



Netherlands Enterprise Agency



# Strategic Research Agenda (SRA) Bio-based Economy

## Europe- India

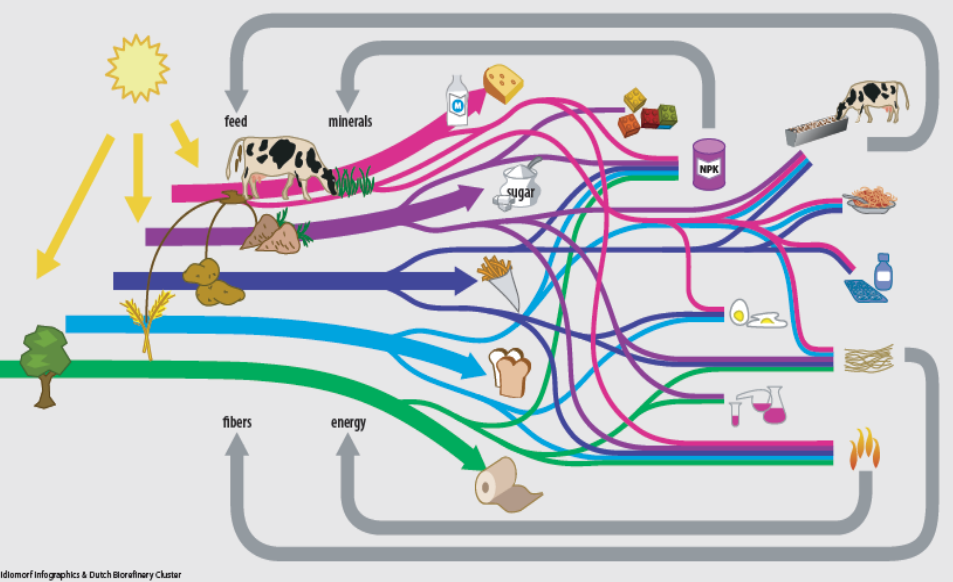
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# Content

- The bio-economy approach;
- Methodology;
- Biomass Availability;
- Biorefinery approach;
- Markets and Policies;
- Conclusions.



# Sustainable Biobased Approach



## Integrated Food & Materials production

- Smart agriculture
- Increased production



## Sustainable and Rural Development

- Local Resources and local use
- Tapping unused or abandoned land



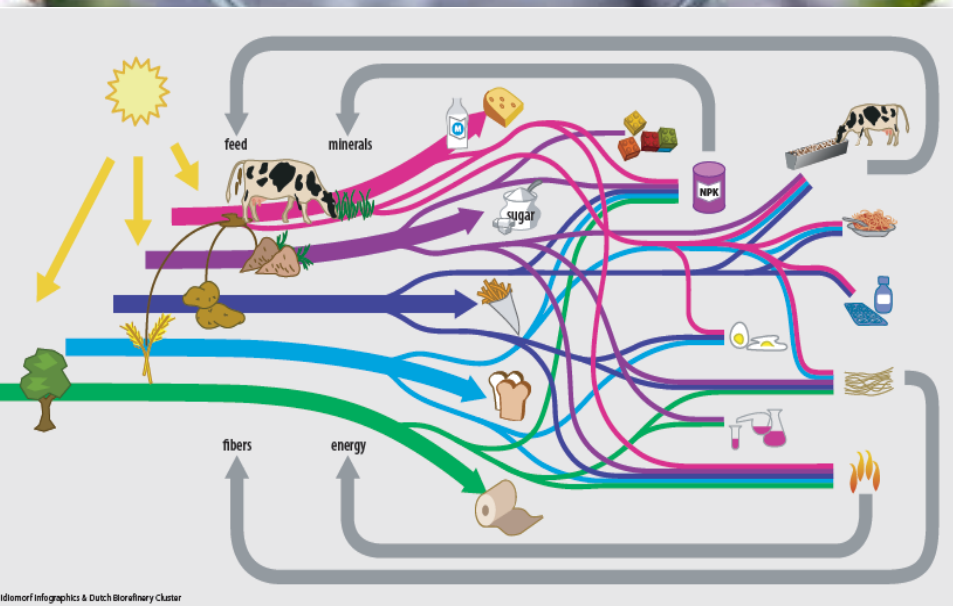
## Smart use of biomass

- Circular Economy, Cascading
- Biorefinery

Ref: [http://www.sahyog-europa-india.eu/images/D2\\_3\\_Strategic\\_Advise\\_on\\_Biobased\\_Research\\_based\\_on\\_Sahyog\\_inventory\\_V3.pdf](http://www.sahyog-europa-india.eu/images/D2_3_Strategic_Advise_on_Biobased_Research_based_on_Sahyog_inventory_V3.pdf)



# Methodology





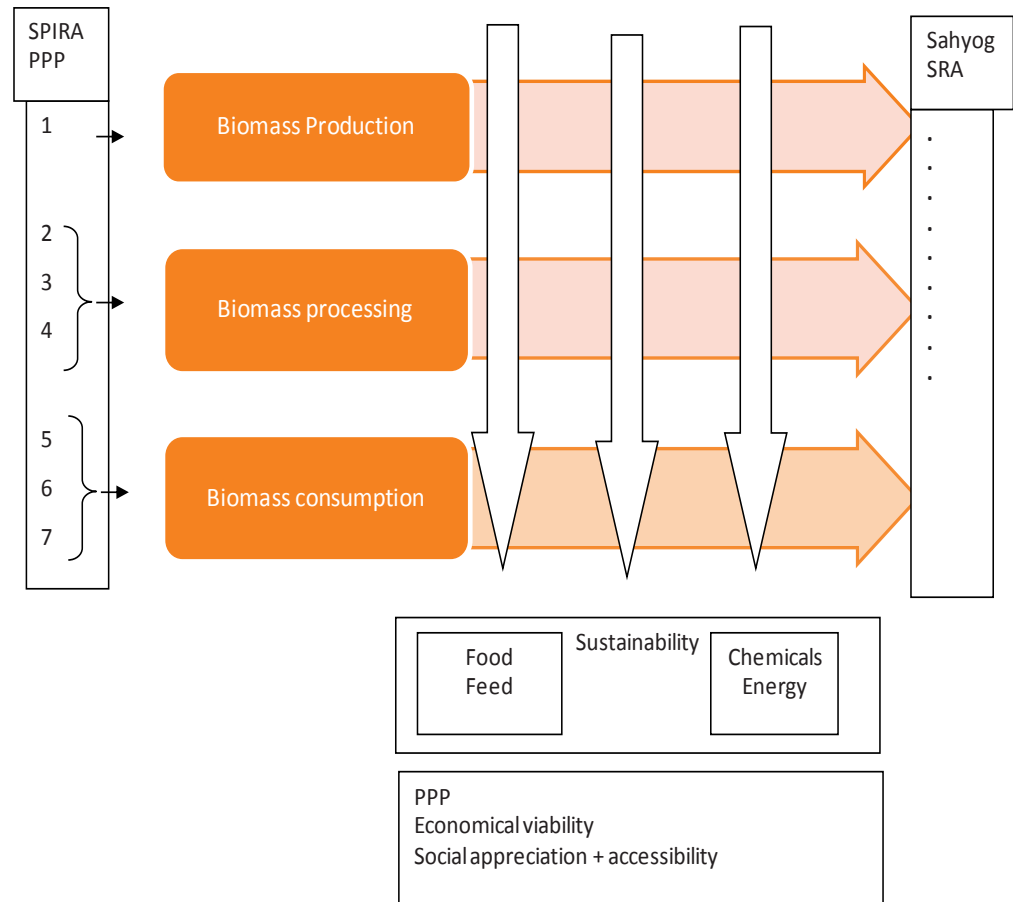
# SRA Bioeconomy India - Europe

Information from:

- Reviews
  - Existing Roadmaps
- Workshops with Industry
- Questionnaire
- Analysis- Evaluation
- Conclusions

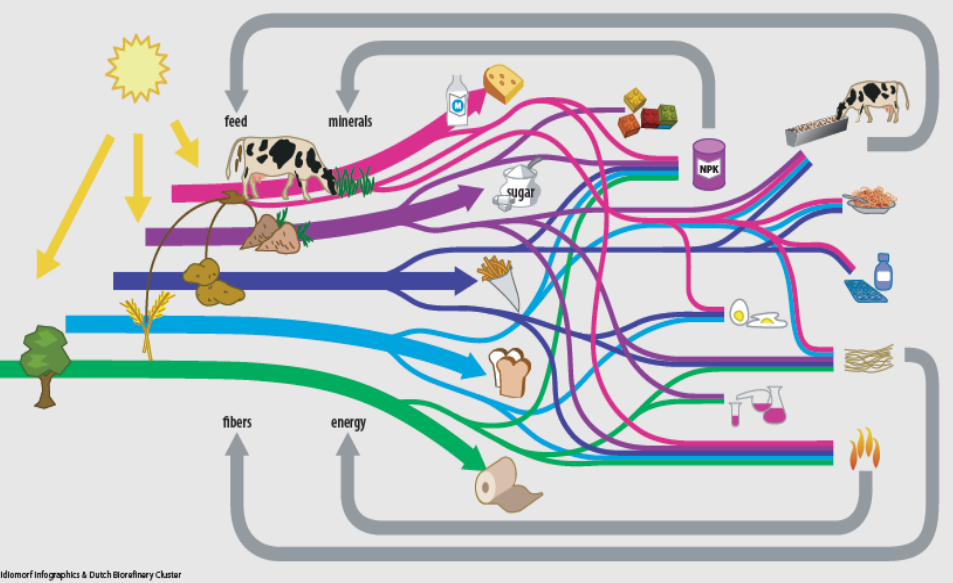
Chapters:

- 1.Vision
- 2.Biomass Production
- 3.Processing
- 4.Products/ Markets
- 5.Conclusions





# Biomass Availability



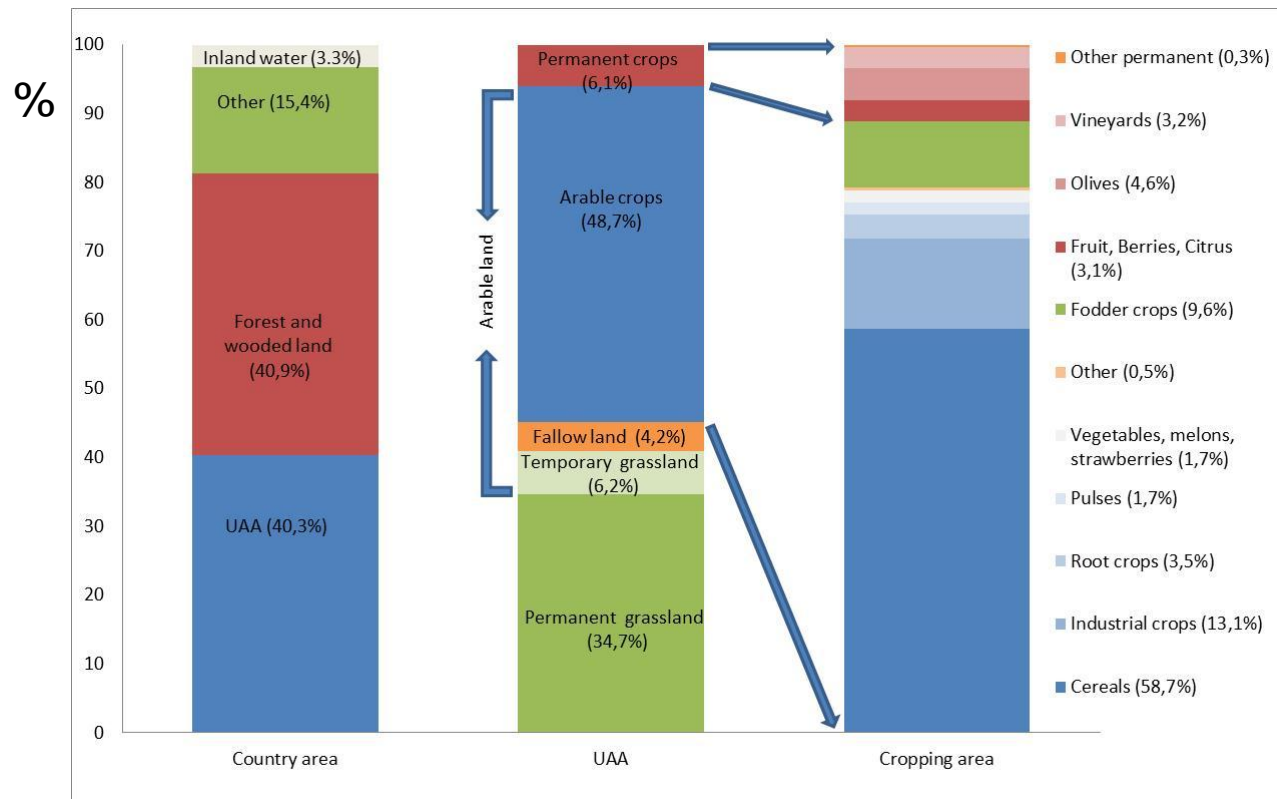


# Comparing EU-27 and India

	EU-27		India	
	(Mha)	(%)	(Mha)	(%)
Total country area	432.5		328.7	
Inland water	14.3		31.4	
Land area	418.2	100	297.3	100
Utilized Agricultural Area (UAA)	174.5	41.7	179.8	60.5
Arable land	103.1	24.6	157.5	53.0
Permanent crops	10.6	2.5	12.1	4.1
Permanent meadows & pastures	60.5	14.5	10.1	3.4
Forest area and other wooded land	177.0	42.3	68.4	23.0
Other land	66.8	16.0	49.0	16.5



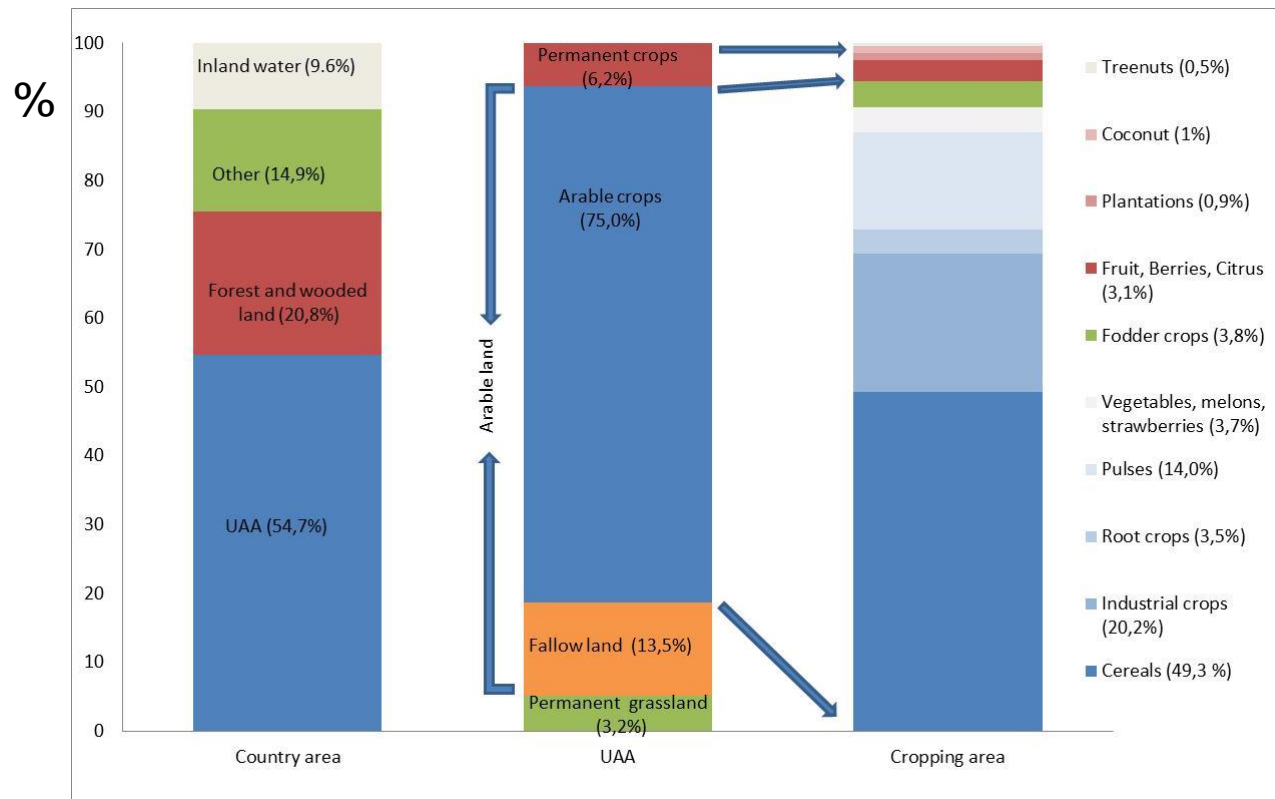
# Land-use in Europe





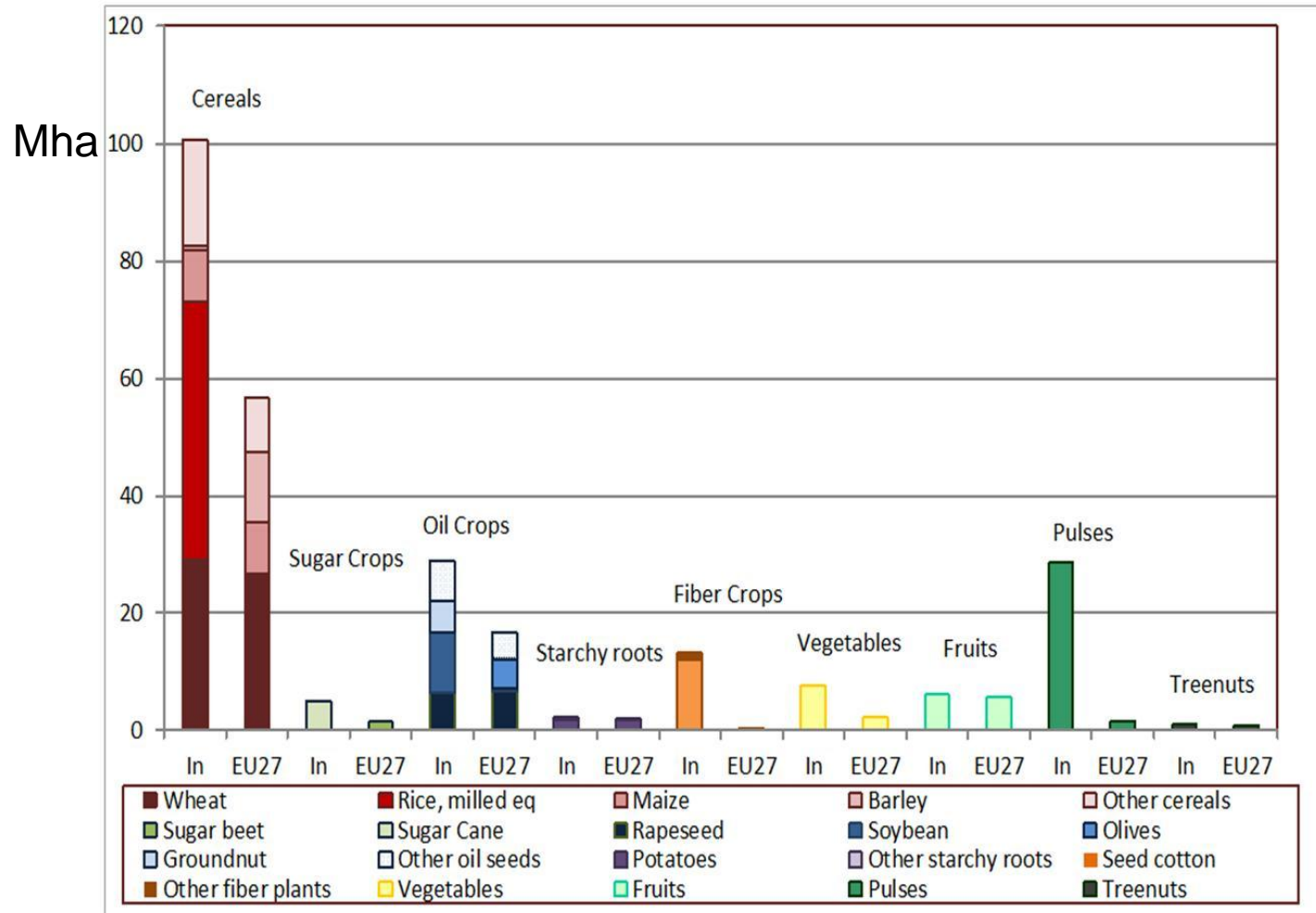


# Land-use in India



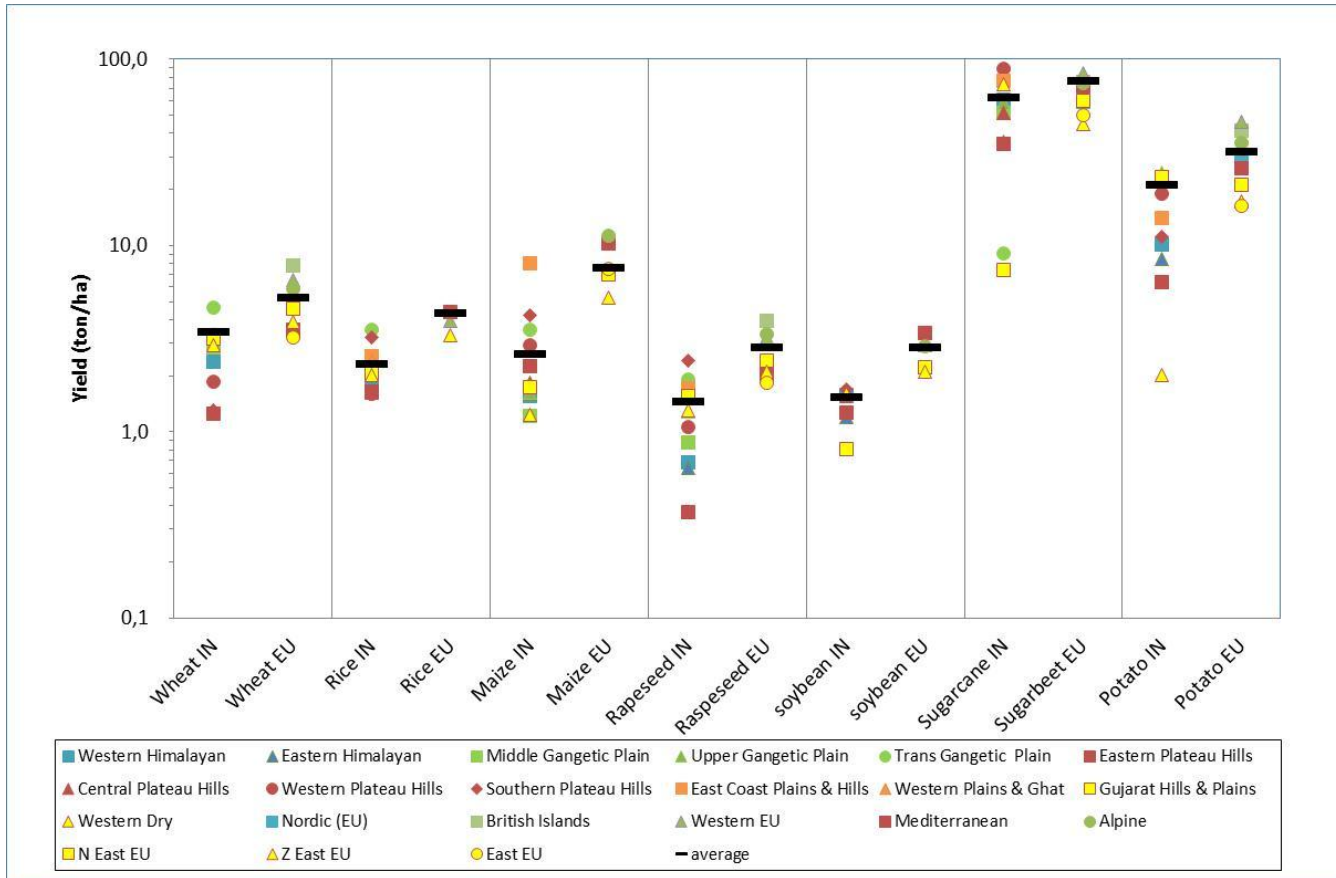


# Agricultural crops





# Yields (ton/ha), logarithmic scale



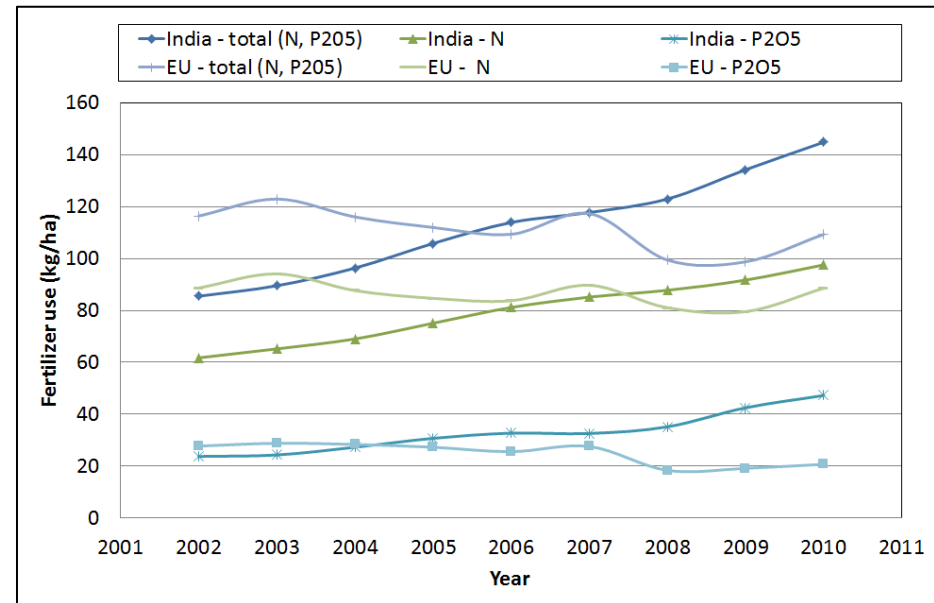
Large  
Regional  
Differences

Potential  
- to increase  
Yields



# Yield Improvements

- Depends on:
  - Soil quality, degradation
    - > (water, wind, salinisation, nitrates, )
  - Water availability (rain, monsoon, climate change)
  - Fertiliser, pesticides
  - Biodiversity



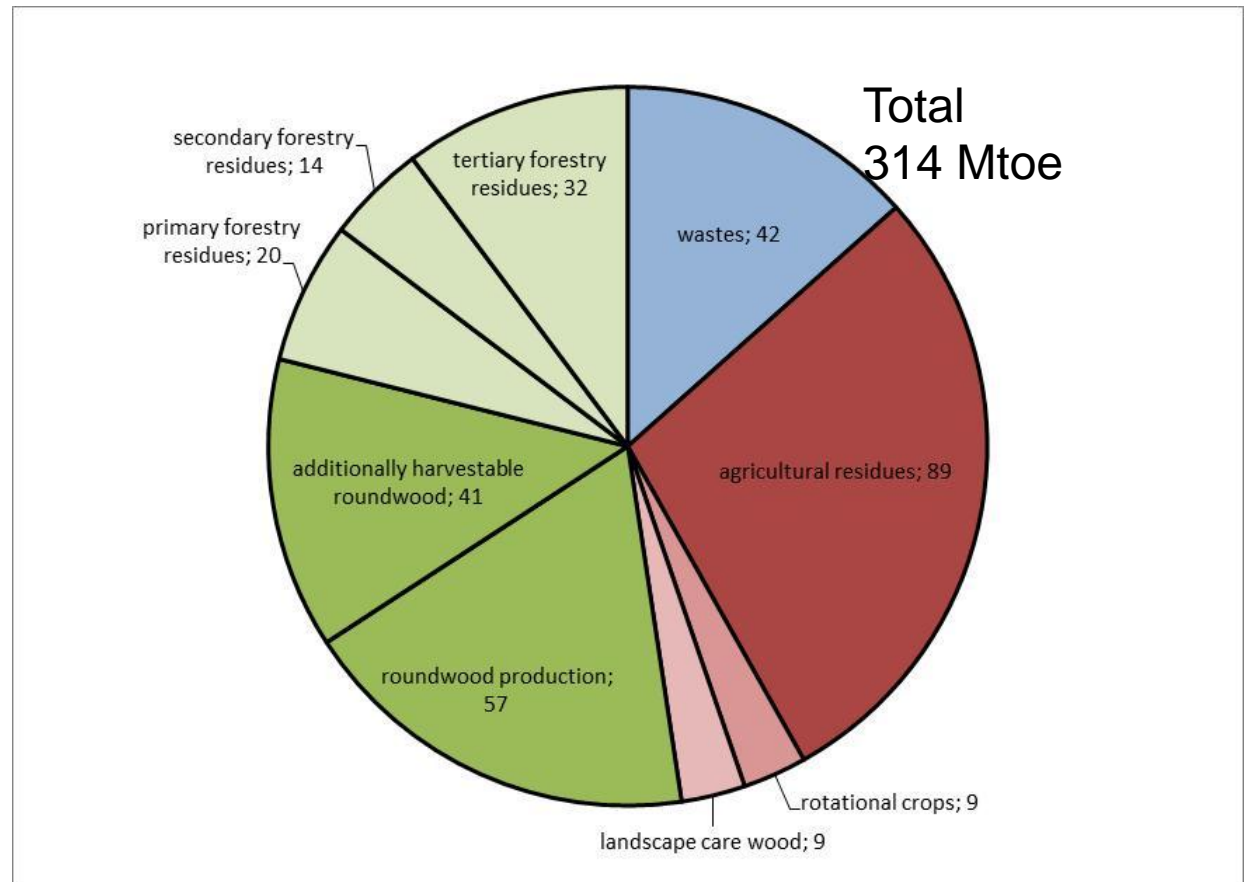
Fertilizer supply EU, India



# Biomass potential Mtoe in Europe

	Mtoe
Total availability:	314
waste	42
agricultural	107
forestry	164

From Biomass Futures





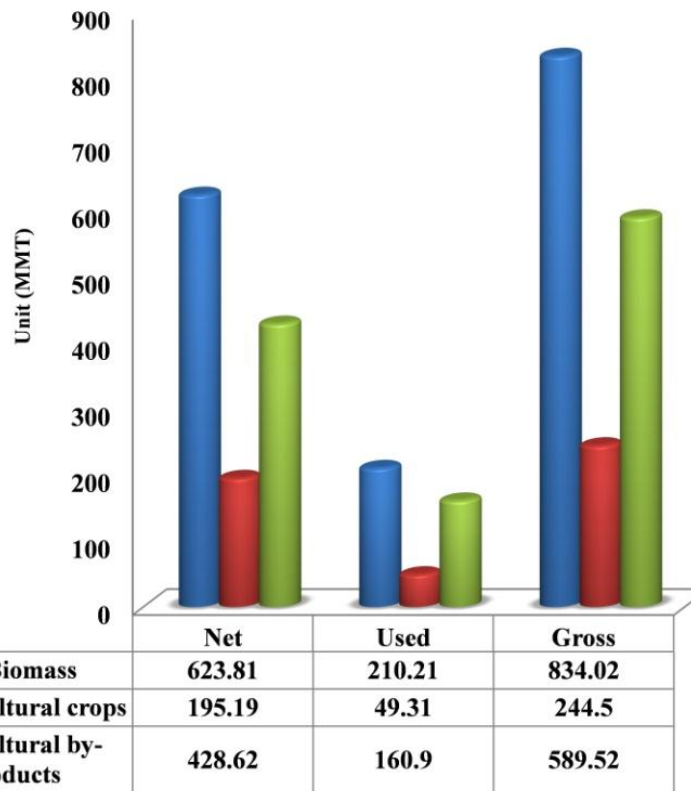
# Biomass Potential India from agricultural residues

Total 429 Mton

@10GJ/ton

= 4.3 EJ

=



## Total Biomass Resource Potential

### ➤ Agricultural Crops

- **Starch Crops** (Potato, Sweet Potato)
- **Oil Crops** (Oil seeds, Soybean, Groundnut, Sunflower, sesamum, safflower, Niger, Linseed)
- **Sugar Crops** (Sugarcane)

### ➤ Agricultural by-products

- **Straw, Husk, Stover** (Rice, Wheat, Maize, Bajra, Ragi, Grams, Pulses)
- **Fruit biomass** (Banana, cotton, Mesta, Coconut)
- **Processed residues** (Coffee, Tea, Tobacco, Turmeric)



# Biomass Availability Summary M odt

**Table 2. Comparison of Biomass and Wastes**

<b>Biomass and Waste resources</b>	<b>India</b>	<b>Europe</b>
<b>(Millions of dry tonnes)</b>		
<b>Agricultural residues</b>	214	109
<b>Industrial Waste</b>	n.a.	290
<b>Municipal Solid Waste</b>	67	251
<b>Organic degradable content</b>	51 %	38%
<b>Forestry fuel wood, Mton</b>	45	21



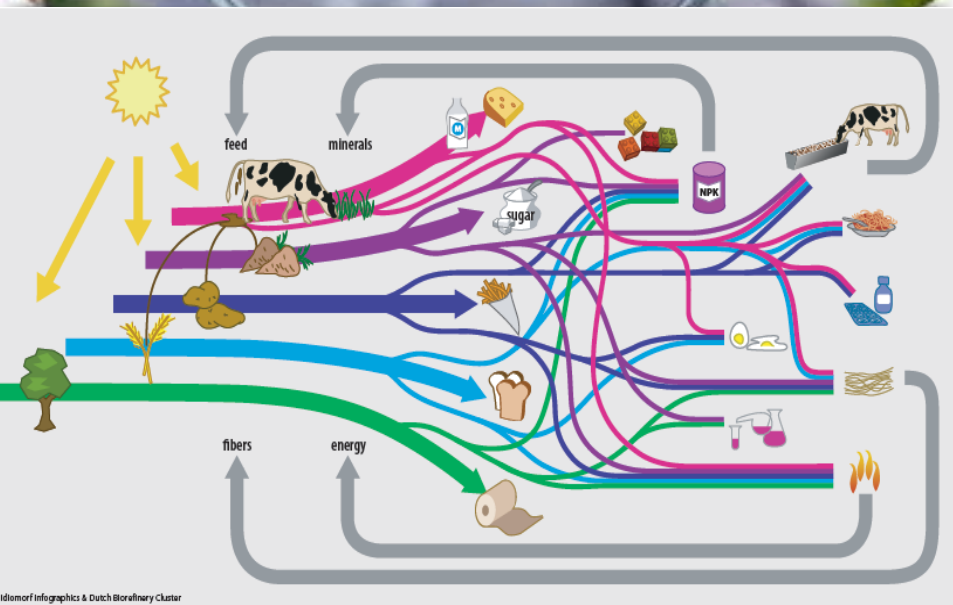
# Research Recommendations

- Smart agricultural intensification, site and crop specific, (soil, water, nutrients, fertilizers);
- Supply chain management (logistics, reduction of losses, storage);
- Improved waste collection, treatment, valorisation to products and energy;
- Improved characterisation and administration of biomass and waste resource flows.





# Biorefineries

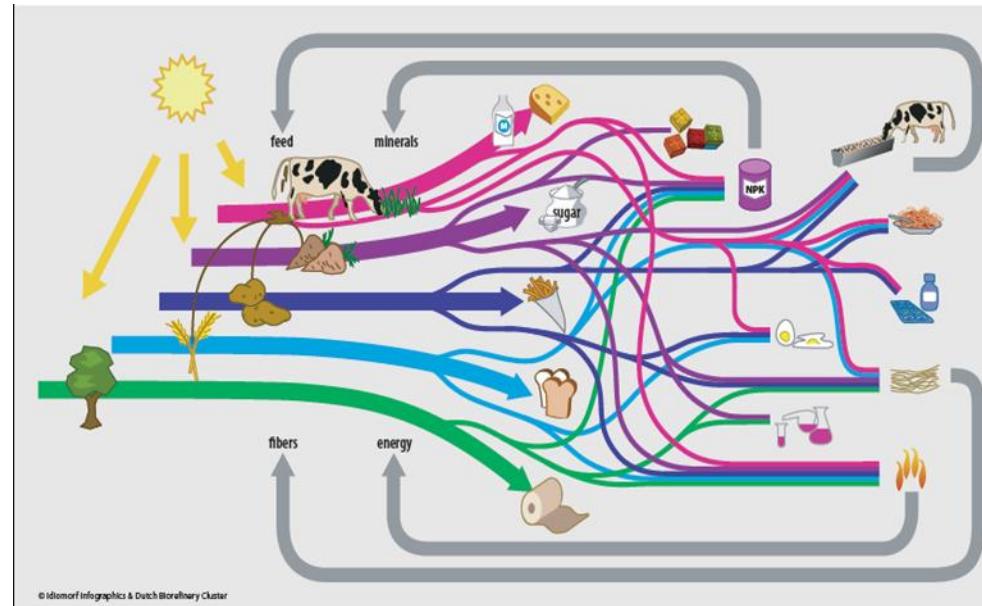






# Future of Biorefineries

- New job opportunities
- New markets
- Production of biofuels (transport sector) as main focus
- Input flexibility
- Demonstration





# Support for market introduction

- Bring sectors together:
  - Agro, forestry, chemicals, energy,
- Region specific
  - Coasts, wetlands, mountaints, biodiversity
- Market incentives:
  - Blending obligations, purchase mandates
- Financial support:
  - Capital, fiscal, etc.



# Research Recommendations for biorefineries

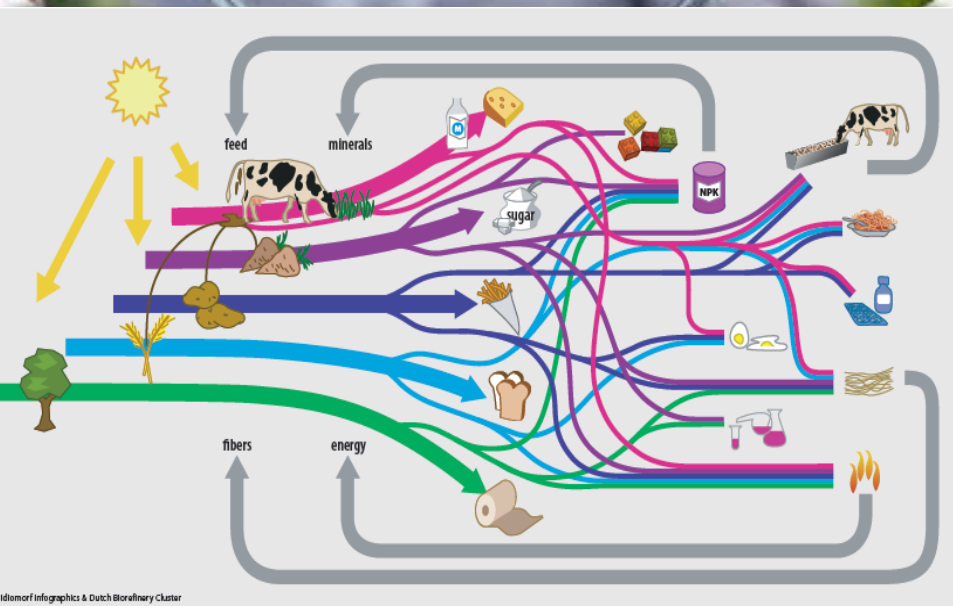
- Development and Demonstration of Improved Biorefineries:
  - Development of smart enzyme systems at lower cost price;
  - Development of bio-based value chains (from crop to chemical and energy); Lignocellulosic biorefineries towards production of fuels and chemicals extraction;
  - Bio-refinery based on gases (CO<sub>2</sub>/methane) towards fuels and chemicals
  - Analysis and optimisation of geographical locations for bio-based production and products.
- Utilisation of Residues
  - Development of smart micro-organisms for conversion of residues and waste
  - Development of smart processing equipment, process intensification;
  - Improved thermal conversion by gasification and pyrolysis for simultaneous production of chemicals and energy;
  - Improved anaerobic digestion by bacteria selection, pre-treatment, post treatment to fertiliser;



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# Markets and Policies



Idiomorf Infographics & Dutch Bioeconomy Cluster



OR





# Market is defined by society

- Drivers
- Research/  
Technologies
- Policies
- Regulations
  - Taxes;
  - Obligations;
  - Subsidies.
- Market conditions





# Europe: Legislation: Waste Directive

- Obligation for all Member States:
  - Reduce Land-filling to less than 50%;
  - Sanitation of Landfills;
  - Recycling of Waste;
  - Clean incineration, no dioxins etc.
- Member State measures
  - Tax on landfilling: 80 €/tonnes in NL

# Renewable Energy Directive

- Obligation for all Member States to achieve:

In 2020	In 2030
> 20% Renewable Energy	27% Renewable Energy
> 20% GHG reduction	40% GHG reduction
- > Market for biomass!





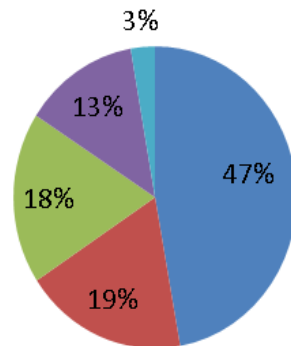
# Biomass for Markets in Europe

**Market: 2 trillion €**

**Non Food Biomass**

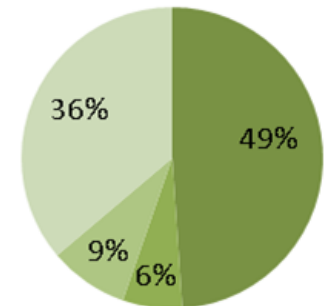
**Annual turnover (2009)**

- Food
- Agriculture
- Paper/ Pulp
- Forestry/ Wood
- Biobased products



**Uses of biomass (in Million t)**

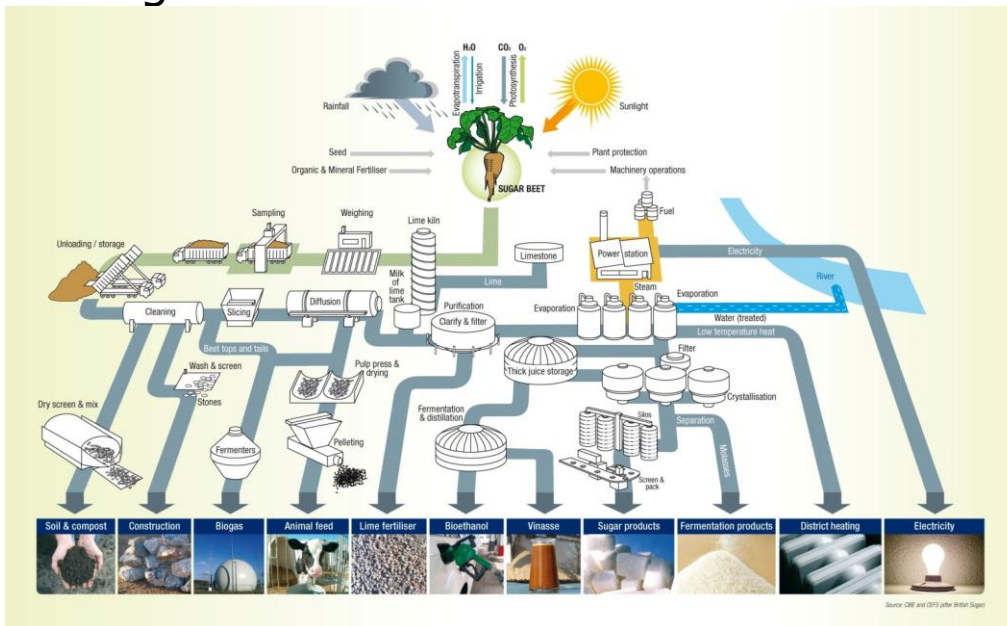
- Wood for industrial material use
- Agricultural biomass for industrial material use
- Agricultural biomass for bioenergy, incl. electricity, heat, biofuels and biogas
- Wood for bioenergy, incl. Electricity, heat, biofuels and biogas





# Europe: Common Agricultural Policy

- Stop of Production quota
  - Sugar, Milk
- Open Borders
- Opportunities for increased production -> Sugarbeet





# Research & Development Bioeconomy & Climate & Energy

- Societal Challenges:
  - Food Security
  - Resource Security
  - Climate Change/  
Sustainability
  - Economic Benefits/Jobs
- -> Horizon 2020
  - > 80 billion €
- JTI Biobased Industries
- Climate package 2030
  - 40% CO2 reduction
  - 27 % Renewable Energy
  - No target for biofuels yet



# India & Biomass

- Drivers:
  - Poverty alleviation
  - Food security
  - Energy security
- Strive for low carbon, green economy
- Focus on Energy
  - Improved Cooking Stove  
> 10 million in 2022
  - Biomass Power ->4.6 GW
- Biotech
  - Bioplastics (ban)
- Medicine:
  - Ayurvedic treatments



# India: Products to be considered:

Biofuels	Bioprocess	Bioproducts
<ul style="list-style-type: none"><li>• Biodiesel 1st , 2nd, 3rd generation</li><li>• Cellulosic ethanol</li><li>• Biobutanol</li><li>• Bio-oil and Biochar</li><li>• Bioethers</li><li>• Bio- SPK (Aviation biofuels)</li><li>• Dimethylfuran</li><li>• Hydrogen</li></ul>	<ul style="list-style-type: none"><li>• Mechanical biological treatment</li><li>• Thermal Depolymerization</li><li>• Biomethanation</li><li>• Trans esterification</li><li>• Biomass gasification</li><li>• Enzymatic and acid hydrolysis</li></ul>	<ul style="list-style-type: none"><li>• Biomaterials for biomedical applications</li><li>• Bioplastics, biopolymers and bioresins</li><li>• Biopesticides / biofertilizers</li><li>• Biobased cosmetics</li><li>• Biobased insulation materials</li><li>• Bio based chemicals</li><li>• Biobased Solvents for Biopharma applications</li><li>• Biobased lubricants</li><li>• Biobased sorbents</li><li>• Biobased surfactants</li><li>• Biobased flocculants</li><li>• Biomass to renewable chemicals using thermochemical methods (for instance, biomass → syngas → chemicals)</li></ul>



# No Level Playing Field for Renewable Energy and Renewable Materials

- Financial Support for
  - Renewable Energy
  - Research & Development
- No support for bio-based materials and chemicals
  - > Need for action
- Public Procurement of Bio-based Products





## Research recommendations

- Develop agreement on sustainable production and use of biomass;
- Develop a common political framework to stimulate the bio-based economy approach (level playing field);
- Develop standards for residues and declassify them as waste;
- Develop standards for performance criteria of bio-based products
- .....



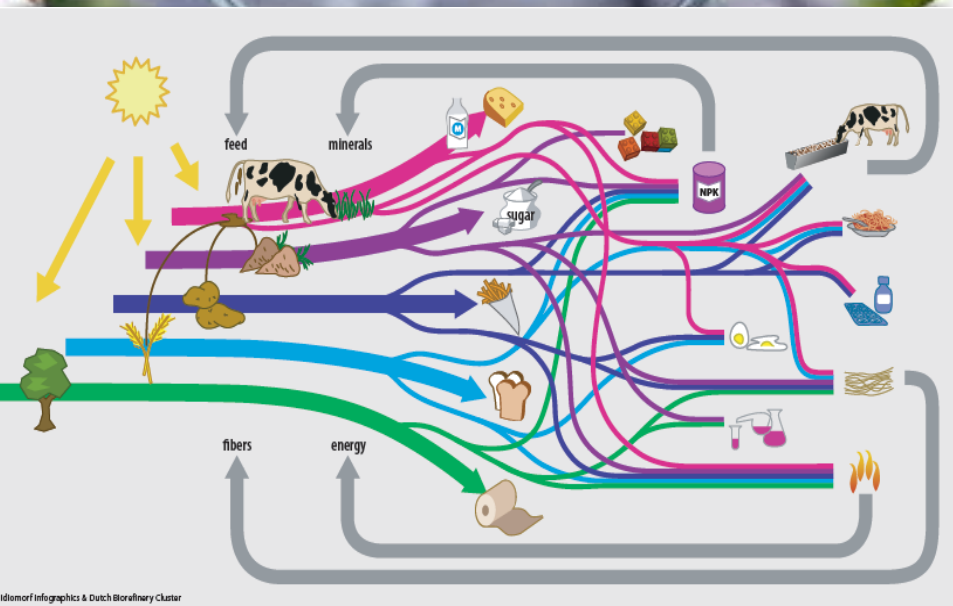
## Research recommendations 2

- Develop Public Procurement of bio-based products;
- Stimulate Zero Waste communities and production system (circular economy);
- Develop awareness raising and education programmes on a sustainable bio-economy with proper waste management;
- Develop Training and Education for researchers and engineers in the bio-economy (Human Capital)





# Conclusion





# Sustainable Bioeconomy & Bioenergy

- Need for collaboration
  - Continue with joint projects
    - > Biomass resources, smart agriculture
    - > Biorefineries, valorisation of residues
    - > Policies to implement a sustainable bioeconomy
- Build on existing industrial partnerships
  - Public Private Partnerships
  - Focus on integrated biorefinery approach
    - > Creating Value, jobs and new products
    - > Reduction of Green house Gases
- Create enabling environment (by Govts)



## Conclusions

- Policy measures create economic opportunities for industry;
- Integration: Energy, Waste, Agriculture, Products;
- European Commission supports measures;
  - Job Creation, Rural Development;
  - Sustainable Development;
  - Cleaner Environment.
- What Policies in India support this?