

Hong Kong Student Science Project Competition  
2006

# Plastic Fuel

Carmel Pak U Secondary School

塑膠 · 燃油

# Oil Price



# Domestic Waste



# Landfill Burden



Landfill: Ta Kwu Ling



Landfill: Tuen Mun



Landfill: Tseung Kwan O

- Covering 1/400 of HK
- 17,500 tones of solid wastes are disposed of everyday
- Landfill sites will be **FULL** in 6 to 10 years

*Are there any new solutions?*

# Plastic Fuel

**Alleviate  
Landfill  
Burden**

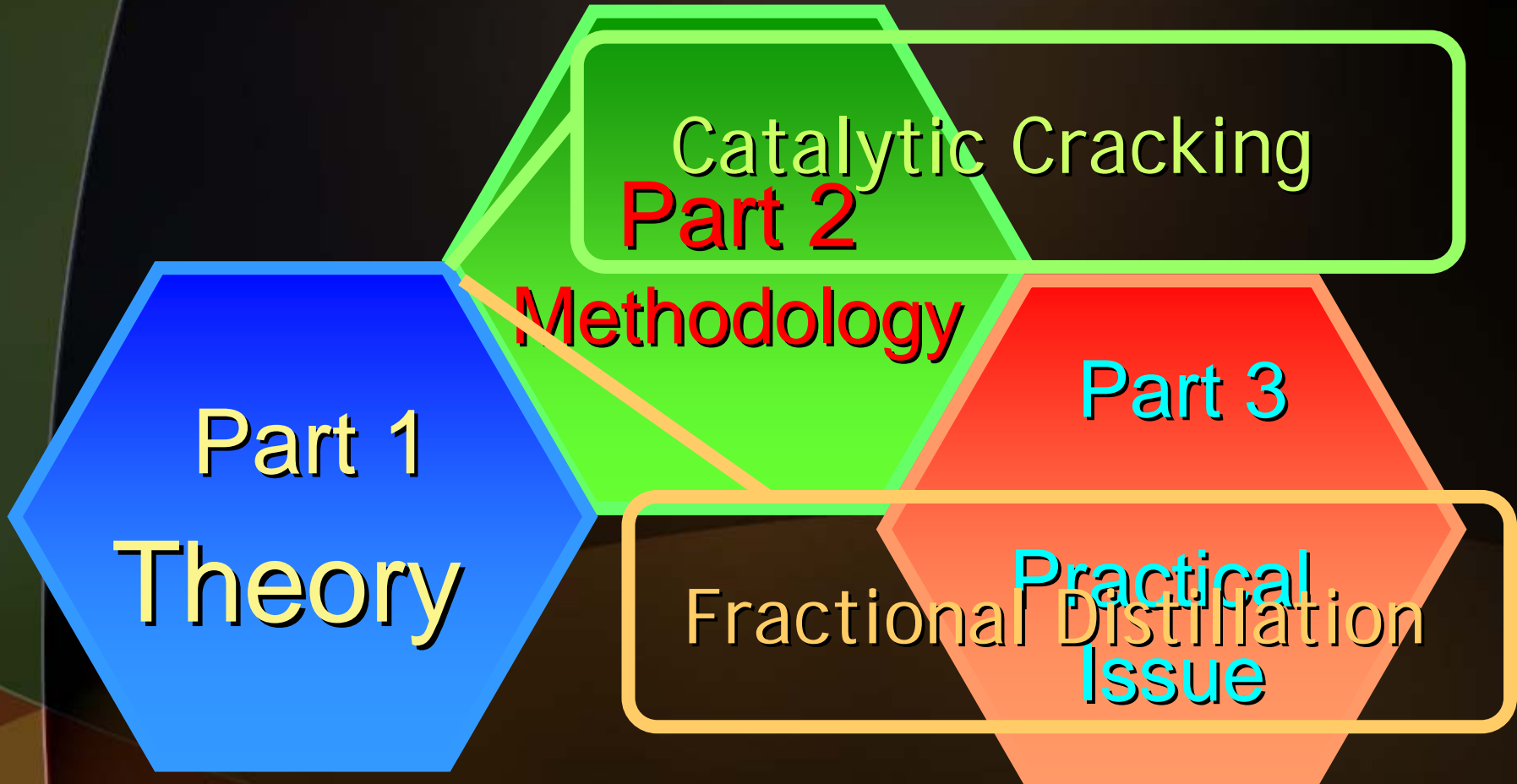
**Conserve  
Natural  
Resources**

**Aims**

**Reduce  
Dependence  
On  
Fossil Fuels**

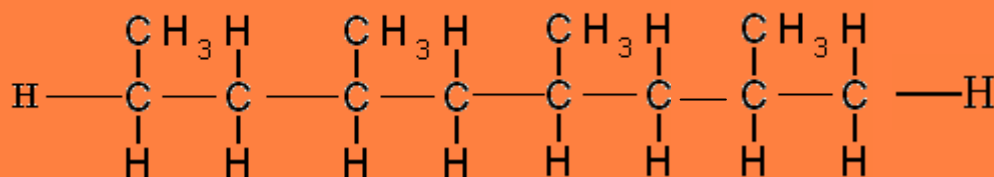
**Convert  
wastes  
into fuels**

# Presentation



# Catalytic Cracking

Cracking



Liquid Alkanes

Polypropene

Gaseous Alkenes



Sand Brick

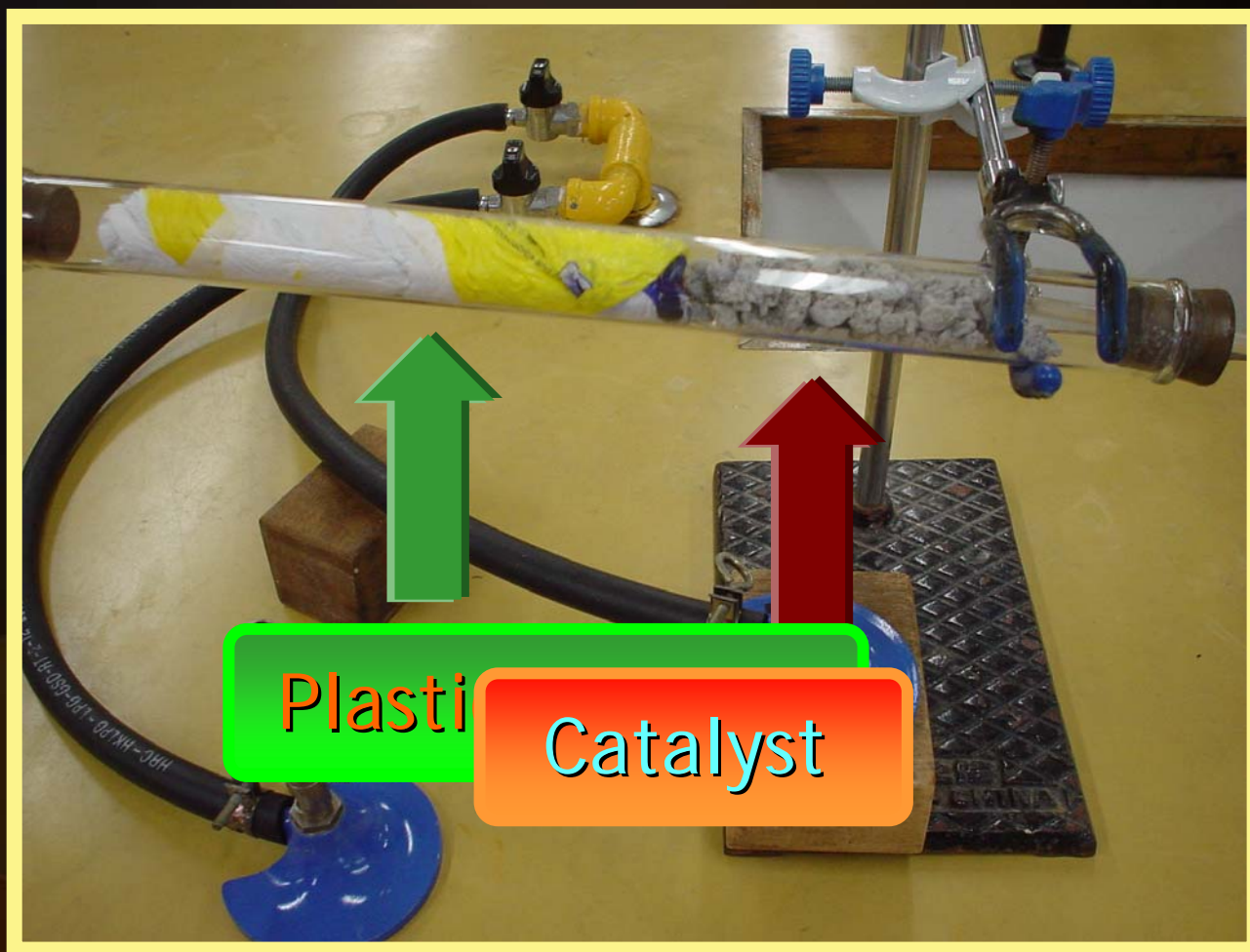


Catalyst



Steel Wool

# Catalytic Cracking



Part 1

Theory

# Catalytic Cracking

## Catalytic Cracking of Plastic



Part 1

Theory

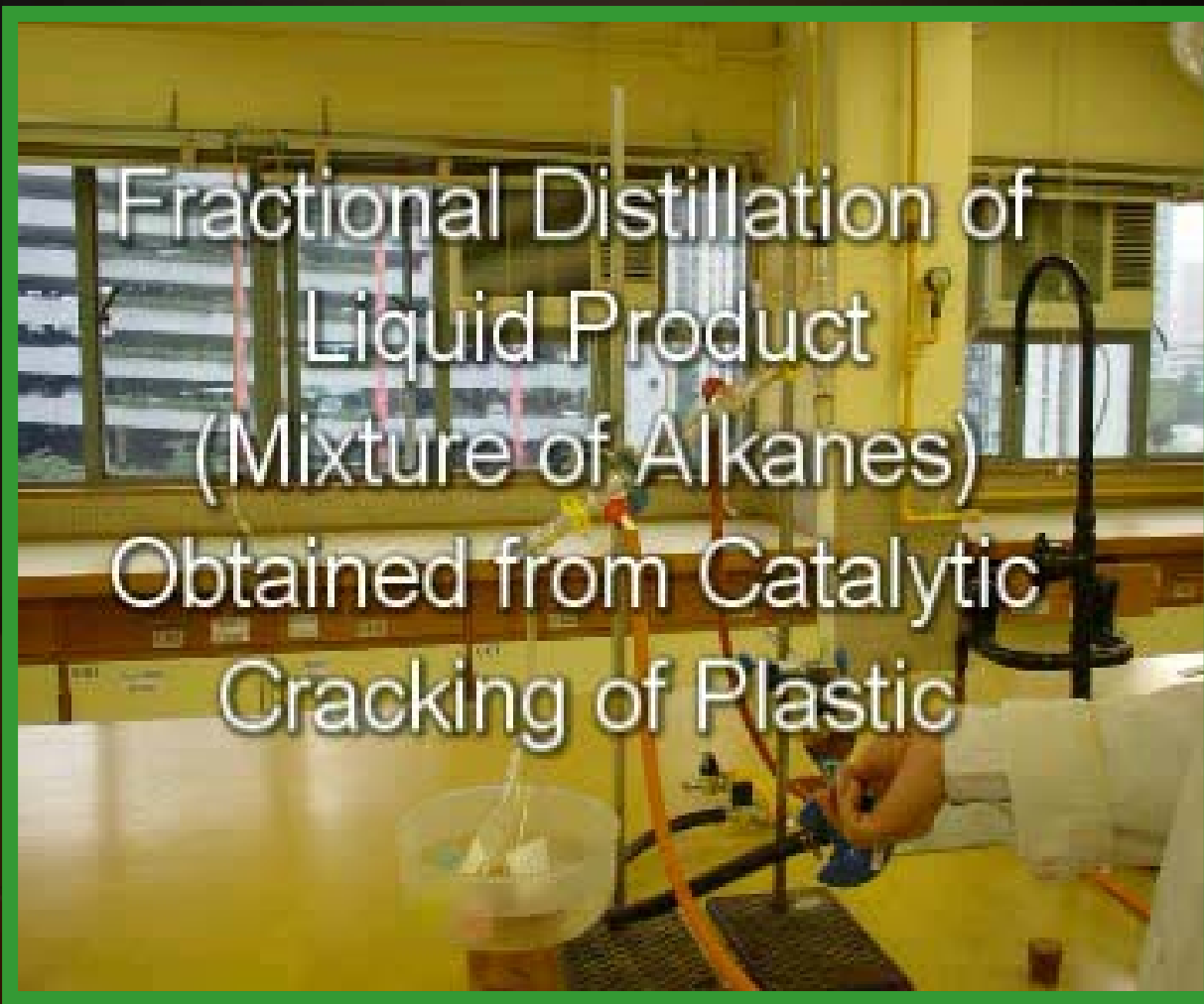
Test using  $\text{Br}_2$

## Testing Gaseous Alkenes Using $\text{Br}_2(\text{aq})$



**Fractional  
Distillation**

Fractional Distillation of  
Liquid Product  
(Mixture of Alkanes)  
Obtained from Catalytic  
Cracking of Plastic

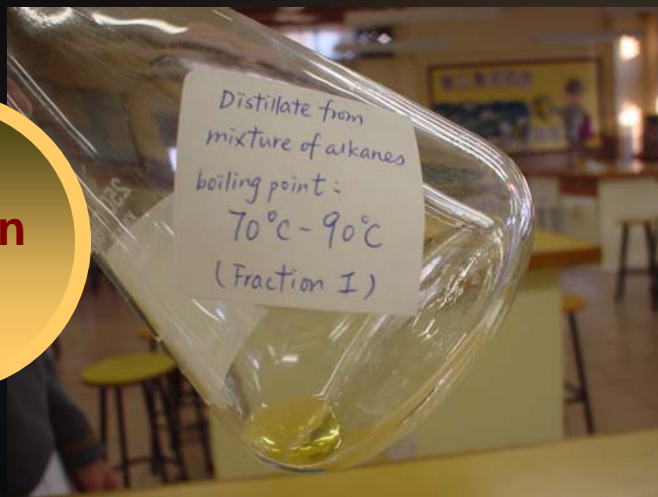


*Part 1*

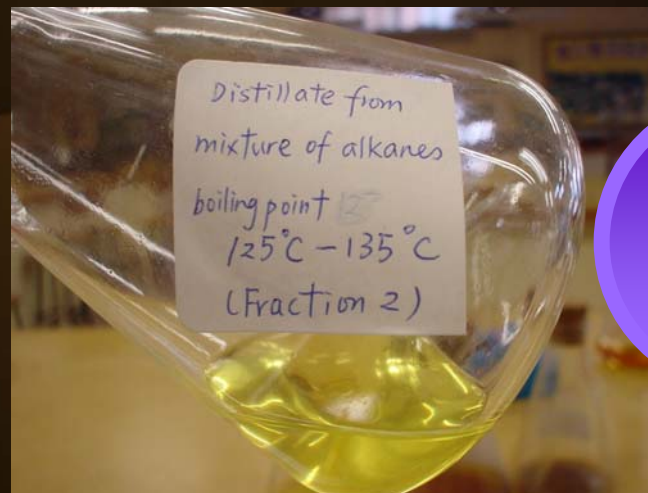
*Theory*

# Fractions of liquid products

**Fraction  
1**



**Fraction  
2**



Part 1

Theory

Fraction  
3

Distillate from  
mixture of alkanes  
boiling point  
 $160^{\circ}\text{C} - 180^{\circ}\text{C}$   
(Fraction 3)

Fraction  
4

Distillate from  
mixture of alkanes  
boiling point  
 $220^{\circ}\text{C} - 240^{\circ}\text{C}$   
(Fraction 4)

# End of Part 1

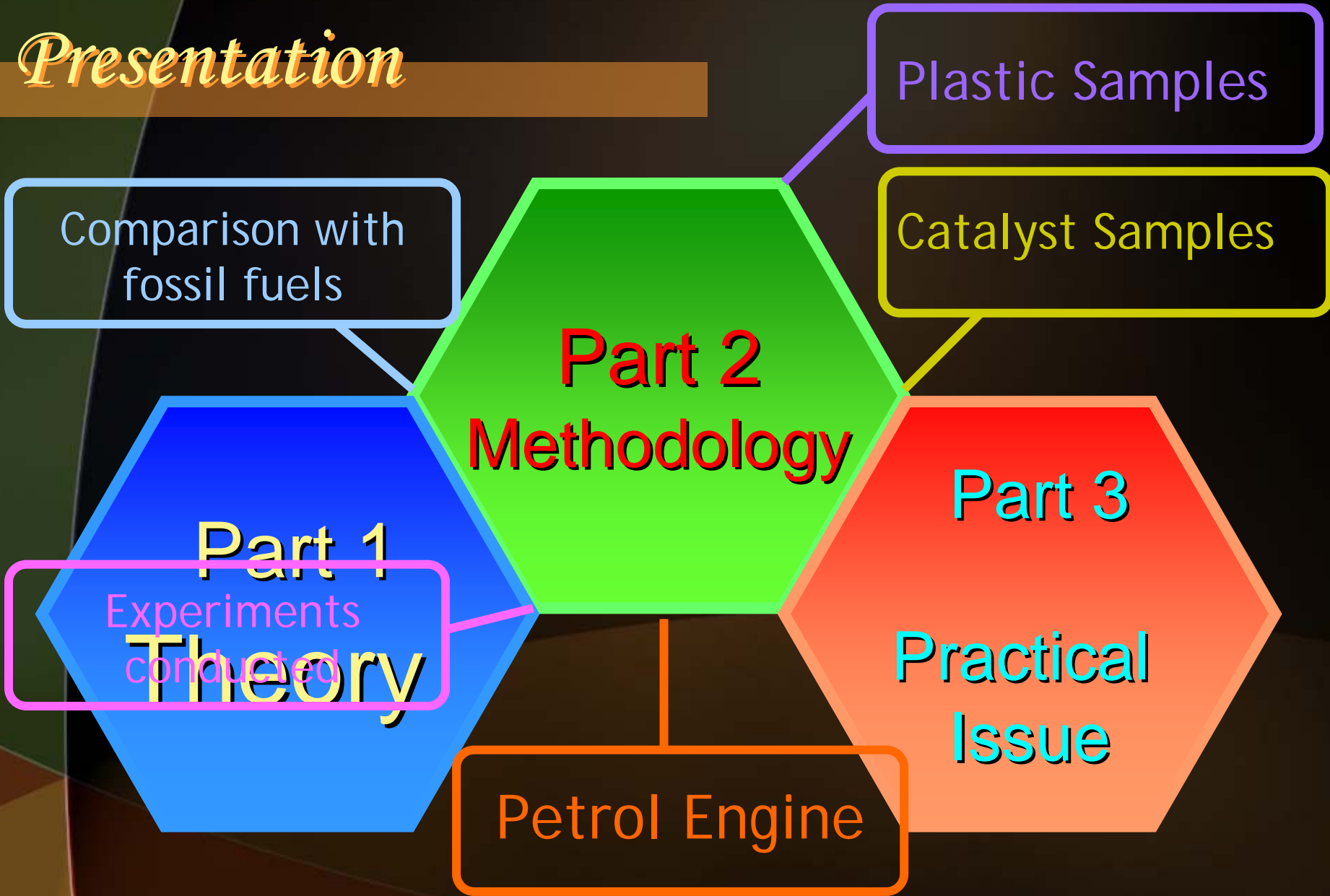
Fraction  
5

Distillate from  
mixture of alkanes  
boiling point  
 $> 300^{\circ}\text{C}$   
(fraction 5)

Part 1

Theory

# Presentation



# *Plastic Samples*

Polyethene (PE)

Polypropene (PP)

*Plastic  
Samples*

# Polypropylene (PP) Products



**Drinking Straws**



**Trays and containers**

# Polyethene (PE) Products



**Plastic Bags**



**Wrappings**

# Catalyst Samples



Sandbrick

Iron Wool



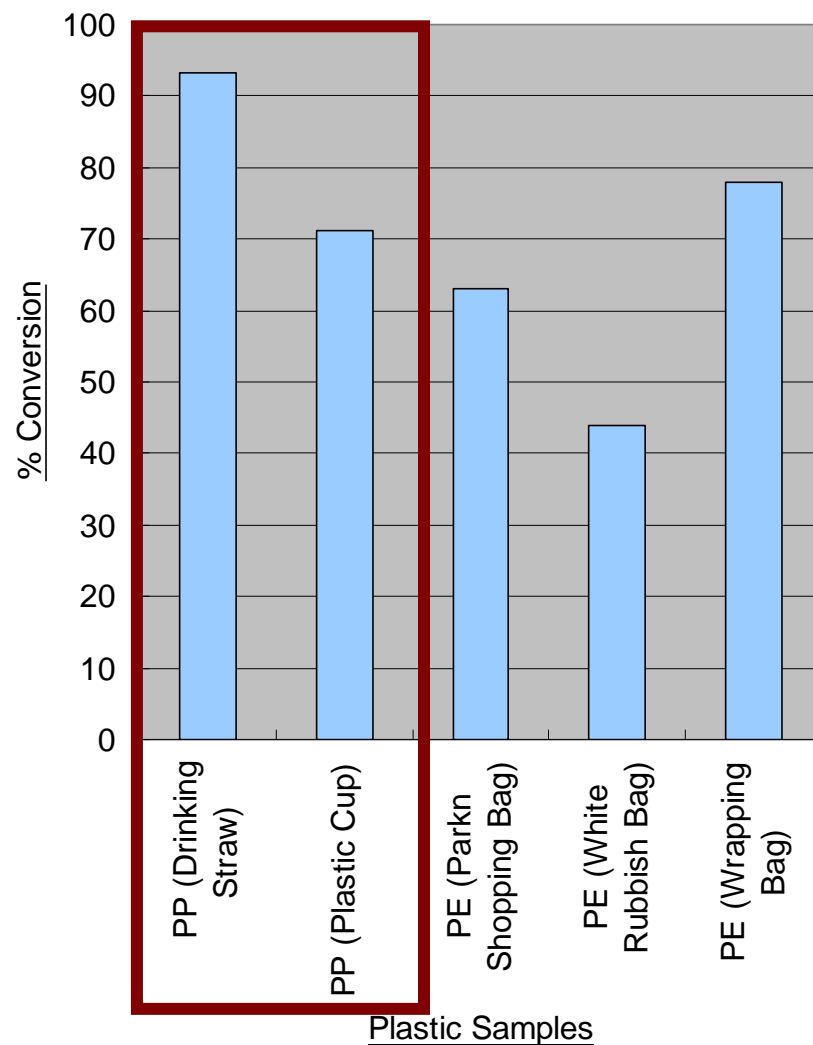
# Conversion

PP : Higher % conversion

Highest  
Conversion %

93.2%

% Conversion of Different Plastics to Alkanes & Alkenes Using Sand Brick as Catalyst



# Comparison of Plastic Fuels and Fossil Fuels



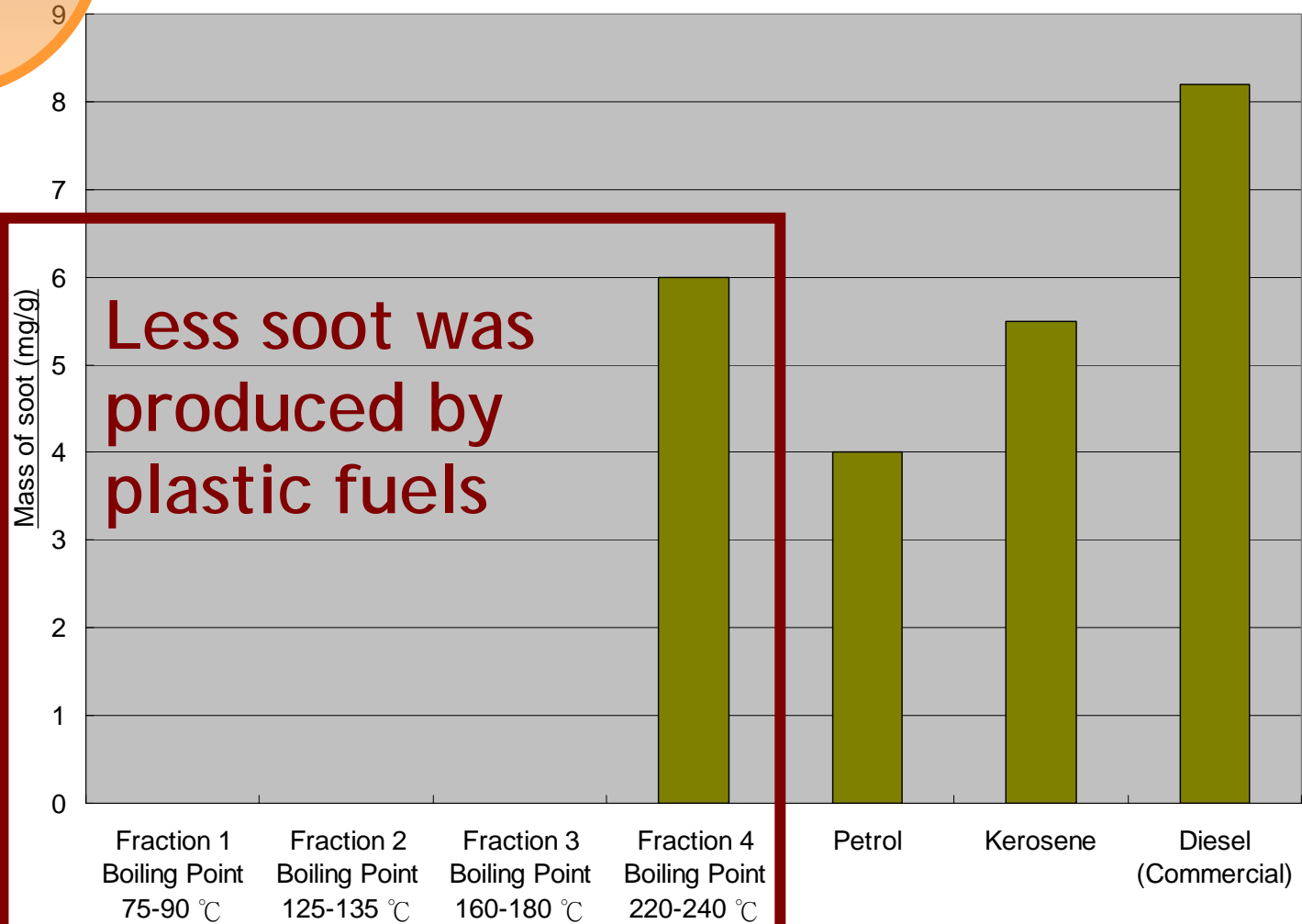
Enthalpy

Part 2

Methodology

# Soot

Mass of soot formed for different samples of liquid alkanes & petroleum



Different liquid alkanes and petroleum

# Comparison of Plastic Fuels and Fossil Fuels



Enthalpy

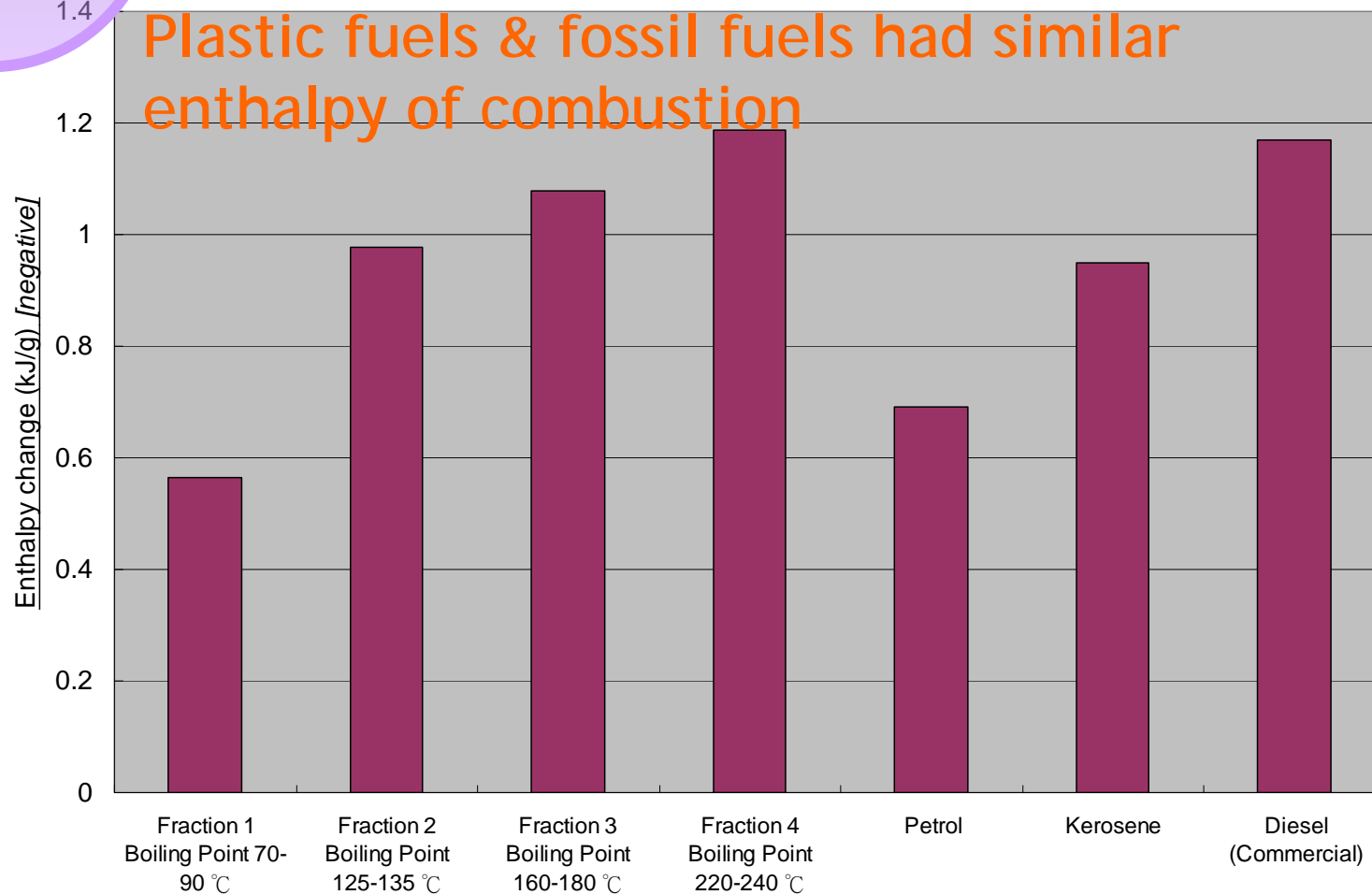
Part 2

Methodo

# Enthalpy

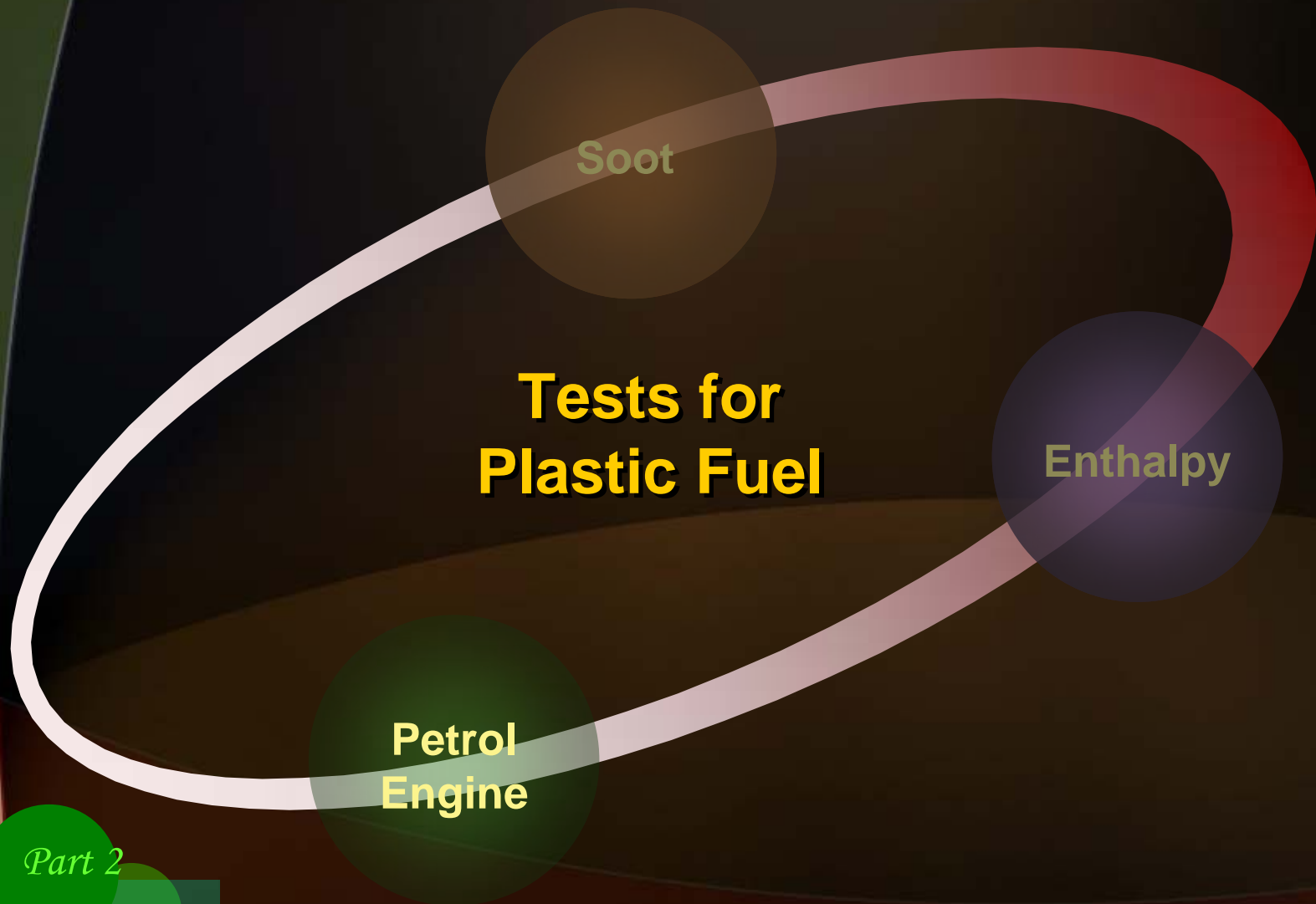
1.4

## Enthalpy of combustion of different sample of liquid alkanes and petroleum



Different liquid alkanes and petroleum

# Comparison of Plastic Fuels and Fossil Fuels



Part 2

Methodology

# *Performance of Plastic Fuel in Petrol Engine*

**Petrol  
Engine**



*Part 2*

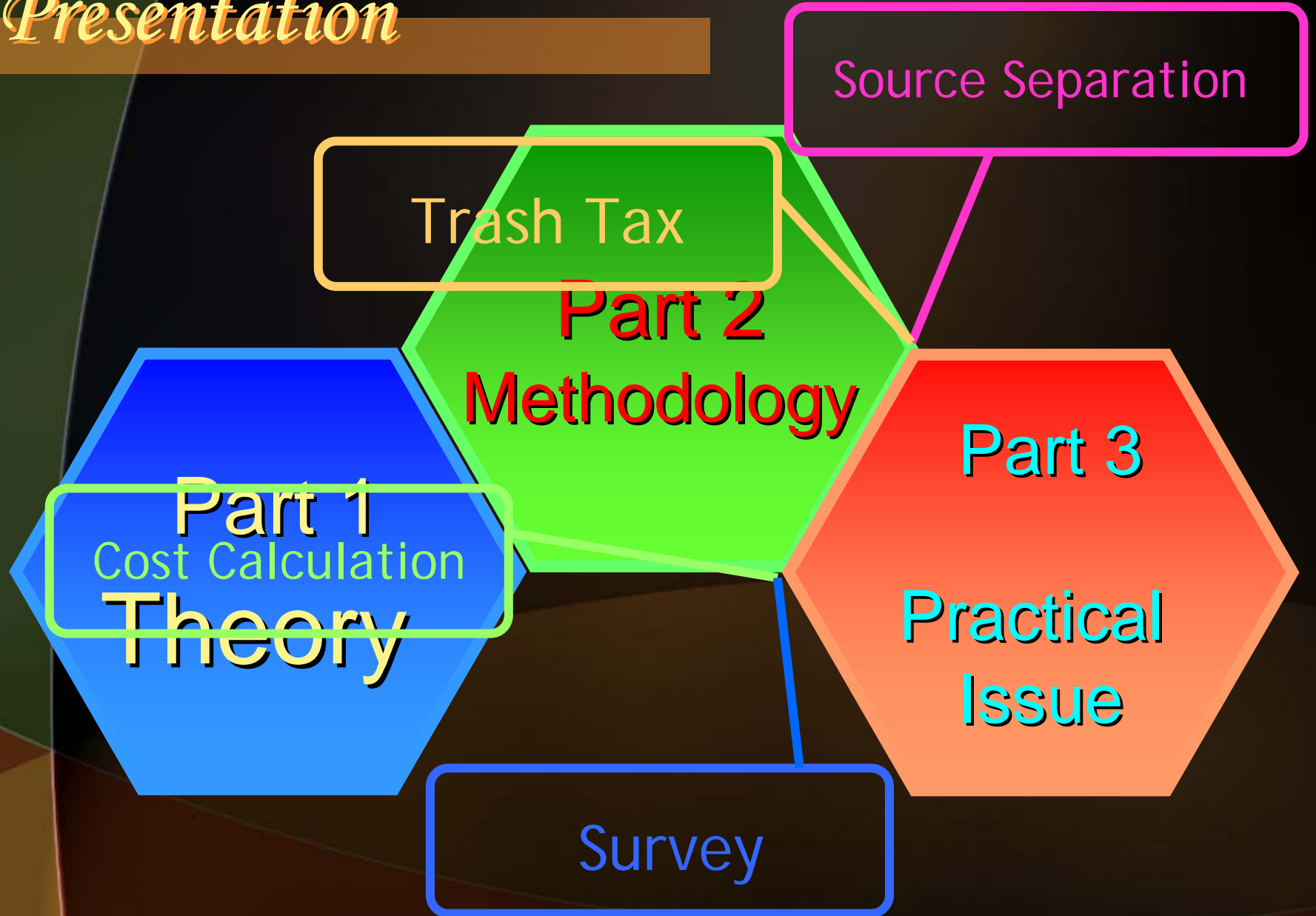
*Methodology*

*Plastic Fuels — as substitutes for fossil fuels*

Plastic Fuel (Fraction)	1	2	3	4	5
Fossil Fuel	Petrol	Kerosene	Diesel	heavy Oils	

End of Part 2

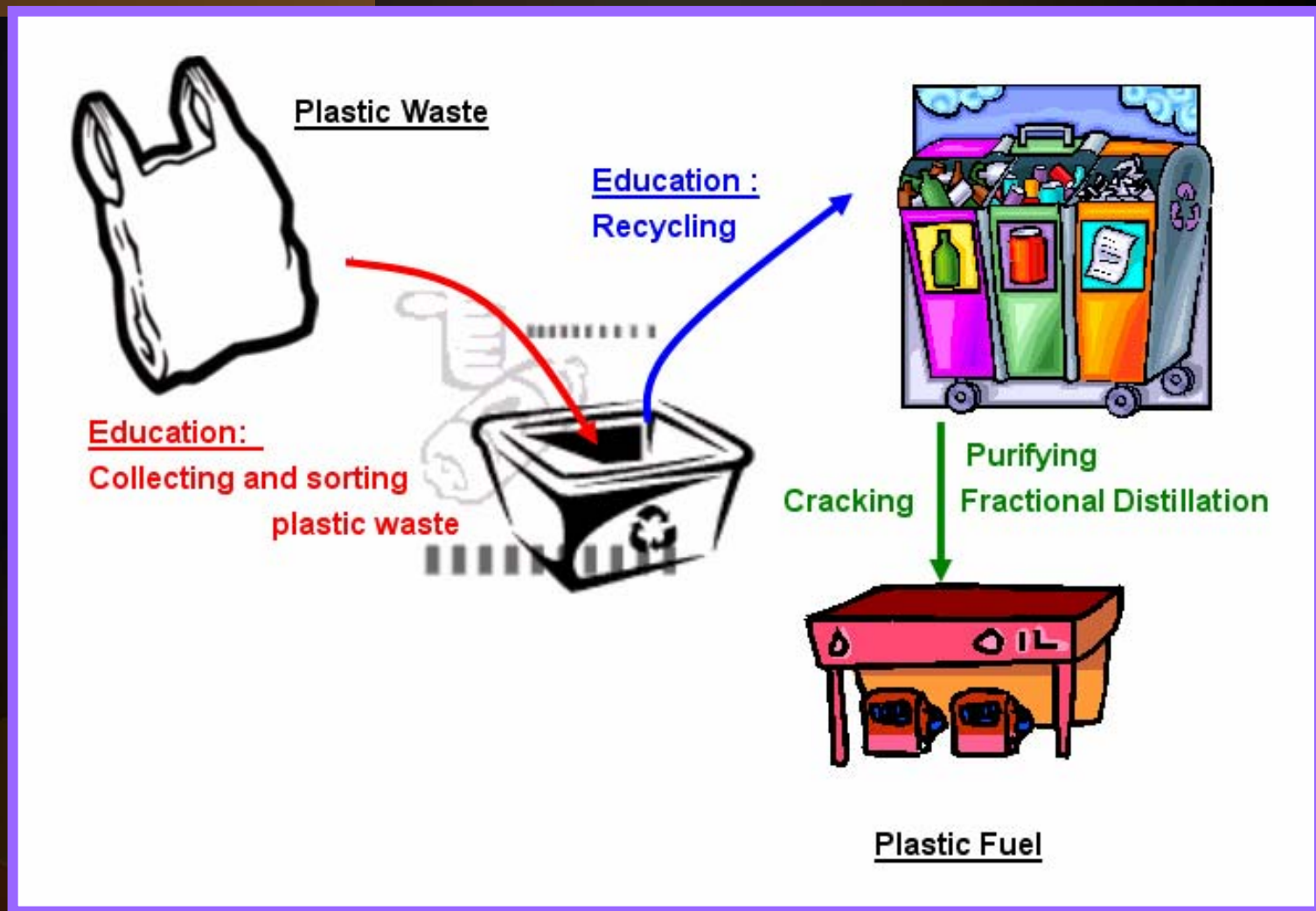
# *Presentation*



# Cost Calculation

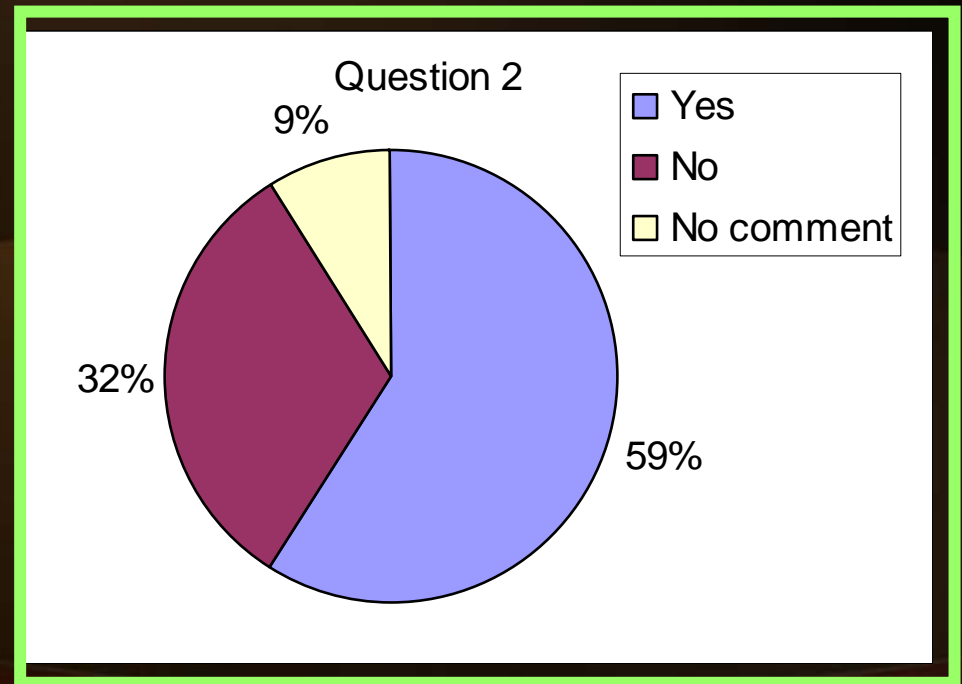
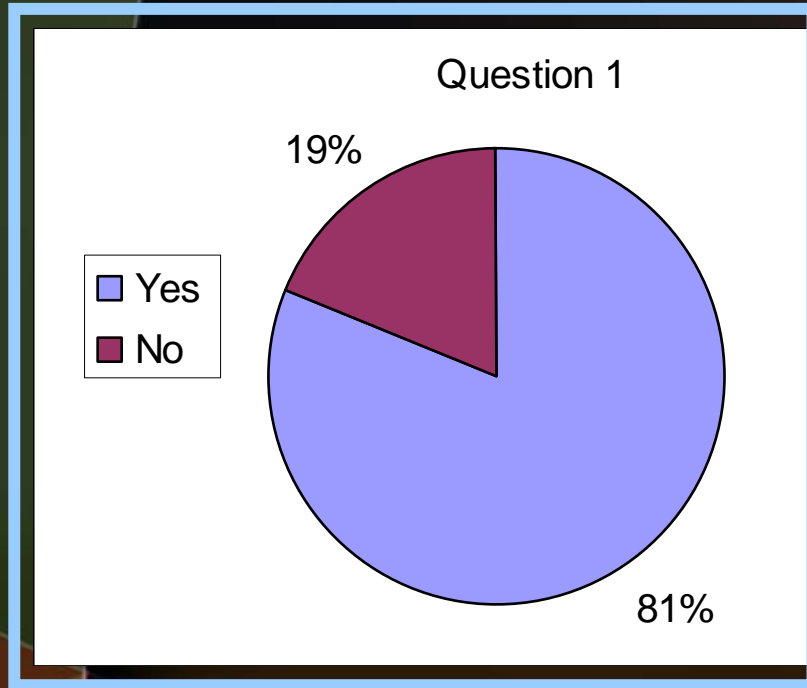
	Price (HK \$ /g)
Caltex Petrol (8/4/2006)	0.0195 (tax included) 0.0109 (tax excluded)
Fraction 1 (Plastic Fuel)	<b>0.0106</b>
Fraction 2 (Plastic Fuel)	0.0115

# How can we do it ?

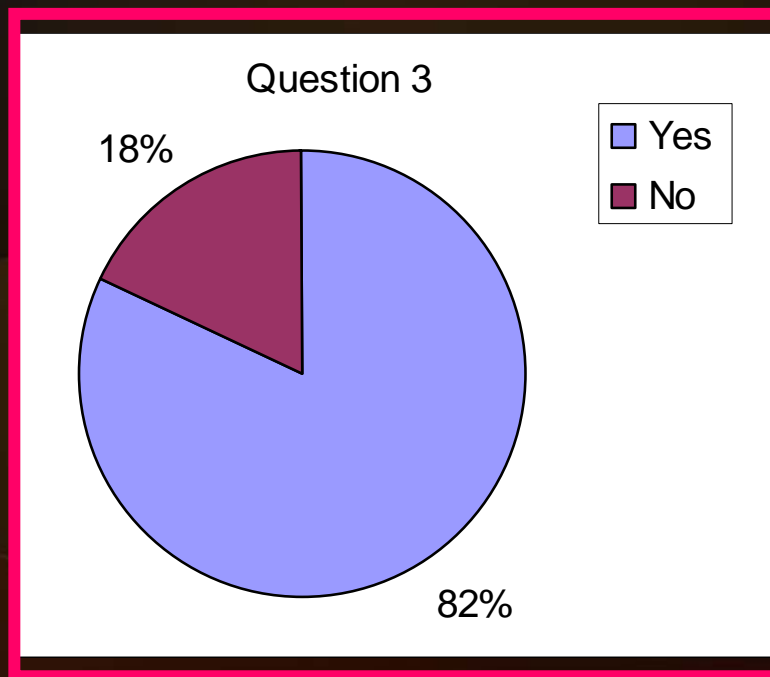


# Survey

- 1. Are there any recycling bins in your buildings?
- 2. Have you ever used the recycling bins?



- 3. *The present recycled materials are paper, aluminium cans and plastic bottles etc. If plastic products are able to be converted into fuels, will thus raise your interest in using the recycling bin?*



# Trash Tax



**Sharing of the cost of operation and production of plastic fuel**

**Reduction of the use of plastic bags**

Part 3

Practical Issue

# Public Education



Part 3

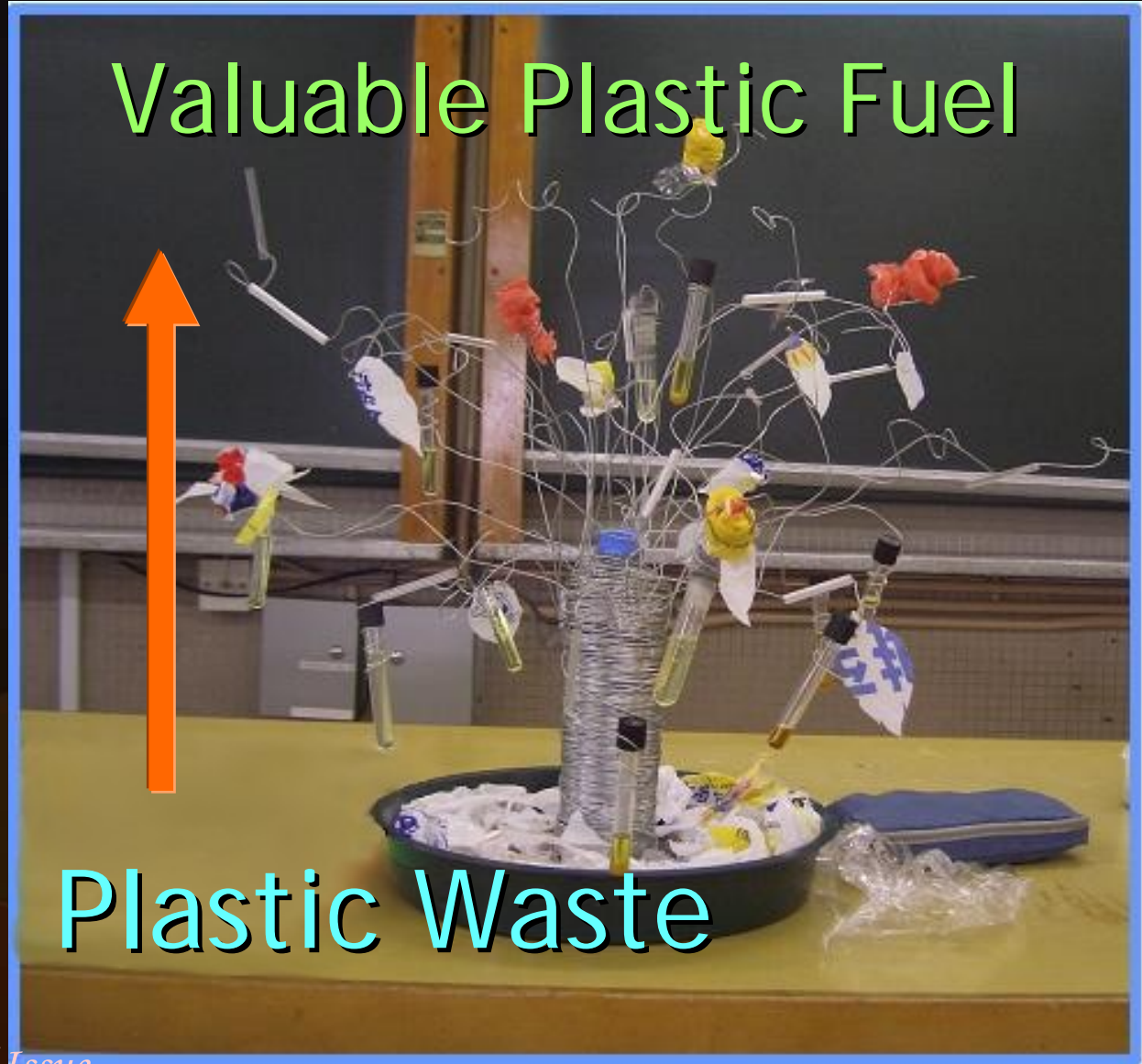
Practical Issue

# Recycling scheme



# Plastic Fuel Tree

Valuable Plastic Fuel



Plastic Waste

Part 3

Practical Issue

# *Acknowledgement*

- Chak Sang Motor Service
- Sun Kee Motor Car Body
- TVB
- ATV
- Information Service Department, HKSAR
- Environmental Protection Department

# Reference

- Nnamso S. Akpanudoh, Karishma Gobin and George Manos, Catalytic Degradation of Plastic Waste to Liquid Fuel over Commercial Cracking Catalysts, Effect of Polymer to Catalyst Ratio/Acidity Content, Journal of Molecular Catalysis A: Chemical, Volume 235, Issues 1-2 , 1 July, 2005
- T.Yoshinaga, M, Yamaye T. Kito, T. Ichiki, M. Ogata, J.Chen ,H. Fujino, T. Tanimura, T.Yamanobe, Alkaline dechlorination of PVC in organic solvents under mild conditions, Kyushu Institute of Tech., Kyushu Kyoritsu Uni., Kitakyushu City Institute of Environmental Sci., Gunma Uni., Yamahuchi Prefectural Research Institute of Public Health, Feb., 2004

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The End



Thank You

Plastic Fuel