Regional Development and Innovation in the more Diversified Industrial Future

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13.11.2014

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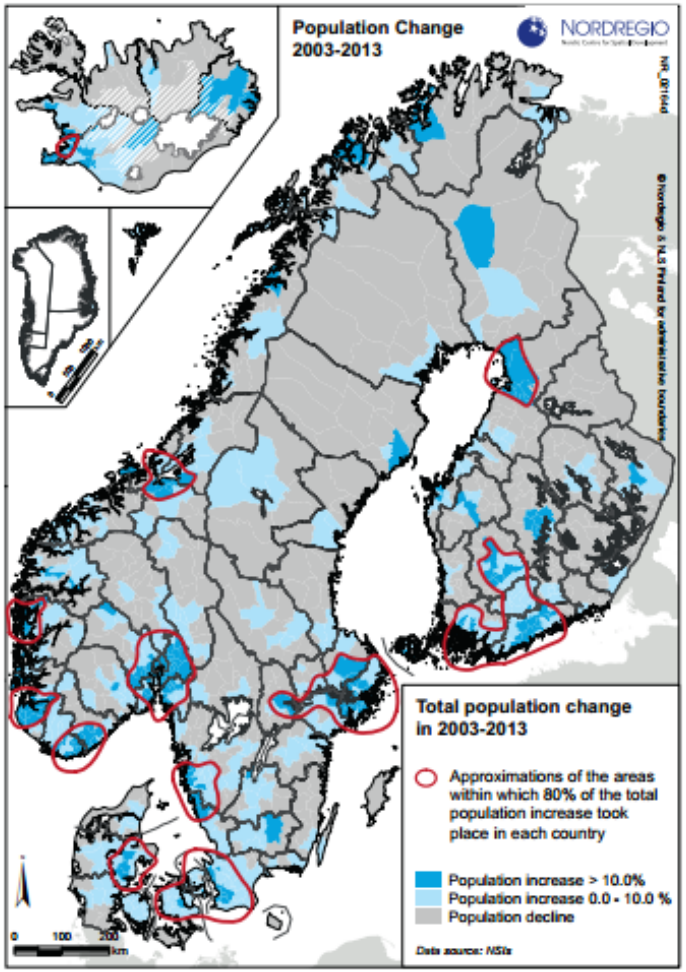
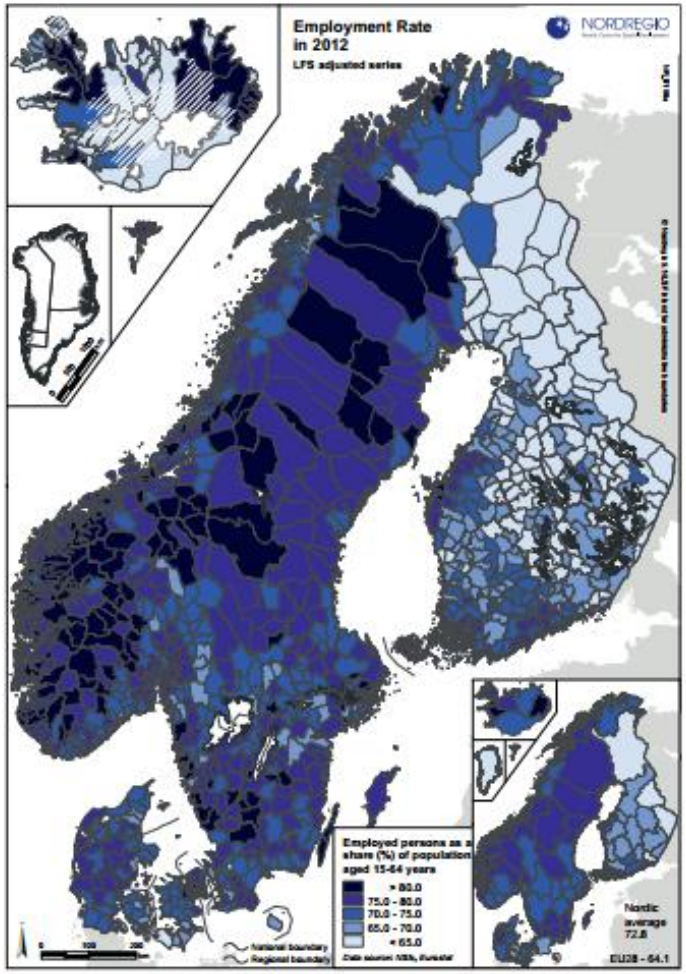
Contents

- Background information
- Bioproducts
- BCD

Population Change and Employment Rate





GDP per capita

purchasing power standards

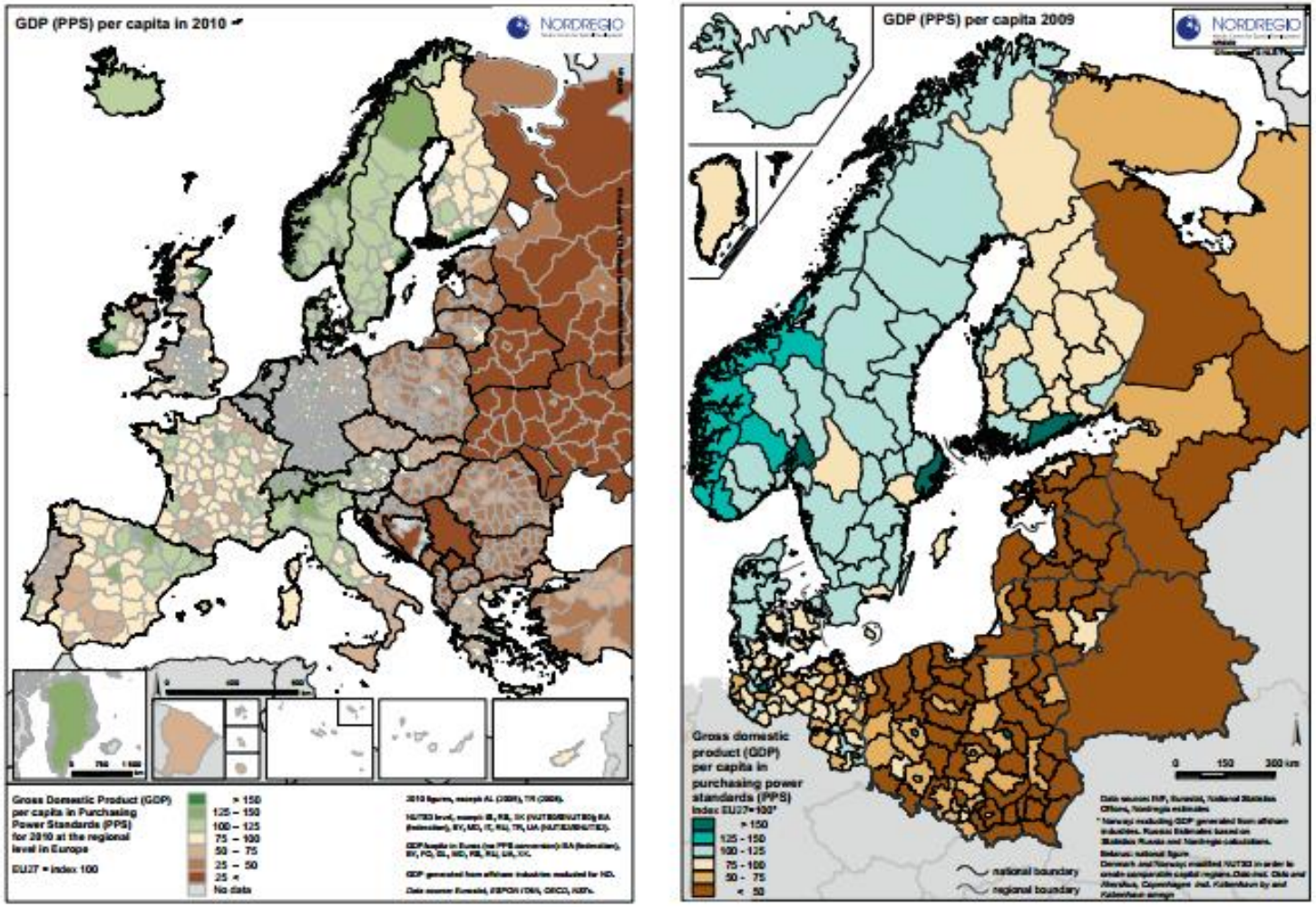
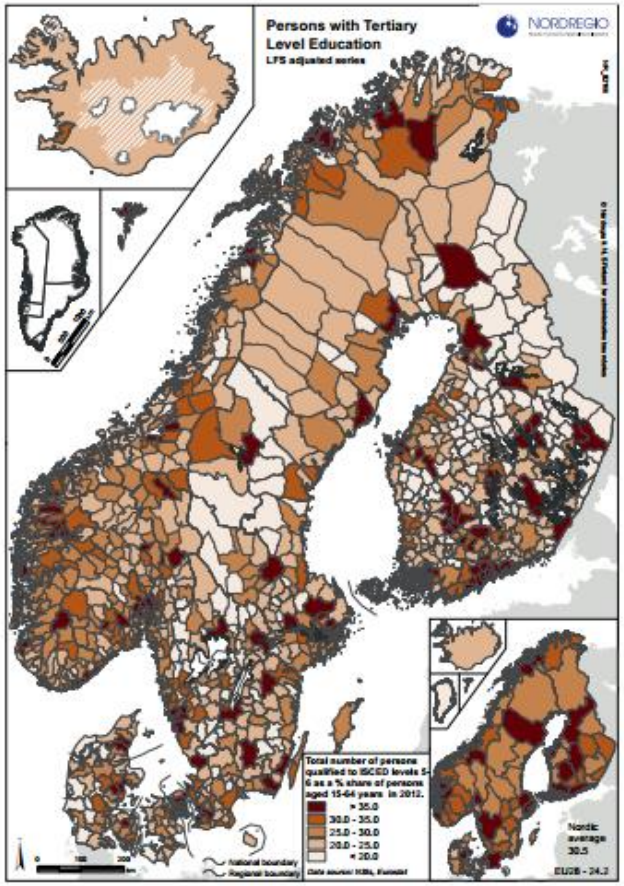
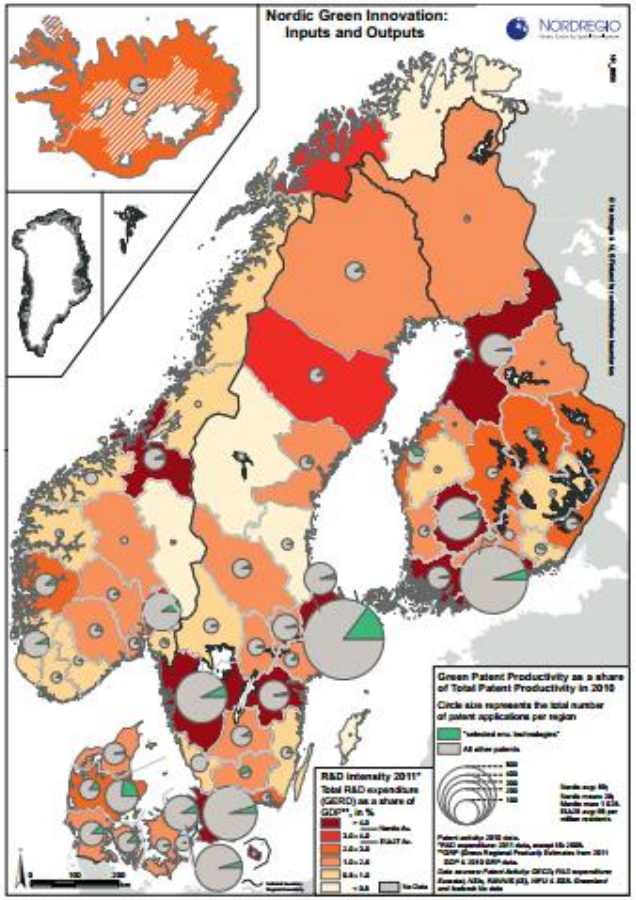


Figure 8.1 and 8.2: *GDP (purchasing power standards) per capita of the Nordic regions in a broader European (2010) and BSR (2009) context*

Persons with Tertiary Level Education
Nordic Green Innovation

R&D Intensity,% and Green Patent Productivity versus Total

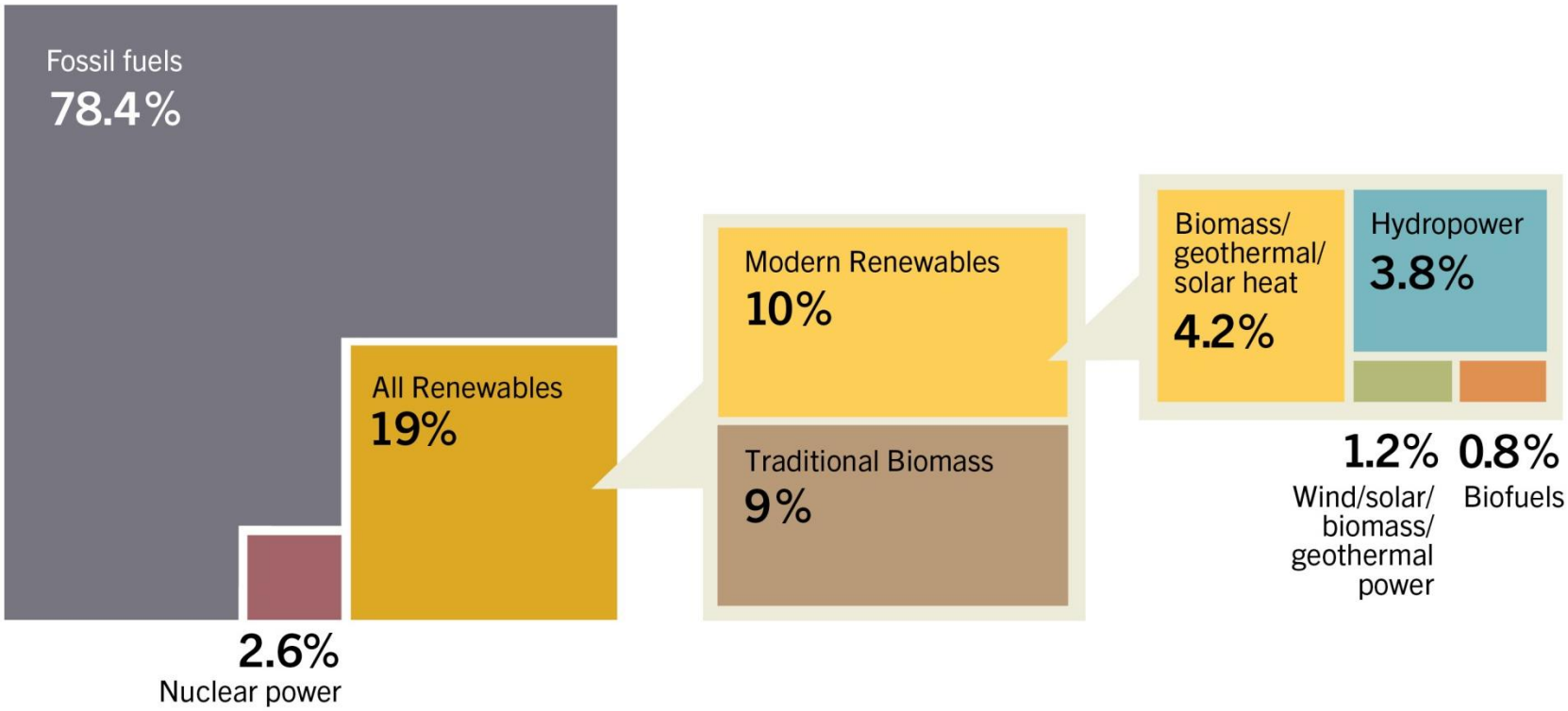




OECD Ministerial Council Meeting Statement on Climate Change, 6 May 2014

- Reinforcing our existing efforts and using the OECD's research and evidence-based analysis, including under the **OECD's Green Growth Strategy**, to help us to pursue ambitious and cost-effective policies with a view to doing our part to **limit effectively the increase in global temperature below 2ºC above pre-industrial levels** and simultaneously supporting the recovery from the economic and financial crisis, including by:
- investing in public research and fostering a **strong business climate for new technologies and innovations**;
- better aligning investment and climate policies to support an effective partnership among governments, development partners, and the private sector in order **to incentivise private investment in low-carbon and climate-resilient infrastructure**;
- Achieving the developed countries' goal **to jointly mobilise USD 100 billion per year by 2020** from a wide variety of sources...

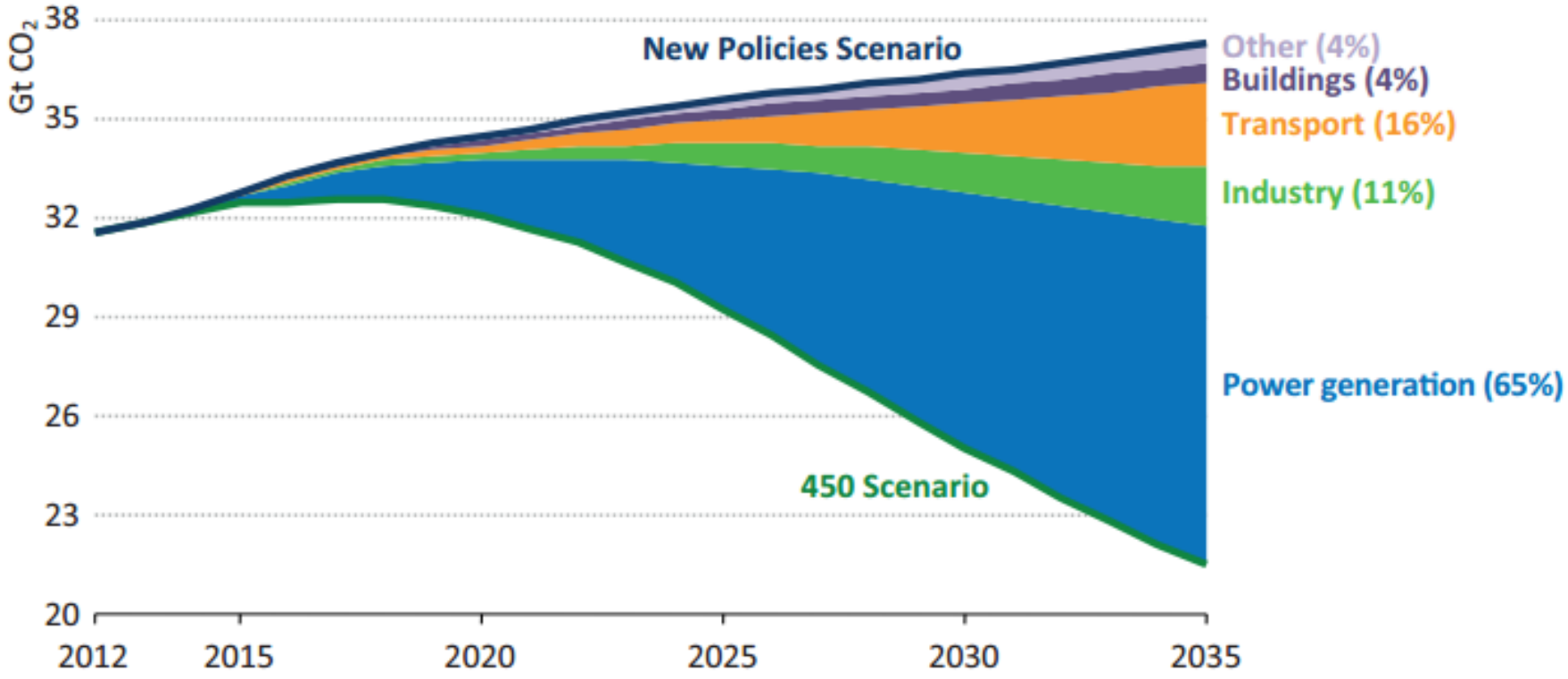
Estimated Renewable Energy Share of Global Final Energy Consumption, 2012



REN21. 2014. *Renewables 2014 Global Status Report* (Paris: REN21 Secretariat).

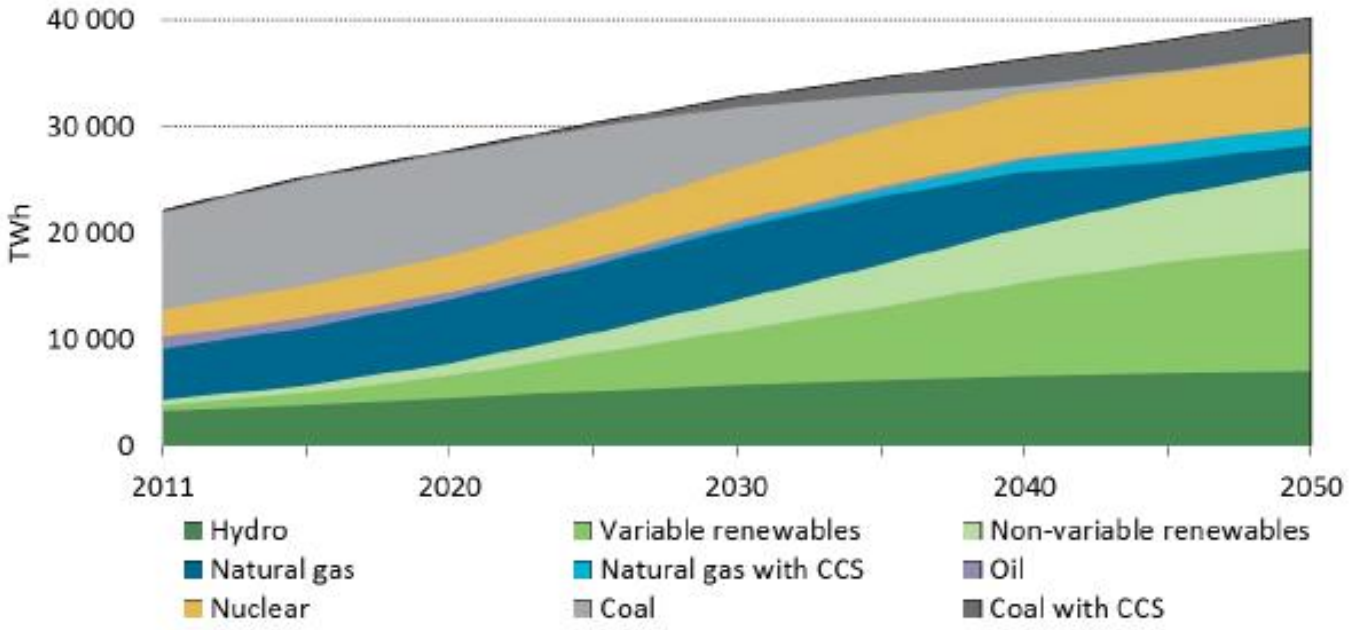
REN21 Renewable Energy Policy Network for the 21st Century

World energy-related CO2 emissions by scenario



Note: Share of savings by sector in 2035 denoted in brackets.

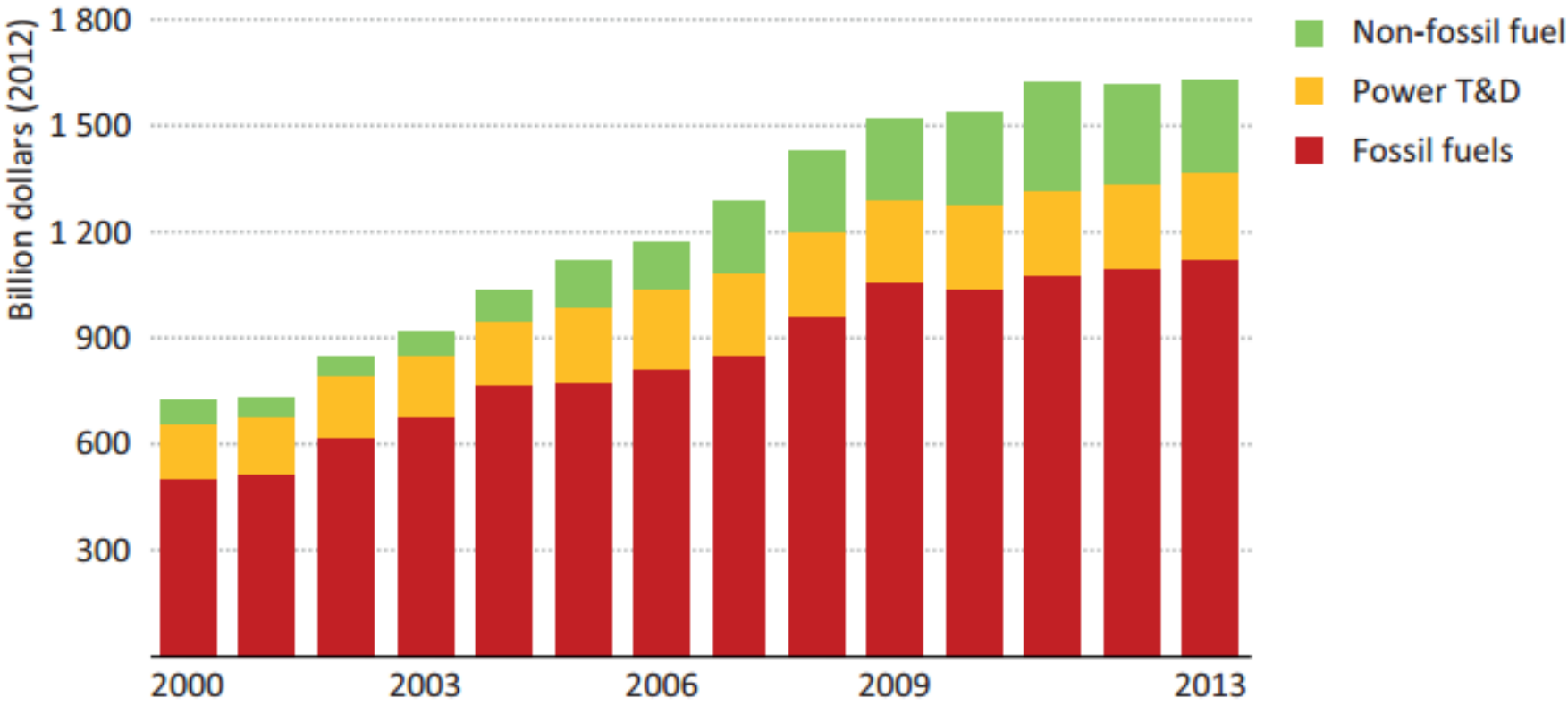
Electricity Generation: a Share Reversal



- Generation today:
  - Fossil fuels: 68%
  - Renewables: 20%
- Generation 2DS 2050:
  - Renewables: 65%
  - Fossil fuels: 20%

International Energy Agency

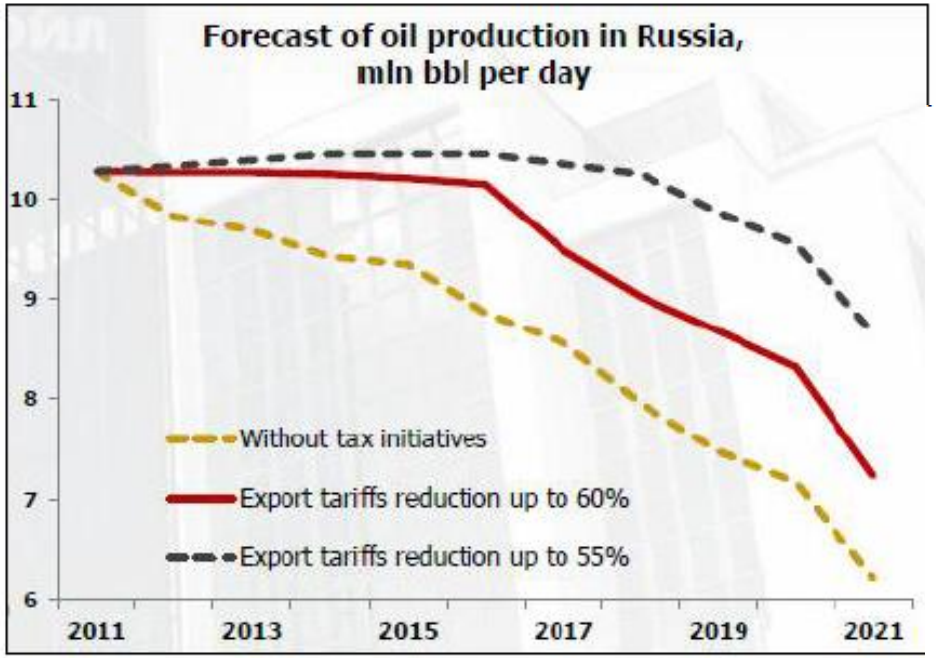
Investment in Global Energy Supply by Fossil and Non-fossil Fuel and Power T&D

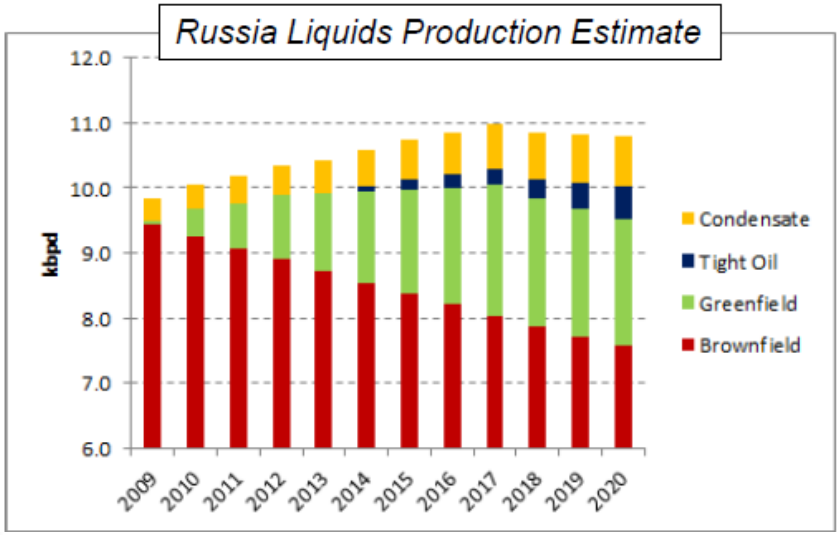


Notes: Non-fossil fuel includes all renewable technologies, nuclear and biofuels. Power T&D is transmission and distribution for the power sector: this cannot be assigned to either fossil-fuel or non-fossil fuel use.

http://www.iea.org/publications/freepublications/publication/weio2014.pdf

Example: Fossil Oil Resources in Russia





Lukoil

New Consortia and Value Chains for Bioproducts

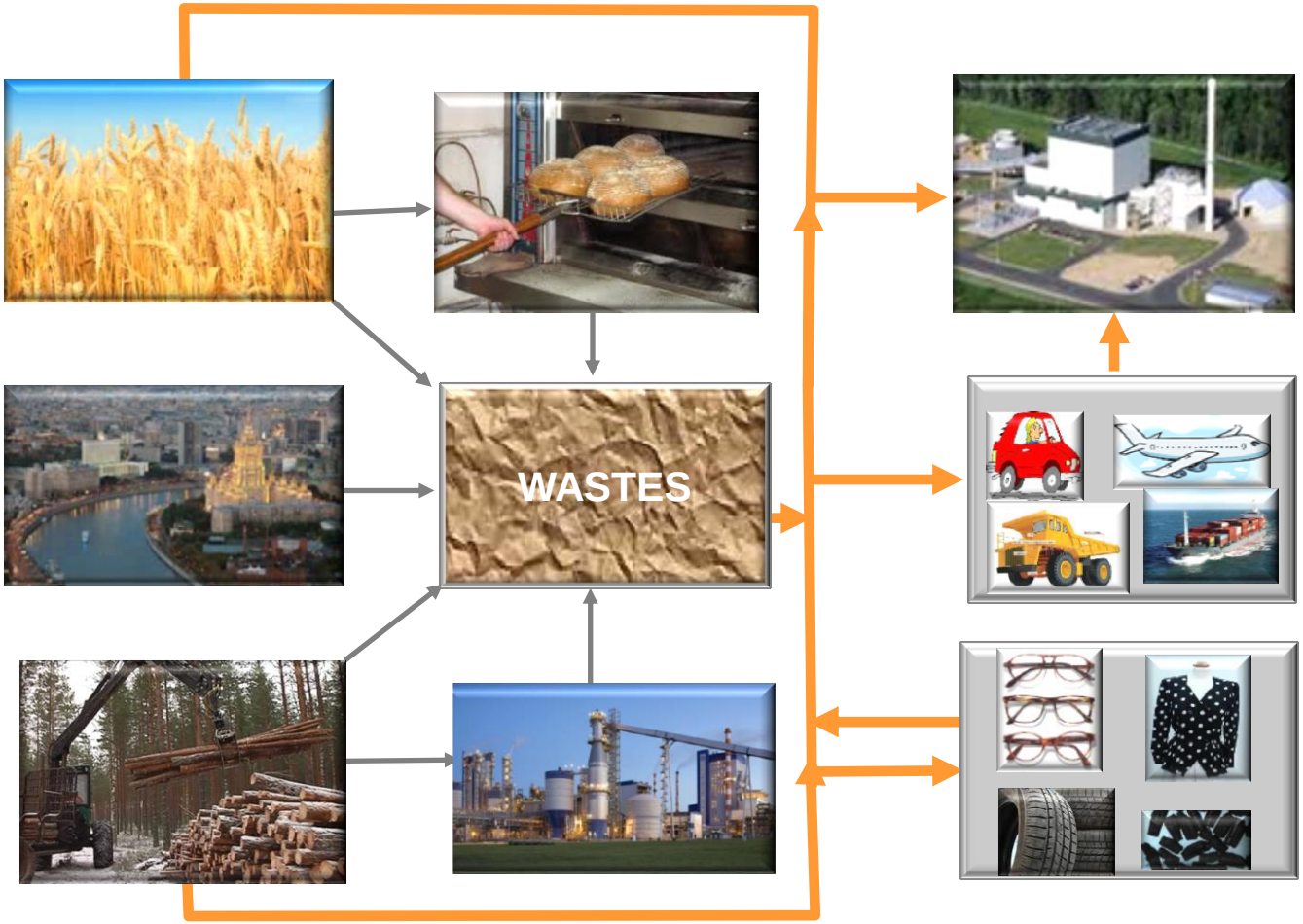
Raw material producers, different industries, machine constructors, traffic companies, funders participate in the development

VC

European Investment Bank

zymes

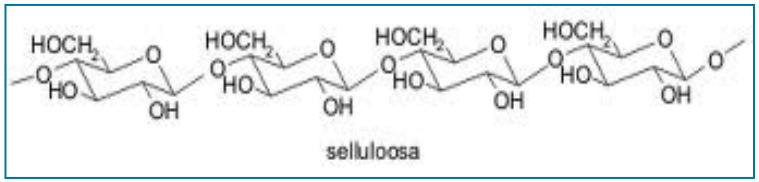
Competition for Raw Material



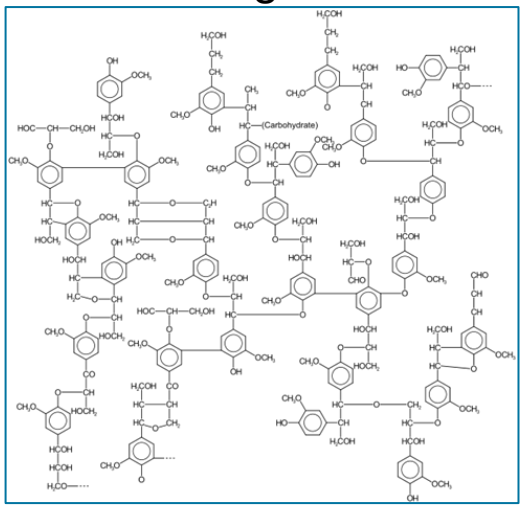
Lignocellulose ?

- Plant dry matter, biomass, is called lignocellulosic biomass.
- It is the most abundantly available raw material on the Earth for the production of biofuels. Cellulose and hemicellulose are built from sugars and can be hydrolyzed back to sugars. Lignin functions as glue in wood.

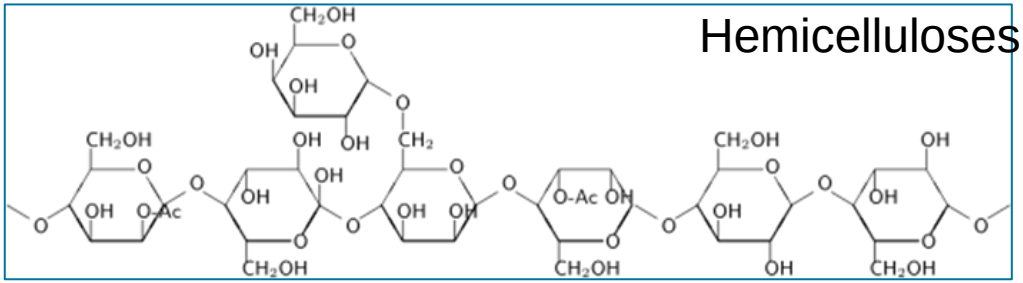
Cellulose



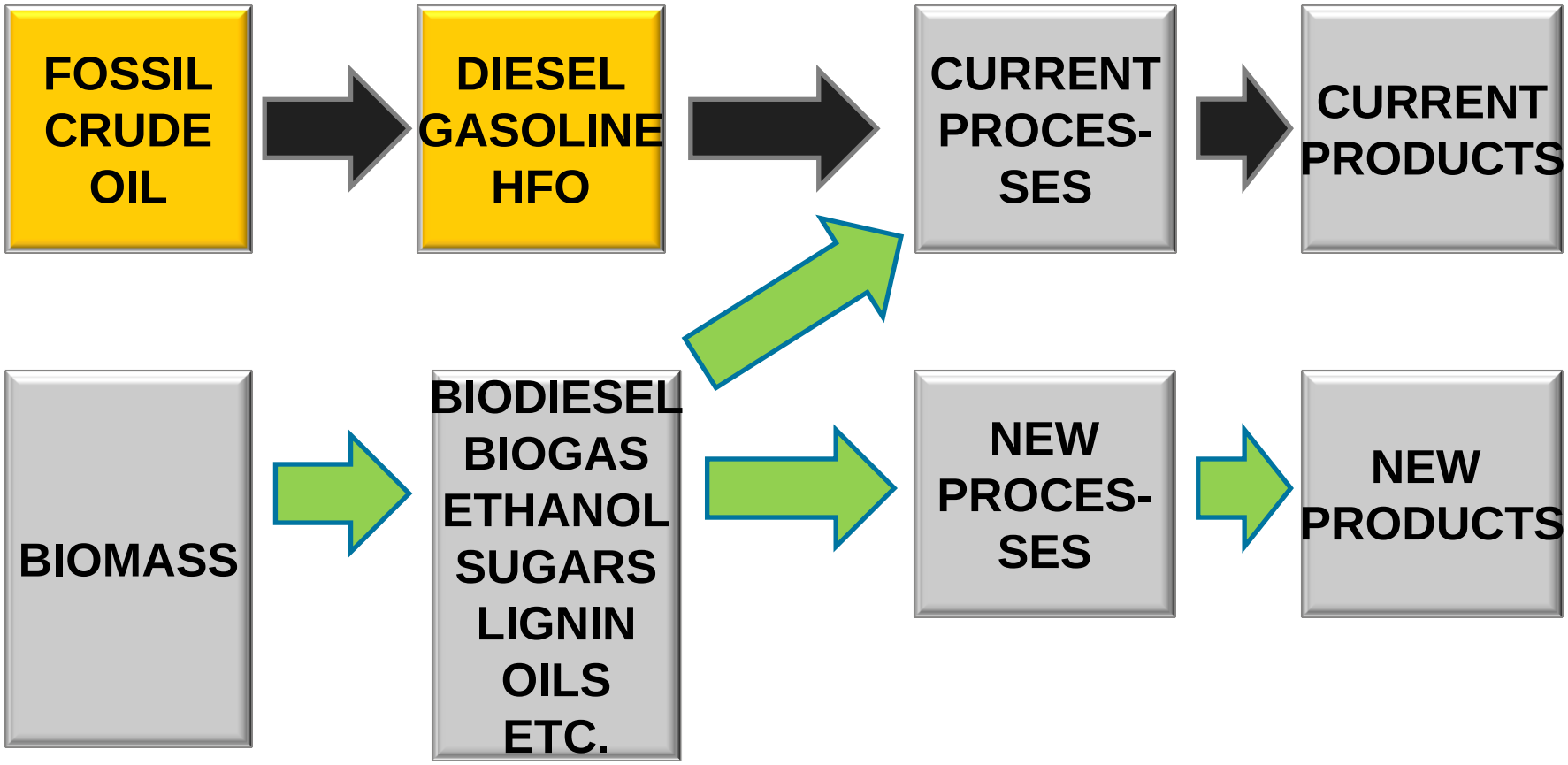
Lignin



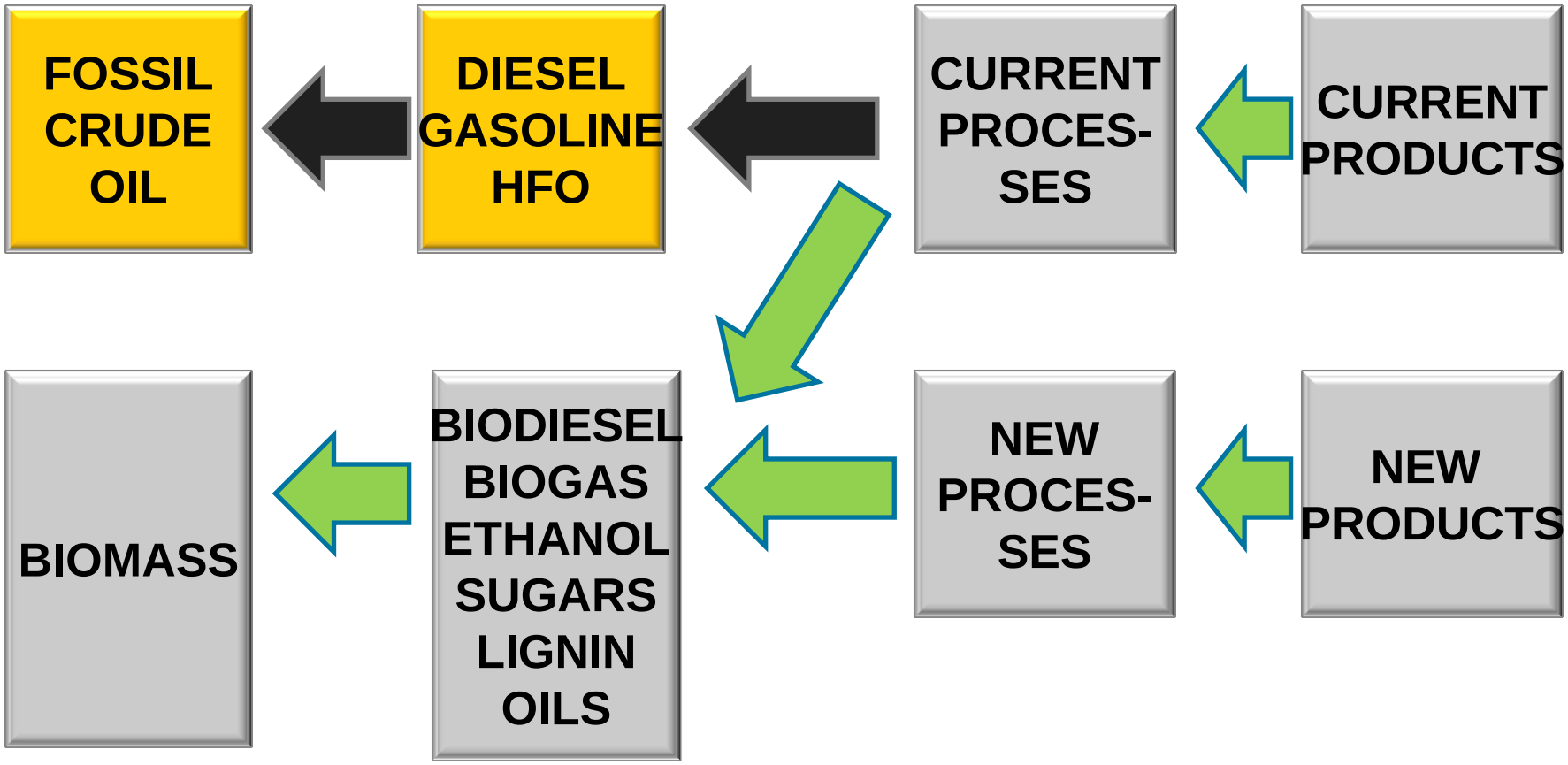
Hemicelluloses



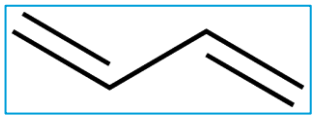
Towards Biobased Products



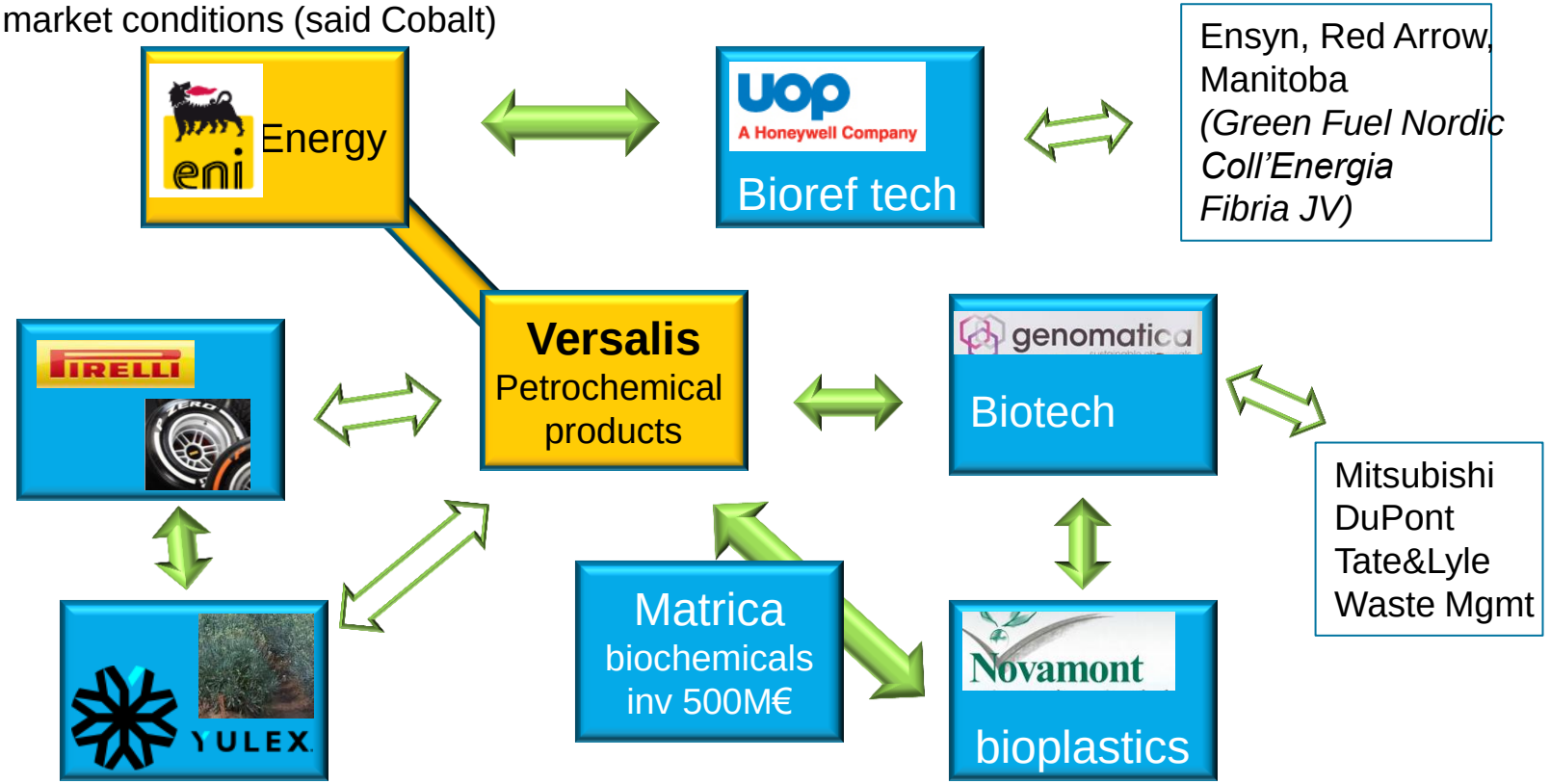
Towards Biobased Products



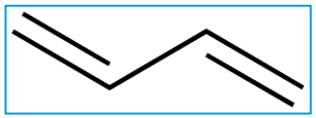
Example: JV's for Biobased Butadiene (C_4H_6)



- Raw material for rubber for tires, electrical appliances, footwear, plastics, asphalt modifiers, additives for lubricating oil, pipes, building components, and latex
- Biomass-to-butadiene path can be highly competitive with petroleum-based butadiene under current market conditions (said Cobalt)



Butadiene Markets
2011: 10,5 Mt / 40 BUSD

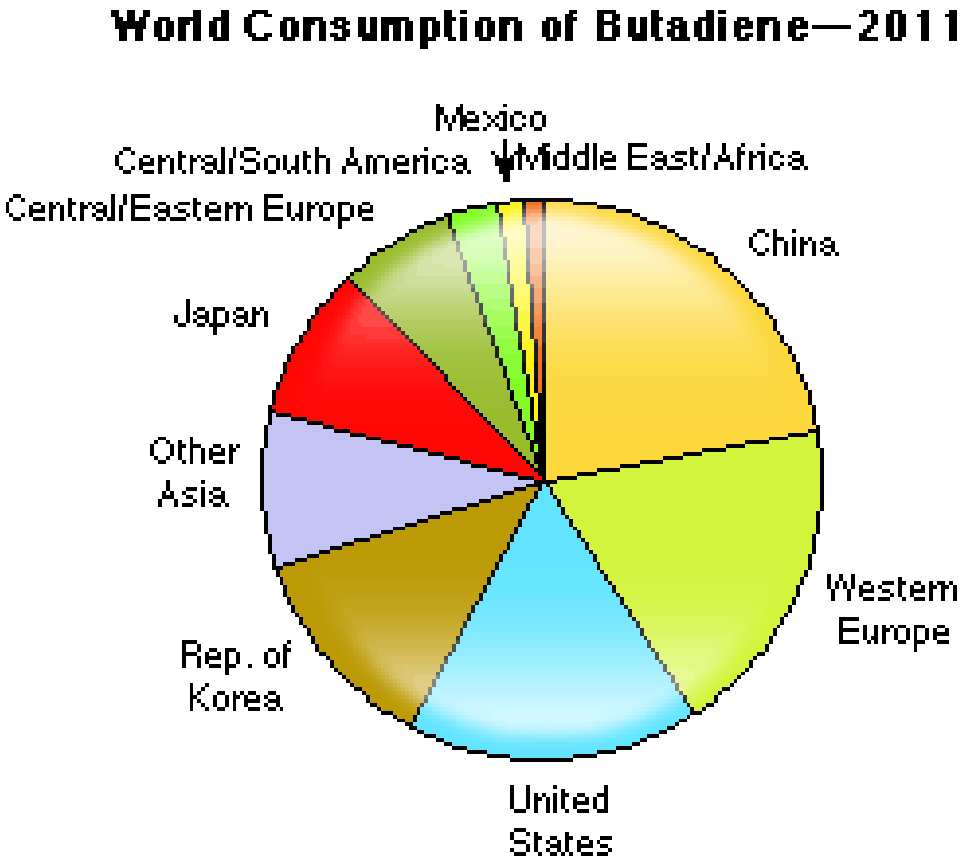


Elastomers (rubber),
60-65%, 4-6% CAGR

- Tires
- Nitrile rubber hoses
- Mechanical belts
- Carpet backing
- Footwear
- Neoprene products

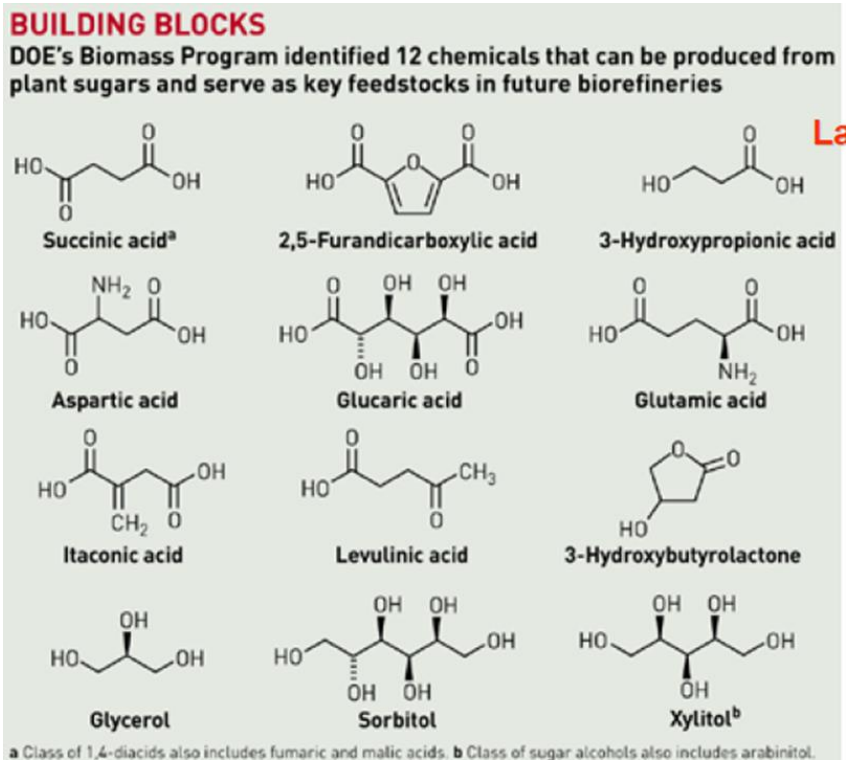
Plastics

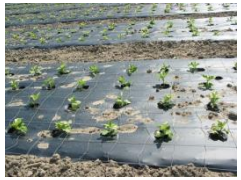
- ABS resins, 5-6% growth



Products on the Way to Biobased

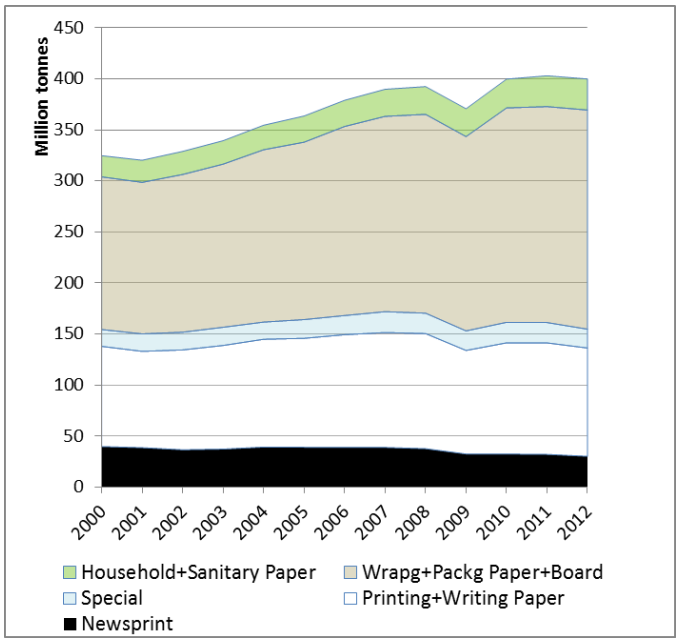
- Biofuels for cars, ships, airplanes
- Biogas for coal fired power plants and transportation
- Simple chemicals like
  - Sugars and the chemicals derived thereof
  - Nitrogen nutrient (natural gas)
  - Butadiene for rubber (fossil oil)
  - Lignin and the chemicals derived thereof
- Plastics
  - PE, PLA, PGA,PHA, PHB, PA etc.
- Rubber
- Active carbon
- Carbon fibre



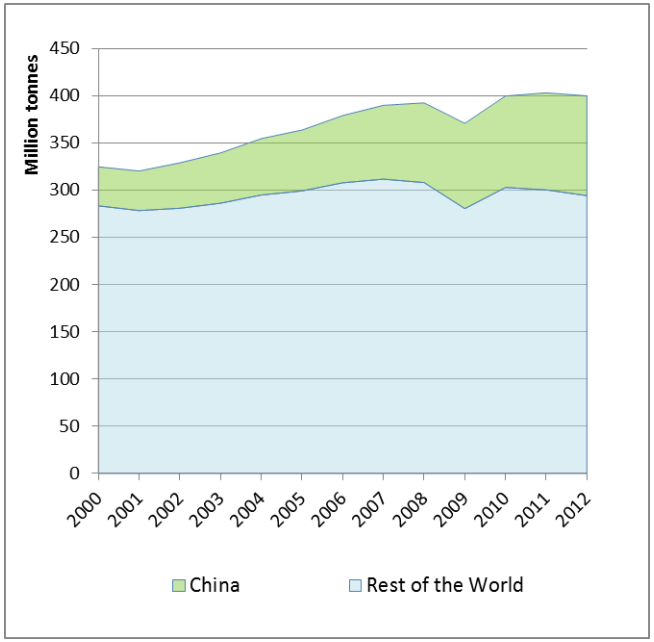



Global Paper Market 2000-2012

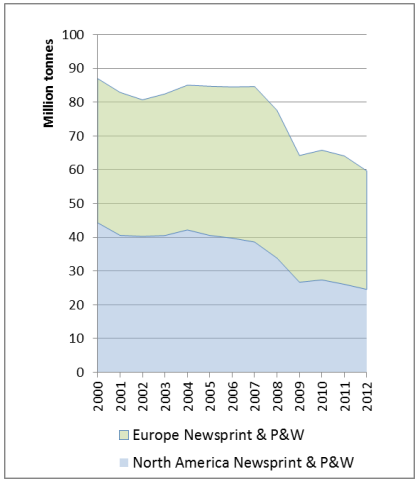
Consumption by grade



China vs Rest of the World

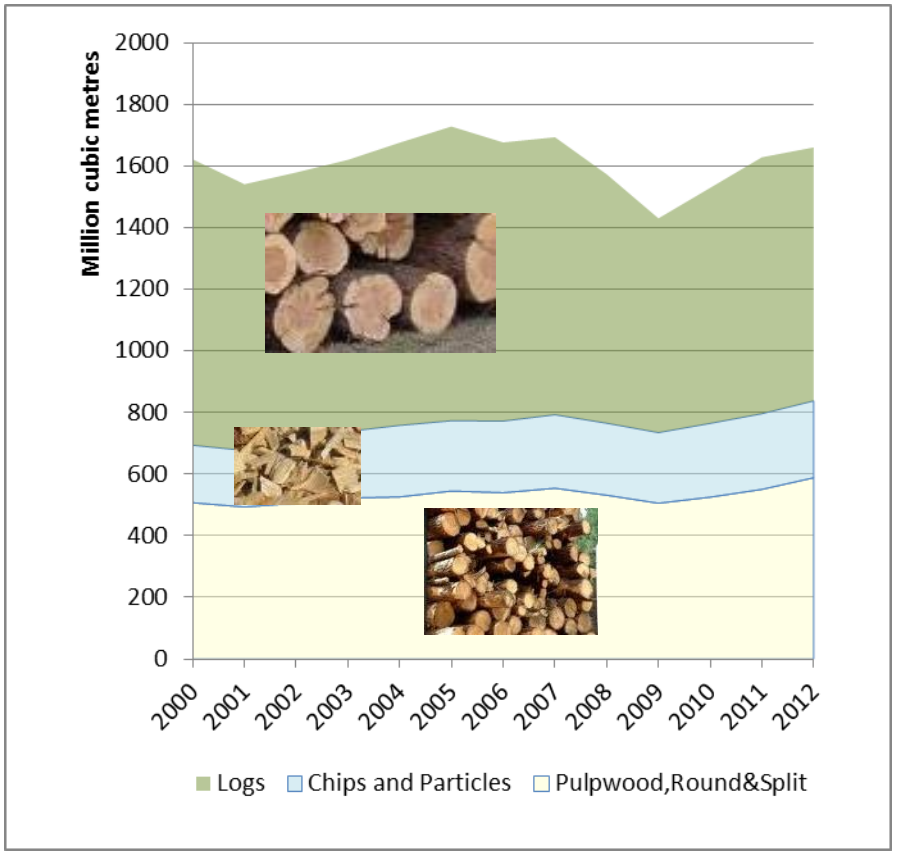


Newsprint and Printing & Writing in North America and Europe

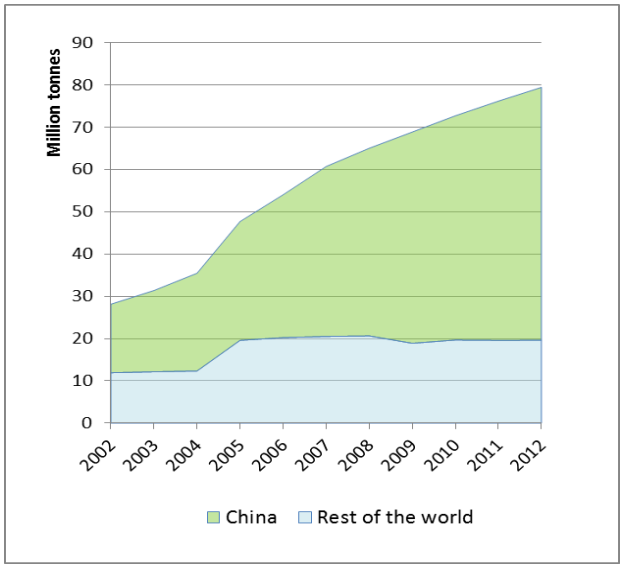


Global Forest Industry Raw Material Basis

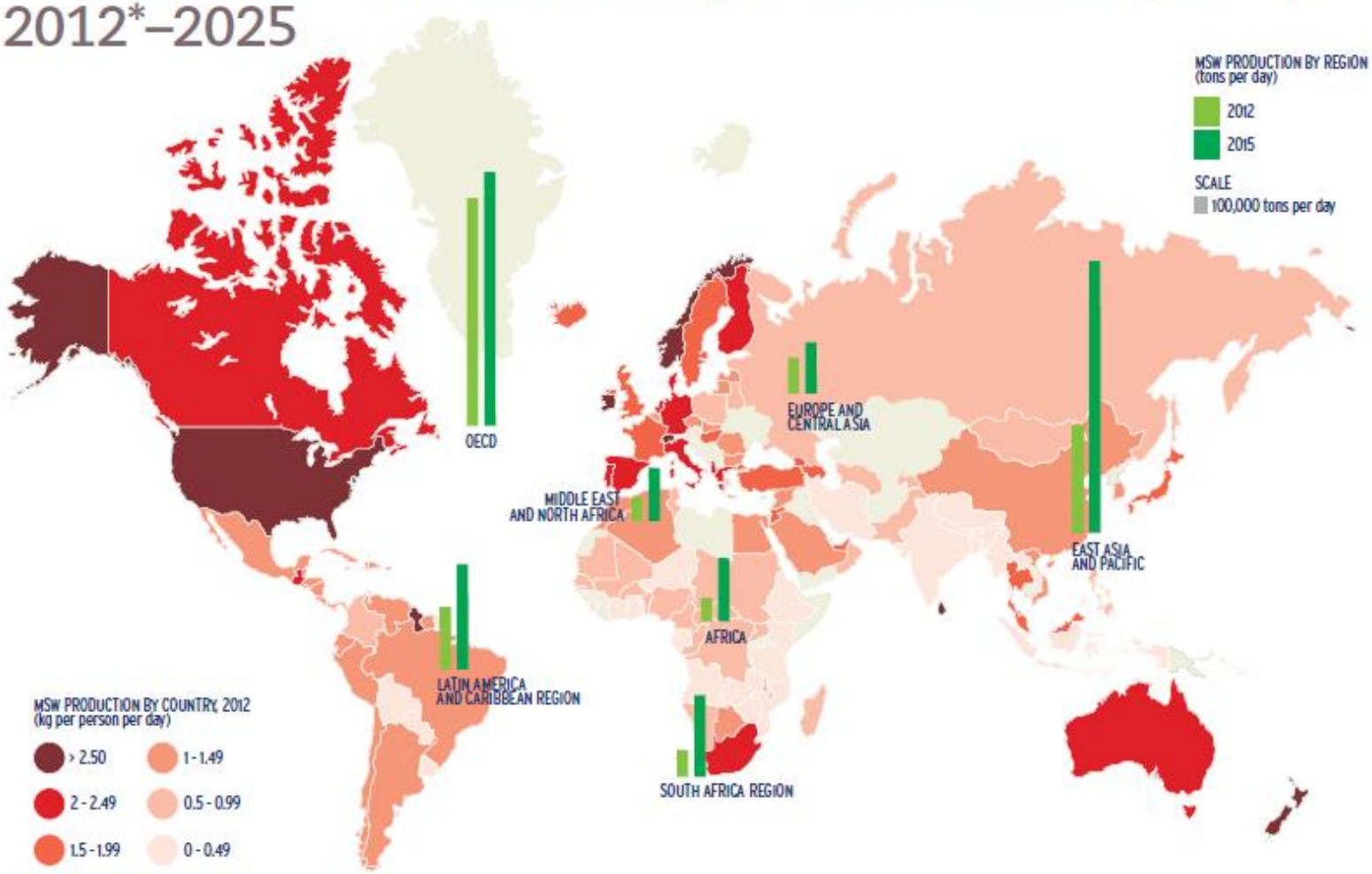
Industrial Roundwood consumption



Recovered Fibre Pulp
Calculation: 1 tonne recovered fibre pulp for ~ 2,5-5 m^3 of wood

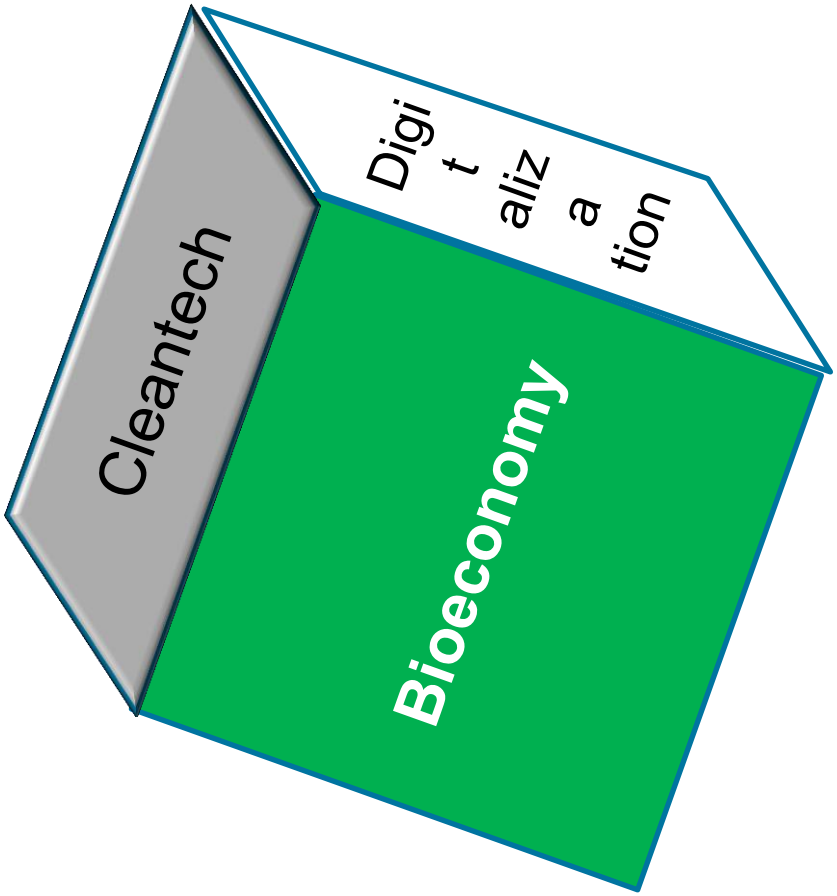


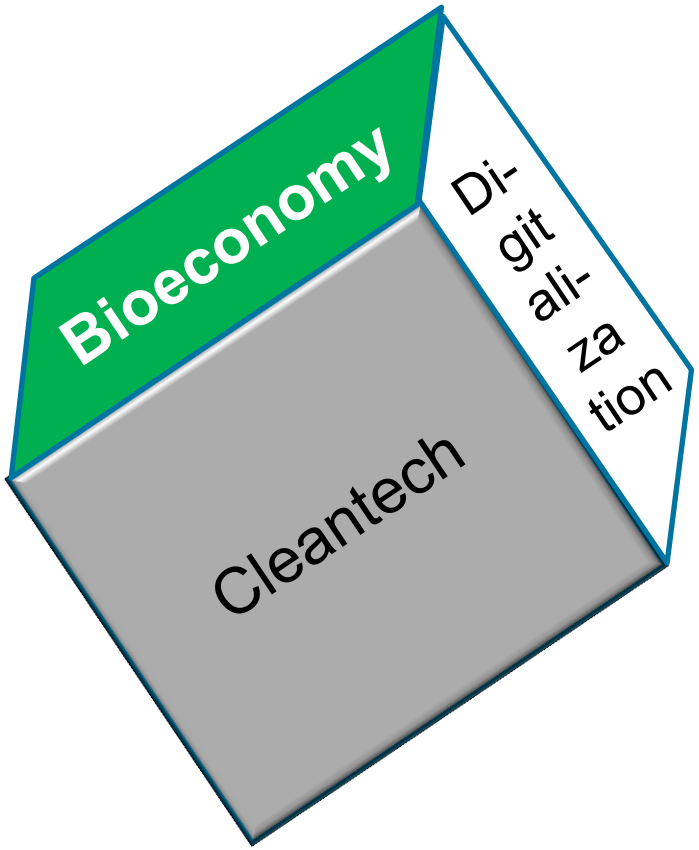
World production of Municipal Solid Waste (MSW), 2012*–2025



Source: The Economist, 2012

The Finnish Way





Energy and Environment (Cleantech) R&D in Finland since 2008

€ 200 M/a from Tekes

+

>€ 800 M/a from companies

=

> € 1 B/a

Governmental Strategic Programmes

Primary actions

1. BCD up to a top theme of the country brand
2. Advancing investments
3. Creating demonstration environments
4. Strengthening competitive
   operation environment

Targets

- Cleantech

  2012
  - Revenue* 25 B€

  → 2020
  50 B€
  40 000 new jobs

- Bioeconomy

  2012
  - Output 60 B€

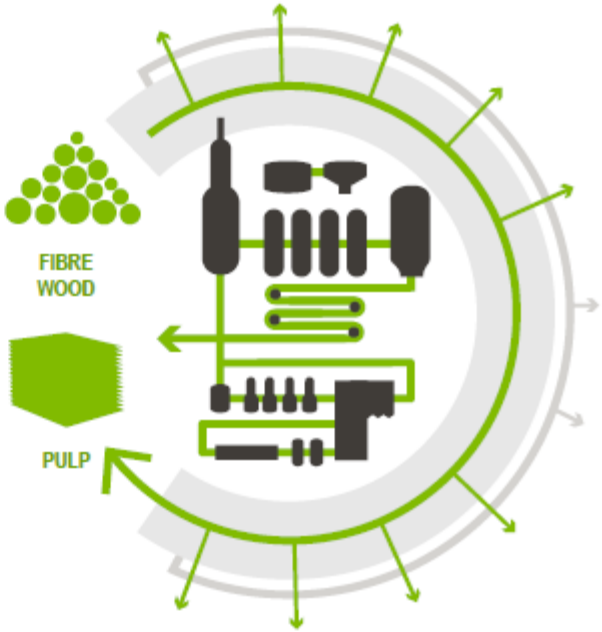
  → 2025
  100 B€
  100 000 new jobs

- Digitalization TBA

* Numbers do not include energy- or forest industry

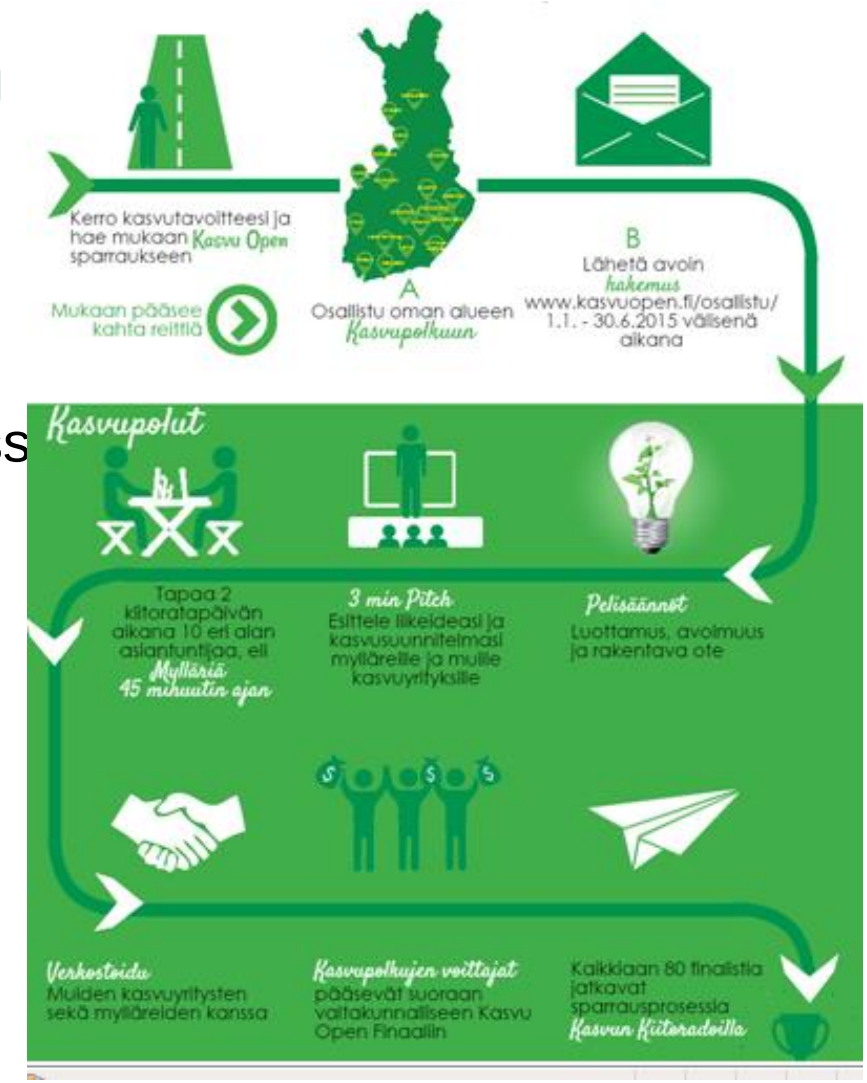
Bio-product mill – more than a traditional pulp mill

- Wood is refined into bio-materials, bio-energy, bio-chemicals and fertilizers sustainably and with great resource efficiency
- The mill will not use fossil fuels
- Energy efficiency will be emphasized when choosing equipment and machinery
- The operating model will be based on an efficient partner network
  - Creates opportunities especially for small and medium-sized enterprises to produce innovative bio-products with high added value



KasvuOpen 2015: Runway for the Growth

1. Present your growth target
2. Participate regionally
3. Apply
4. Rules of the game: trust, openness constructive
5. Pitch
6. Meet 10 specialists in 45 min
7. Network
8. Winners will participate in the statewide KasvuOpen Final
9. 80 finalists will continue the process



Climate Leadership Council

Vision 2030

Forerunner companies are leading other companies and organisations with their example to move towards operations that lead to carbon-neutrality and sustainable use of natural resources, both in Finland and abroad. They have succeeded in creating competitive solutions to global environmental challenges.

Strategy

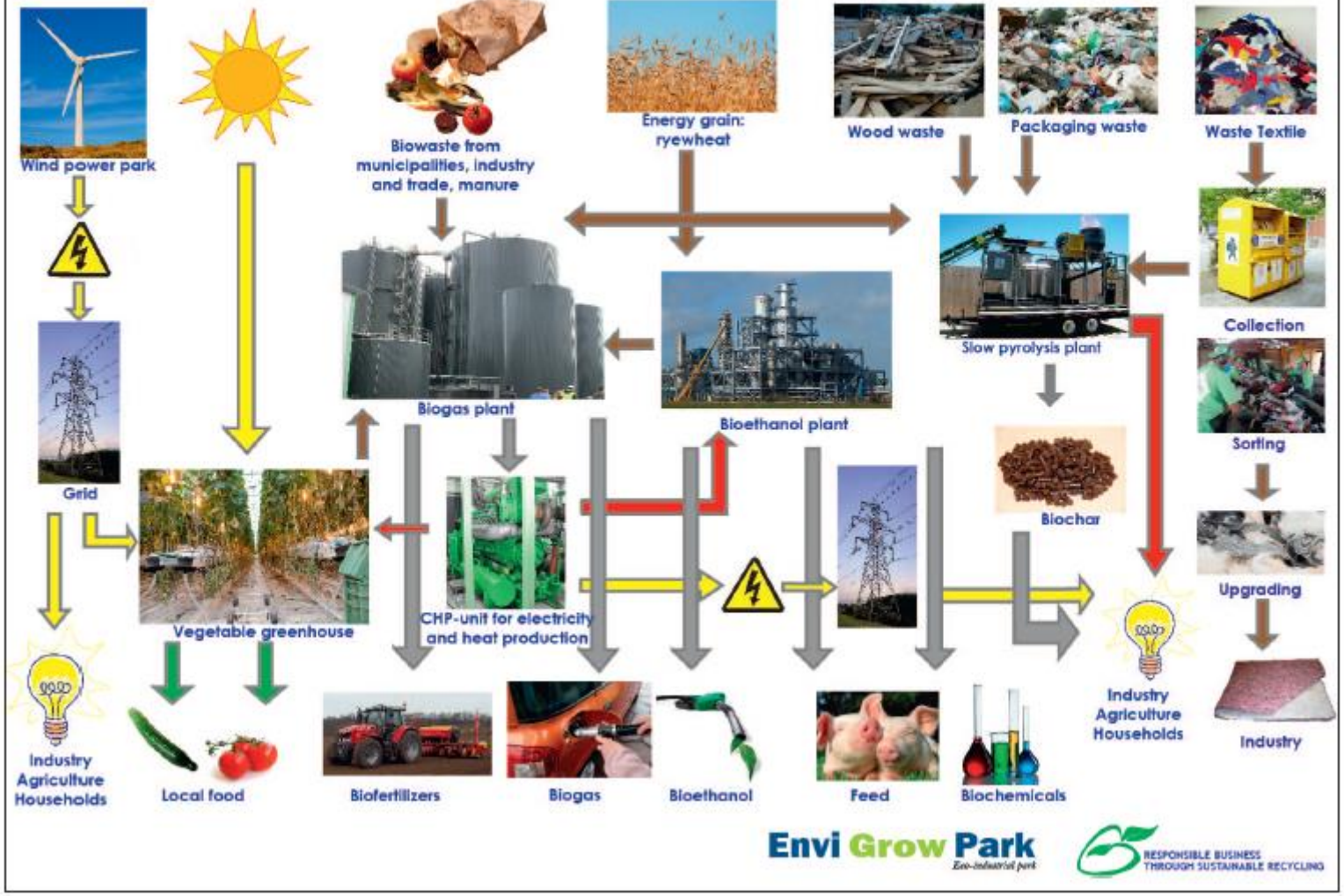
The members of the Council are systematically developing their operations / actions, thereby encouraging other organisations, communities and decision-makers to join. The Council is also collecting best practices and sharing information.

Each year, the Council selects a few significant common projects to develop and promote.

Envi Grow Park - eco industrial park

business from the bioeconomy innovations

Brightgreen
Forssa region



Honkajoki / Kirkkokallio

Organic products

Bio degradable packaging

Bio-CHP

Organic waste from animal industries

Non gluteinic

Green automation

Netled lights

Toholampi

New clients

District heating

Valio

New clients

Pramia Plastic

New CHP

Bio gas

planned

Own fuels

Chip terminal

planned

Own peat

Own forests

Chip conve rting

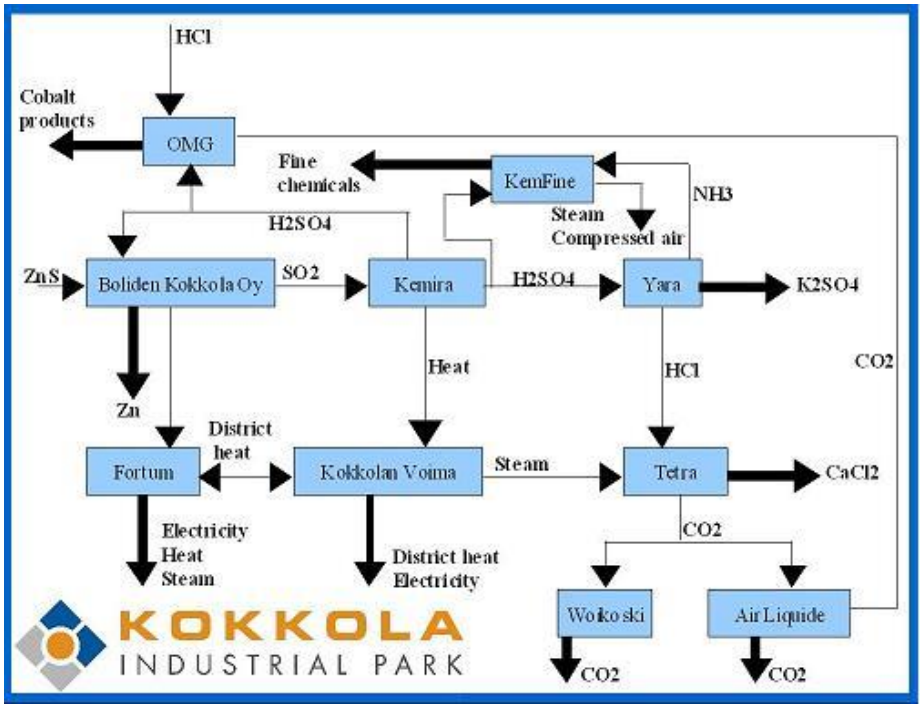
planned

KIP Kokkola Industrial Park

Sulphuric acid / Boliden (ex Kemira)
Calcium chloride / TETRA Chemicals
Hydrochloric acid / TETRA Chemicals
Potassium sulphate / Yara
Phosphoric acid / Yara
Limestone / Nordkalk
Carbon dioxide / Polargas / Woikoski
Ammonia / Yara
Cobalt products / Freeport Cobalt Oy (before OMG)
Zinc / Boliden

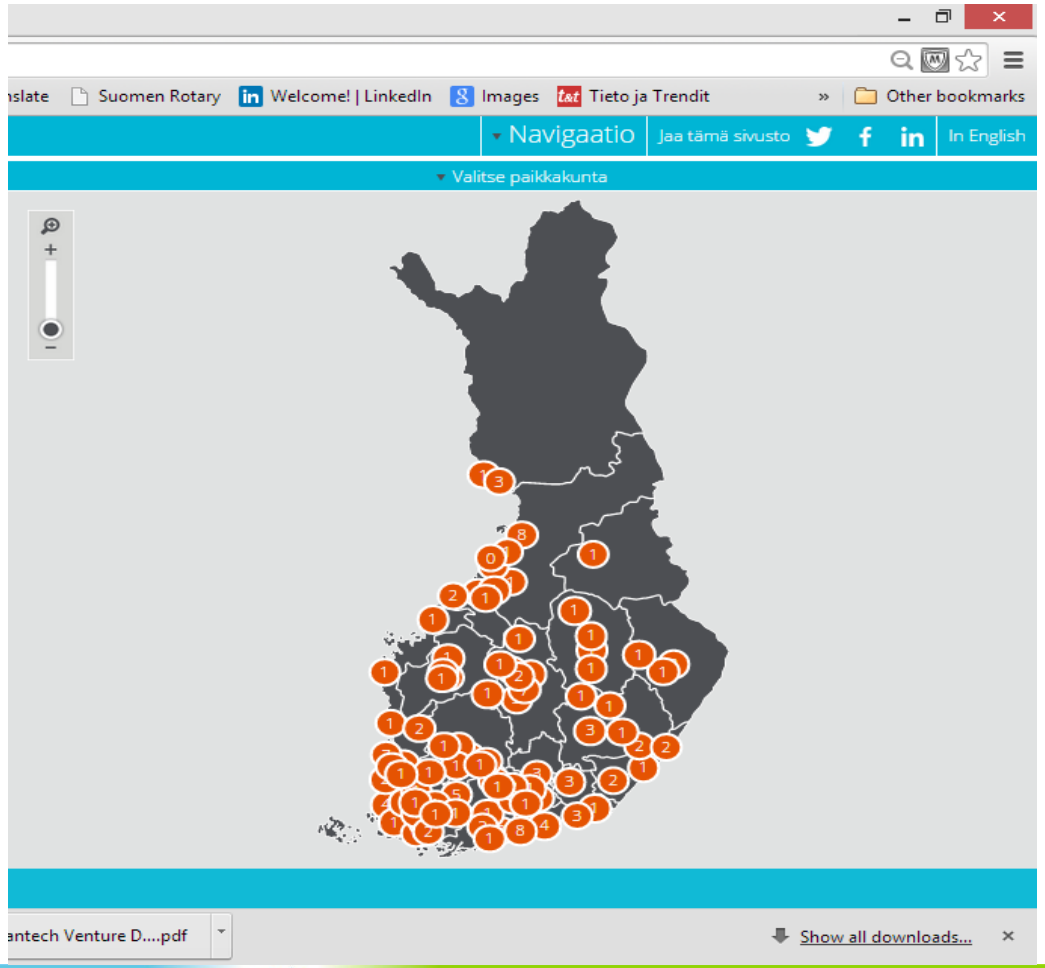
Utilities
Sea / fresh / potable / deionised water
District heating, Compressed air,
Nitrogen (gaseous) , Oxygen (gaseous)
Heavy oil
Steam, Power

Infrastructure
Roads, railroad, port
City services



Recognize the Opportunities – Improve the Result

- Database for industrial side streams available for utilization by outsiders



Still Envying : Biopreferred.gov of USA

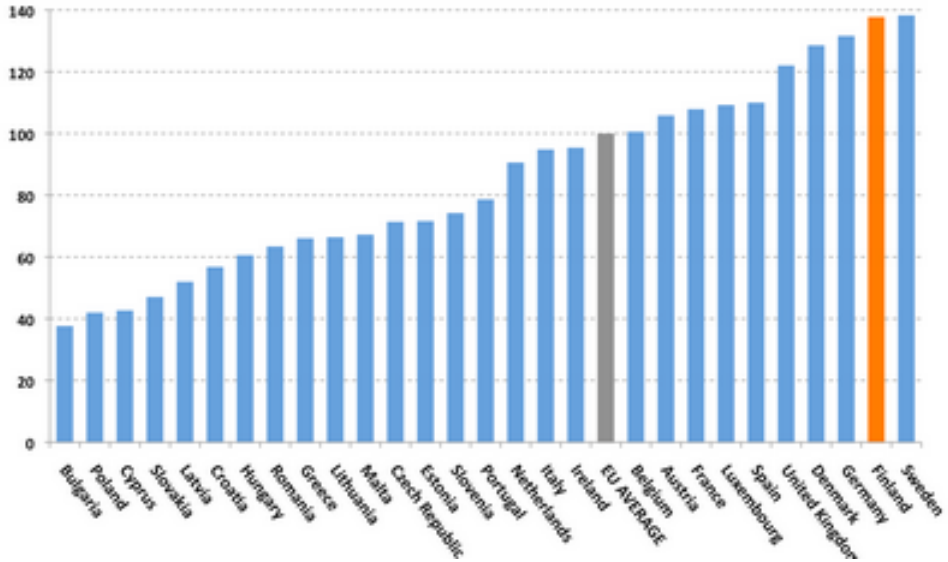
- **Congressionally mandated Federal buying preference for biobased products** into actual buying, certification and label
- Certification
- Challenge: specifications that do not pertain to product performance but which can only be fulfilled by petroleum-based content – and in some cases, specs require petroleum-based content
- 1st stage: declaration of performance, 2nd: testing of samples, 3rd stage: retesting for compliance
- To date, traditional materials that “don’t need help” – wood, paper, leather, cotton are excluded from the program – plus food, and fuels have been excluded

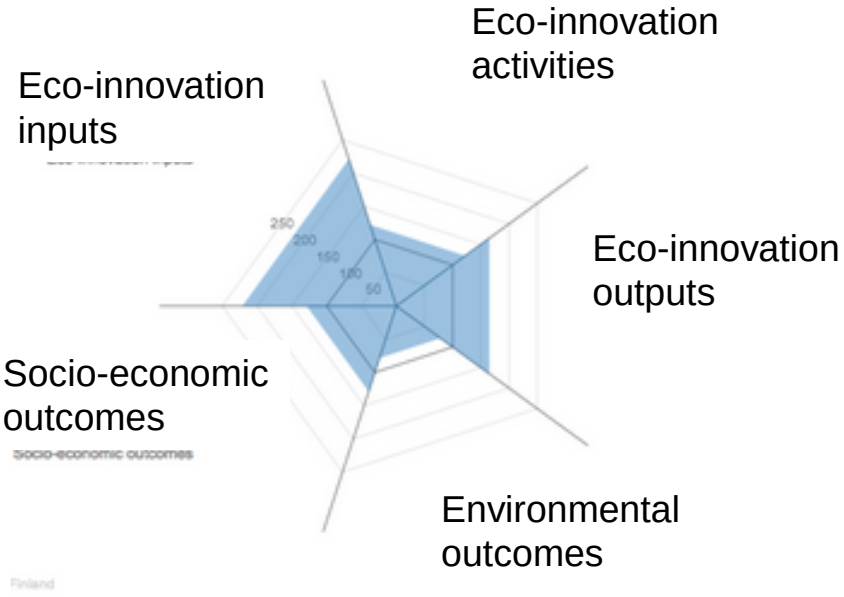
Circular Economy in Västerås, Sweden (Finnish equipment)

Algae Pilot in Kalundborg, Denmark

EU Eco-innovation Index, 2013

- Sweden, Finland, Germany, Denmark, Great Britain, Spain…





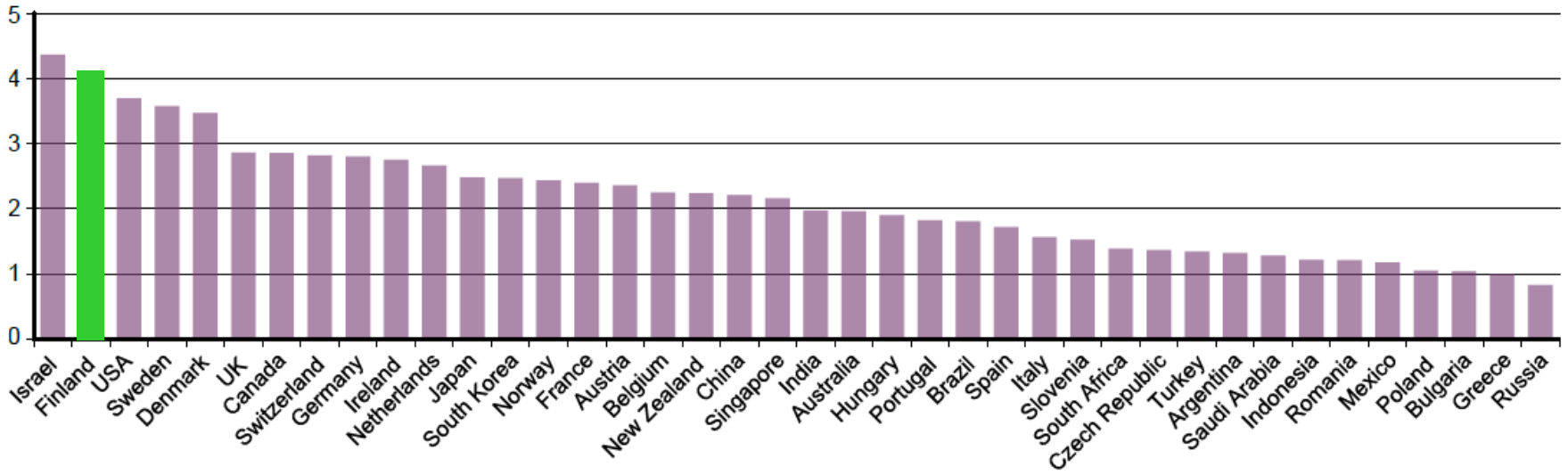
"Finland is one of the most innovative EU Member States. The Finnish national innovation system is an extensive entity, based on education, research, product development as well as knowledge-intensive business and industry. The innovation policy is bound to science and technology policies, which together aim at ensuring balanced development and extensive cooperation within the innovation system. Eco-efficiency and environmental approach has traditionally been a baseline of Finnish production technology, which has been apparent through the research and development (R&D) funding and development of increased eco-efficiency in industrial processes."

http://www.eco-innovation.eu/index.php?option=com_content&view=article&id=469&Itemid=57

Global Cleantech Innovation Index 2014

- Israel, Finland, USA, Sweden, Denmark, Great Britain, Canada, Switzerland, Germany, Ireland, Netherlands…

Figure 2: Cleantech Countries Innovation Index



http://www.cleantech.com/wp-content/uploads/2014/06/WWF_2014_Coming_Clean_2014_FINAL.pdf

Bioeconomy, Cleantech, Digitalization in Finland

8.5.2014	Decision-in-principle of the government about the spear heads for growth: bioeconomy and cleantech, including strategies
June 2014	Renewal of industrial policy, including cleantech and bioeconomy and digitalization
June 2014	New government programme, including bcd
2013-2014	Renewal of funding, including bcd
1.7.2014	EU change in state aid, allowing funding of demonstration plants
August	Future review including bcd

There is the will!

Find the ways!

Thank you!

Valmet

First commercial installation of Lignoboost™ lignin recovery, Domtar

Plymouth, NC in US:
5% increase in pulp production capacity and 25,000 t/a of lignin

Scope: Lignin recovery island

First demonstration scale integrated pyrolysis unit, Fortum

Joensuu in Finland:
Convert 225,000 m^3 of forest residue and sawdust into 50,000 tons of bio-oil

Scope: Pyrolysis plant

Germany's largest lignocellulosic ethanol demonstration plant, Clariant

Straubing in Germany:
Convert 4,500 tonnes of wheat straw into 1,000 tonnes of ethanol

Scope: Pre-hydrolysis equipment

World's largest Waste-to-Energy Gasification Plant, Lahti Energia

Generate 50 MWe and 90 MWth from 250,000 t/a of recovered waste

Scope: Gasification plant

World’s largest biomass gasification plant in Vaskiluodon voima,Vaasa, Finland

- The 140 MW gasification plant produces biogas from wood (mainly forest residue) to generate electricity and provide district heating to the local community
- Nearly half of the coal used by the plant can be replaced with gasified biomass
- The €40M project became operational in March 2013
- The biogasification plant is located adjacent to the company's existing 565MW Vaskiluoto 2 coal-fired plant

WÄRTSILÄ

Éxhaust gas Scrubbers

Dual fuel engines

Ballast water mgmt

Power plants

- Flexicycle
- CHP
- Floating
- GasCube
- Wartsila OilCube

Examples of the Finnish Wind Energy Cluster

ABB
axco motors
ELTEL
EMPOWER
FINN WIND
FIBOX
Enclosing innovations
Labkotec
INDUTRADE GROUP
MeriTaito
MERUS POWER
MERVENTO
Direct Reliability
moventas
onninen
neorem magnets
OBELUX
LED LIGHTING
STALA TUBE
THE SWITCH
VAISALA
VTT

Example of a Waste Management Consortium Ready for Service

Doranova, Enevo, Ferroplan, Ficote, Gradientti, Haba Group, Odoroff, Molok, Tramel

ZENROBOTICS®

- ZenRobotics Brain is the name of the robot control technology
- ZenRobotics Recycler can identify wanted items and raw materials from the waste stream and reclaim them for recycling.
- Multiple sensor inputs in realtime, reacts to changes and learns from its mistakes
  - various camera types (visible light, spectrometric cameras like NIR), 3D scanners, haptics , metal detectors etc.
- On the market, references exist

BMH Technology

- Example: Tyrannosaurus SRF
- The Waste-to-Energy systems are industrial scale waste processing plants including heavy-duty shredding equipment, separation technology and state-of-the-art conveying and storing technology
- The plants are able to handle various types of waste in a single plant:.
  - From household and commercial waste to industrial waste and difficult mono fractions to high quality SRF.

AW Energy WaveRoller

reNews

Radar demo fires blanks

The long and winding road

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HOME > WAVE AND TIDAL > WAVEROLLER 'LEADS THE PACK'

WaveRoller 'leads the pack'

07/02/2014

Finnish developer AW Energy is staking a claim at the front of the wave technology pack after the performance of its WaveRoller technology was verified by independent experts.

The 100kW device *(pictured)* generated 500kWh in a 24-hour period in moderate seas of 2.5 metres significant wave height, indicating a capacity factor of around 20%.

The findings, *first reported yesterday in subscription newsletter reNews*, were certified by experts at DNV GL.

Data suggests a larger 300kW version will pump out as much as 2.1MWh per day in

Vaisala in Brief

- Vaisala is a global leader in environmental and industrial measurement.
- We serve customers in weather and controlled environment markets.

Vision

- To be the leading provider of operational value for our customers in targeted segments of weather and controlled environment markets.

Mission

- To offer high reliability and added value with our products and services by bringing together customer business expertise and our technical expertise.

1936	Vaisala founded in Finland (Vilho Väisä
1985	Acquisition of Tycho Technologies Inc., U
	nbH, Germany
	Unit of Radian
2005	Acquisition of Sigmet Corporation, US
2009	Acquisition of Aviation Systems Maintena
2009	Acquisition of Quixote Transportation Tec
2010	Acquisition of Veriteq Instruments Inc., Ca
2010	Divestment of oxygen measurement techn
2012	Divestment of wind profiler business
2013	Divestment of three non-weather road tra
2013	Acquisition of Second Wind Systems Inc,

SeaHow

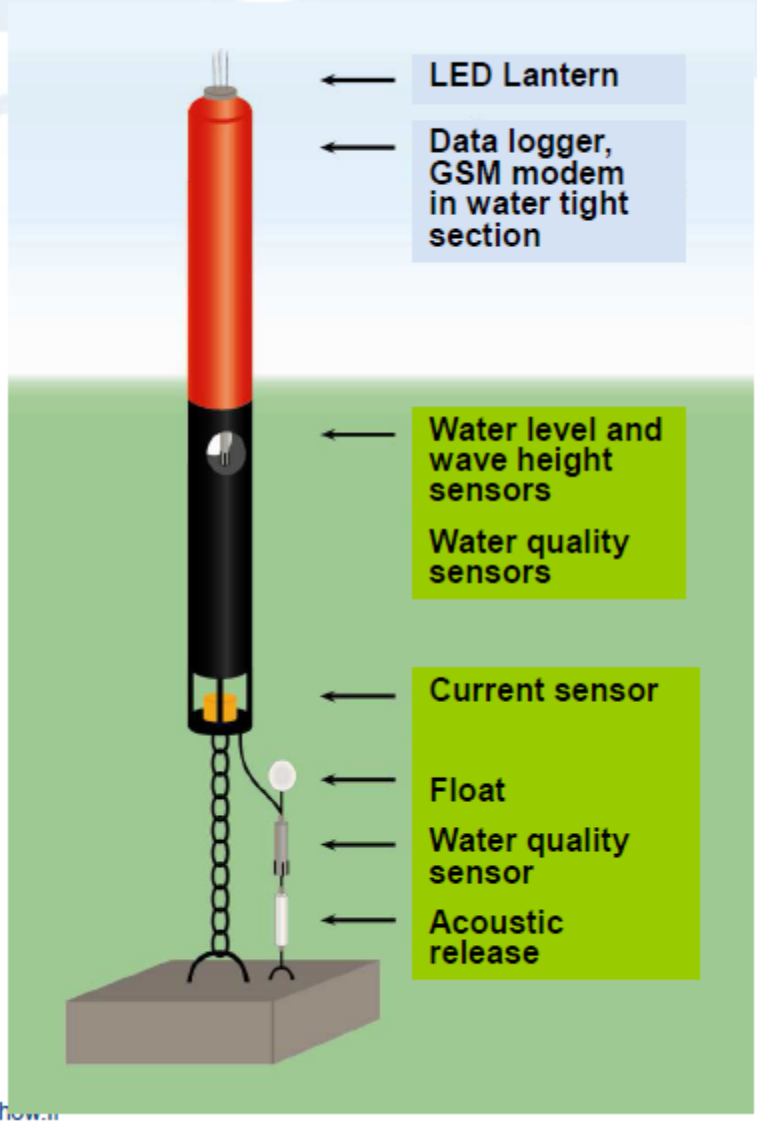
Monitor data according needs

Environmental data

- Oil spill detection
- Oxygen content
- Algae status
- Salinity
- Turbidity

Navigation data

- Wave height
- Water level and tides
- Current; direction and strength
- Water temperature
- AtoN remote control



Environmental monitoring

- A-Weather weather stations
- A-WS environmental monitoring station
- A-Water water monitoring station

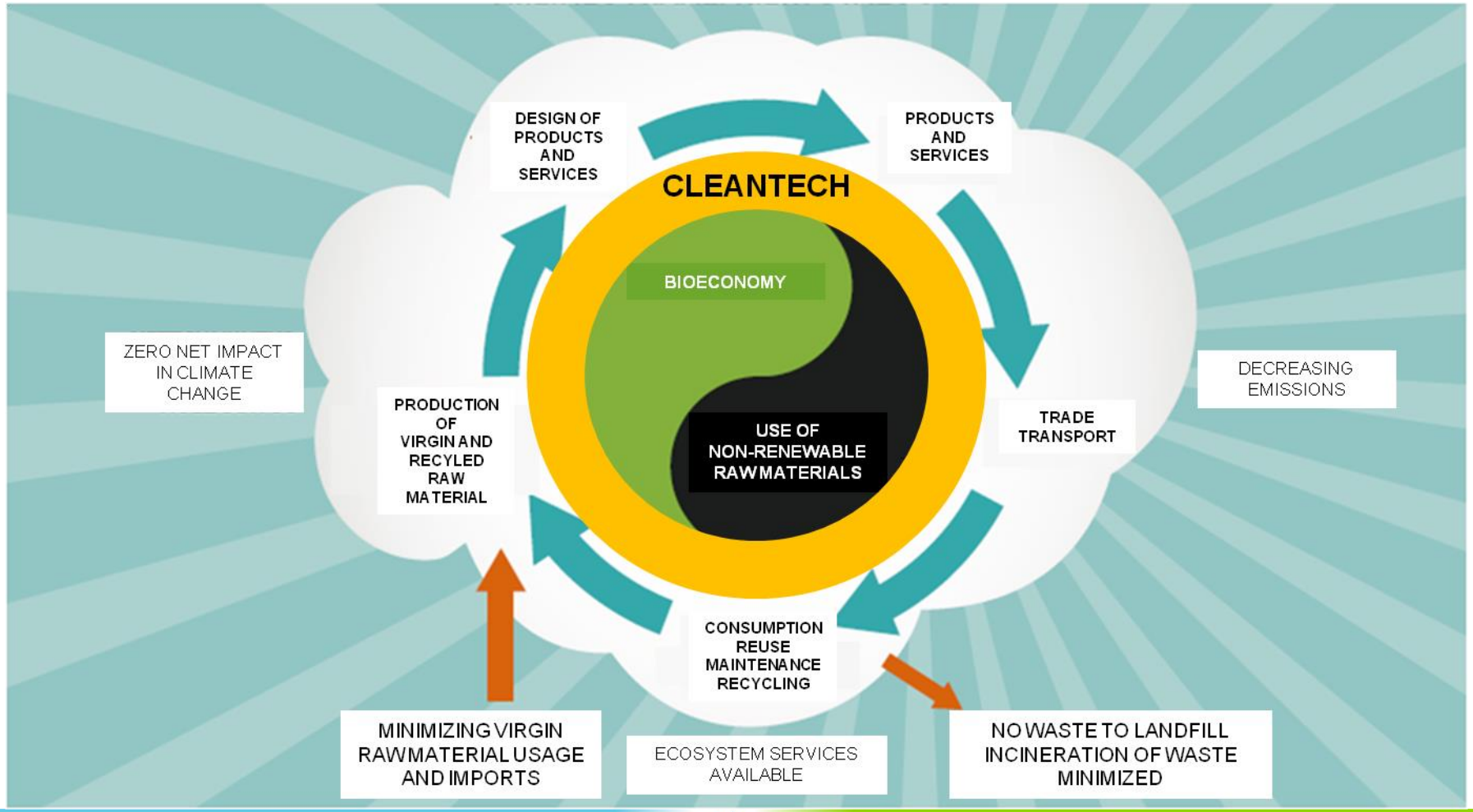
Control services for agriculture

- Fresh produce storaging
- Monitoring milk containers
- Growth condition monitoring

Innovative solutions for cold chain and industry

- Temperature, process surveillance, maintenance, logistics etc.

Thank you!


DESIGN OF PRODUCTS AND SERVICES
PRODUCTS AND SERVICES
CLEANTECH
BIOECONOMY
USE OF NON-RENEWABLE RAW MATERIALS
ZERO NET IMPACT IN CLIMATE CHANGE
PRODUCTION OF VIRGIN AND RECYLED RAW MATERIAL
TRADE TRANSPORT
DECREASING EMISSIONS
CONSUMPTION REUSE MAINTENANCE RECYCLING
MINIMIZING VIRGIN RAW MATERIAL USAGE AND IMPORTS
ECOSYSTEM SERVICES AVAILABLE
NO WASTE TO LANDFILL INCINERATION OF WASTE MINIMIZED