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K. K. PANT

EB PPT

BIOGRAPHY

Dr. K. K. Pant is currently Petrotech Chair Professor in chemical engineering department at Indian Institute of Technology, (IIT) Delhi. He has published more than 85 papers in various international research journals and currently actively engaged in research areas of application of heterogeneous catalysis for greener environment, catalytic hydrocarbon conversion process, hydrogen fuel generation from renewable energy sources, and biomass conversion and utilization. He is reviewer of several international journals and also the member of several chemical engineering professional societies.

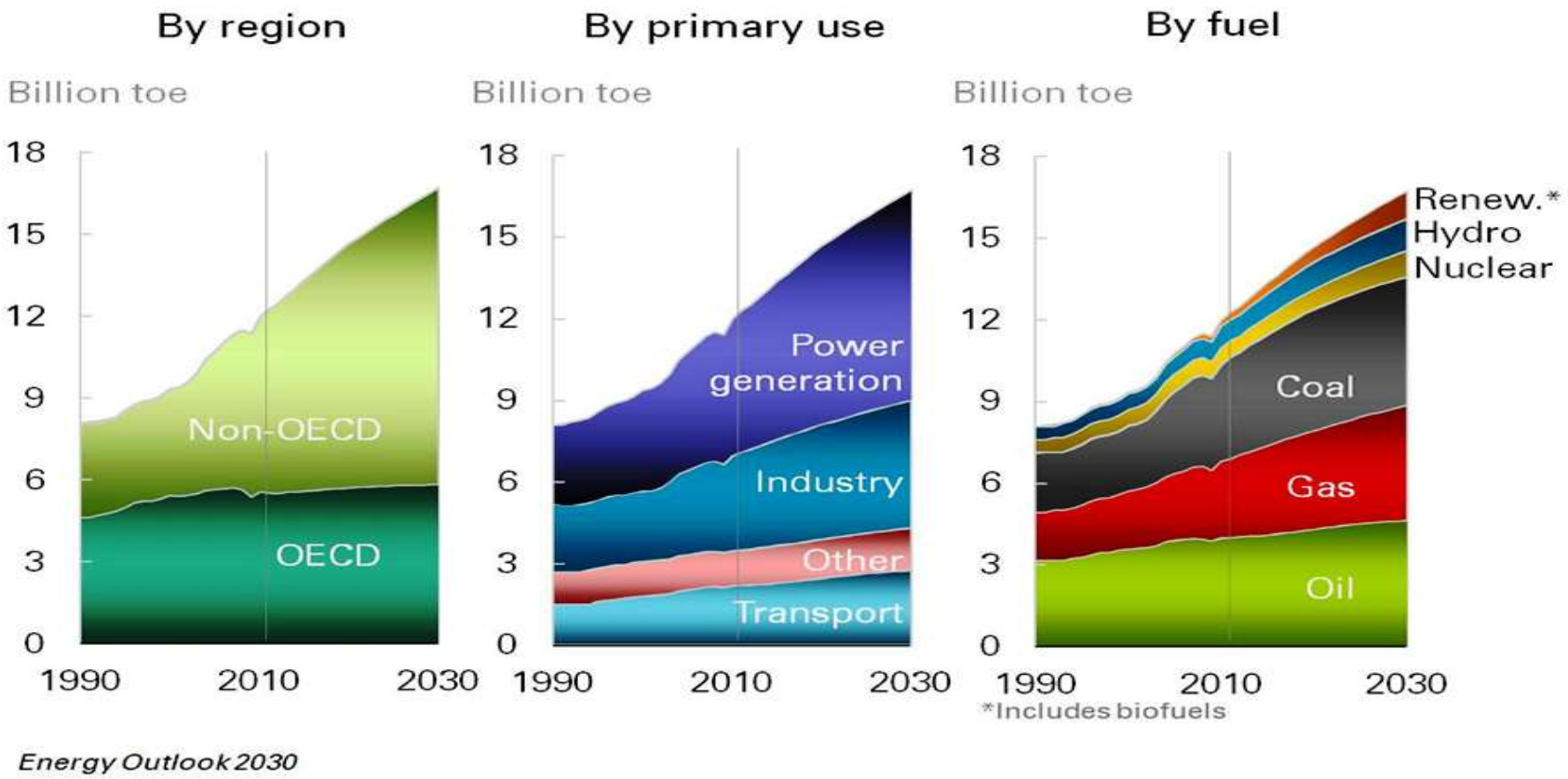
RESEARCH INTRESTS

Heterogeneous Green Catalytic Processes for Hydrocarbon Conversion, Bio-fuels.

BIO FUELS

- Contains energy from geologically recent carbon fixation and produced from living organisms.

Growing Energy Demand



Oil Dependency of Various Nations

	Region/ Country	% Oil of Imported
Asia	India	92.5%
Europe		
USA		

What are Renewable Resources ?

- Micro Algae
- **Plants**
- Animals

Viability Questions ?

- Which plants ?
- Where do we grow them?
- How much can we grow ?

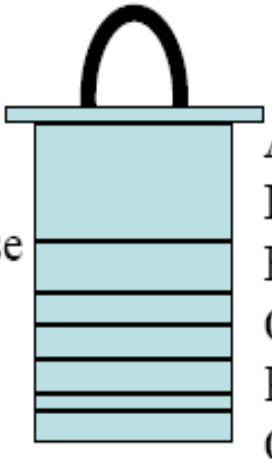
Cellulosic Biomass Composition

Cellulose 43%
Hemicellulose 27%
Lignin 17%
Other 13%

Agricultural Residues

Cellulose 45%
Hemicellulose 25%
Lignin 22%
Extractives 5%
Ash 3%

Woody Crops



Cellulose 45%

Ash 15%
Lignin 10%
Hemicellulose 9%
Other carbohydrates 9%
Protein 3%
Other 9%

Municipal Solid Waste

Cellulose 45%
Hemicellulose 30%
Lignin 15%
Other 10%

Herbaceous Energy Crops

Interest in Biomass by- 2050

- About 10% of available residues (75 GT/Yr by 2030) could provide 120-150 billion lge of liquid biofuels (its has the potency to cover 5% of the 230 biofuels demand.
- **Projected Demand by 2050 (Total ~ 145 EJ)**
  - IEA projected bio-energy demand 65 EJ for biofuels
  - 80 EJ for heat and power requirement
- **Potential from different sectors**
  - From agricultural & forestry residues 85 EJ
  - Surplus forest growth 60 EJ
  - Surplus arable land (enrgy crops) 120 EJ
- **Bioenergy demand by land availability (IEA projection)**
  - Today 30 Mha to 100-160 Mha by 2050

Solid Fuel → Liquids (XTL)

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STEAM + AIR
Gasification

- COAL
- PET COKE
- BIOMASS

SYNTHESIS GAS GENERATION → $CO + H_2$

Basic (FT Synthesis)

$nCO + 2nH_2 \Rightarrow (-CH2-)_n + nH_2O$ ($\Delta HR = -165$ kJ/mol)

GAS CLEANUP

Need a well engineered shift

FISCHER -TROPSCH SYNTHESIS

PRODUCT SEPARATION & UPGRADING

- Naphtha
- Green petrol
- Green diesel
- Wax

Biomass Pyrolysis

IITD

Ligno-cellulosic Biomass

Bio-oil

- Acids
- Alcohols
- Aldehydes
- Ketones
- Furan
- Phenols
- Sugars

$CH_{1.4}O_{0.7}$

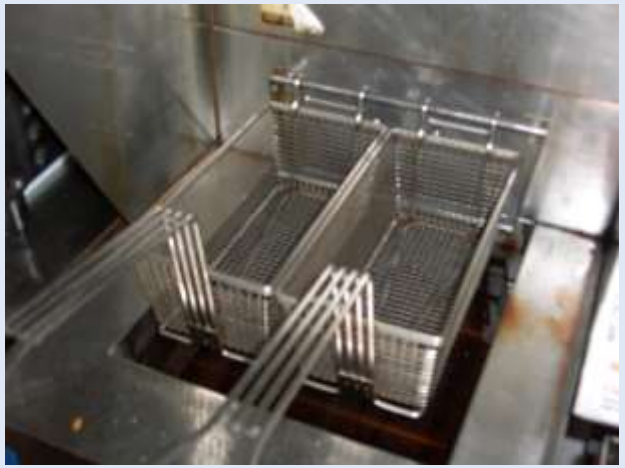
Hydrothermal Breakdown
(Excess supply of Heat and Water)

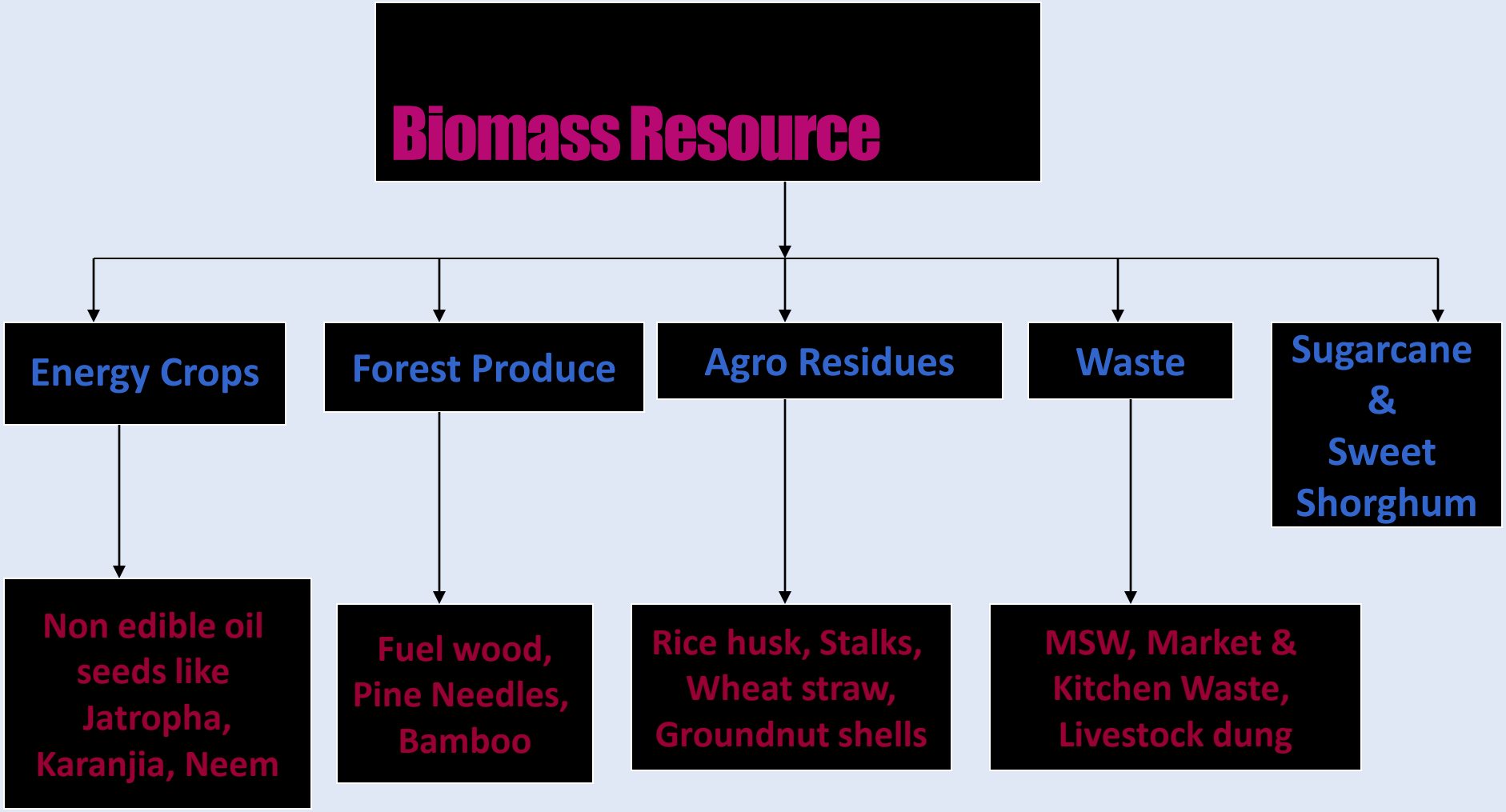
Biochar

Catalytic Cracking and steam Reforming of Biooil for olefins/Liquid fuels and/or Hydrogen

Biodiesel

- What is Biodiesel?
- Mono-alkyl esters
- How is biodiesel made?
- transesterifucation
- Is Biodiesel the same thing as raw vegetable oil?





- **Biomass caters to 80% of total rural energy requirement.**
- **Rice straw, rice husk, wheat straw, sugarcane tops & bagasse : main crop residues generated in India**

Biodiesel Feedstocks

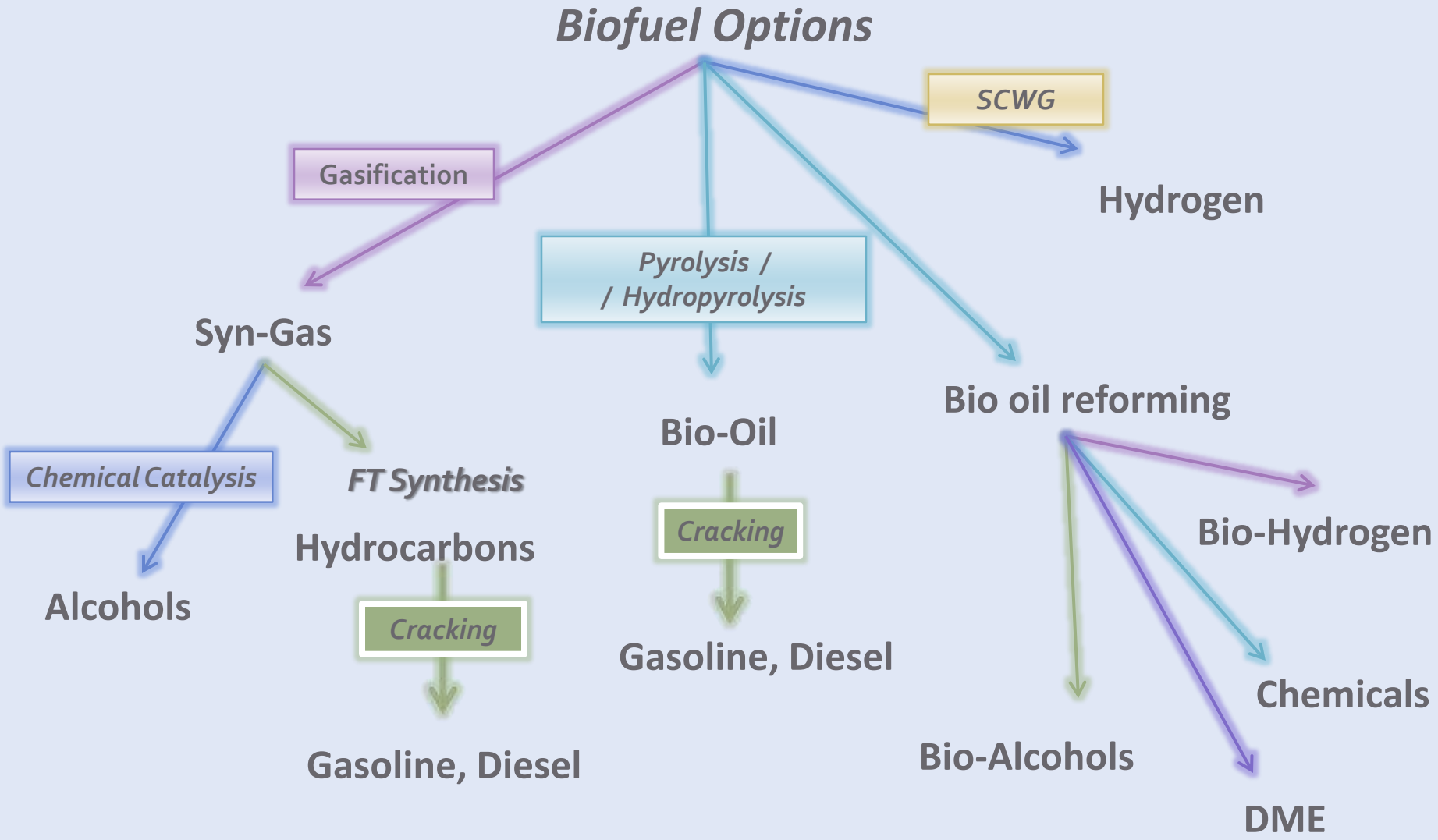
- Total annual production of US Fats and Oils (2004)
- 35.3 billion pounds = 4.6 billion gallons of biodiesel

Vegetable Oil	(Billion lbs/yr)
Soybean	18.340
Peanuts	0.220
Sunflower	1.000
Cottonseed	1.010
Corn	2.420
Others	0.669
Total Vegetable Oil	23.659

Animal Fats/Oils	(Billion lbs/yr)
Edible Tallow	1.625
Inedible tallow	3.859
Lard & Grease	1.306
Yellow Grease	2.633
Poultry Fat	2.215
Total Animal Fat	11.638

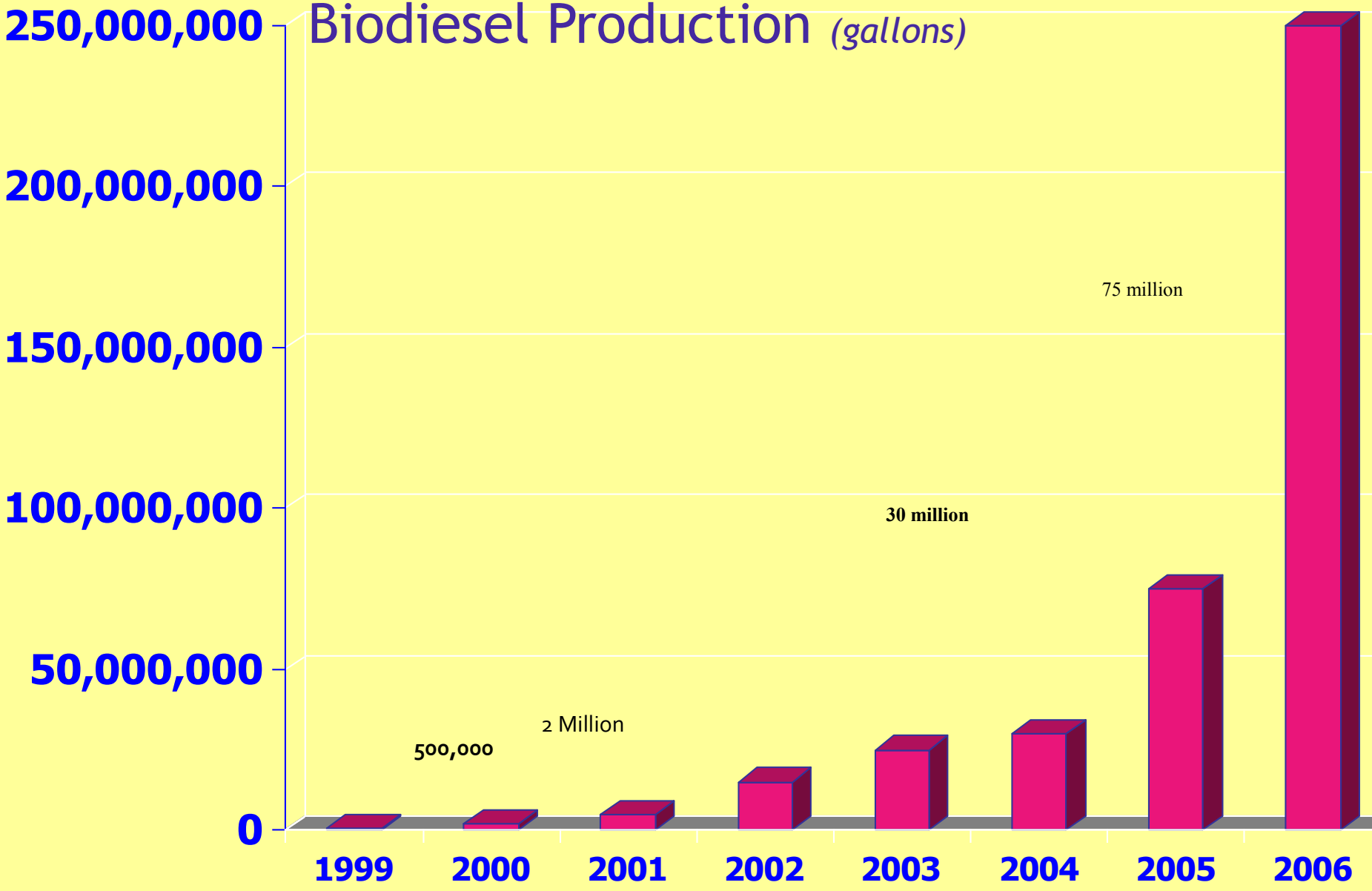
IITD

AGRICULTURAL BIOMASS



The Chemistry of Biodiesel

- All fats and oils consist of triglycerides
  - Glycerol/glycerine = alcohol
  - 3 fatty acid chains (FA)
- *Transesterification* describes the reaction where glycerol is replaced with a lighter and less viscous alcohol
  - e.g. Methanol or ethanol
- A catalyst (KOH or NaOH) is needed to break the glycerol-FA bonds


Biodiesel Production (gallons)
250,000,000
200,000,000
150,000,000
100,000,000
50,000,000
0
500,000
2 Million
30 million
75 million
1999
2000
2001
2002
2003
2004
2005
2006

JOURNALS

1.Analytical & Bioanalytical Techniques
http://omicsonline.org/analytical-bioanalytical-techniques.php
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