Second Generation Biofuel Potential in India: Sustainability Considerations

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Outline of presentation

- Definition, scope setting, background to biofuel sustainability discussions
- Rationale for the study & objectives
- Methodology
- Results & discussions
- Concluding recommendations

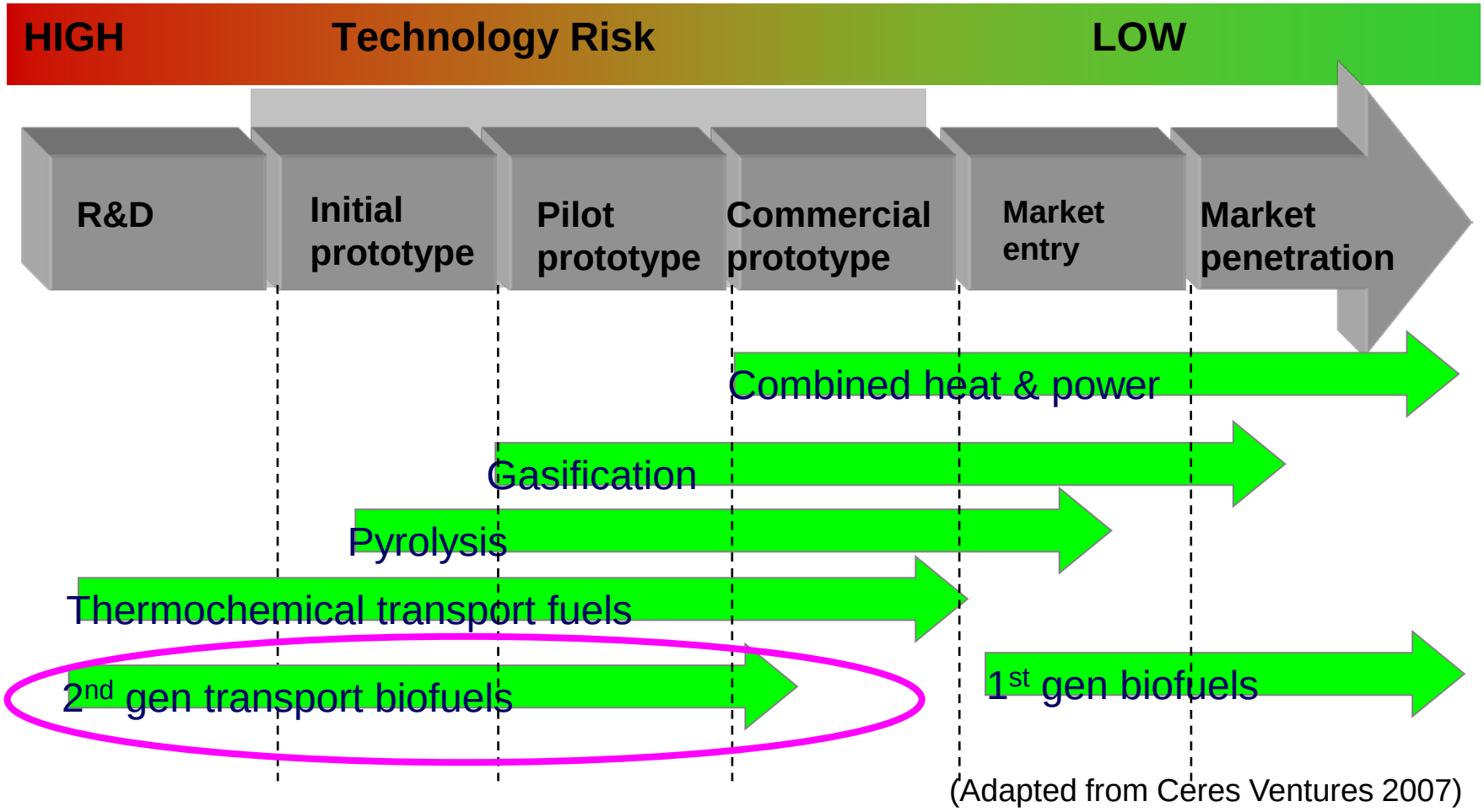
Definitions

- Focused on **Liquid biofuels**

- IEA definition of Liquid Biofuels used in the study:
  Biofuels classified either as ***conventional*** or ***advanced*** *based on level of maturity*

- Conventional biofuel technologies= well established processes and biofuel being produced on commercial scale. Commonly referred to as 1st Generation. E.g. sugar based ethanol, starch based ethanol, oil crop based biodiesel and straight vegetable oil

- Advanced biofuel technologies = processes that are still in R&D, pilot or demonstration phase. Usually referred to as 2nd and 3rd Generation. Eg. biofuels from lignocellulosic biomass i.e. cellulose ethanol, biomass-to-liquids diesel, algae based biofuels.



Need for policy support for 2nd generation biofuels

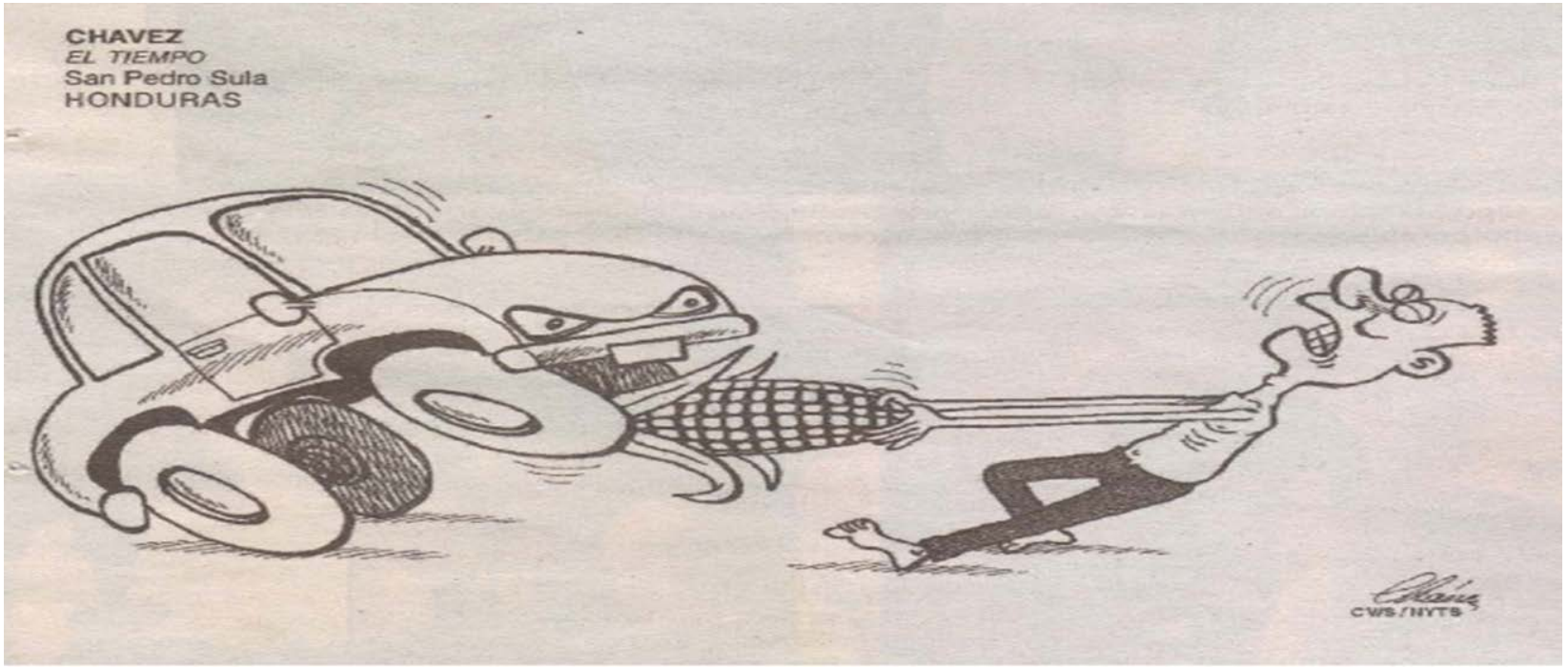
Key sustainability concerns on biofuels

- Social & Environmental

Key concerns on biofuels

Social:

Food vs. fuel



Other SOCIAL concerns (contd.)

- Consultation & communication with local communities
- Biofuel production shall not take place on contested lands
- Compliance with national laws and ratified international laws on employment conditions and workers' rights
- Fair wages and compensations
- Workers are informed about their rights
- Working hours are not excessive
- Freedom of association and right to collective bargaining
- No child nor forced labour, health and safety concerns,
- etc

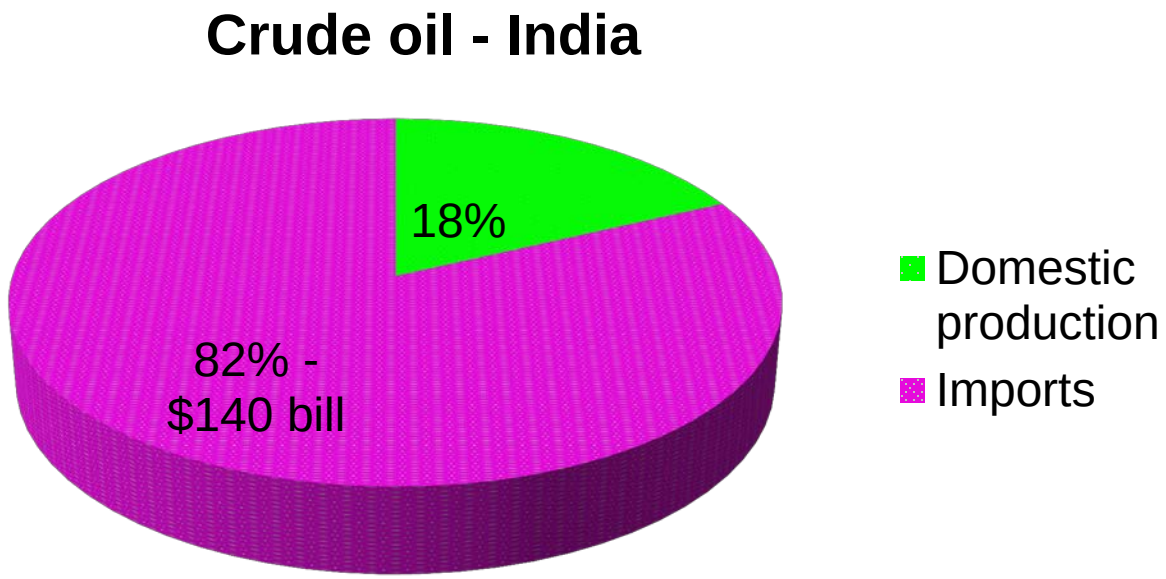
Sources: ILO, RSB, GBEP

Major ENVIRONMENTAL concerns

- Net GHG balances
- Land use change (direct & indirect)
- Net energy balances
- Water (use and consumption)
- Biodiversity
- Soil quality & health
- Pollution (air, water, soil) – responsible use of chemicals
- Etc

Sources: Hill *et. al*, 2006; Searchinger *et. al, 2008*; Williams *et. al*., 2009; Ackom *et. al.,* 2010

Why the interest in liquid biofuels?



- Volatilities in oil prices
- Uncertainties about sustained oil supplies
- Local energy security
- Rural development
- Diversification in agricultural and energy product streams

Rationale for the study

- National Policy:
  - biofuel blending targets in India

Year	Petrol demand (Mt)	Bioethanol demand (Mt)		
		5%	10%	20%
2010	14.2	0.7		
2017	20.8		2.1	
>2017	31.1			6.2

Source: Adapted from Purohit & Fischer, 2013

Research question:

- How much of these mandated targets could be obtained from sustainably derived agricultural residue sources?

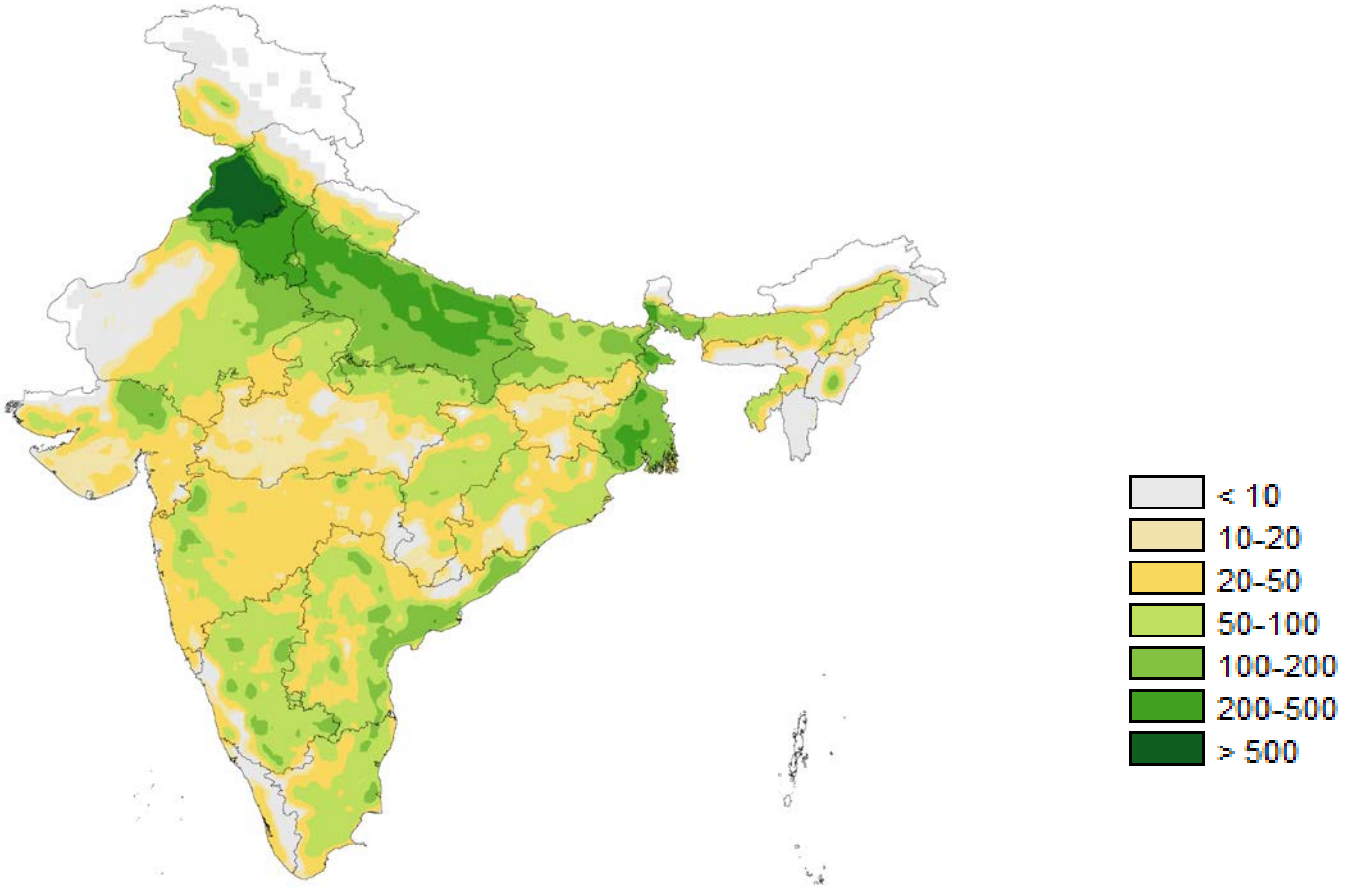
Year	Petrol demand (Mt)	Bioethanol demand (Mt)		
		5%	10%	20%
2010	14.2	0.7		
2017	20.8		2.1	
>2017	31.1			6.2

Methodology

- Using data collected in the collaborating institutions
- crop production statistics e.g. data from Government of India, Ministry of Agriculture; Kumar *et al*., 2002; Ravindranath *et al*., 2005; Purohit *et al*., 2006, Purohit and Michaelowa, 2007; Purohit, 2009; Purohit & Fischer, 2013;
- estimation of residues and ethanol bioconversion using published peer reviewed data including: OECD/IEA, 2011; Simms *et. al*. 2010; Ackom *et. al*. 2013

Results & Discussions

Cereal crop production in year 2011



Intensity and spatial distribution of cereal production in 2010-11 (tons/km^2

(Source: Purohit and Fischer, 2013)

India:

2nd Gen biofuel potential from agricultural residues

Crop	Residue type	Prod. (tonnes)	RPR	Res. (dry wt.)(tonnes)	Sustain. Res.(20%)	Biochem. EtoH-low(litre)	Biochem EtoH-high (litre)
Rice	Straw/husk	96.0E+06	1.8	173.0E+06	34.6E+06	3.8E+09	10.4E+09
Wheat	Straw	87.0E+06	1.6	139.0E+06	27.8E+06	3.1E+09	8.3E+09
Jawar	Stalk	7.0E+06	2.0	14.0E+06	2.8E+06	0.3E+09	0.8E+09
Surgar cane	Bagasse/leaves	342.0E+06	0.4	137.0E+06	27.4E+06	3.0E+09	8.2E+09
Bajra	Straw	10.40E+06	2.0	20.7E+06	4.1E+06	0.5E+09	1.2E+09
Maize	Stalk/cob	21.7E+06	2.5	54.3E+06	10.9E+06	1.2E+09	3.3E+09
Gram	Waste	8.2E+06	1.6	13.2E+06	2.6E+06	0.3E+09	0.8E+09
Tur (Arhar)	Shell/waste	2.9E+06	2.9	8.3E+06	1.7E+06	0.2E+09	0.5E+09
Other cereal	Stalk	4.6E+06	2.0	9.1E+06	1.8E+06	0.2E+09	0.5E+09
Total					**136E+06**	**15.0E+09**	**41.0E+09**

Summary of findings in addressing the research question

Year	Petrol demand (Mt)	EtoH from residues (low)	EtoH from residues (high)	Bioethanol demand		
				5%	10%	20%
		15 bill. litres	41 bill. litres			
	(Mt)	Mtoe				
2010	14.2	**11.8**	**31.6**	0.7		
2017	20.8				2.1	
>2017	31.1					6.2

Conclusions

- India's bioethanol blending targets could be met from environmentally benign 2nd generation sources derived from agricultural residues

- However, increased investments in R&D would be required in order to bring the technology to commercial scale for this bioethanol potential in 2-G to be realised.

- Partnerships with global players would be required.

Thanks for your attention !

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