



Biofuel Scenarios for India

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ENERGY, CLIMATE
AND SUSTAINABLE
DEVELOPMENT

Biofuel Scenarios for India

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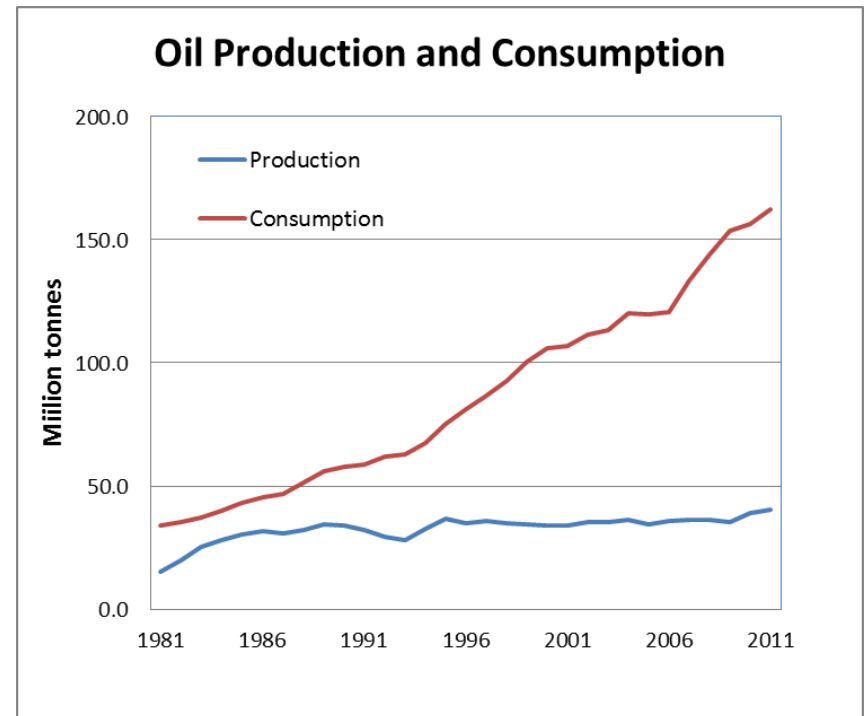
Biofuel Policy

- 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)

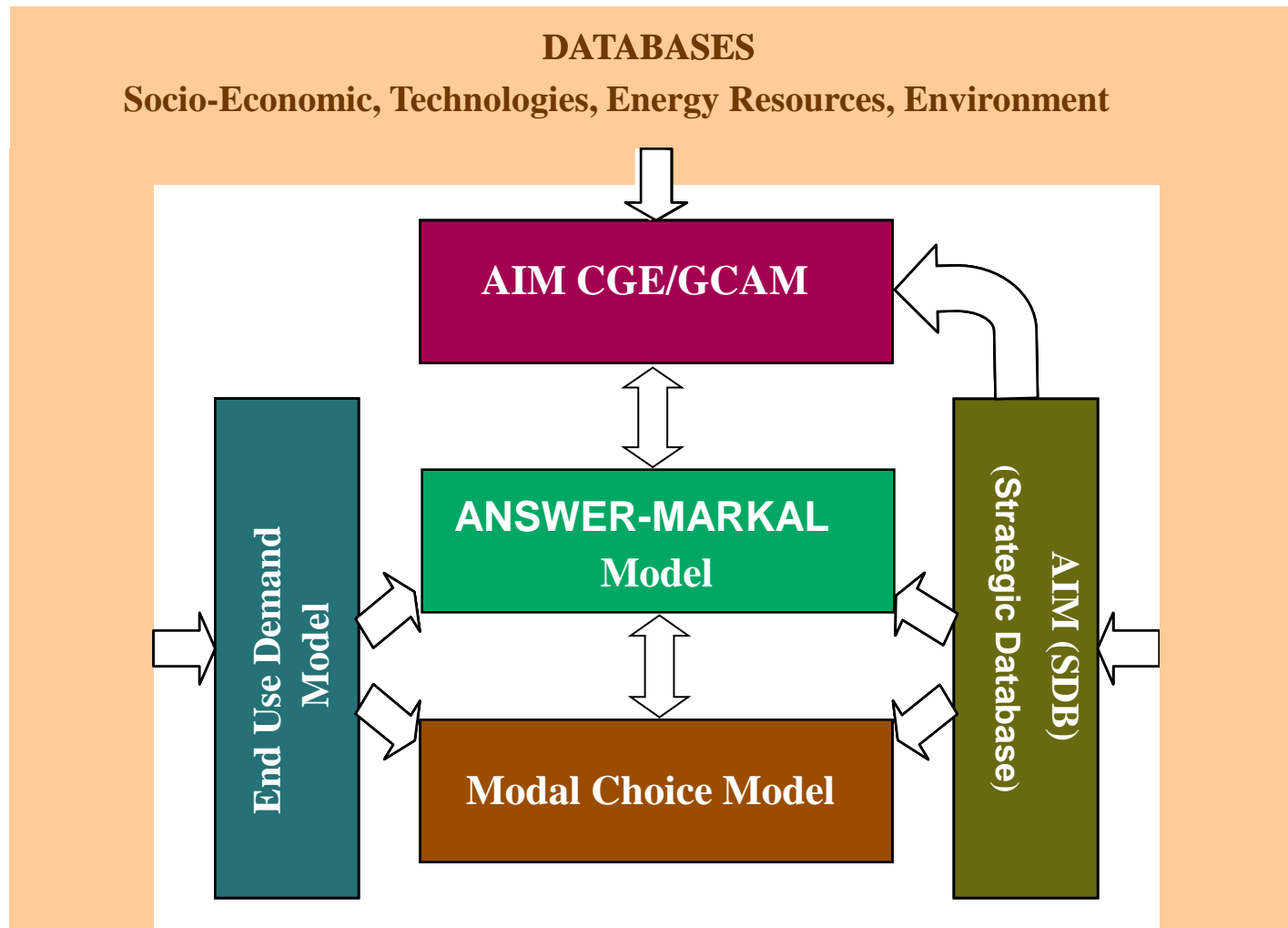


Research Questions

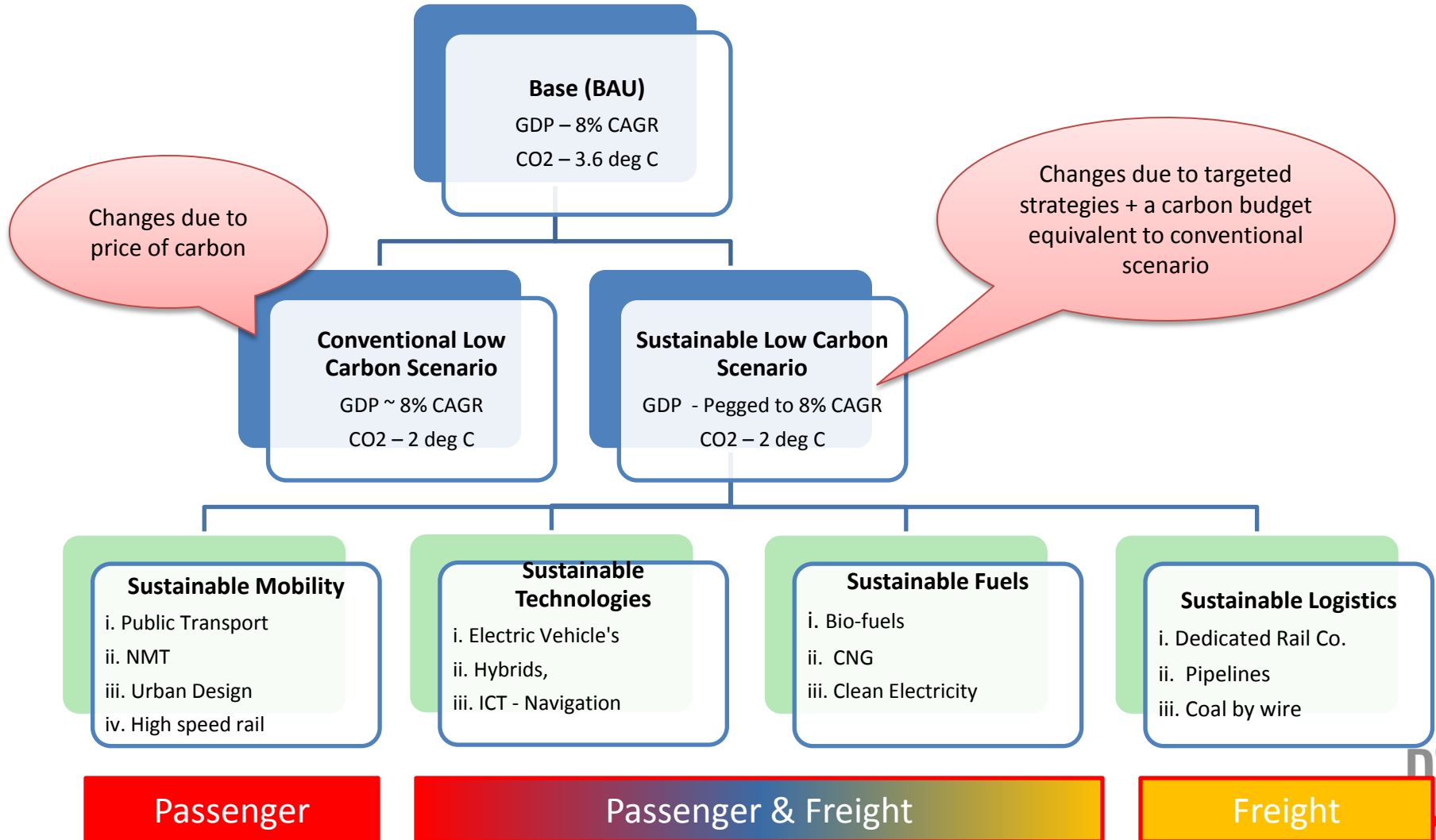
- What are the biomass resources available for biofuels in India?
- What is the economic potential of biofuels in BAU scenario?
- What is the economic potential of biofuels in a Low Carbon Scenario?



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 as 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

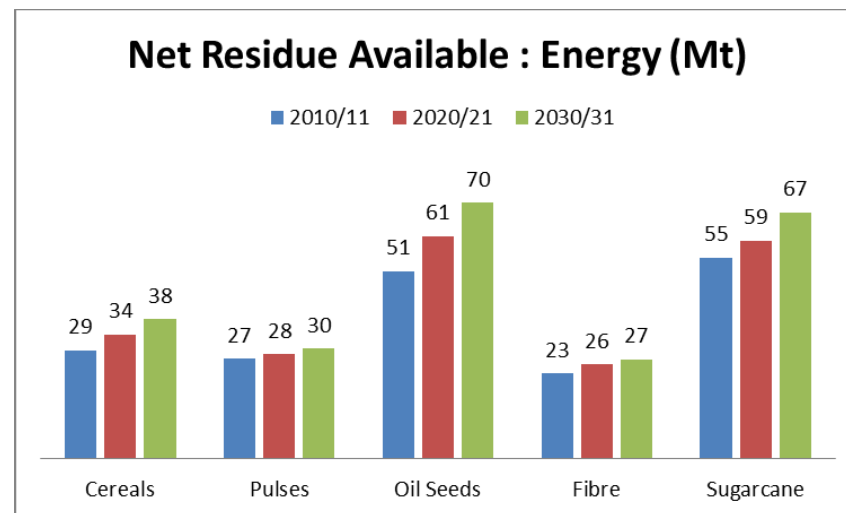
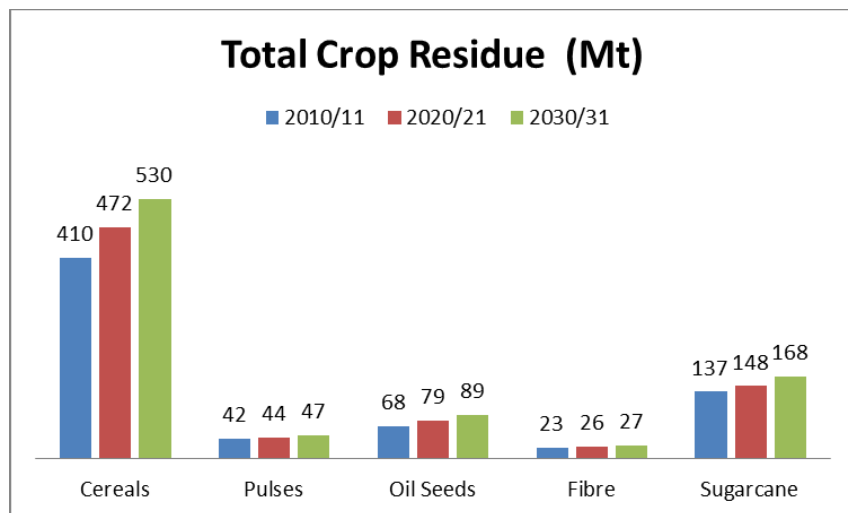
Technical Potential

| | 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

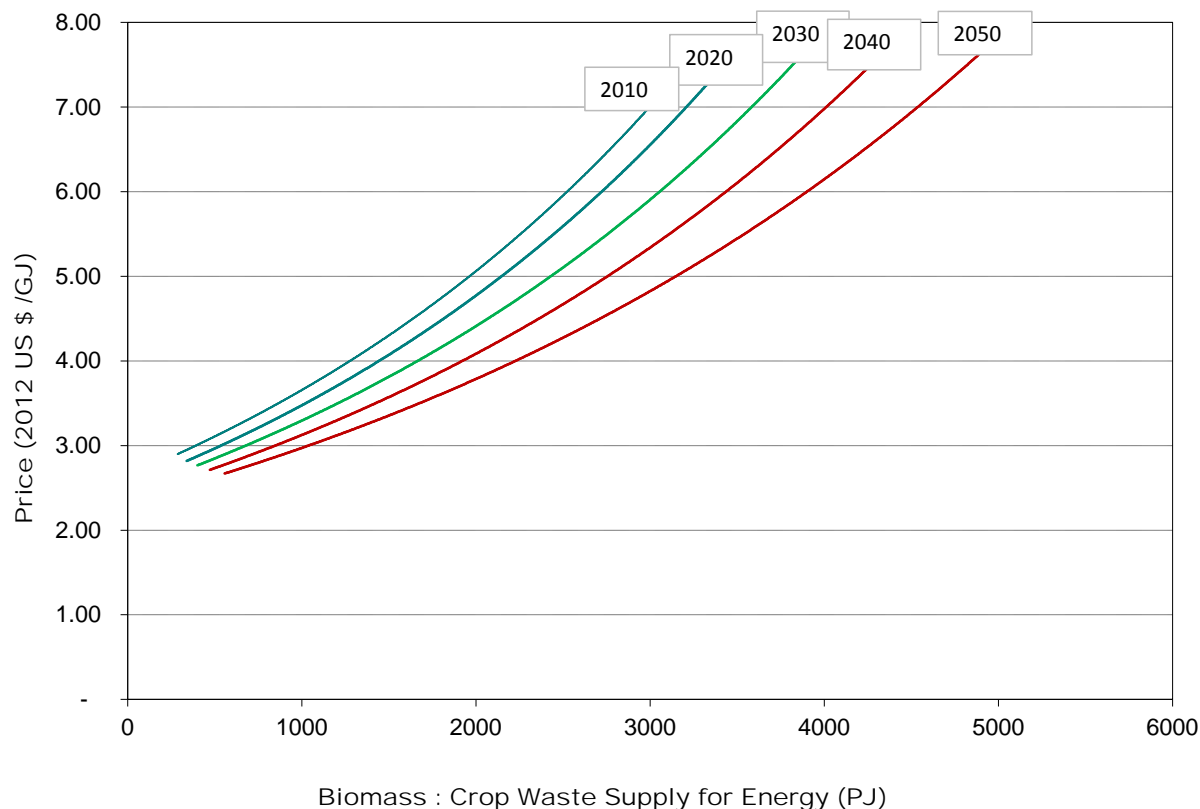
Net Residue Availability

2010 – 72.3 Mtoe

2020 – 80.3 Mtoe

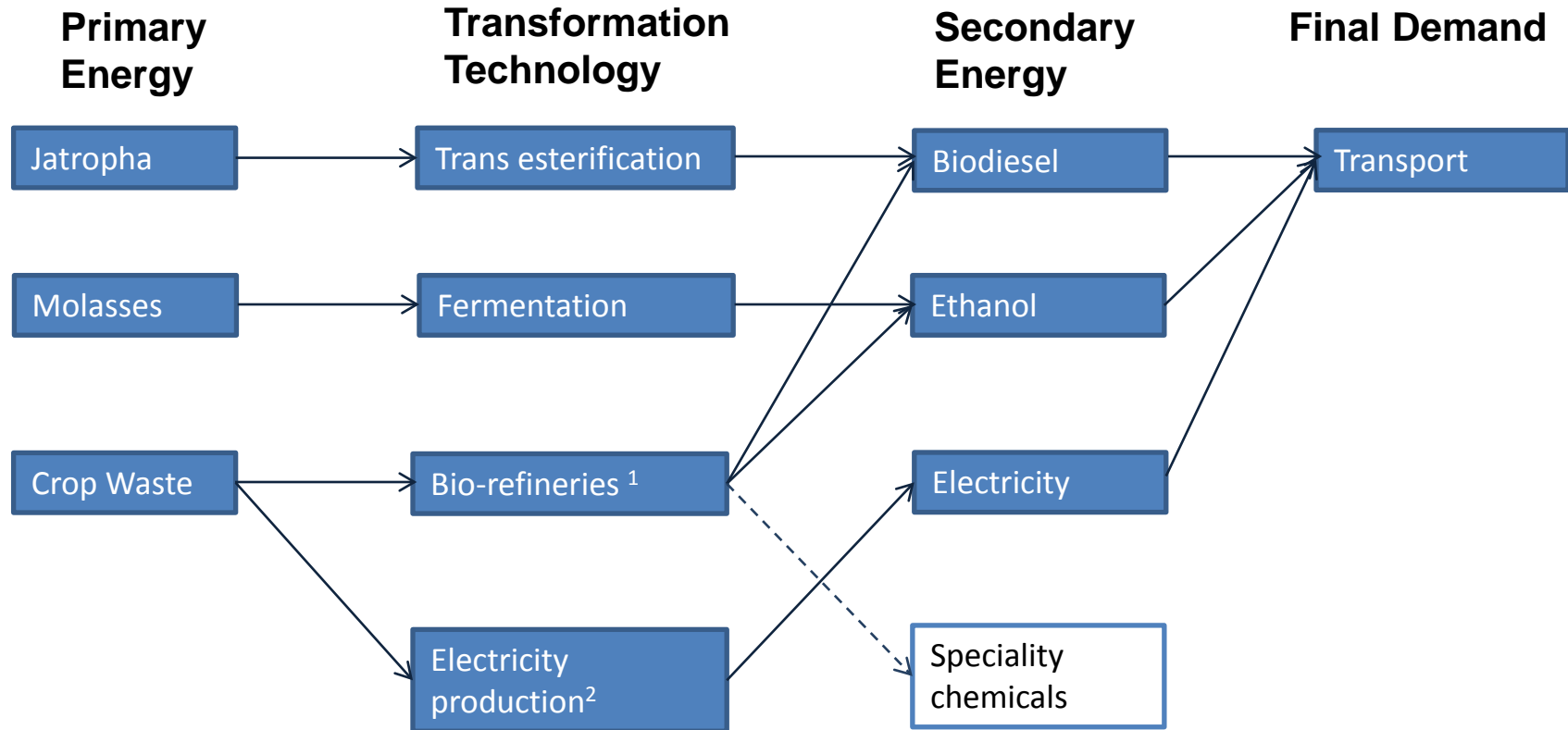
2030 – 89.3 Mtoe

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

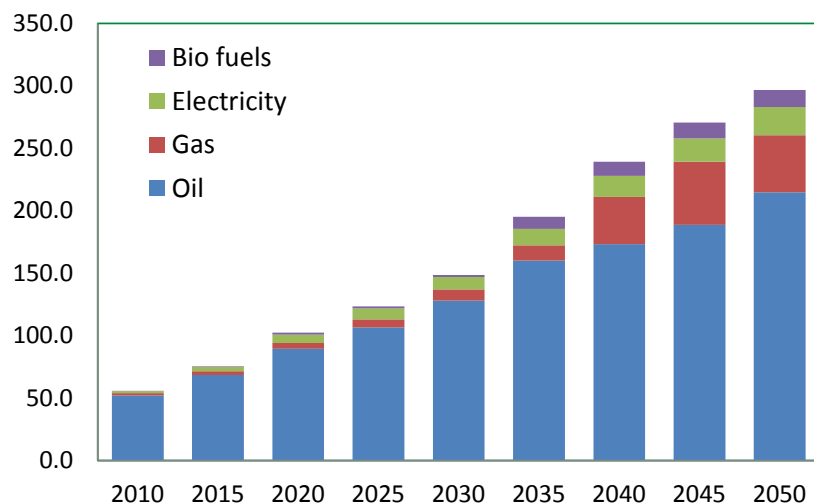


1. Bio refineries include Cellulosic technology for Ethanol, hydrogenation and FTP technology for biodiesel
2. Both Co-firing of biomass & dedicated biomass gasifier.

Results

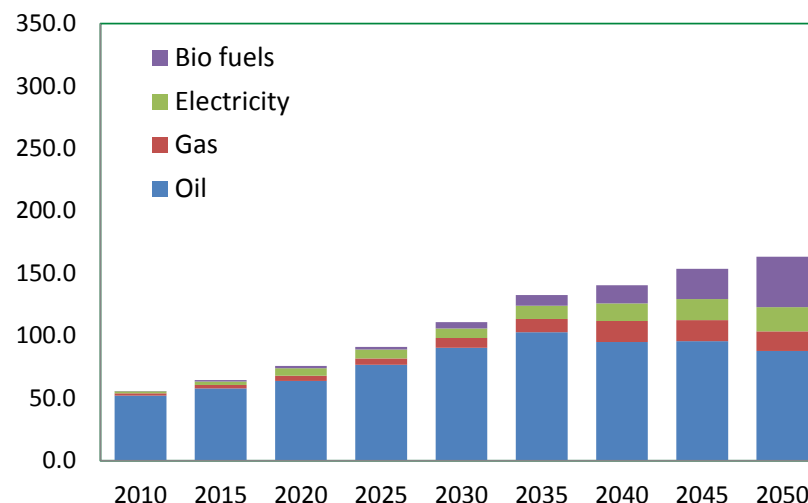
Fuel Mix for Transport

**Energy Demand - BAU
(Mtoe)**



0.3% 1.6% 1.1% 4.7% 4.6%

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



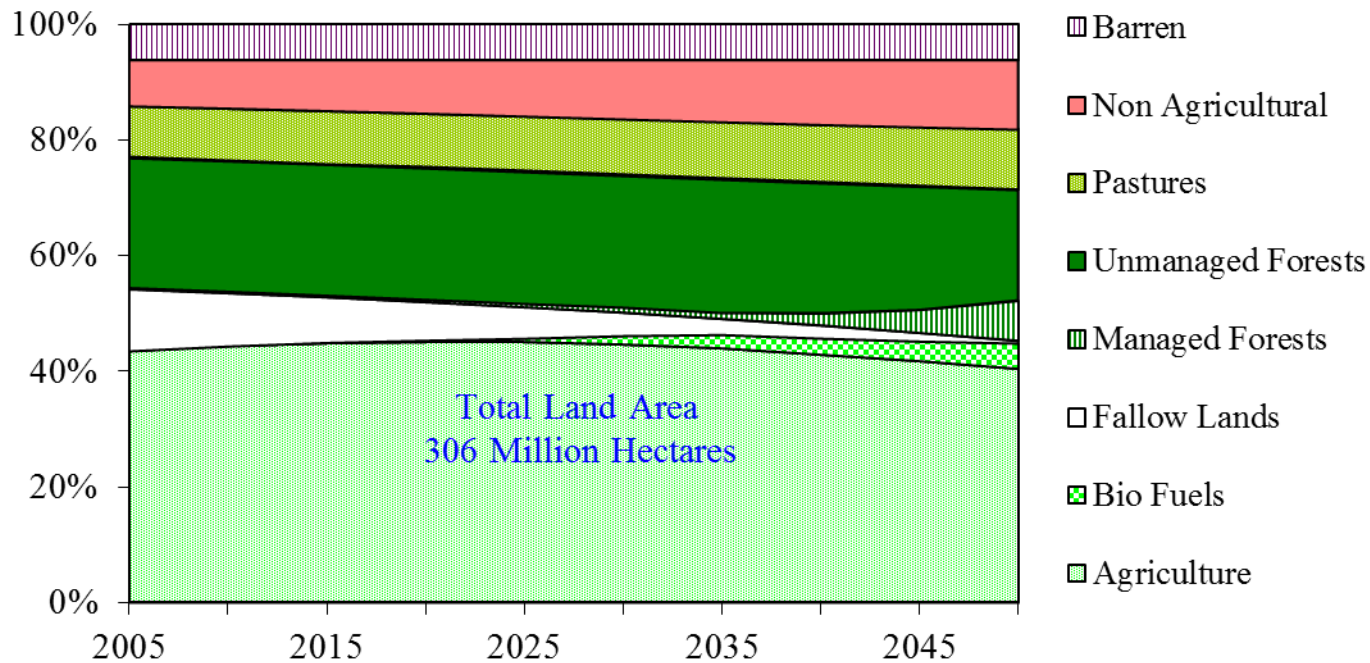
0.3% 2.3% 4.6% 10.3% 24.7%

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