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# NATURAL GAS VEHICLE DEVELOPMENT IN THE PHILIPPINES

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LPG/CNG Vehicles for a Cleaner Tomorrow  
in Metro Manila  
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## NGV Development in the Philippines

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### Outline of the Presentation

- Accomplishments in Natural Gas Vehicle (NGV) Development**
- Natural Gas Utilization in Transport (NGUT) Project**
  - **Project Profile**
  - **Conversion Activities**
  - **Engine Performance Testing**
  - **Summary of Comparative Results**
- Benefits/Advantages that can be derived from NGV Technology**
- NGV Demonstration Activities**
- Current Developments and Future Plans/Targets**

Natural Gas Vehicle Development in the Philippines



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### Accomplishments in the NGV Development

- ❑ 1994 - The first development of the Natural Gas Vehicle (NGV) through the project entitled “Natural Gas Utilization In Transport (NGUT)” in the Philippines was initiated by the Government.
  - Its overall objective is to look into the potential of Compressed Natural Gas (CNG) as an alternative fuel to diesel in the transport sector (in order to alleviate the emerging pollution problems in the country) as well as an addition to possible investment opportunities for the country’s natural gas resource.
- ❑ 1999 - ERDC, as a co-implementor of the NGUT project, successfully converted an Isuzu Hi-Lander 4JA-1 direct injection system into a 100% Natural Gas Vehicle (NGV).



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### Accomplishments in the NGV Development

- ❑ 2000 - ERDC also successfully tested an Isuzu 4JA-1 engine system into a dual-fuel system (natural gas and diesel at the same time).
  - This was a practical move considering the country does not have a network of natural gas refilling stations for vehicles yet
- ❑ October 2001 - The DOE created a task force (NGV Program Office and the NGV Program Management Team) with members composed of PNOc, PNOc-EDC-ERDC, and PNOc-EC to integrate all efforts in the development and of the infrastructure of natural gas for the transport sector.



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### Accomplishments in the NGV Development

- ❑ **November 2001 - The PNOC-EDC Shuttle Bus was converted by ERDC from diesel-fired to a dual-fired (natural gas & diesel) vehicle.**
  - This vehicle was presented and demonstrated to Pres. G. Macapagal-Arroyo during the 2001 Energy Week.
- ❑ **February 2002 - The Shuttle Bus of the Department of Energy was converted by DOE to a 100% Natural Gas Vehicle.**
  - PNOC-EDC-ERDC headed the conversion activity as a start of the technology transfer
- ❑ **May 2002 - The DOE have conducted the conversion of its Nissan Patrol Safari Service to CNG utilization under technical supervision of ERDC.**
- ❑ **June 2002 - PNOC Holdings Company accepted six (6) units of Enviro 2000 NGV-converted taxis (Renault Espace) donated by the Malaysian-firm Petronas for promotional purposes.**



### Natural Gas Utilization in Transport (NGUT)

- ❑ **In 1994, the Philippine Government initiated the *Natural Gas Utilization in Transport (NGUT) Project* to search for economical and environment-friendly alternative fuels**
- ❑ **The ASEAN, the New Zealand Government and the Department of Science and Technology (through PCIERD) provided the funding for the project**
- ❑ **Government agencies involved in the project:**
  - DOST-PCIERD (as the lead coordinating agency)
  - DOE (as the implementing agency)
  - PNOC-EDC/ERDC (as the co-implementing agency in charge of developing and testing the Natural Gas Vehicle)
  - PNOC-EC (as cooperating agency providing the natural gas )



## NGUT - PROJECT PROFILE



### □ ERDC's Scope of Work

- Conversion of a diesel engine into natural gas spark ignition operation
  - Technology Transfer/Adoption
  - Engine Conversion
- Coordination with PNOC-EC for the supply of compressed natural gas (CNG) fuel
- Performance and emission testing of the converted engine
  - Stationary Performance Test
  - On-the-Road Performance Test

## NGUT - CONVERSION ACTIVITIES



### □ Pre-Conversion

- Technology transfer
  - Attendance to seminars and workshops abroad
  - Acquisition of services of a foreign expert
- Selection of the diesel engine to be converted
- Purchase of diesel engine vehicle (Isuzu Hi-Lander -- 4JA-1 Engine) to be converted into a Natural Gas Vehicle (NGV)
- Out-sourcing of materials, accessories, and parts required in the conversion process both in local and international markets
- Stationary Engine Performance Test (prior to actual engine conversion)

## NGUT - CONVERSION ACTIVITES



### □ Conversion

- Ignition System Modification
  - Modification of cylinder head
  - Replacement of the injection pump w/ a distributor assembly
- Engine Displacement Adjustment
- Fuel Supply System Modification
  - Gas Carburetor Assembly
  - Pressure reducing/regulating and automatic shut-off valves
  - Fuel Line
  - Gas Tank

## NGUT - CONVERSION ACTIVITES



### □ Post-Conversion

- Debugging
  - Focus on ignition system
  - Two distributor assembly units were tested (one local and another from abroad)
  - Initial tests showed that both were reliable, however, the local unit was preferred to be used in the project due to availability within the country
- Break-in of CNG Test Engine

## NGUT - ENGINE PERFORMANCE TESTING

### □ Stationary Bench Dynamometer Performance Testing

- Full Load Performance Test
- Variable Load Performance Test
- Exhaust Emission Test

### □ On-the-Road Performance Test

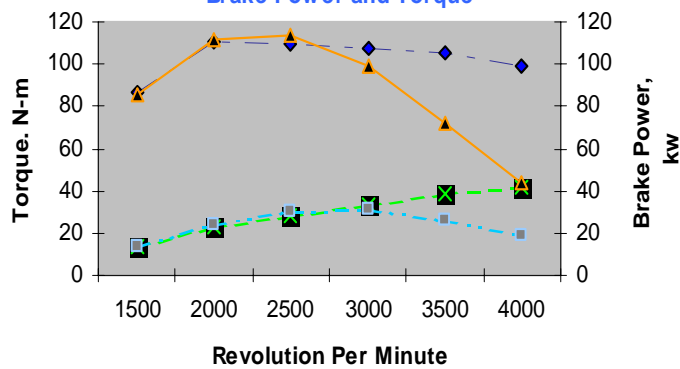
- Preliminary On-the-Road Performance Test
- 15,000 Km On-the-Road Performance Test



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## NGUT - ENGINE PERFORMANCE TESTING

### Full Load Performance Test Results Brake Power and Torque



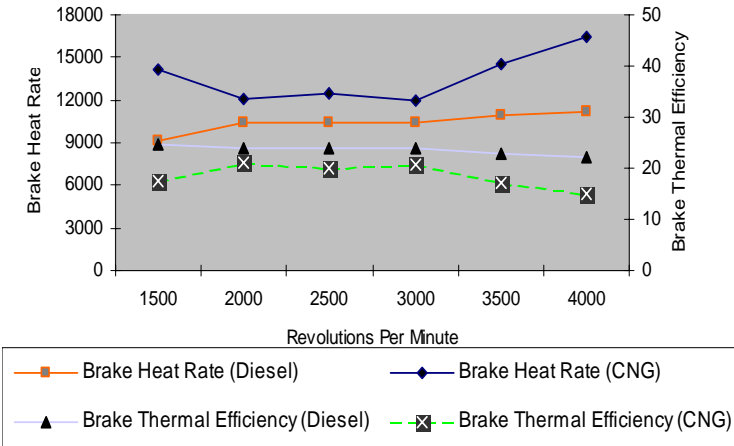
- ◆ — Torque (Diesel), N-m
- ▲ — Torque (CNG), N-m
- - ■ - - Brake Power (Diesel), kw
- - □ - - Brake Power (CNG), kw



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## NGUT - ENGINE PERFORMANCE TESTING

### Full Load Performance Test Results Brake Heat Rate and Brake Thermal Efficiency



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## NGUT - ENGINE PERFORMANCE TESTING

### On-the-Road Performance Test Results

PARAMETER		Natural Gas Vehicle (NGV)	Diesel-fed Vehicle	REMARKS
Fuel Consumption	Km/kg or km/li	13.0	11.3	
	BTU/km	3940.0	3237.4	
Temperature (°C)	Engine	70	75	Average
	Oil	69.5	77.5	Average
Lubricating Oil (TBN)		8.95	7.05	After 5,000 km traveled
Exhaust	CO (%vol)	0.08	(opacity)	
	CO <sub>2</sub> (%vol)	9.98	(opacity)	
	HC (in ppm)	0.01753	(opacity)	



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## NGUT - SUMMARY OF COMPARATIVE RESULTS

- The overall results of the performance tests (both stationary and on-the-road performance tests) showed that:
  - The performance of the Natural Gas Vehicle (NGV) is at par with that of the original vehicle (diesel engine setup)
  - And that there is no noticeable power deration as compared with the original (diesel) engine's performance



## BENEFITS / ADVANTAGES THAT CAN BE DERIVED FROM THE NGV

- **Cleaner Emissions**
  - Significant reduction in emission of harmful fumes and greenhouse gases:
    - Carbon Monoxide (CO) by 95%
    - Hydrocarbons by 50%
    - Oxides of nitrogen (Nox) by 50%
    - Non-methane organic gas (NMOG)
  - No evaporative emissions during fueling.
  - CNG is non-toxic. It is lighter than air and therefore disperses quickly
- **Reduced maintenance cost due to less oil changes and spark plug replacements**
  - Oil changes can be made higher than 15,000 kms. instead of the normal interval of 5,000 kms.



## BENEFITS / ADVANTAGES THAT CAN BE DERIVED FROM THE NGV

- Lower Fuel Consumption
- Dollar Savings from displaced oil imports
- Requires higher ignition temperature thereby reducing chances of accidental ignition



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## NGV Demonstration Activities

- Climate Change Exhibit – April 2001
- National Science & Technology Week 2001:  
Scientific Meeting on Industry, Energy and Advance  
Science and Technology – July 2001
- Alternative Energy Seminar – October 2001
- 2001 Energy Week – December 2001
- 2002 Earth Day – April 2002
- Independence Day Celebration – June 12, 2002
- ABS-CBN Sineskwela NGV Demo Video Shoot –  
October 8-11, 2002
- Malampaya Gas Project Anniversary and CNG  
Program Launching – October 16, 2002



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## Current Developments and Future Plans/Targets

### □ Current Developments

- DOE is implementing a joint venture project with Isabela State University, PNOC-EC, and the Local Government Unit of Echague (Isabela) to conduct the conversion of three diesel engines to CNG utilization. The Project cost is estimated a P1.3 MM and is funded by PCIERD.
- ERDC is presently conducting an engine-mapping paper based on CNG-conversion experiences from the NGUT Project and other conversion activities.



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## Current Developments and Future Plans/Targets

### □ Current Developments

- The establishment of a network of CNG refilling stations within CALABARZON region, Metro Manila and other areas covered along the proposed BatMan 1 & 2 natural gas pipelines is now under study.
  - The “mother-daughter” refilling scheme is being experimented on. Trucks (daughter) carrying several tanks of CNG shall be distributed along common routs. These trucks refill their tanks from a mother station in San Antonio (Isabela) or Batangas refilling stations, whichever is nearer.
- Pres. GMA has asked DENR to consider requiring ECC applicants to consider the use of NGV’s especially in Metro Manila



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## Current Developments and Future Plans/Targets

### □ Current Developments

- To facilitate the conversion of public utility vehicles, the Government is working on the following incentives
  - Possibility of setting the price of CNG at about half (50%) the price of diesel
  - DTI has committed to reduce the tariff on conversion kits by one percent and enhance the incentive package for natural gas vehicles. A conversion kit is expected to cost around P25,000-P30,000 excluding labor and fuel system (CNG tank, CNG pipes) renovation
  - GFIs (e.g. DBP) to come up with innovative financial packages for those interested to purchase conversion kits, NGVs and those interested to put up re-fuelling stations/facilities
  - Special incentives are being drawn up, such as toll-free privileges on highways and dedicated lanes on major thoroughfares for NGV



## Current Developments and Future Plans/Targets

### □ Current Developments

- Private Sector Response
  - California Bus Lines has expressed its intention to purchase 100 buses to run on CNG and add these to its fleet
  - Shell SPEX and First Gas Power have committed to construct refueling stations to support the CNG supply infrastructure
- Government to get ODA support for NGV endeavor
  - USAID is providing technical and financial assistance through the Clean Cities Program
  - JBIC is also providing technical support in drawing up the country's master plan for the natural gas industry



## Current Developments and Future Plans/Targets

### □ Future Plans and Targets

- As a priority initiative of Pres. GMA, the DOE-NGV Program Office and the NGV Program Management Team have targeted the conversion of 113 vehicles by 2003, 390 vehicles by 2007, and 300,000 vehicles by 2015, starting with public buses, then taxis, and later on jeepneys and private vehicles in Metro Manila.
  - The deal with California Bus Line is still under negotiation with the proposed 100 CNG Bus units to be ready by October next year
- An equivalent 4.5 million liters of diesel is expected to have been displaced by next year due to CNG conversions



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[Thank You Very Much](#)

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