

**The number of batteries in an SEV conversion will depend on the voltage of the battery type to be used, the size of the battery type to be used, the desired nominal system voltage, and the size of the vehicle in which the batteries will be installed.**

**Greater system *voltage* will result in increased *performance*, whereas greater *watt-hour capacity* will result in increased vehicle driving *range*.**

# Benefits Of Solar/Electric Vehicles

Costs significantly less per mile to operate

Vehicle is reliable

Engine is quiet

Engine is simple, flexible and adaptable for upgrades

Requires only electricity, water and solar power

Uses electricity from a myriad of sources

# SEV Benefits Continued…

Electric motors are more powerful than ICEs with same horsepower.

Low center of gravity allow SEVs superb handling and rapid acceleration.

Electric motors have continuous torque allowing SEVs to drive over obstacles with little effort unlike ICEs.

# SEV Benefits Continued…

Zero emissions

No greenhouse effect

No air pollution gases

No solid waste (Batteries are 97% recyclable)

# SEV Myths

**Speed**

**Range**

**Convenience**

**Cost**

# Conversion

**Costs less than purchasing a new vehicle**

**Conversion has double benefits:**
***Removal* of a polluting ICE**
***Addition* of a nonpolluting SEV**

# Barriers To Entry

High upfront costs

Politics

# Market Mainstream

**Conversion will influence consumer acceptance and investment into SEVs.**

# Next Steps

- Establish design and specifications of the solar/battery conversion kits and/or an entirely new vehicle
- Design a working prototype
- Determine the cost of the solar components
- Create an implementation strategy

# Final Thoughts and Questions