

The route to a Biobased Economy

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OUR ECONOMY IS BASED ON CARBON



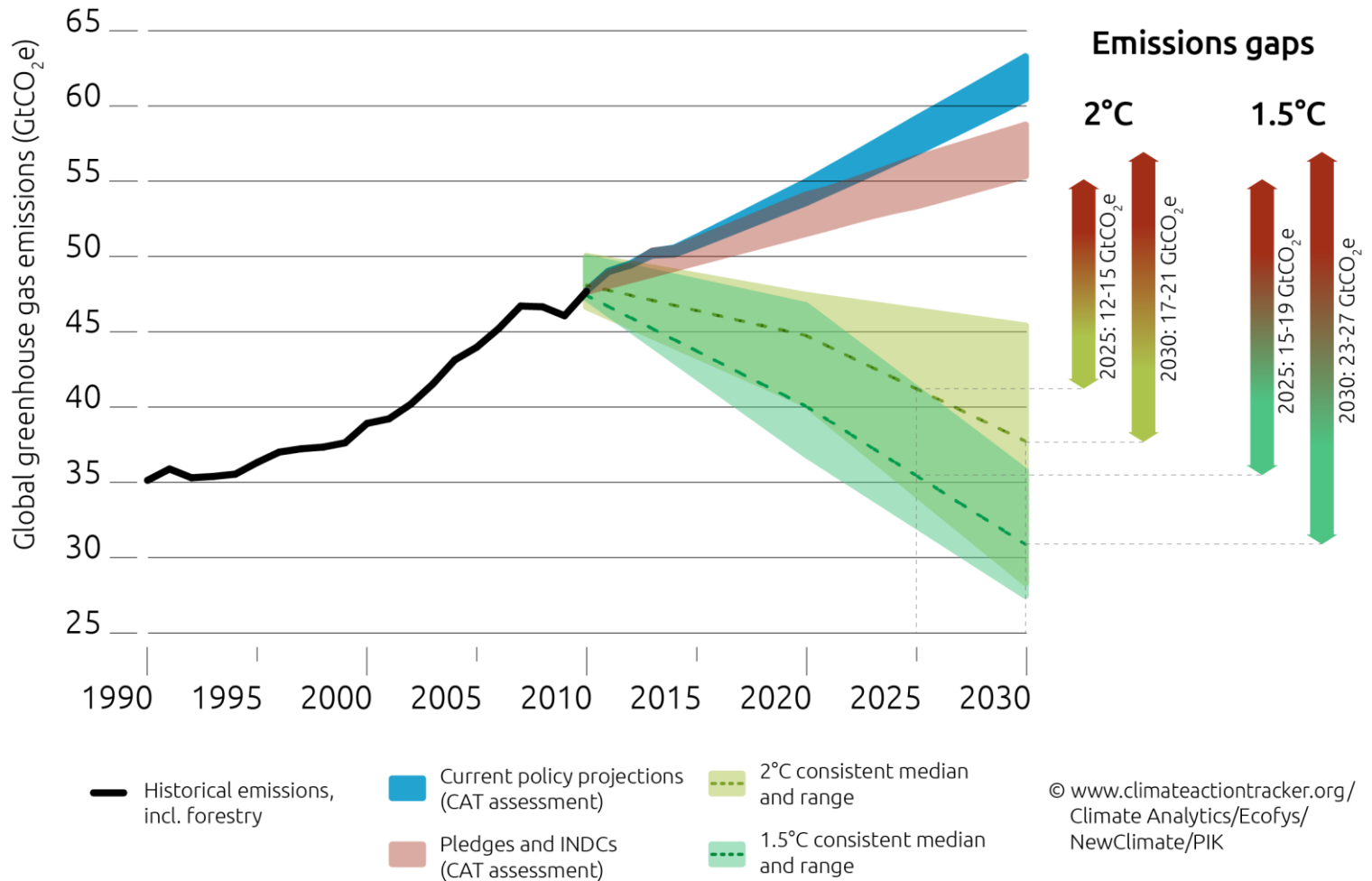
(FOSSIL) CARBON IS PRESENT IN FUELS, CHEMICALS AND MATERIALS WE USE AND PRODUCE!



A partial list of products made from Petroleum (144 of 6000 items)					
One 42-gallon barrel of oil creates 19.4 gallons of gasoline. The rest (over half) is used to make things like:					
Percolators	Solvents	Guitar Strings	Lipstick	Shoe Polish	Telephones
Life Jackets	Dieselfuel	Luggage	Denture Adhesive	Motorcycle Helmet	Enamel
Rubbing Alcohol	Motor Oil	Aspirin	Linoleum	Caulking	Pillows
Linings	Bearing Grease	Safety Glasses	Ice Cube Trays	Petroleum Jelly	Dishes
Skis	Ink	Antifreeze	Synthetic Rubber	Transparent Tape	Cameras
TV Cabinets	Floor Wax	Football Helmets	Speakers	CD Player	Anesthetics
Shag Rugs	Ballpoint Pens	Awnings	Plastic Wood	Faucet Washers	Artificial Turf
Electrician's Tape	Football Cleats	Eyeglasses	Electric Blankets	Antiseptics	Artificial limbs
Tool Racks	Upholstery	Clothes	Glycerin	Clothesline	Bandages
Car Battery Cases	Sweaters	Toothbrushes	Tennis Rackets	Curtains	Dentures
Epoxy	Boats	Ice Chests	Rubber Cement	Food Preservatives	Model Cars
Paint	Insecticides	Footballs	Fishing Boots	Basketballs	Folding Doors
Mops	Bicycle Tires	Combs	Dice	Soap	Hair Curlers
Slacks	Sports Car Bodies	CD's, DVD's	Nylon Rope	Vitamin Capsules	Cold cream
Insect Repellent	Nail Polish	Paint Brushes	Candles	Antihistamines	Movie film
Oil Filters	Fishing lures	Detergents	Trash Bags	Purses	Soft Contact lenses
Umbrellas	Dresses	Vaporizers	House Paint	Shoes	Drinking Cups
Yarn	Tires	Balloons	Water Pipes	Dashboards	Fan Belts
Fertilizers	Golf Bags	Sun Glasses	Hand Lotion	Cortisone	Car Enamel
Hair Coloring	Perfumes	Tents	Roller Skates	Deodorant	Shaving Cream
Roofing	Cassettes	Heart Valves	Surf Boards	Footballs	Ammonia
Toilet Seats	Dishwasher parts	Crayons	Shampoo	Putty	Refrigerators
Fishing Rods	Tool Boxes	Parachutes	Wheels	Dyes	Golf Balls
Shower Curtains	Refrigerant	Gasoline	Paint Rollers	Panty Hose	Toothpaste



The challenge: To reduce 23-27 billion tonnes CO_{2eq} (2030)



Drastically reducing CO₂ emissions will require a deep transformation of our economy

**But what is
1 tonne of CO₂?**



1 tonne of CO₂ weighs as much as 10 baby elephants

Takes about 3-5 trees for 30 years to absorb 1 tonne of CO₂



AVERAGE CO₂ EMISSIONS PER CAPITA IN THE NETHERLANDS



~ 10 tonnes

Drivers of a sustainable future

GDP & pop.
growth
urbanization

Demand
Growth

Supply
Challenges

- Significant resources
- Non-conventionals

Technology
and policy

Local
pollution
Climate
change

Environmenta
l Impacts

Security
of Supply

- Dislocation of resources
- Import dependence

Deep transformation of our economy is not just about reducing CO₂... For sustainable systems we need to consider :

- Resources used (land, water, minerals...)
- The characteristics of the products
- Economic viability
- Potential risks
- Social acceptability
- Effective production and delivery infrastructure

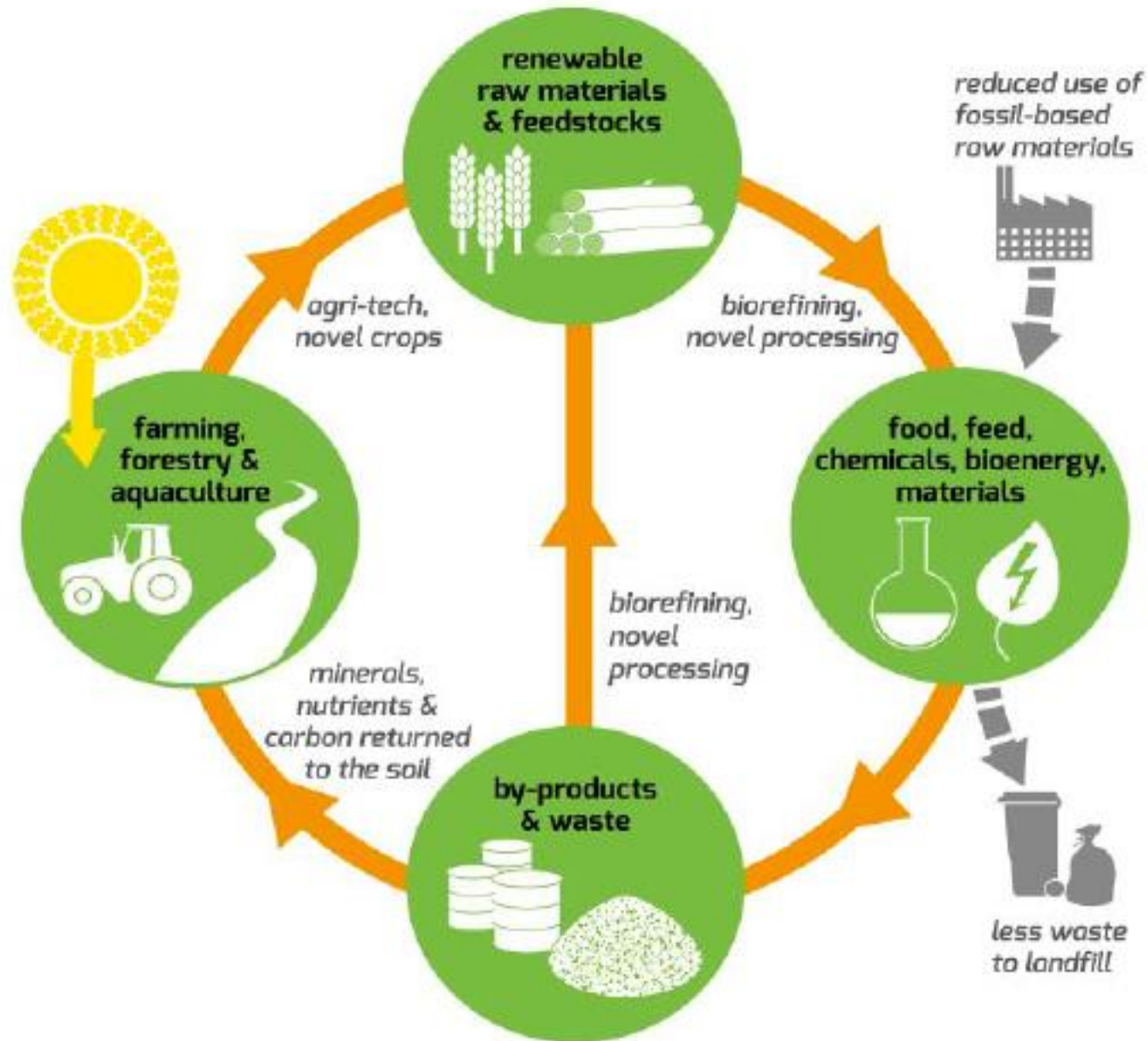
A silver bullet is shown in motion, moving from right to left. It has a bright blue and purple energy trail behind it, suggesting high speed or a magical effect. The background is black.

THERE IS NO SILVER BULLET

BUT THERE ARE SOME KEY STRATEGIES:

- Use less resources
 - Increase efficiency
 - Reuse
 - Recycle
- Replacing of fossil fuels with alternative feedstocks:
 - Waste
 - Biomass
 - CO₂

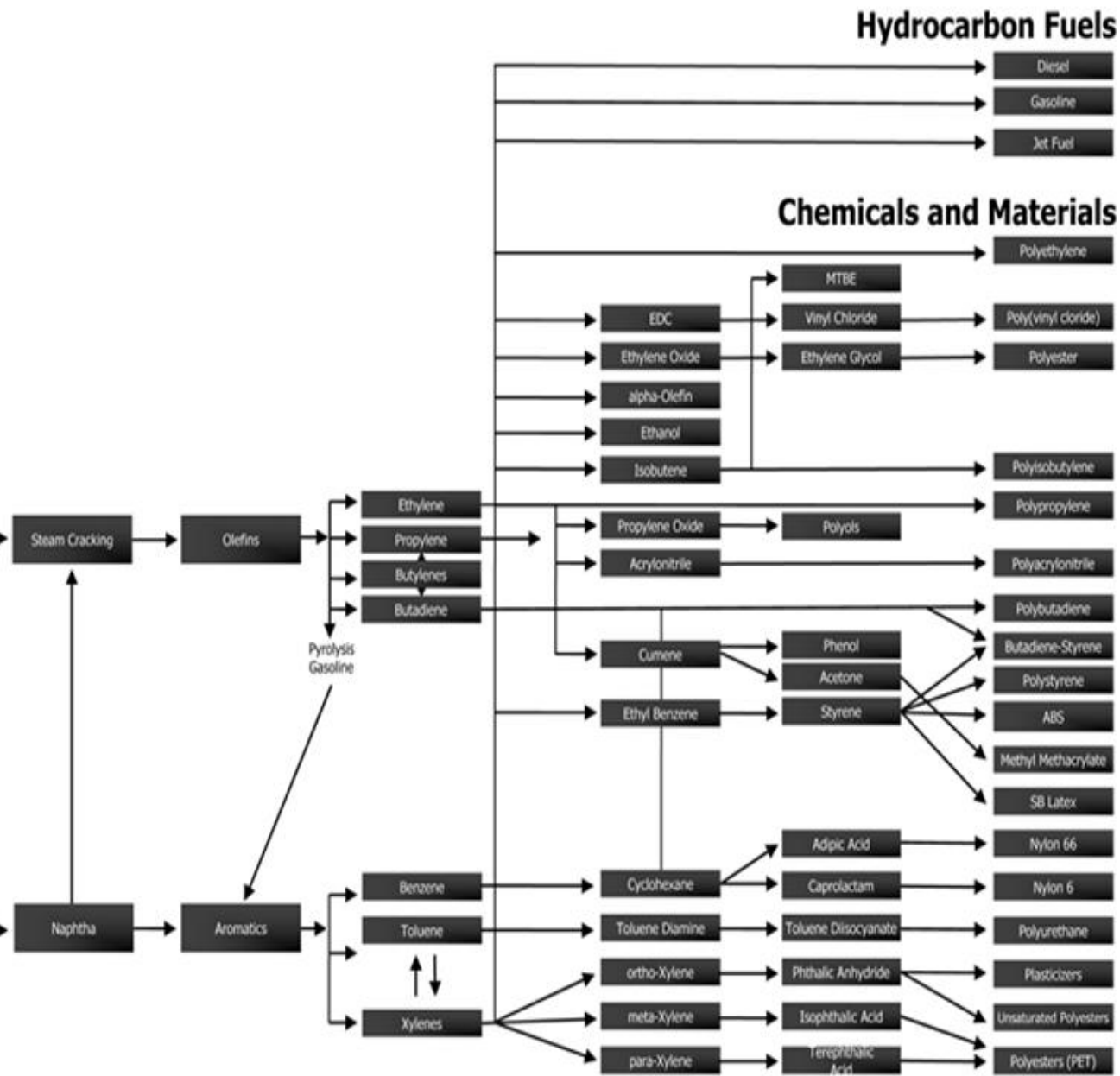
A circular biobased economy

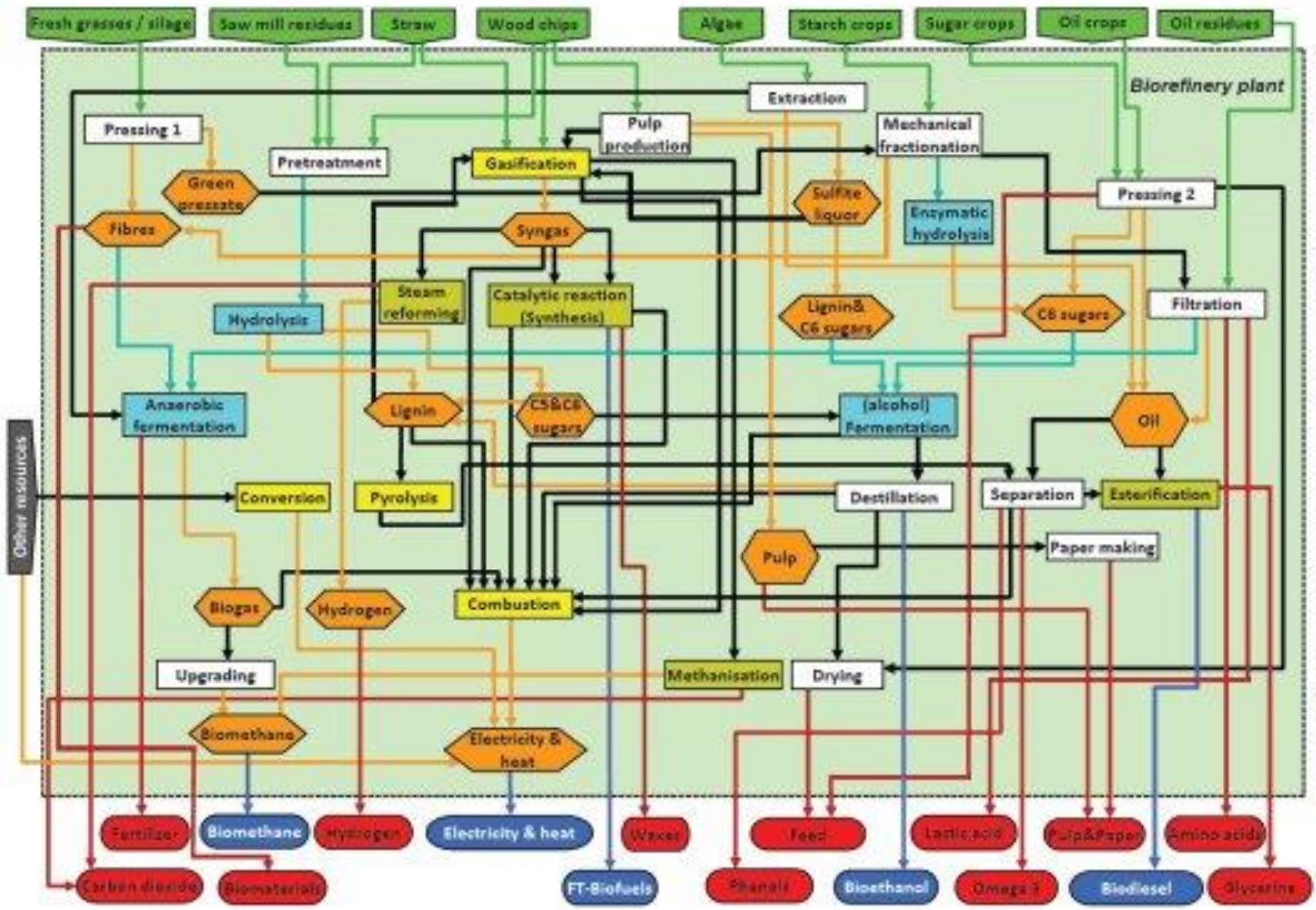


Source: biovale, 2015

The Netherlands

- Biobased economy has been widely "adopted" in the last 10 years
- NL possesses a successful agri-food-chemical sector (world leader)
 - Second largest exporter of agricultural and food products worldwide
 - Dutch production per ha is the highest in Europe
 - Global leader in the breeding of new plant varieties
- International port links to a close-knit logistic network
- High quality education and knowledge institutes



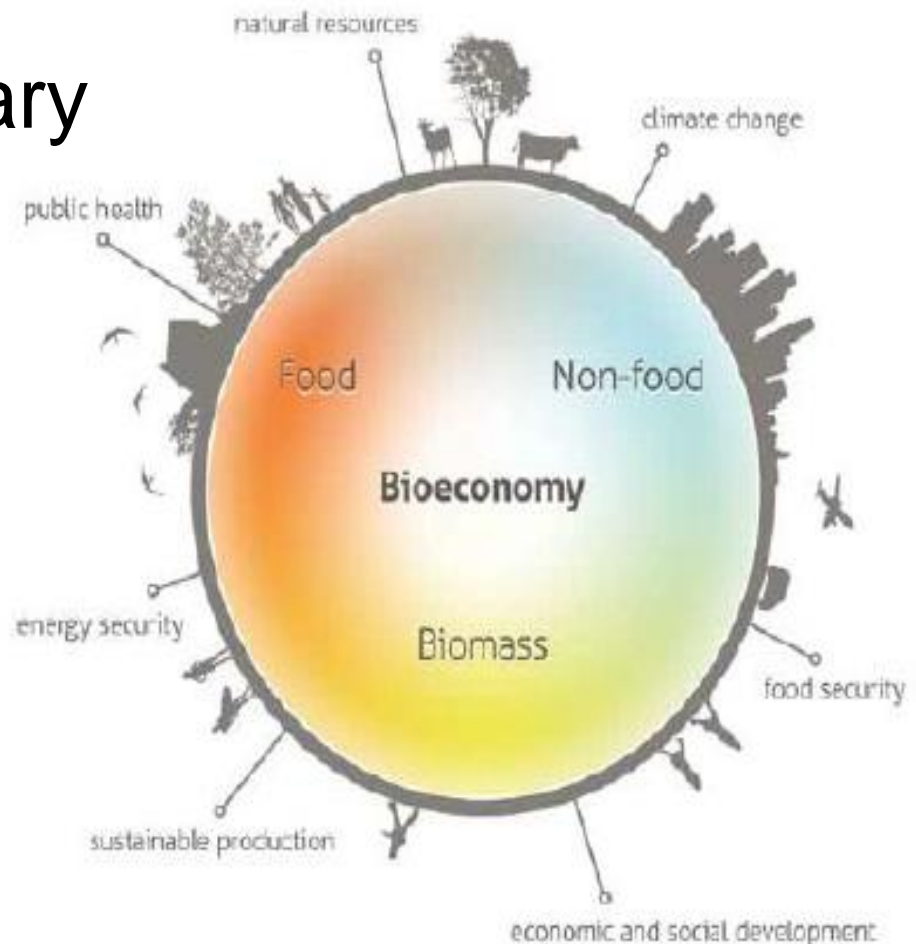


According to the European Commission, A biobased economy....

- Promotes sustainable production of renewable resources from land and sea and their conversion into food, bio-based products, biofuels and bioenergy.
- Encompasses the sectors of agriculture, forestry, fisheries, aquaculture, food and pulp and paper, as well as parts of the chemical, biotechnological and energy industries.
- Provides and protects public goods, such as clean air and water, fertile and functioning soils, landscapes, sustainable marine ecosystems and biodiversity, and addresses social needs.
- Applies a wide array of sciences (e.g. life sciences, agronomy, ecology, forestry-, fisheries- and social sciences) and enabling and industrial technologies (e.g. biotechnology, nanotechnology and ICT) with local and tacit knowledge.
- Contributes to addressing major societal challenges (e.g. food security, climate change, limited natural resources), economic growth and job creation.

A biobased economy

- Multi-sector
- Multi-actor
- Multi-disciplinary



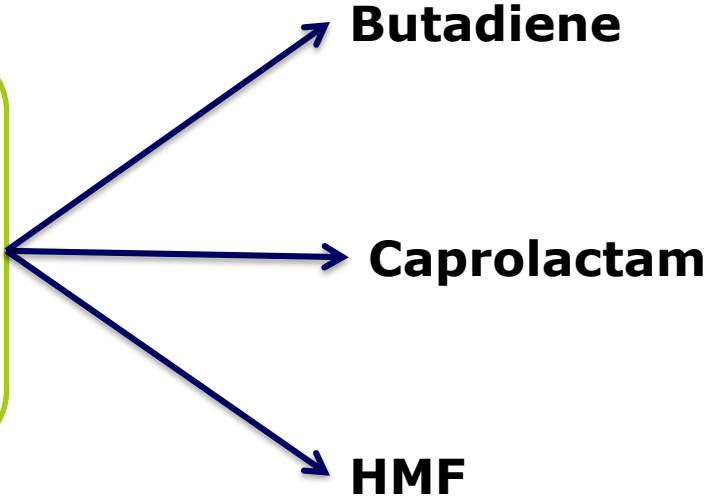


Food crops
(i.e., classical processing)

Which feedstock performs better (for producing C6 sugars) from a technical, economic and environmental point of view?



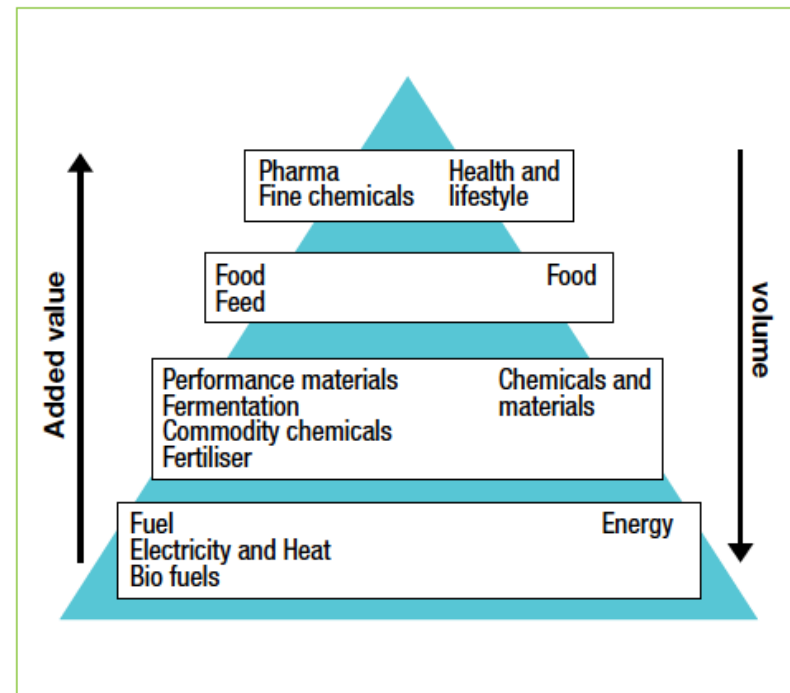
Lignocellulosic biomass
(i.e., emerging alternative)



Which product shows the highest potential, from a techno-economic and environmental perspective?

At the foundation of the biobased economy is the production of biobased raw materials

- How to increase production volumes and improve the quality of the raw materials?
- What, where, when?
- Matching supply and demand



Source: www.bio-basedeconomy.nl⁴

Further refining of the biomass into products

- There is great potential for generating added value in the further refining and use of bi-products.
 - Which ones?
 - Business cases?
- The challenges are to achieve 'smarter' products (Health-promoting food products; more efficient use of bi-products and recycling) and more efficient processing

 achieve a growing bioeconomy and generate more jobs.

Consumption

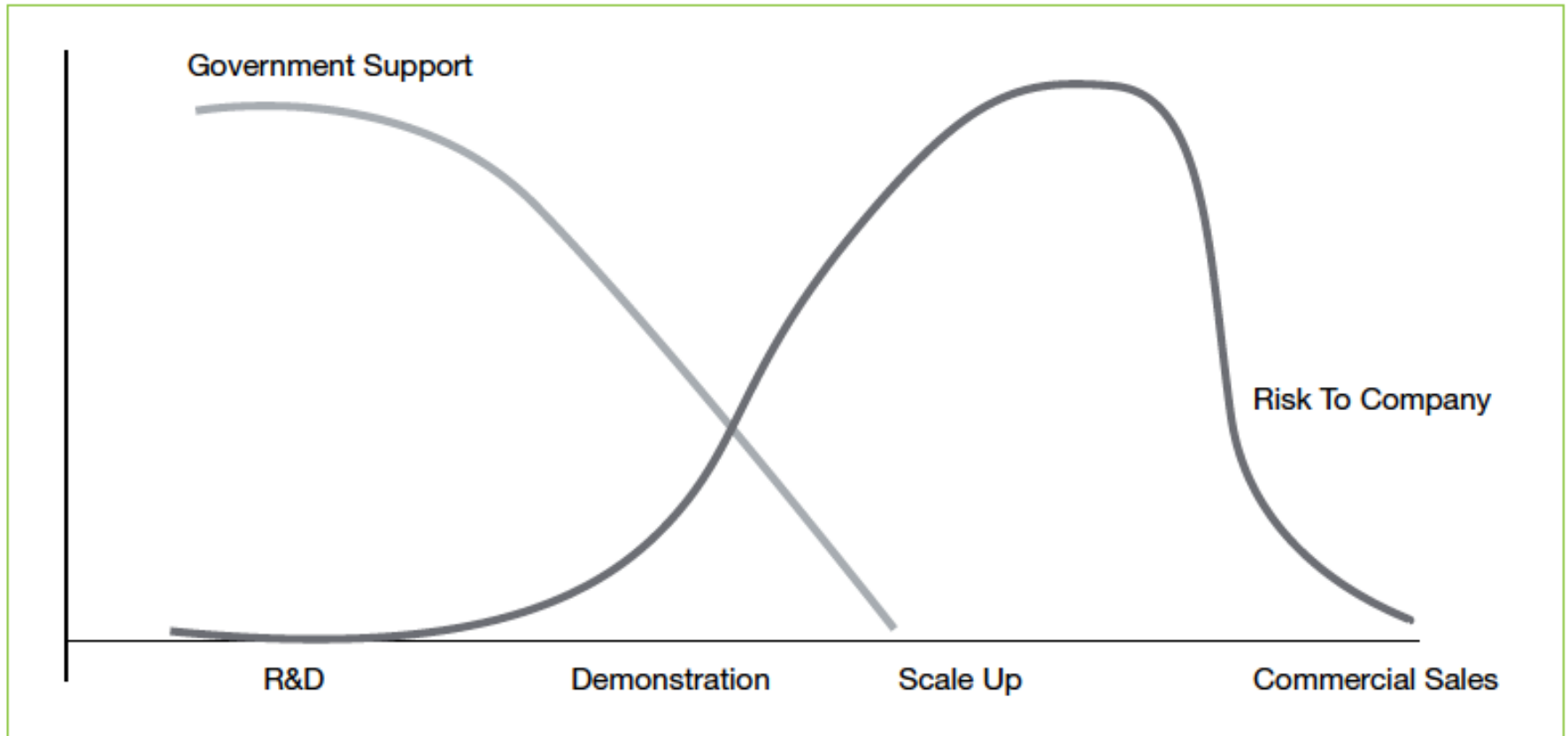
- bio-based economy cannot be achieved until the materials and products developed are sold on the market.

Projected production biobased chemicals in 2025:
>5% commodities
Almost 50% of speciality and fine chemicals
>15% polymers

Source" IB 2025, BERR 2009

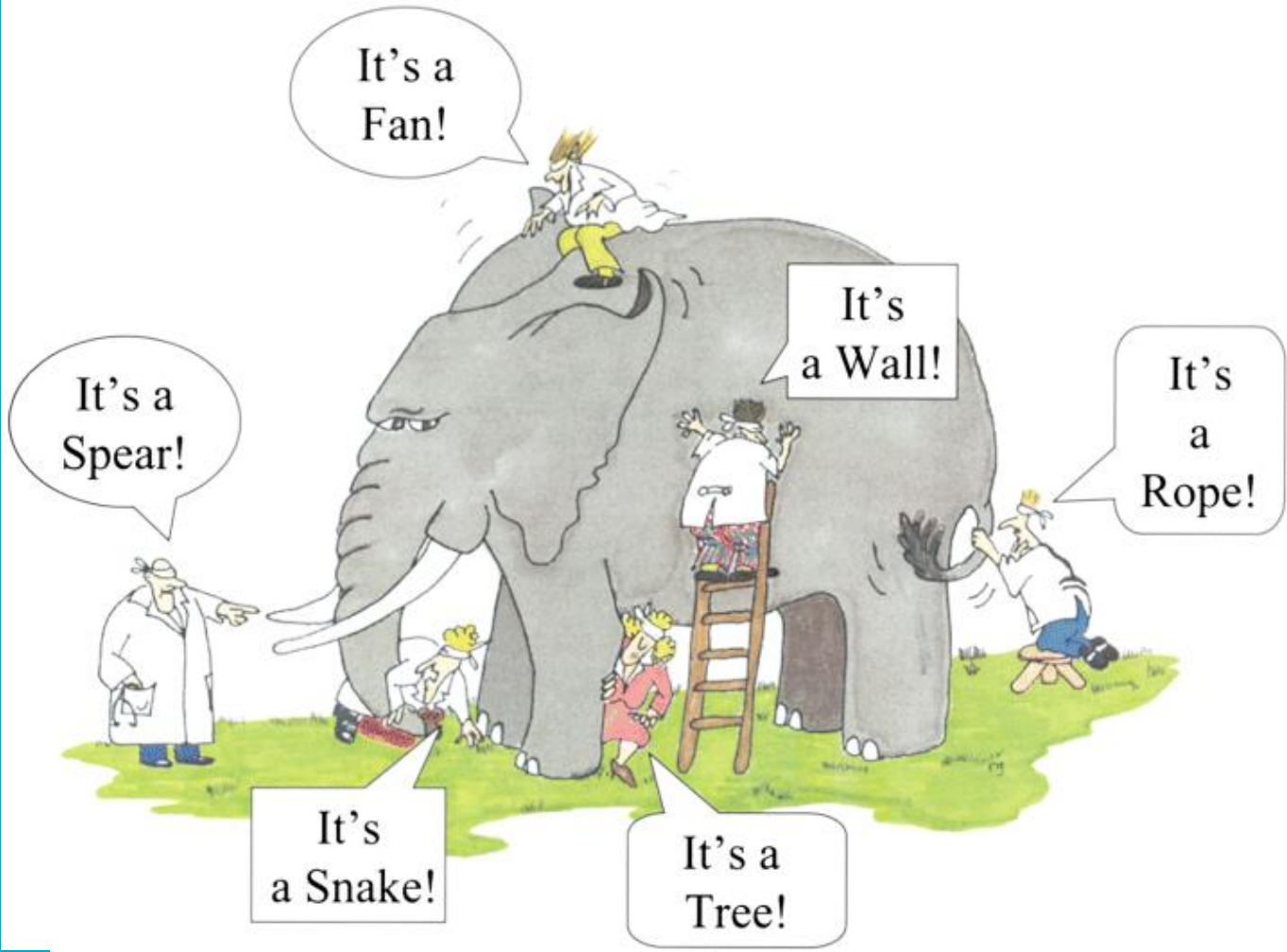
- The challenge here is also to achieve consumer awareness and a desire to contribute to switching to a bioeconomy

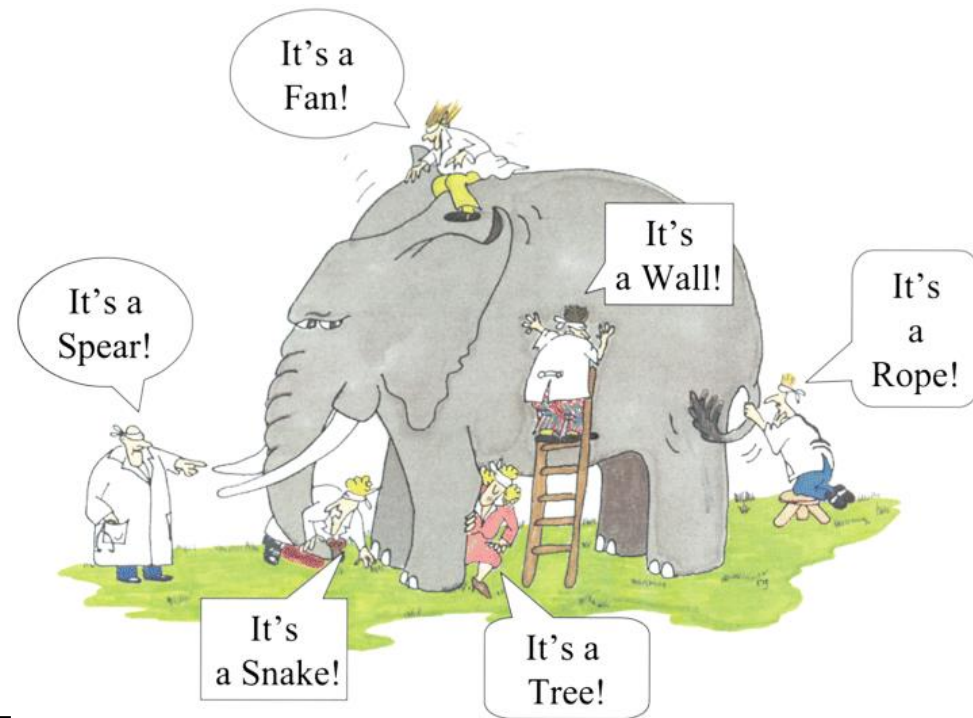
Risk profiles for companies of innovation processes



Source: DTI in COWI⁸⁸

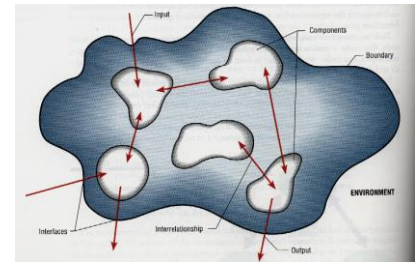
SUCH A REVOLUTION
requieres a systemic
approach





- Assess each Technology as a separate entity
- Limited integration into the larger context/system
- One element at the time
- Limited assessment of risks
- Simplified systems

Sustainable design of new industrial ecosystems will require

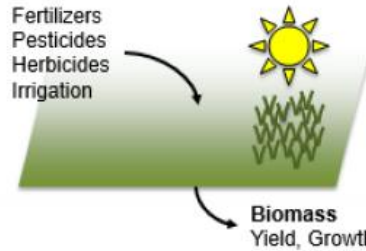


- Look at the broader picture over the life cycle
- Assess several scales and dimensions
- Recognize and integrate knowledge gaps
- Integrate risks into the assessment
- Include (local) stakeholders in decision process
- **FEEDBACK LOOPS!**

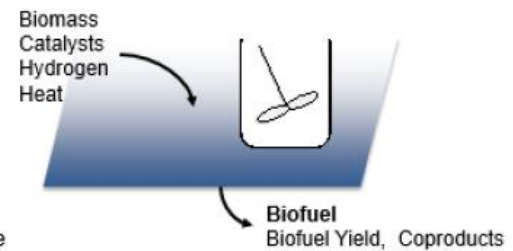
*Low Uncertainty,
Low Complexity*

Field Trials &
Lab Scale

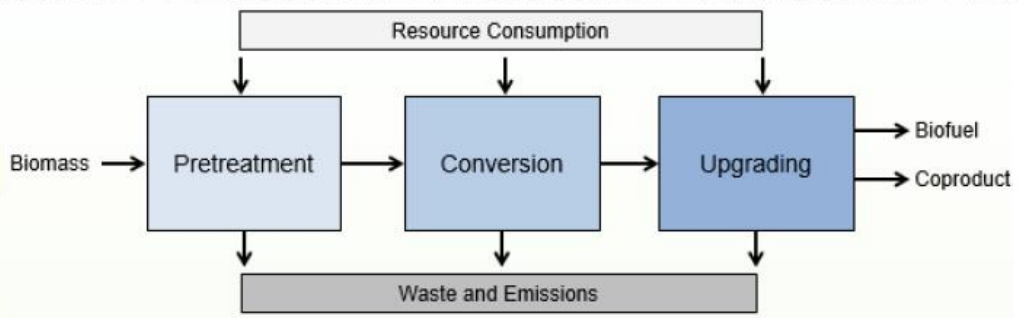
Field Trials



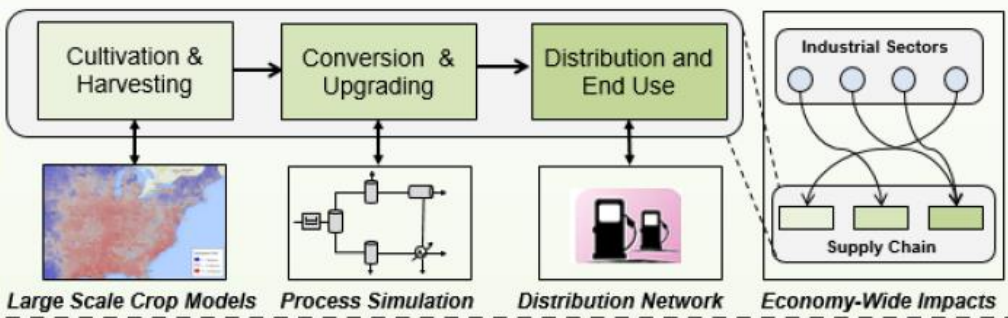
Lab Scale Experiments



Process Scale

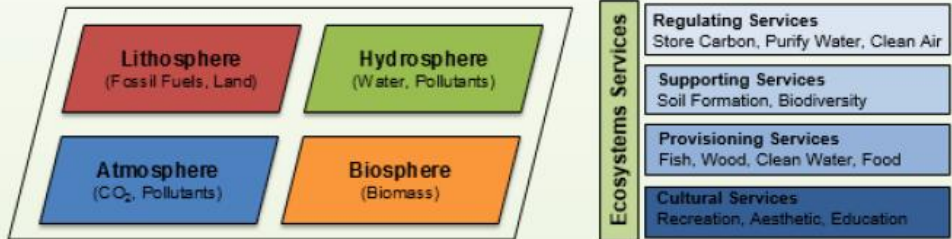


Supply Chain



Ecosystems

*High Uncertainty,
High Complexity*

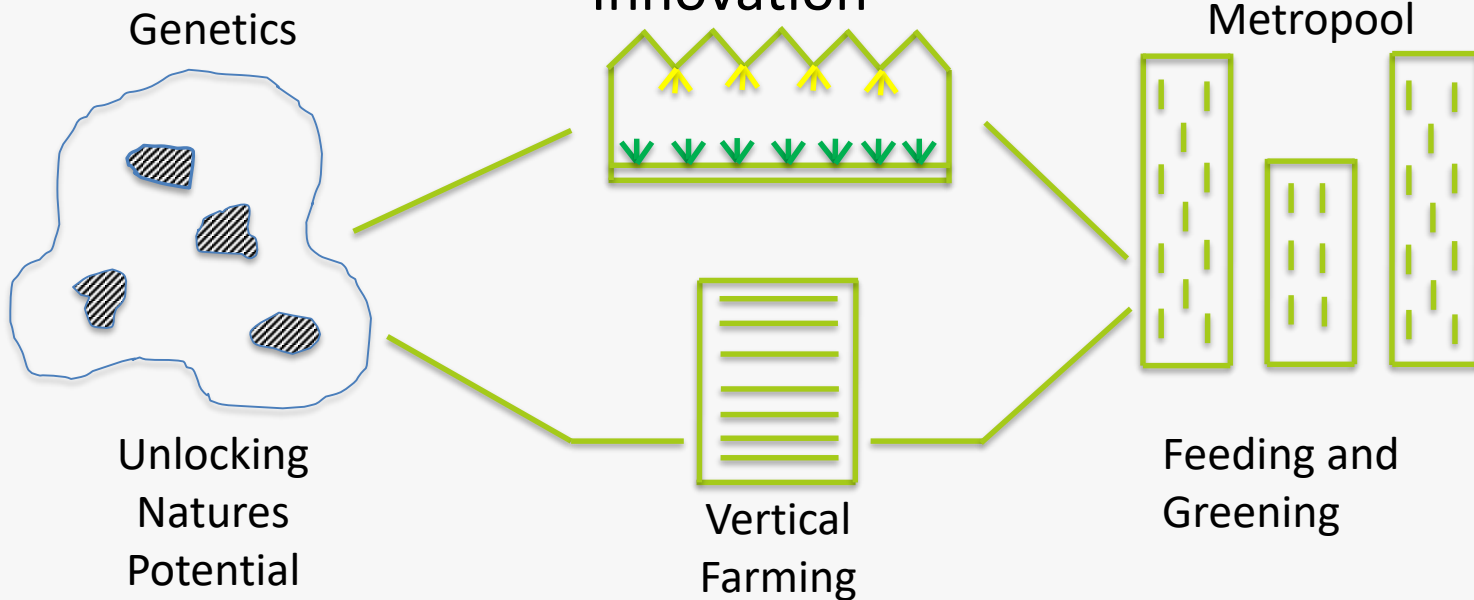


Circular Biobased Greenport

1. Optimisation

2. System

Innovation



Universiteit
Leiden
The Netherlands



Delft
University of
Technology

Erasmus
University
Rotterdam



Thanks for your attention!

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