The future is

BIOREFINING

Vision, Opportunities, Initiatives and Challenges on Bio-based Economy

Pasi Rousu

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Outline of presentation

- Vision
- Opportunities
- Chempolis corporation
- **formico**bio™ - 3G technology for the production of cellulosic ethanol and –sugars & co-production of green electricity
- Challenges
- Initiatives

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Vision

- India is a leading producer of sustainable biobased fuels and chemicals, which are based on efficient utilization of residual biomass
- Use of residual biomass has reduced air pollution due to reduced burning of biomass in fields and due to low carbon biofuels & chemicals
- Biobased value chain has created employment for hundreds of thousands of people, while rural areas has remarkably developed
- India has reduced its dependency on imported petroleum, which also has positively influenced on India's currency
- EU-India collaboration brings continuously new solutions for biobased fuels and chemicals to be sustainably produced in India

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Opportunities

- Rice straw is wasted in Punjab, Haryana and UP
- Sugarcane bagasse is inefficiently used especially with co-operative sugar mills in UP and Maharashtra
- Many locations where wheat straw, cotton stalks and other biomass residues are abundantly available
- Ethanol blending has started showing the way forward
- As huge food & sugar producer India has leading edge companies already in food supply chain, which can supply also residual biomass
- Several world class companies in engineering, EPC & machinery
- Several leading edge OMC's, chemical & pharma companies as potential offtakers/ manufactures of biofuels and chemicals
- People, skills & education already in place

100+ Biorefineres can be easily implemented for production of cellulosic sugars, fuels & chemicals
=> 20 % ethanol blending target could be reached

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THE BIOREFINING TECHNOLOGY CORPORATION

Chempolis is private independent medium sized company (est. 1995) who supplies sustainable globally patented biorefining technologies, which has been acknowledged by World Bank, DoE, etc

- **formico**fib™ the fibre technology platform
- **formico**bio™ the cellulosic sugar technology platform

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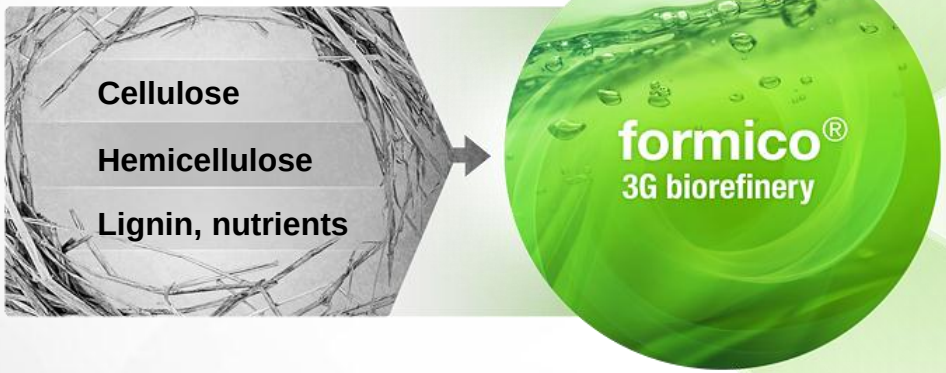
formicobio™- THE 3G BIOREFINING PLATFORM

Non-Food biomass



Cellulose products

- **Paper fibres** — Paper, board, tissue
- **High value fibres** — Viscose, CMC, Nano
- **Glucose** — Ethanol, butanol, Lactic acid, succinic acid

Hemicellulose products

- **Pentose sugars** — Xylose, arabinose
- **Platform chemicals** — Acetic acid, furfural Ethanol, butanol etc

Lignin products

- **Lignin** — Polymers, plastics
- **Biocoal** — Steam, electricity
- **Nutrients** — Fertilizer

3G biorefinery integrates biomass conversion process and equipment to produce multiple fuels, power, heat, platform biochemicals and fibres from biomass

3G biorefinery is analogous to petroleum refinery, which produces multiple fuels and products from petroleum

Tested Raw materials

Wood	Agricultural residues	Energy crops
Acacia	Bagasse & sugarcane trash	Arundo donax
Birch	Cassava stem	Bamboo
Chestnut	Castor straw	Chinese alpine rush
Eucalyptus	Coconut husk	Common reed
Oil palm trunk	Corn stalk & cob	Flax
Tropical hardwood mix	Cotton stem	Miscanthus sinensis
Finnish forest residues	EFB (Empty fruit bunch)	Reed canary grass
	Oat straw	Sarganda
	OPF (Oil palm frond)	Sisal
	Rye straw	Various Finnish grasses
	Pineapple stem	
	Rice straw	
	Wheat straw	

ethanol, butanol, acetic acid, lactic acid, succinic acid
amino acids, furfural, antibiotics, microbial oil lignin etc
Could be done with co-production of steam and electricity

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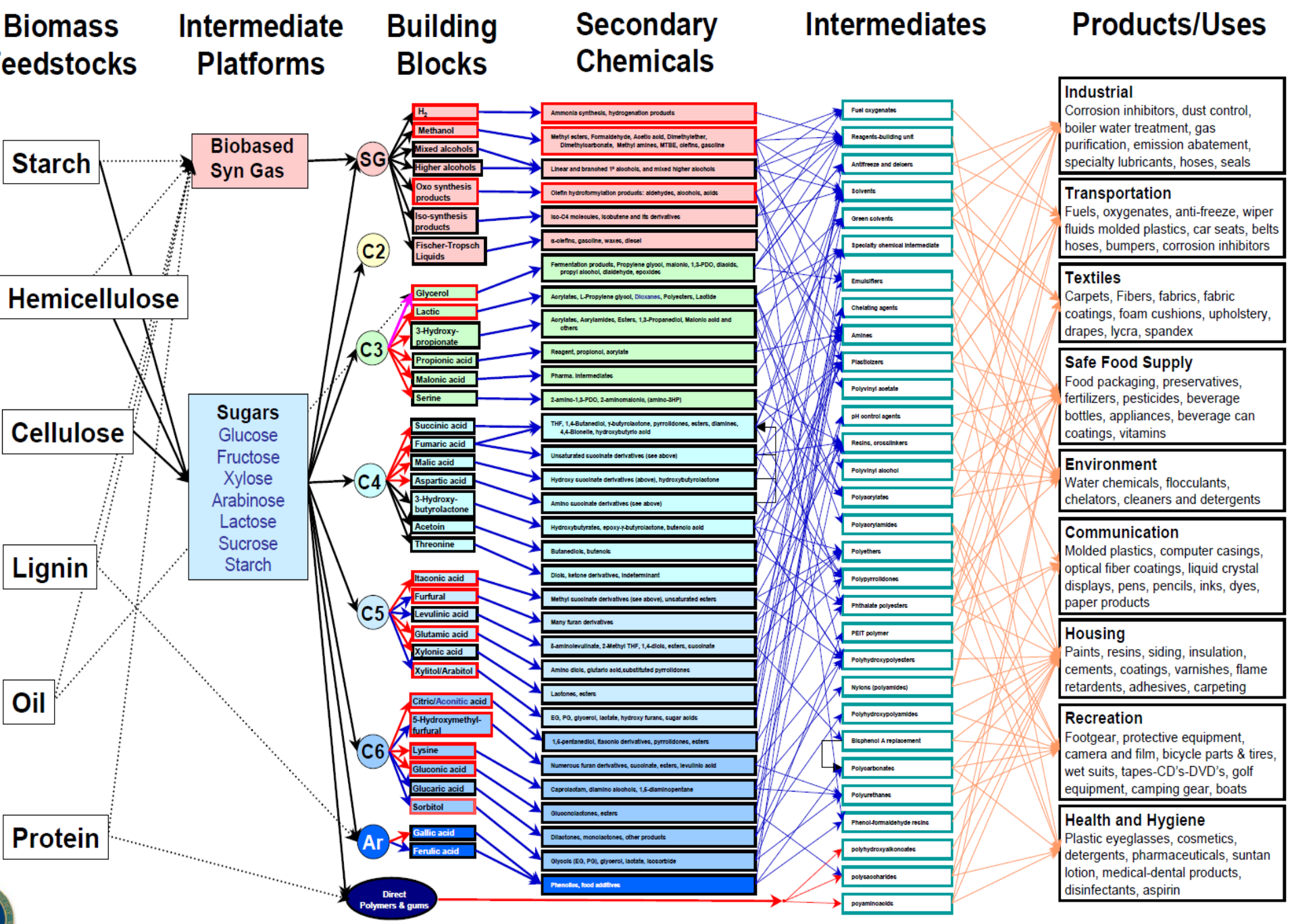

Figure 3 – Analogous Model of a Biobased Product Flow-chart for Biomass Feedstocks

Challenges

- Nobody want to be first
- Slow implementation of ethanol blending program
- No good mechanism to enable adoption of new leading edge technologies
- Lignocellulosic based electricity??? Lignocellulosic residues are too valuable just to be burnt
- Slow implementation may lead to “wrong” use of residual biomass which is not optimal and ultimately all are loosing

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Steps have also been taken

Signing ceremony between Chempolis and ONGC about biorefinery co-operation OCT 2013

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Initiatives

- Demonstration biorefinery project using sustainably rice straw for cellulosic ethanol and platform chemicals, while co-producing green electricity
- Demonstration biorefinery project using sustainably bagasse & its residues/ cotton stems/bamboo etc for cellulosic sugars and lignin for more advanced biobased chemicals, while co-producing green electricity
- Clear funding mechanism for supporting technology transfer from EU countries, especially for big demonstration projects
- Early stage partnering in R&D level between EU-India

1. **Biofuels, like cellulosic ethanol**
2. **Other glucose & xylose based basic fuels & chemicals for food, bioplastics, pharma etc**
3. **Lignin based basic chemicals**

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The future is

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Technologies are already available

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