



Alternative Transport Fuels in New Zealand

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Coverage

Responses to the Energy Crises

Natural Energy Resources Available

Transport Fuels Production

Transport Fuels Distribution

Transport Fuels End Use

Field Trials

Commercialisation

Current Status

Key Points



Response to the Energy Crises

Two new Energy Research Agencies were formed:

The NZ Energy Development Committee, ERDC

The NZ Liquid Fuels Trust Board, LFTB

Both were small and very flexible,

Both Reported and made Recommendations to Govt.

A Task Force Approach



The ERDC and LFTB Years

The ERDC

- **Mission:** Pursuit of New Energy Initiatives,
- 1973 – 1988,
- Driver: The First International Energy Crisis,
- Funded through Votes Science and, later, Energy,
- Board of Directors - Govt, Private and University,
- Management Team,
- Contracts open to all Energy Research Providers,



The ERDC and LFTB Years

The LFTB

- **Mission:** Independence from Imported Transport Fuels,
- 1979 – 1987,
- **Driver:** The International Energy Crises,
- **Funded** by a levy on petrol and diesel,
- **Board of Directors** - Govt, Private, and University,
- **Management Team,**
- **Contracts open to all Energy Research Providers.**



Contributions of the ERDC

- **Established a broad Energy knowledge base,**
- **Introduced the idea of contestable research funding,**
- **The GDC and Energy Research units in Universities,**
- **Introduced CNG and LPG as a transport fuels,**
- **Established the possibility of Wind Power,**
- **Identified prospects for indigenous energy production,**
- **Established a task force targeting energy research,**
- **Introduced a new Energy Research Paradigm.**

Funding Base too small?



Contributions of the LFTB

- **Established an in depth Energy Resource base,**
- **Advanced the practice of contestable research funding,**
- **Re-configured NZ's Transport Fuels supply system,**
- **Commercialised CNG and LPG as a transport fuels,**
- **World's first Synthetic Petrol production from gas,**
- **Identified and Evaluated all prospects for Indigenous Transport Fuel production,**
- **A cost effective task force for Applied Energy Research,**
- **Established a new Energy Research Paradigm.**

Built upon the Success of the ERDC



Political and Economic Drivers

- **The oil shocks of the 1970's and 1980's,**
- **Fuel shortages – “Car-less days”,**
- **High Oil prices,**
- **Balance of Payments,**
- **Energy Security initiative.**

Large Energy Resource Base to work with



New Zealand's Energy Resource Base

- **Crude Oil,**
- **Natural Gas,** **(Alternative Fuels Feedstocks)**
- **Gas Condensate,**
- **Coal – mainly Lignite,**
- **Peat,**
- **Forest Biomass,**
- **Agricultural Biomass,**
- **Vegetable Oils,**
- **Animal Fats,**
- **Waste Biomass**

Per Capita, NZ is Energy Rich



Typical Resource Evaluation and Utilisation

- Where is it? **e.g. Lignite**
- What is it?
- How much is there?
- How can we Harvest it?
- How do we Process it?
- How do we use the product as a Transport Fuel?
- How much import substitution is achieved?
- What is the Cost? – full PESTE Evaluation.

Cradle to Grave Evaluation



Alternative Transport Fuel Production Options

- Synthetic Gasoline** - **Natural Gas**
- Methanol** - **Natural Gas**
 - **Forest Biomass (wood)**
- Ethanol** - **Ag. Biomass (sugar beet, corn)**
 - **Forest Biomass (cellulose)**
- CNG** - **Natural Gas**
- LPG** - **Natural Gas**
 - **Crude Oil Refining**
- Biogas** - **Forest Biomass (lignin)**
 - **Ag. Biomass (lignin)**
 - **Waste Biomass**
- Bio-Diesel** - **Vegetable Oil (rapeseed oil esters)**
 - **Animal Fats (tallow esters)**



World's highest ratio of Sheep to Diesel!





Tallow Ester Bio-Diesel

- **High Quality Diesel Blendstock (up to 100%),**
- **Reduced Exhaust Emissions,**
- **Improved Engine Performance,**
- **10% National Diesel Substitution possible,**
- **Ready for Commercialisation,**
- **Economic at Today's Oil Prices.**

A Unique National Alternative Fuel Solution

Alternative Fuel Distribution Investigations



CNG - Commercial

LPG - Commercial

Ethanol (E90) and (E10-20) Gasoline Blends – 3 years pilot,

Ethanol (E10-15) emulsions with Diesel – 1 year pilot,

Methanol (M85) – 5 years regional use,

Methanol (M2-15) Blends with Gasoline, - 4 years regional use,

Methanol (M100) SI and DF Diesel, - 5 years local use,

Methanol (M10) Emulsions with Diesel, - 1 year pilot,

Methanol (M100) with Diesel Ignition Improver -3 years pilot,

Rapeseed Oil Ester/Diesel Blends (R30) – 5 years regional use,

Tallow Ester/Diesel Blends (T10) – 4 years regional use,

Biogas – 6 years local use.



Alternative Fuel End Use Investigations

CNG - Commercial

LPG - Commercial

Ethanol (E90) and (E10-20) Gasoline Blends – 20 vehicles, 3 years,

Ethanol (E10-15) emulsions with Diesel – 10 vehicles, 1 year,

Methanol (M85) – 105 vehicles, 5 years,

Methanol (M2-15) Blends with Gasoline, - 4000 vehicles, 4 years,

Methanol (M100) SI and DF Diesel, - 15 vehicles, 5 years,

Methanol (M10) Emulsions with Diesel, - 10 vehicles, 1 year,

Methanol (M100) with Diesel Ignition Improver – 5 vehicles, 3 years,

Rapeseed Oil Ester/Diesel Blends (R30) – 150 vehicles/tractor, 5 years,

Tallow Ester/Diesel Blends (T10) – 40 buses/2 marine launches, 4 years,

Biogas – 50 vehicles, 6 years.



Transport Fuels System Balance

- **Most Alternative Fuels substitute for Gasoline (Not Diesel),**
- **This leads to Refinery/Fuel Supply Unbalance,**
- **NZ needed to increase Diesel Supply,**
- **Significant Refinery/ Fuel Supply System Modeling required,**
- **Major Refinery and/or Fuel Distribution System Re-design involved,**
- **Very large associated costs.**

Introduction of Alternative Fuels is not a Simple Matter!



Codes, Standards and Institutional Changes

- **Inadequate Standards and Codes for Alternative Fuels Introduction,**
- **Major effort required to establish these,**
- **New Institutional structures and responsibilities needed,**
- **Considerable associated cost,**
- **Strong Government support required.**

Introduction of Alternative Fuels is Not a Simple Matter!



Outcome of Alternative NZ Fuels Program

Alternative Fuels Introduced Commercially

Synthetic Gasoline

- mostly exported for refinery blending,
- 53% Gasoline Substitution.

CNG

- about 130,000 vehicles,
- 530 refueling stations,
- 9% Gasoline substitution.

LPG

- About 55,000 vehicles
- 130 refueling stations,
- 3% Gasoline Substitution.

Most self sufficiency from Additional Condensate



Outcome of Alternative Fuels Program

Alternative Fuels that **Could** be Introduced

- Ethanol** - (E90) and (E5-10) Gasoline Blends,
- Methanol** - (M85)
- Methanol** - (M2-15) Gasoline Blends,
- Methanol** - (M100) SI and DF Diesel,
- Methanol** - (M100) with Diesel Ignition additive,
- Rapeseed Oil Ester/Diesel Blends** - (R30)
- Tallow Ester/Diesel Blends** - (T10)
- Biogas.**

When Economics Permit!



National Benefits Achieved

- **Fuel Self Sufficiency 8 – 65% in 6 years,**
- **300-400 years Self Sufficiency if needed,**
- **Knowledge Base to introduce Alternative Fuels,**
- **World's First Gas-to-Gasoline Plant,**
- **New Energy Research Units and Competence**
- **International Status**
 - **CNG, Methanol**
 - **GTL**
 - **Forest Biomass**
 - **Tallow Esters**



Costs

LFTB RD & D Costs

- About **US\$ 45 Million** in Current terms.

Implementation Costs

- About **US\$ 4.8 Billion** in Current terms.

Introduction of Alternative Fuels is Not Cheap Either!



Key Points

- **A Motivated Task Force can make it Happen,**
- **Government must take a leading Role,**
- **Need to Fully Evaluate National Options,**
- **Introduction of Alternative Fuels is **Not** a Simple Matter,**
- **Link with, feed off and coordinate with International experience.**

Be Prepared!