Sustainable use of bio-resources in the context of Bioeconomy and Circular Economy

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CHALLENGES WE FACE TODAY
INCREASED ENERGY NEEDS DUE TO HIGH ANNUAL PRODUCTION OF GOODS
From our planet’s point of view, there’s no throwing garbage out. Because there is no “out”.

Bank of the Planet.
Investments generating information and actions.

www.bancodoplaneta.com.br
Anthropogenic Climate Changes and Social Upheavals

Mediterranean
Economic crisis, unemployment, immigration
RE-THINK

Come TOGETHER let's think DIFFERENTLY"
GREEN ECONOMY =

LOW CARBON GROWTH + RESOURCE EFFICIENCY + SOCIAL INCLUSIVITY

=SUSTAINABLE DEVELOPMENT?
Photosynthesis - GENESIS
Terrestrial and Marine Biomass
Wasted matter
We don’t see everything !!!
A system restorative by design to retain more volume and value within the economy

Biological cycles:
- Soil restoration
- Biogas
- Anaerobic digestion/composting
- Extraction of biochemical feedstock
- Farming/collection
- Biochemical feedstock
- Cascades

Technical cycles:
- Mining/materials manufacturing
- Refurbish/remanufacture
- Recycle
- Reuse/redistribute
- Maintain
- Utilization in another value chain

Materials/parts manufacturer
- Product manufacturer
- Retail/service provider

Consumer/User Collection
- Collection
- Maintain

Energy recovery
- Landfill
Holding out for Sustainability

FOR systemic health

FOR resilience

AT different scales, from local, to regional and global.
Strategic objectives
One of the main pillars of green growth and sustainability

the **Sustainable Development** Goals
WHY Bioeconomy

- Sustainable and safe food production for our growing population,
- Developing new and more environmentally friendly sources of energy,
- Combating global warming, which can have serious consequences both on land and in the oceans
- Employment
The bioeconomy challenges our centralised social model

• Sustainable well-being is based on the smart and responsible use of renewable resources.
• The bioeconomy can also be seen as a strategy used by society to combat urgent problems, such as climate change, increasing competition for natural resources and rural and regional development.
• The bioeconomy should be viewed as a new economic and social order that will challenge most of our existing practices and structures.
• As well as agriculture, forestry, chemical, fishing, food and pharmaceutical industries make Bioeconomy.
• Ecotourism can also be considered part of the bioeconomy.
Application......Bio-industry

It includes sectors such as agriculture, forestry, fishing, food and paper production and energy industries.

biofuels, biopower, bioproducts.
A biorefinery might produce one or several low-volume, but high-value, chemical products and low-value, but high-volume liquid transportation fuel, while generating electricity and process heat for its own use and perhaps enough for sale of electricity.

The high-value products enhance profitability, the high-volume fuel helps meet national energy needs, and the power production reduces costs and avoids greenhouse-gas emissions.
CIRCULAR ECONOMY

The 7th EU Environment Action Programme to 2020
**EU target:** To develop a competitive, resource efficient and low carbon economy by 2050.

**Move from**

- Resource Extraction
- Production
- Distribution
- Consumption
- Waste

**To**

**A CIRCULAR AND REGENERATIVE MODEL**

- Smart and efficient use of resources
- Turn waste into a new resource
- Sustainable and circular design of products, processes and systems.
Bioeconomy: circular by nature

A transition towards a circular bio-economy could see the traditional approaches to circular economy and bio-economy integrated together, leading to more sustainable resource use at a lower cost while developing new income streams, favouring the emergence of new sectors, adding value to products and boosting jobs.
Towards Circular bioeconomy

Link and integrate with different sectors

- BIOENERGY
- BIO-FUELS (e.g., biodiesel production)
- AGRICULTURE
- NON BIO-BASED SECTORS (e.g., coal-based power production)
- BIO-BASED INDUSTRIES

- Symbiotic synergies between industrial partners
- Tailored made solutions
- Energy & material closed loop systems

Increase resource and energy efficiency
Sustainability is not enough; we need regenerative cultures

Regenerative cultures safeguard and grow biocultural abundance for future generations of humanity

The Regenerative Design Framework

Regenerative
- Appropriate participation and design as nature.

Reconciliatory
- Reintegrating humans as integral parts of nature.

Restorative
- Humans doing thing to nature.

Sustainable
- Neutral point of not doing any more damage.

Green
- Relative improvements.

Conventional practice
- Compliant to avoid legal actions.
Building Circular Bioeconomy

- The first step of that is building up understanding of
  - ecological,
  - economic and
  - social ecosystems at

  the local level,

  and integration of all the dimensions of the ecosystem by a mutual holistic view.
Regenerative Biorefineries

Respect the specific characteristics of the territories and resource efficiency

• integrated biorefineries in local areas,
• respecting the specific characteristics of the territories and in partnership with farmers

• with a cascade approach in the use of biomass and in partnership with the various industry players.
Creating regenerative systems is not simply a technical, economic, ecological or social shift:

It has to go hand-in-hand with an underlying shift in the way we think about ourselves,

Our relationships with each other and planet with life as a whole.
We need to apply a broad view on regional development including the importance of

- natural and
- cultural heritage to
- human health,
- well-being,
- social inclusion and
- local identity.
Regenerative agriculture:
call for a beyond-modern approach, combining the best of traditional agriculture with the finest science
Local Resources Availability

SOUTH

NORTH
Forest Based Bio and Circular Economy

Climate-KIC
The Bioeconomy Strategy of Finland

- Finnish Bioeconomy Strategy aims to generate new economic growth and new jobs from an increase in the bioeconomy business and from high added value products and services while securing the operating conditions for the nature’s ecosystems.

- Goals of the Finnish Bioeconomy Strategy:
  1. A competitive operating environment for the bioeconomy,
  2. New business to derive from bioeconomy,
  3. A strong bioeconomy competence base,
  4. Accessibility and sustainability of biomasses.

- The objective of the Bioeconomy Strategy is to push the Finnish bioeconomy output up to EUR 100 billion by 2025 and to create 100,000 new jobs.
Agro-industrial residues based Circular bioeconomy
Nutrient recycling

The economic value and opportunities of nutrient cycling for Finland

Maija Aho, Tiina Pursula, Mari Saario, Tea Miller, Anna Kumpulainen, Minna Pällysaho, Venla Kontiokari, Miikka Autio, Anna Hillgren, Laura Descombes, Gaia Consulting
October 2015
A national resource efficiency programme should be prepared.

- **Business opportunities** created by the need to restore and close material cycles should be promoted.

- Their **effectiveness should then be tested in practice**.
Local biorefinery activities should be created as regional networks

• Biorefineries
• The establishment of biorefineries that process organic materials to produce energy and new raw materials should be promoted.
• Technologies and business models should be developed to promote the utilisation of diverse local biomaterials through regional networks.
• Models for the development of logistics chains for biomaterial procurement and new purification techniques should be created and tested.
Product-centred resource efficiency

• A network of expertise on product-centred environmental management should be set up to bring together expertise in this field.
• systems. Resource efficiency thinking should be integrated into public sector purchasing policies.
• Product labelling systems based on material flows and life cycle analyses should be created and adopted for application in evaluating both material and energy solutions.
Restoring and closing cycles

The utilisation of **side streams** in production systems as raw materials and sources of energy should be promoted. Measures to close local cycles of materials such as **biochar** and ash, or **restore such materials to wider nutrient cycles**, should be promoted.

Business opportunities created by the need to restore and close material cycles should be promoted.
Multidisciplinary networks for forecasting natural resource issues should be developed
Towards a collaborative Model
TECHNOLOGICAL PATHWAYS

The thermochemical pathway in Circular Bioeconomy
The thermochemical platform involves breaking down biomass into its elemental components by using heat and chemical synthesis. It includes pyrolysis and gasification, followed by a chemical synthesis process. The most prevalent emerging technology is gasification, followed by catalytic conversion of the synthesis gas to ethanol or other high-value products.
The gasification pathway

the biomass is first thermally fragmented to synthesis gas consisting of rather simple molecules such as: hydrogen, carbon monoxide, carbon dioxide, water, methane, etc.

These gaseous material are then chemically re-synthesized to biofuels.

✓ The Fischer-Tropsch process for production of diesel from biomass
✓ Methanation to obtain bio-SNG as a substitute for natural gas
✓ Synthesis into mixed alcohols
✓ Production of BioDME
Biomass stored → gasifier → hot air (~800°C) → gas (400°C) → CHP
The pyrolysis pathway

Dry biomass → Fast Pyrolysis (500°C, 1 bar, residence time ~2 sec) → Solids

Hydrogen (Up to 400°C, 130 bar, Space velocity 0.0-0.3) → Multi-step upgrading → Liquid hydrocarbons

Current Opinion in Chemical Engineering
Biochar-closing the loop

- Efforts to compost carbon-based flows so that the nutrients can be returned to the soil are important.
- Using **pyrolysis**, any organic material can be heated at low temperatures with little oxygen until it is carbonized.

**Environmental Development**

**Volume 14, April 2015, Pages 22–36**

Boosting circular economy and closing the loop in agriculture: Case study of a small-scale pyrolysis–biochar based system integrated in an olive farm in symbiosis with an olive mill

A. Zabaniotou, D. Rovas, A. Libutti, M. Monteleone

[Show more](https://doi.org/10.1016/j.envdev.2014.12.002)
SMALL SCALE
Thermochemical for CHP

Agro-industrial sector
Mobile Pyrolysis in Utah
LARGE SCALE
Thermochemical for transport biofuels
BTL

1. Water Vapor
2. Woody Biomass
3. Pruned Branches of Peach and Grapes, Forestry Residue
4. Gasification by Rapid Reduction 1000°C
5. Gases Generated (CO, H2)
6. FT Synthesis (Fischer-Tropsch)
7. Liquid Fuel
8. 100 kg/hr
9. 20 L/hr
Conceptual process design and economics for the production of high-octane gasoline blendstock via indirect liquefaction of biomass through methanol/dimethyl ether intermediates
Authors Eric CD Tan, Michael Talmadge, Abhijit Dutta, Jesse Hensley, Lesley J. Snowden-Swan, David Humbird, Joshua Schaidle, Mary Biddy
But because there were no adequate quality controls, the market was flooded with biofuels that are worse for the climate than fossil fuels.

For example, crop biodiesel – which makes up 80% of the market – is, on average, 80% worse for the climate than fossil diesel and is increasingly sourced from palm oil.
FROM A MONO PROCESS...

- one substrate
- one technology process
- one main product

Substrates  Technology process  Products
Multi processes-multi products

CASCADE

BIOREFINERY APPROACH

- Fibres
- Oil
- Protein

- Fuels
- Power
- Heat
- Materials
- Chemicals
- Food

Biomass

Pretreatment & Fractionation

Conversion & Downstream processing
Thermochemical biorefineries with multiproduction using a platform chemical

Multiproduction is a promising option for thermochemical biorefineries in order to reduce the risk of investment. It promotes the diversification of revenue, allows a better material and energy integration, and enhances profitability.

In the case of sustainability, it is necessary to know how to allocate the greenhouse gas (GHG) emissions of each product (including electricity).

The incorporation of bioenergy with carbon capture and storage is assessed as a potential income platform chemical: are able to co-produce low-value high-volume products like fuels along with high-value low-volume products like solvents and chemicals, which have been demonstrated by conventional oil refineries to be highly profitable.
Waste biorefinery models

- Waste (feed stock)
- Recycle
- Biorefinery
- Reduce
- Reuse
- Fuel
- Power
- Chemicals
- Food
- Feed
- Fertilizer
- Heat
Cascade Biorefinery

This principle is called cascading.

• Various components in biomass can be isolated using biorefining technologies, such as pretreatment, fractionation and separation techniques.
• In this way cascading and biorefinery concepts allow to increase the economic value of biomass.
CASCADE BIOREFINERY

PRIMARY PRODUCTS

- Proteins
- Polysaccharides
- Lipids
- Pharmacology
- Cosmetics
- Chemicals

Secondary Products

- Biogas
- Energy
- Biooil
- Biofuels
- Char
- Soil Fertility

Primary Refining

Pyrolysis

Solid side streams
Sunflower meal biorefinery

Biochar production

- **Biochar**
  - 11.54g dry mass

- **SFM**
  - 100.0g dry mass
  - Ultrasound
  - Aqueous extraction
  - Antioxidants ~3.0g

- **Protein-rich fraction (PF)**
  - 50.0g dry mass

- **Lignocellulose-rich fraction (LCF)**
  - 31.0g dry mass

- **Aqueous fraction (IAF)**

- **Solid residue (SR)**
  - 38.3g dry mass

- **Extracted proteins**
  - Alkaline treatment

- **Enzymatic hydrolysis**
  - Enzymes

- **Solid state fermentation**

- **Hydrolysed solid residue (RSH)**

- **Acid precipitation**
  - Protein isolate 9.2g proteins

- **Biochar**
  - 14.05g dry mass

- **Biochar**
  - Slow pyrolysis (400 °C)

- **Nutrient-rich fermentation supplement**

- **Protein isolate**
  - 9.2g proteins

- **Biochar**
  - Slow pyrolysis (400 °C)
ENVIRONMENTAL, SOCIAL & ECONOMIC METRICS AND LCA

Waste/residues and not crops

Sustainability Metrics

treatment in situ by moving the CHP unit

Environmental

Water Quality & Quantity

Land-use Impacts (Direct and Indirect)

Air Quality

Greenhouse Gas Emissions

Soil Health

Biodiversity & Habitat

Economic

Prices

Costs

Natural Resource Accounting

Supply and Demand

Market Access

Trade

Economic

Food security

Property rights

Energy Security

Physical Security & health

Social

Participation

Labor rights

Energy Security

Physical Security & health

Social

Participation

Labor rights
The manifesto of Messogiorno

Targeting sustainable bioeconomy: A new development strategy for Southern European countries. The Manifesto of the European Mezzogiorno

Emmanuel Koukios (Director), Massimo Monteleone (Coordinator), Manuel Jose Texeira Carrondo (Vice President), Anthi Charalambous (Director), Francisco Girio (Head), Eva López Hernández (Project Manager), Sofia Mannelli (President), Juan Carlos Parajó (Professor), Polycarpos Polycarpou (Chief Agricultural Research Officer), Anastasia Zabaniotou (Professor)

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La science a commencé sur les bords de la Méditerranée, les débuts de la physique - de l'Ionnie à Alexandrie, et a été transmise à l'Europe et développée par le monde arabo-musulman entre les ~VII et ~XIII siècles.
Conclusion

support sustainable management and usage of natural renewable resources, based upon ethical, ecological, sustainable practices at the local, European and Global scales.

accelerating the transition to Equitable, Sustainable, Circular Bioeconomy

Intercultural, multidisciplinary and systemic approaches are essential with WISDOM
International Symposium and Workshop
RF-Greece 2016
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Thank you!!

Circular Economy and Sustainable Use of renewable sources in the context of Climate Change and Social Upheavals

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