# Biofuel Scenarios for India

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# Contents

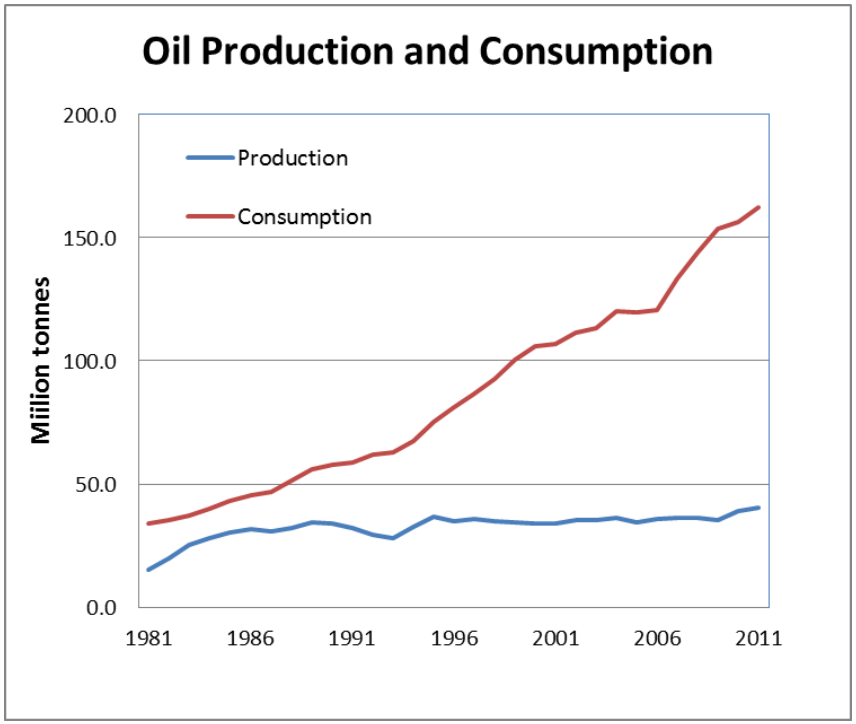
1. Context
2. Methodology
3. Biomass resources
4. Results

# Biofuel Policy

- Blending Targets for Oil Companies
  - Currently 5% Blending of ethanol in petrol (20 states and 8 UT)
  - Future biofuels targets (ethanol and biodiesel)
    - 10% by 2017
    - **20% by 2020**
- Minimum Support Price
  - Rs 27 per litre of ethanol (~ 0.5 US $)
  - Rs 26.5 per litre of biodiesel
- Achievement
  - Petrol : Around 2% ethanol blending (0.4 billion litres )
  - Diesel : No large scale blending ( 0.14 – 0.3 million litres by informal sector)

# Drivers

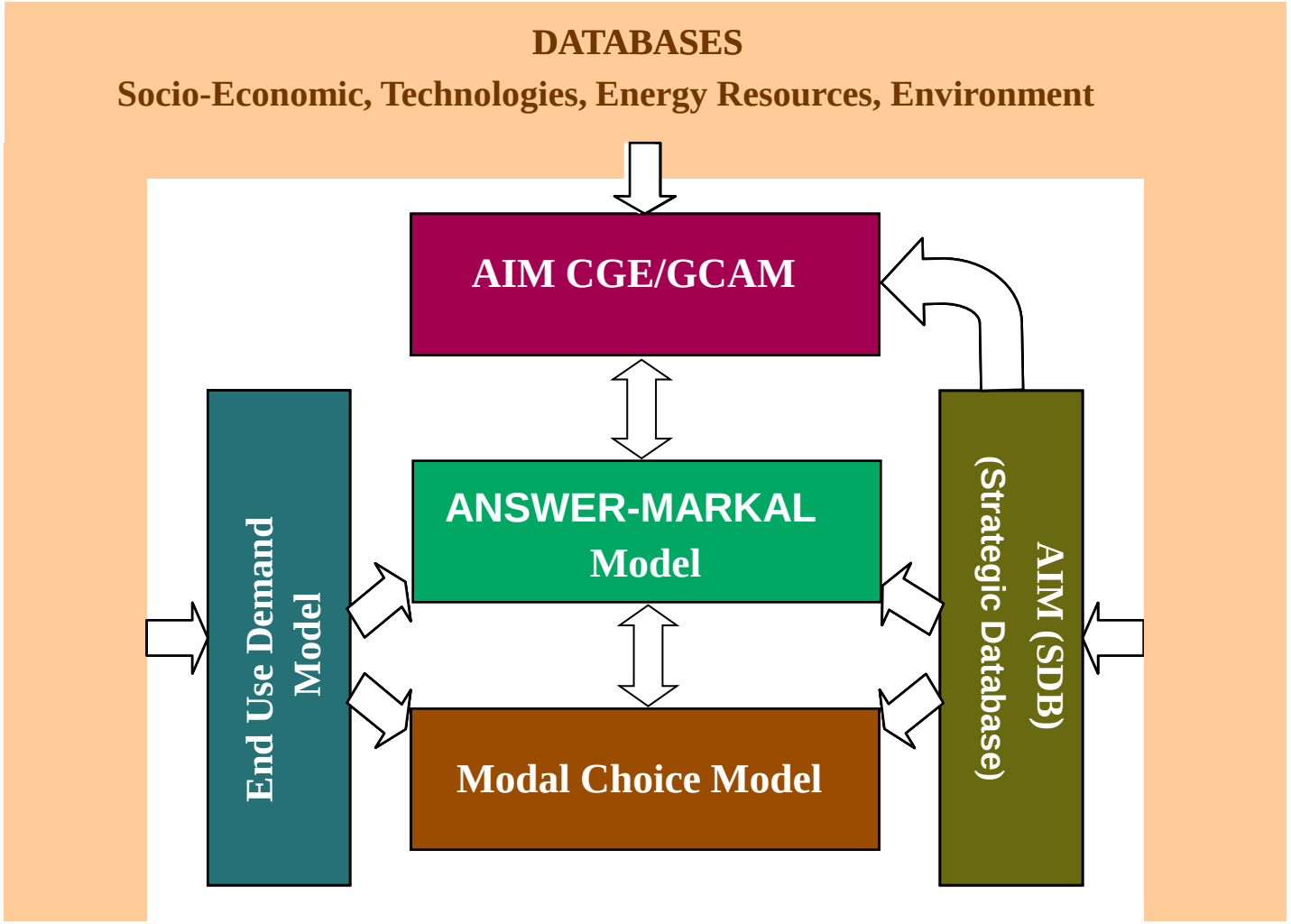
- Push
  - Balance of Payments
  - Rising share of Oil in Imports
- Pull
  - Rural development and job stimulation
  - Identified as a priority for mitigation (NAPCC)



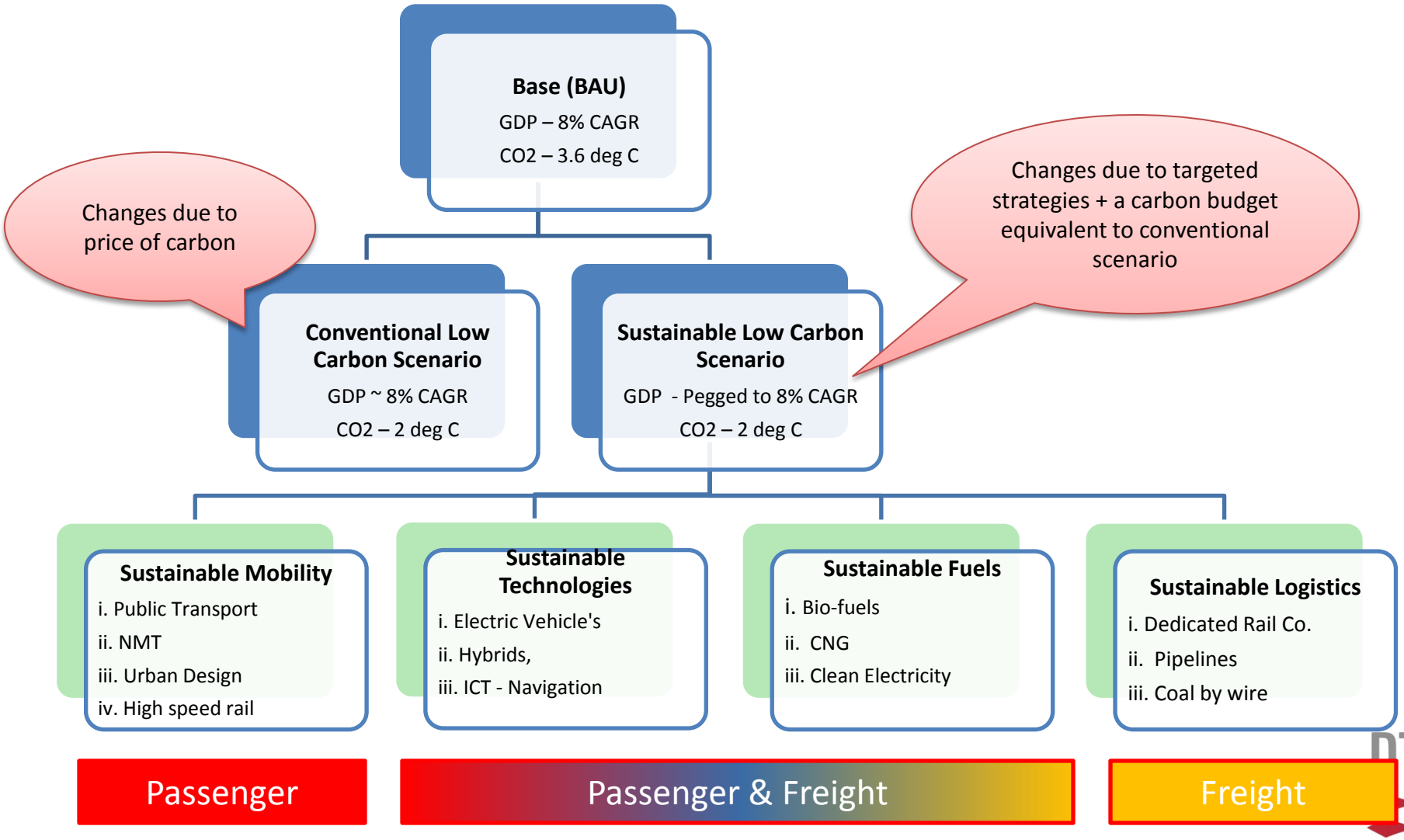
# Research Questions

- What are the biomass resources available for biofuels in India?
- What is the economic potential of biofuels in BAU scenario?
- What is the economic potential of biofuels in a Low Carbon Scenario?

# Integrated Modeling Framework



# Architecture for Transport Scenarios



# Bio fuel Storylines

- BAU
  - Support prices for ethanol and biodiesel are not beyond ex refinery price for petrol and diesel
  - No land from food and forests diverted for bio crops
  - Institutional weakness in taking over marginal lands for bio crops

- Low Carbon Scenario
  - Support pricing framework same a BAU
  - Overall sustainable transitions – demographic, consumptions, dematerializations reduce demand for transport
  - A global price corresponding to 2 deg C target
  - Better success in taking marginal lands for bio crops

# Bioethanol from Molasses

- Concerns
  - Sugarcane production **concentrated** in 4 states
  - **Competing demand** for industrial and other uses for ethanol

Technical Potential

| | 2010 | 2020 | 2030 |
|---|---|---|---|
| Sugarcane Production (Mt) | 342.4 | 370.9 | 418.8 |
| Molasses (Mt) | 11.6 | 12.5 | 14.1 |
| Ethanol (BL) | 2.7 | 2.9 | 3.3 |
| Ethanol Blending (BL) | 1.1 | 1.2 | 1.3 |
| (Mtoe) | 0.55 | 0.59 | 0.67 |

Source : Adapted from Purohit & Fisher, 2013

# Biodiesel from Jatropha

- Concerns
  - **Limited experience** - only 0.5 Mha cropped and blending not started
  - **Low yields** - Actual yield of oil is a low 0.11 – 0.23 mt

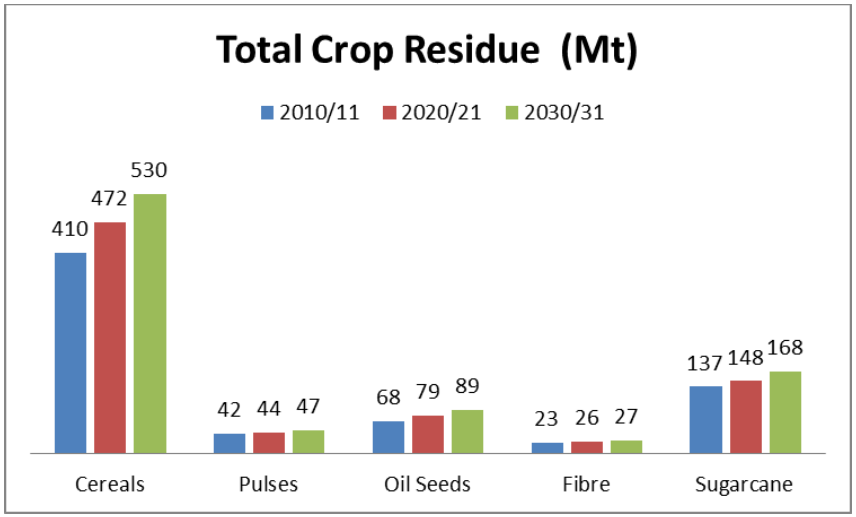
Technical Potential

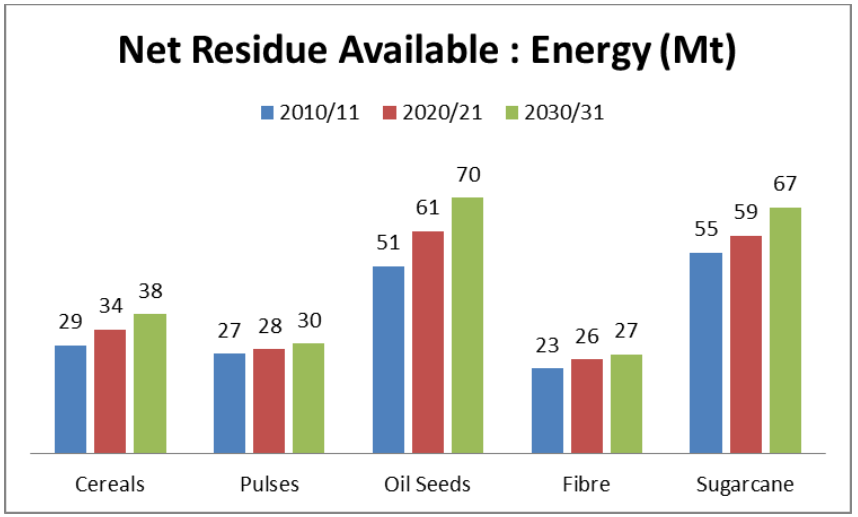
| | Total Area (Mha) | Found Suitable (') (Mha) | Total yield oil (Mt) |
|---|---|---|---|
| Culturable waste land | 12.9 | 2.0 | 3.4 |
| Culturable waste land plus pastures, barren and unculturable land, etc. | 79.4 | 11.1 | 16.4 |

(') Through Agroecological zone assesstement

Source : Adapted from Purohit & Fisher, 2013

# Agricultural Residues for Biofuels




Source : Adapted from Purohit & Fisher, 2013

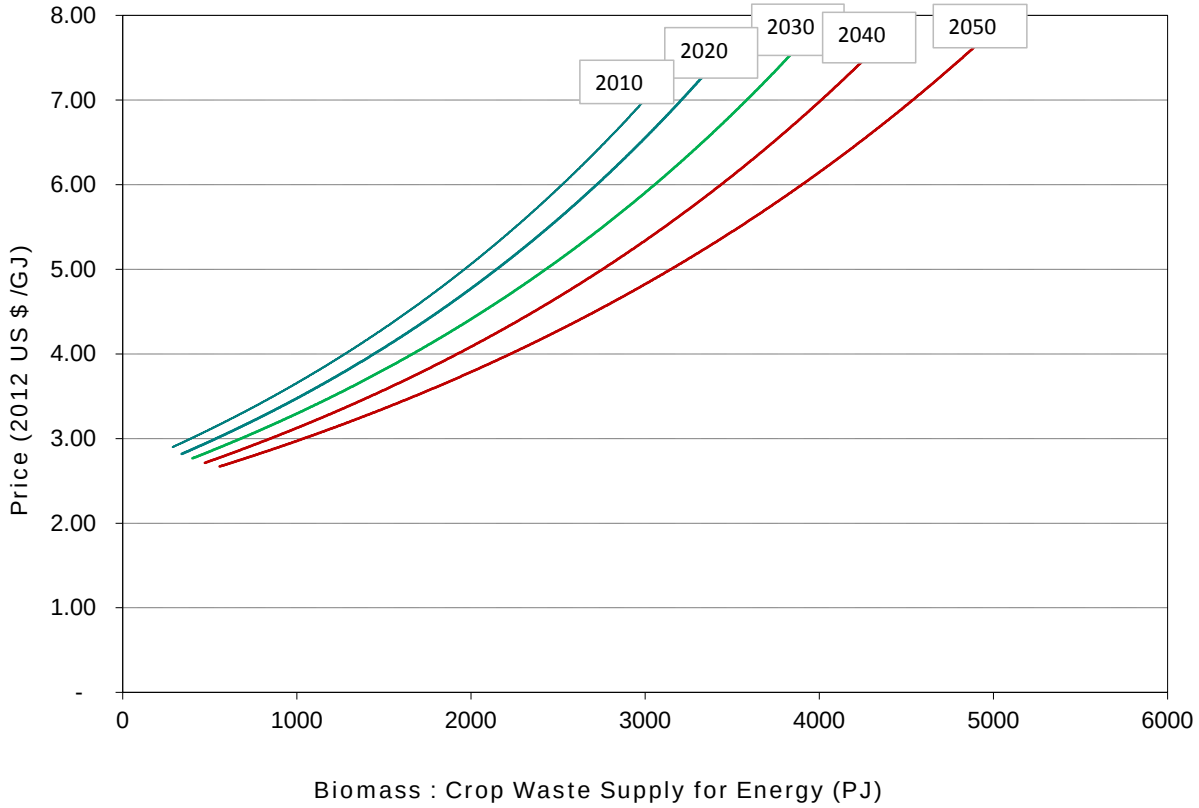
**Net Residue Availability**

2010 – 72.3 Mtoe

2020 – 80.3 Mtoe

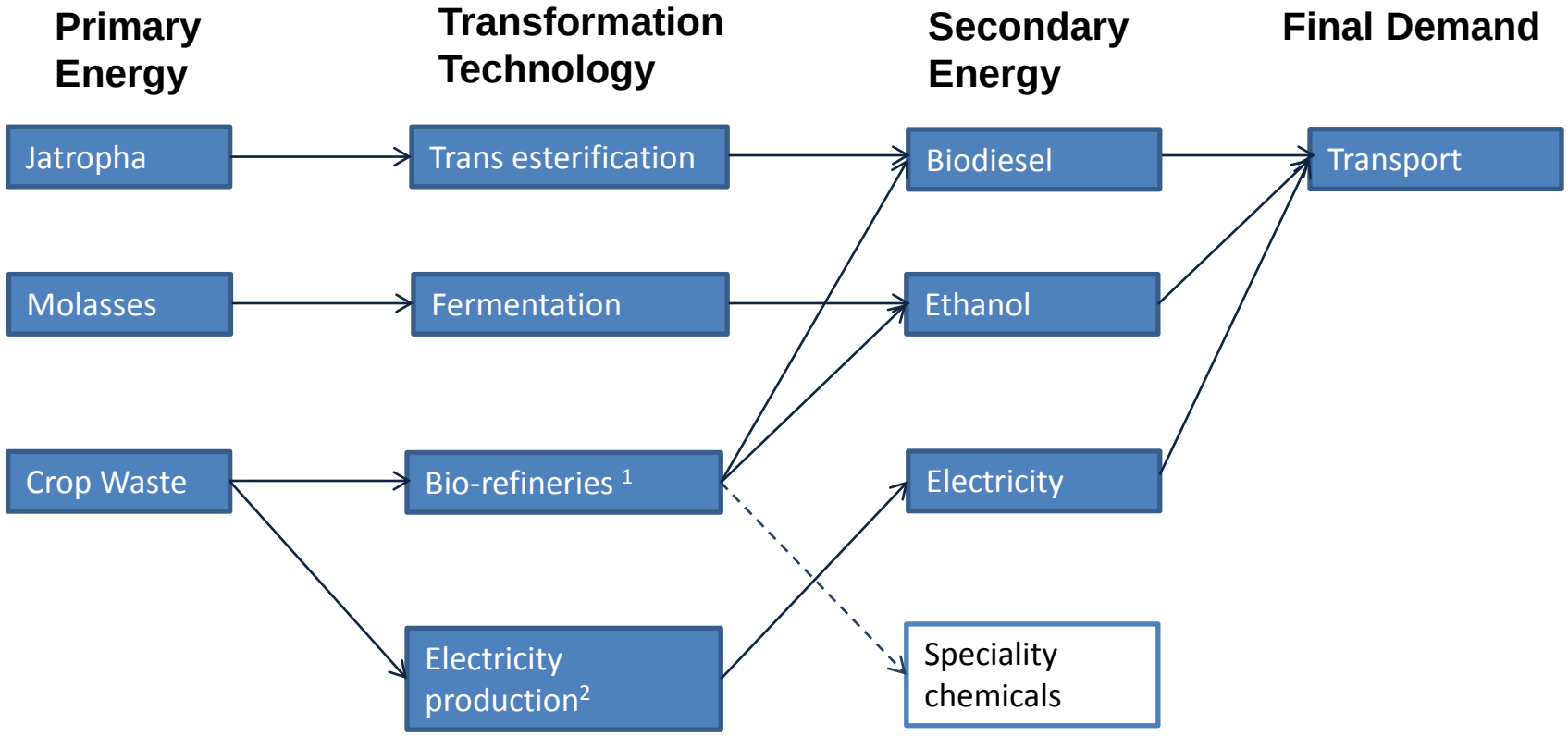
2030 – 89.3 Mtoe

# Cost Curves for Crop Waste




- Underlying data based on detailed estimates for individual crops
- However uncertainties with respect to demand for biomass from other sectors considered

# Partial RES for Bio-fuels

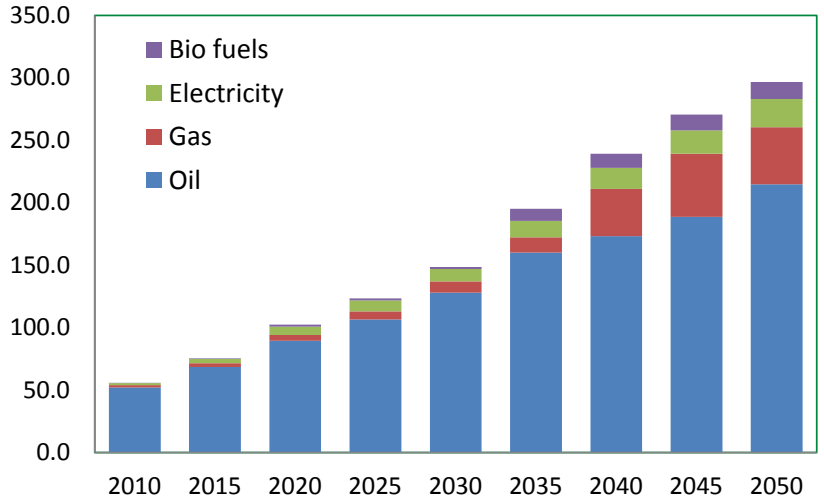



1. Bio refineries include Cellulosic technology for Ethanol, hydrogenation and FTP technology for biodiesel
2. Both Co-firing of biomass & dedicated biomass gasifier.

# Results

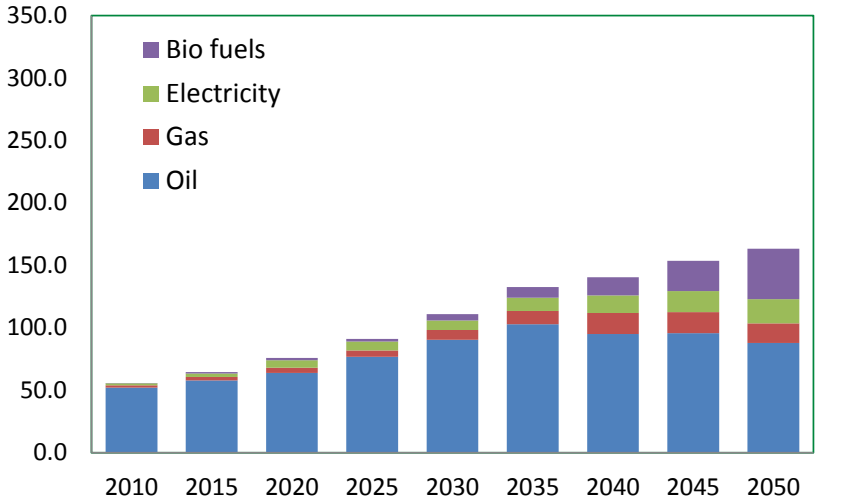
# Fuel Mix for Transport

**Energy Demand - BAU (Mtoe)**




| 0.3% | 1.6% | 1.1% | 4.7% | 4.6% |
|---|---|---|---|---|

**Energy Demand - Sustainable LCS (Mtoe)**

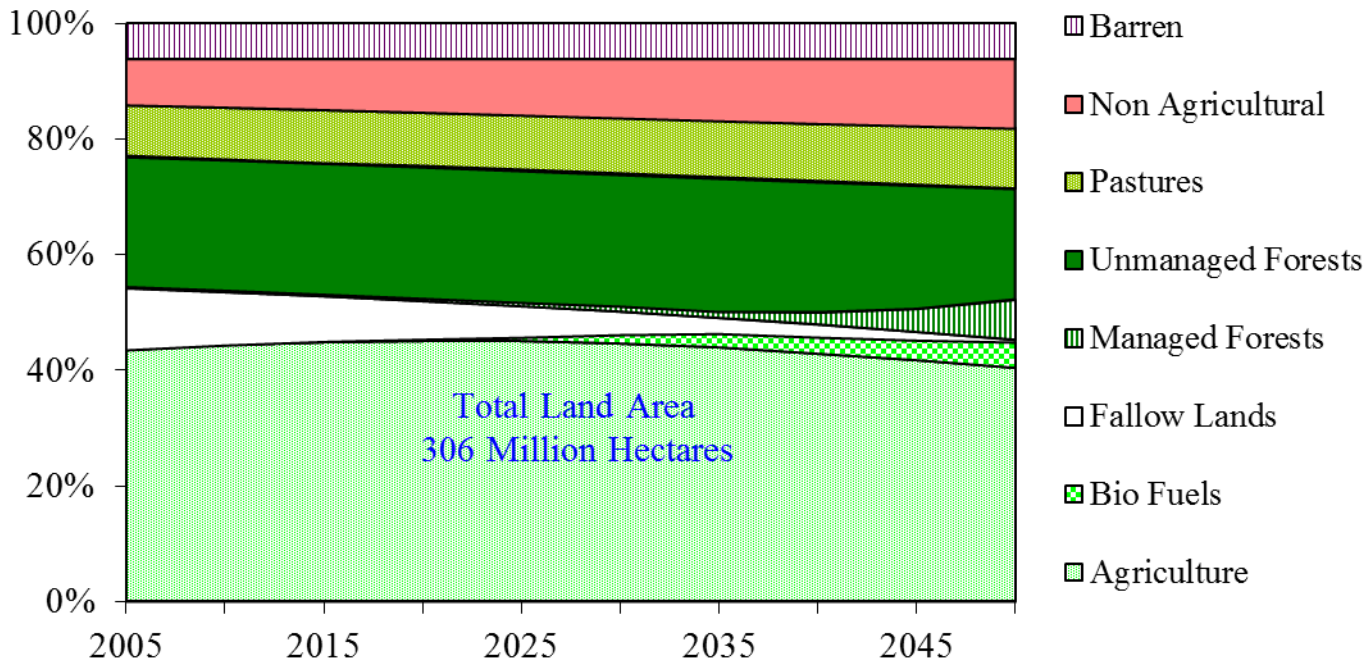



| 0.3% | 2.3% | 4.6% | 10.3% | 24.7% |
|---|---|---|---|---|

Share of biofuels

LCS:
- Bio crops (Jatropha, Sweet Sorghum)
- Crop waste
- Imports of bio fuels

# Land Use : Low Carbon Scenario




Source : Shukla, Dhar & Fujino, 2011

# Conclusions

- **Bioethanol from molasses** can play a very minor role in long term biofuel transitions
- **Jatropha** technical potential high however risks (diversion of land & lack of experiences) and absence of good experiences
- Long term future of biofuels would depend on second generation pathway using **crop wastes** (but would require R&D and global partnerships)

# Thank You

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**Project Website :**

www.unep.org/transport/lowcarbon