Tricycle Technology and Policy Options

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- The Tricycle Issue
- Policy Directions
- Technology Options
- Recommendations and Conclusions

Tricycles
- 1.3 Million tricycles all over Philippines and around 100,000 are in Metro Manila
- 70% are two stroke engine powered
- Issues
  - Emissions
  - Noise
  - Safety and Ergonomics
- Two Stroke Tricycle Emissions
  - Fuel Charge Short-circuiting
  - Poor Maintenance
  - Use of Excessive Oil-Fuel Ratio
  - Overloading
  - Poor roads and operational conditions

Policy Directions
- New Units Management
  - Ban on New Two Stroke Tricycle Registration
  - Standards Based Technology Control
- In-use Units Management
  - Outright or Gradual Phase Out and Shift to Cleaner Vehicles
  - Motorcycle Clinics
  - Adoption of Retrofit Technologies
New Units Management

- Ban on New Two Stroke Tricycles
  - Widely implemented
  - Has been successful in increasing the share of four stroke tricycles
- Emissions Standards

Shift to Cleaner Vehicles

- Outright or Gradual Phase Out and Shift to Cleaner Vehicles

San Fernando, La Union

Phase-Out Schedule

<table>
<thead>
<tr>
<th>Phase</th>
<th>Start</th>
<th>End</th>
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</thead>
<tbody>
<tr>
<td>1980's</td>
<td>1980</td>
<td>2004</td>
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Conversion to 4 strokes

- Financial Assistance provided through a $200.00 zero interest loan to cover down payment
- Some converted to four strokes without financial assistance

Dhaka, Bangladesh

Phase-out Schedule

<table>
<thead>
<tr>
<th>Phase</th>
<th>Start</th>
<th>End</th>
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</thead>
<tbody>
<tr>
<td>Pre-1994</td>
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<td>2002</td>
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<tr>
<td>All Remaining</td>
<td>1994</td>
<td>2003</td>
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</tbody>
</table>

Conversion to 4 CNG and Gasoline, Minibuses, Buses, taxicabs and HPVs

- Incentive policies were provided to assists operators in purchasing cleaner vehicles (ex. Reduction of import duties of CNG vehicles)

Shift to Cleaner Vehicles

- Vehicle Technology Options

- Carbureted Four Strokes
- LPG carbureted Four Strokes
- Electric Trikes
- Non-Motorized
**Clean Vehicle Options**

**Carbureted 4 Stroke**
- Estimated Cost: Php 70,000.00
- 20% to 30% reduction in FC
- Significant Reductions in HC, CO, PM and SOx
- Significant increase in NOx

**LPG Carbureted 4 Strokes**
- Estimated Cost: Php 85,000.00
- 20% to 30% reduction in FC
- Significant Reductions in HC, CO, PM and SOx
- Significant increase in NOx
- Cheaper fuel price

**Clean Vehicle Options**

**Electric Trikes**
- Estimated Cost: PhP 180,000.00 to PhP 230,000.00
- Significant reduction in energy cost
- Significant reductions in emission except SOx

**Non-motorized vehicles**
- Estimated Cost: PhP 15,000.00 to PhP 30,000.00
- Zero energy cost
- Zero emissions
- Could slowdown traffic and increase fuel consumption and emissions of other vehicles
**Motorcycle Clinics**

**Thailand**

- **In-Use MC**
  - Emission Test (MC Dealers to Administer)
    - Fail
    - Minor Tune Up & Emission Test
      - Fail
      - Pass
      - Out on the road
    - Pass
    - Major Repair & Emission Test
      - Fail
      - User to Upgrade
        - Old MC
          - Scrap
          - Repair/Recycle Parts/Sold Upcountry
        - New MC
    - Pass

**Adoption of Retrofit Technologies**

**Two Strokes**
- Gasoline Direct Injection Retrofitting
- Four Stroke Engine Repowering
- LPG Direct Injection Retrofitting
- LPG Four Stroke Engine Repowering

**Four Strokes**
- LPG Four Stroke Retrofitting

**Motorcycle Clinics**

**Bangladesh**

- Engine check-up (Free of charge)
- Emissions Measurement
- Repair / Servicing / Overhaul as needed
- Discussion and collection of statistics on the mechanical state of the baby-taxis
- Medical check-up for drivers and supply of medication
- Information literature and stickers for drivers
- Compensation/Incentives/Stickers

**Two Stroke Retrofit Technologies**

**Gasoline Direct Injection**
- Cost: Php 17,000.00
- 30% to 40% reduction in FC
- Significant Reductions in HC, CO, PM and SOx
- Slight increase in Nox
- Piloted in Palawan, Vigan and Tuguerao
- Available for Yamaha RS100 model only
- Retrofitting temporarily stopped
Two Stroke Retrofit Technologies

4 Stroke Repowering
- Estimated Cost: Php 20,000.00 to Php 25,000.00
- 20% to 30% reduction in FC
- Significant Reductions in HC, CO, PM and SOx
- Significant increase in NOx
- Currently in development stage and expected to be available by February 2010 for RS100, HDIII and X3 models

Two Stroke Retrofit Technologies

LPG Direct Injection
- Estimated Cost: Php 12,000.00
- 30% to 40% reduction in FC
- Significant Reductions in HC, CO, PM and SOx (zero)
- Significant increase in NOx
- Cheaper Fuel
- Currently in Development stage and scheduled to be rolled out locally by middle or late 2010

Two Stroke Retrofit Technologies

LPG 4 Stroke Repowering
- Estimated Cost: Php 30,000.00 to Php 40,000.00
- 20% to 30% reduction in FC
- Significant Reductions in HC, CO, PM and SOx (zero)
- Significant increase in NOx
- Cheaper price
- Currently in development stage and expected to be available by February 2010 for RS100, HDIII and X3 models

Four Stroke Retrofit Technologies

LPG 4 Stroke Retrofitting
- Estimated Cost: Php 12,000.00 to Php 15,000.00
- 20% to 30% reduction in FC
- Significant Reductions in HC, CO, PM and SOx (zero)
- Significant increase in NOx
- Cheaper price
- Currently in development stage and expected to be available by February 2010 for RS100, HDIII and X3 models
Technology Options

- New Vehicles
  - Gasoline Carbureted Four Strokes
  - LPG Carbureted Four Strokes
- In-Use Vehicles
  - Gasoline Direct Injection Retrofit
  - LPG Direct Injection Retrofit
  - Gasoline Four Stroke Repowering
  - LPG Four Stroke Repowering
- Next Generation Vehicles

Fuel Consumption (km/l or km/kWh)

Emission Factors (g/km)

GHG Emissions (eq. g CO2 per km)
Annual Operational Cost Breakdown

Annual Operational and Social Cost Comparisons

Financials

<table>
<thead>
<tr>
<th>Financing Program</th>
<th>Carb 4S</th>
<th>DI 2S</th>
<th>Rep 4S</th>
<th>LPG DI</th>
<th>LPG Carb</th>
<th>LPG Rep</th>
<th>E Trike</th>
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<tr>
<td>Initial Investment</td>
<td>70000.0</td>
<td>17000.0</td>
<td>23000.0</td>
<td>15000.0</td>
<td>85000.0</td>
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<td>Daily Amortization</td>
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<td>75.0</td>
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<td>75.0</td>
<td>100.0</td>
<td>100.0</td>
<td>200.0</td>
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<tr>
<td>Daily Savings</td>
<td>78</td>
<td>77</td>
<td>78</td>
<td>145</td>
<td>142</td>
<td>142</td>
<td>144</td>
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<tr>
<td>Monthly Interest Rate</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
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<tr>
<td>Payment Period (in Mos.)</td>
<td>55</td>
<td>9</td>
<td>12</td>
<td>8</td>
<td>47</td>
<td>16</td>
<td>87</td>
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<tr>
<td>Payment Period (in Yrs.)</td>
<td>4.6</td>
<td>0.7</td>
<td>1.0</td>
<td>0.6</td>
<td>3.9</td>
<td>1.3</td>
<td>7.2</td>
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Payment Period vs. Monthly Interest Rate

Daily Amortization = Php 75.00
Daily Payment vs Interest Rate

E Trikes with Advertising Revenue

- Initial Investment: 230000
- Daily Amortization: 250
- Daily Savings: 323
- Monthly Interest Rate: 2.00%
- Payment Period (in months): 54
- Payment Period (in years): 4.5

Conclusion

- There are financially viable technologies that will be available by 2010 to address in-use emissions from two stroke tricycles.
- Support in terms of financing assistance for the down payment or soft loans will accelerate the adoption of the technologies.
- The shift to LPG four strokes makes a lot of sense for new tricycles.
- The shift to non-motorized vehicles in some areas should be considered.
- E-Trikes at this point may not be viable yet but makes sense in some niche applications.