European Commission

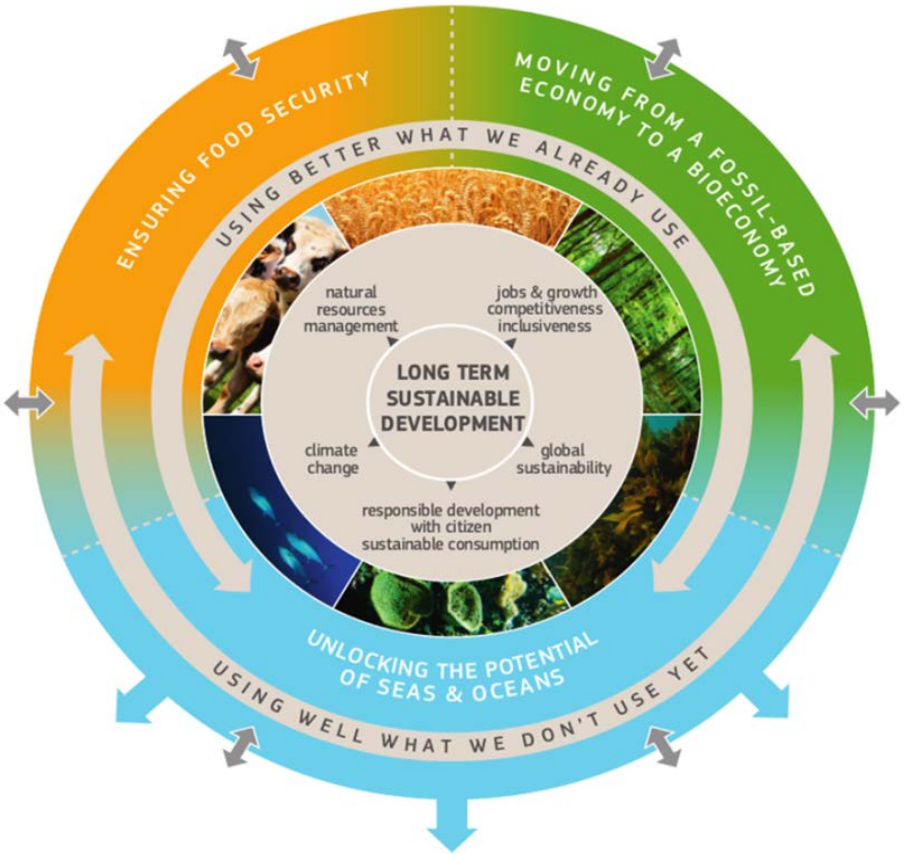
A Bioeconomy for Europe

Using resources from land and sea for a post-petroleum economy

Hans-Joerg Lutzeyer
European Commission, DG Research and Innovation
Dir F – Bioeconomy

Aarhus University, Foulum, 14/09/2016

FACCE SURPLUS



Bioeconomy encompasses the production of **renewable biological resources** from land and sea and the conversion of these resources & waste streams into value added products (e.g. ood, bio-materials, bio-energy and bio-products).

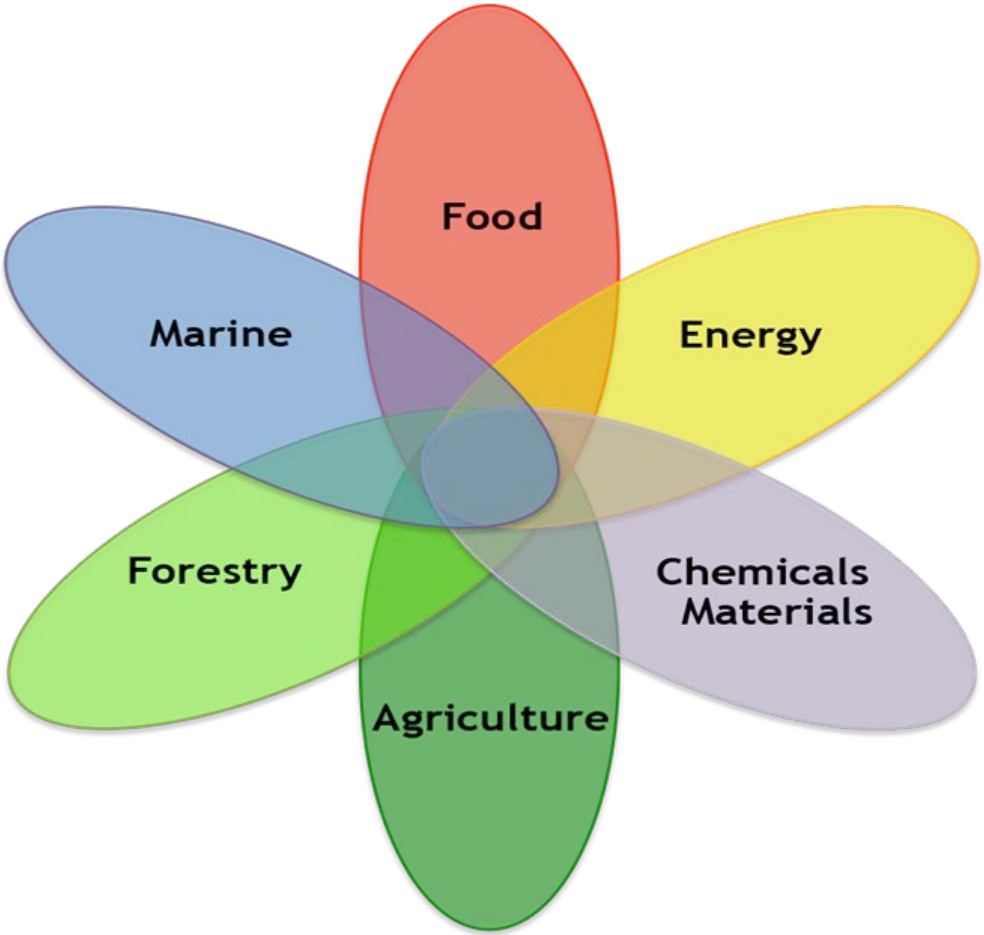
EU bioeconomy strategy, 2012

CHALLENGES:

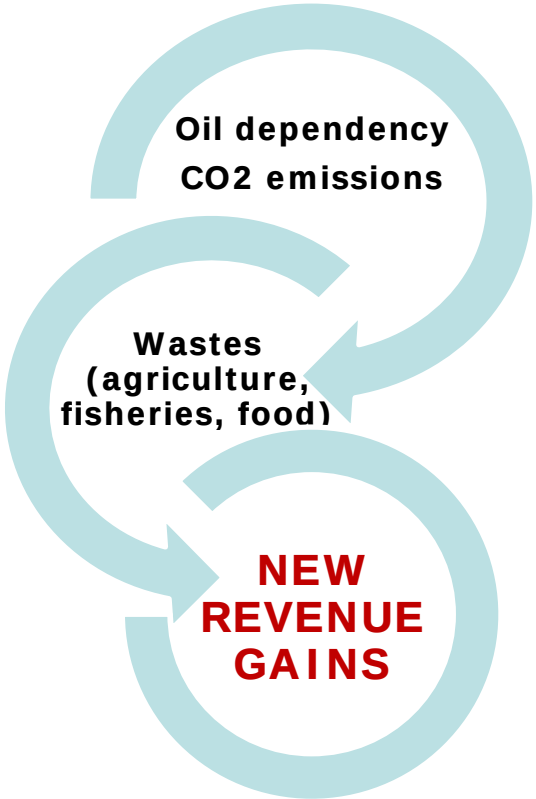
- ✓ **Feed 9 billion people by 2050**
- ✓ **Unlock the potential of seas & oceans**
- ✓ **Mobilise rural and coastal economies**
- ✓ **Boost bio-based markets**

H2020/SC2 WP2016-2017

Bioeconomy -

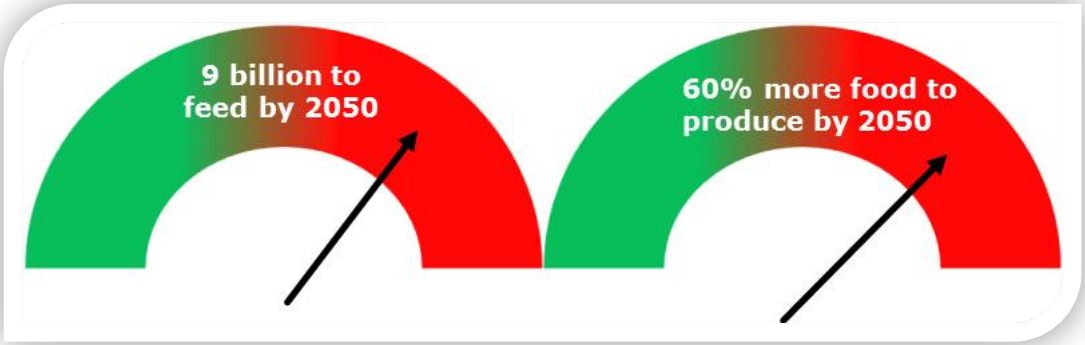


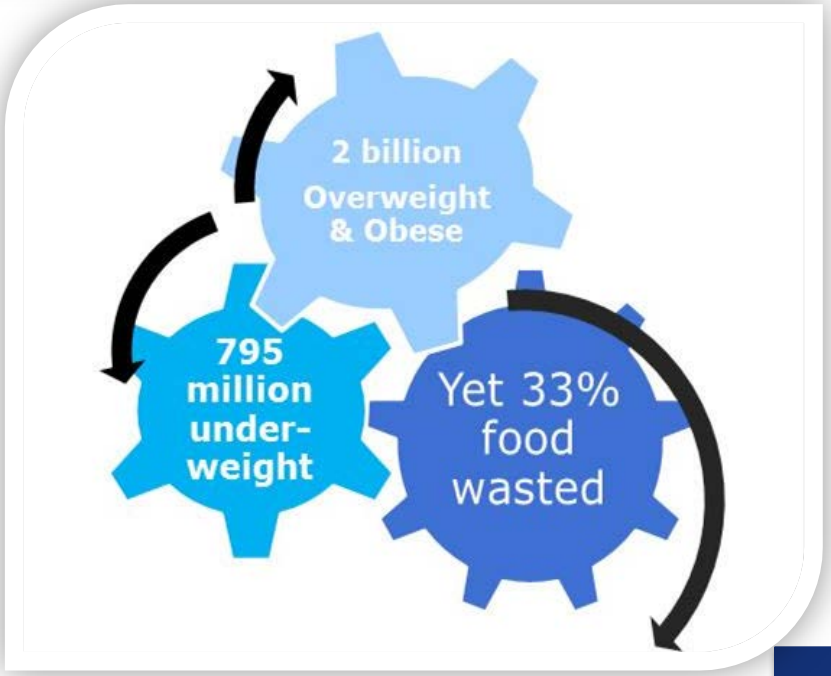
Using biological resources to produce "more and better, from less"

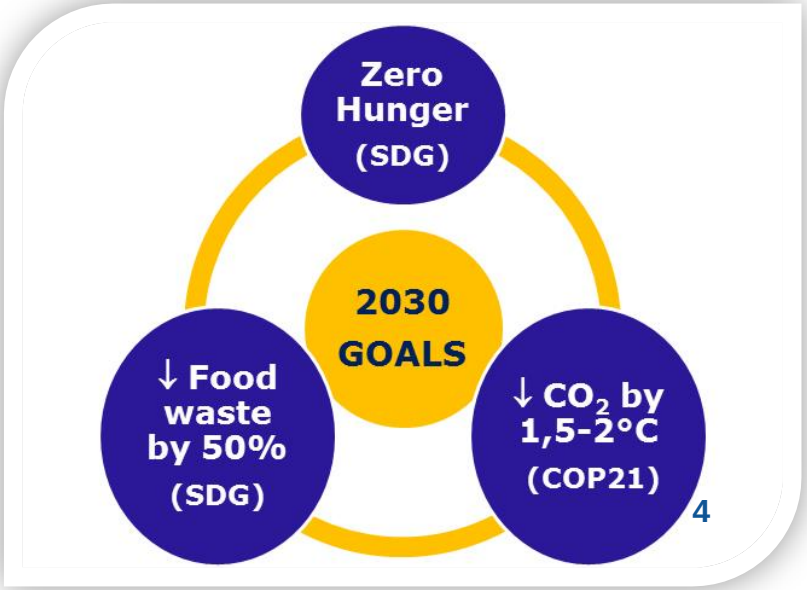


Source: SCAR (Standing Committee on Agricultural Research)

Challenges & Targets

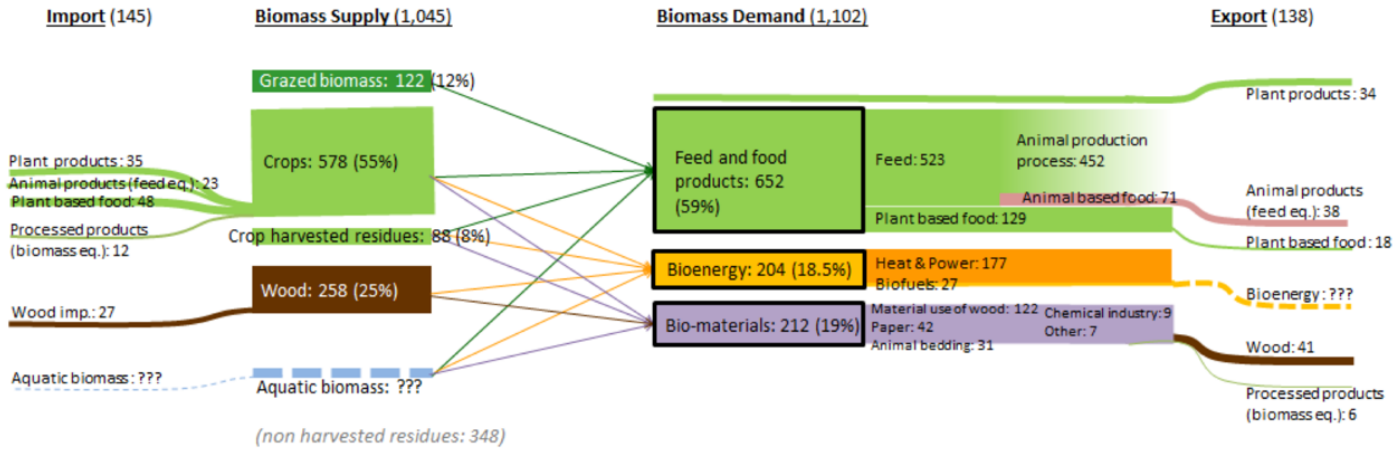






Preliminary biomass balance in the European Union

Figure 2. Preliminary biomass balance in the European Union (million tonnes of dry matter, EU-28, 2013)



In the European Union the biomass is mainly consumed for ***food and animal feed purposes, which represents 61% of the whole biomass consumption****. Animal feed use alone represents 48% of the total use of biomass. The sectors of bioenergy and biomaterials are similar in terms of the quantity of biomass they consume. Each of them consumes around 18% of the whole biomass.*

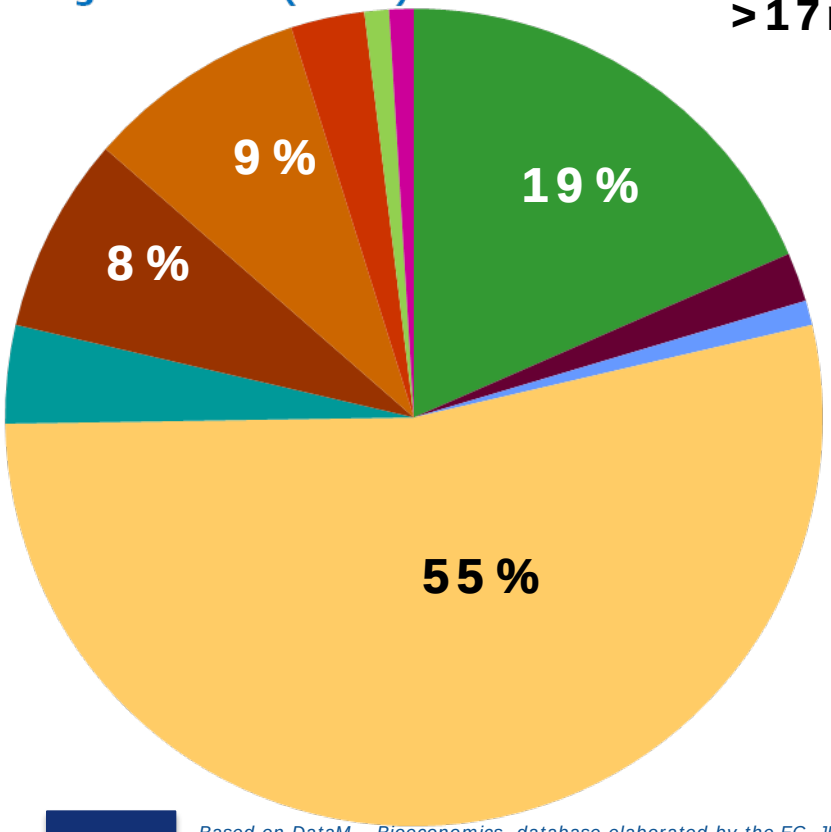
Source: Ronzon, T., Santini, F. and M'Barek, R. (2015). The Bioeconomy in the European Union in numbers. Facts and figures on biomass, turnover and employment. European Commission, Joint Research Centre, Institute for Prospective Technological Studies, Spain, 4p., https://biobs.jrc.ec.europa.eu/sites/default/files/generated/files/documents/BioeconomyFactsheet_Final.pdf

Bioeconomy is key for Europe

2 trillion euro turnover

Employs >17m people

Turnover in the EU-28 by the bioeconomy sector
In percentage of value (2013)



19 %	Agriculture
2%	Forestry
>1%	Fisheries & aquaculture
55 %	Food, beverage & tobacco industry
4%	Bio-based textiles
8 %	Manufacturing of wood & wood furniture
9 %	Manufacturing of paper & paper products
3%	Bio-based chemicals, pharmaceuticals and plastics
>1%	Biofuels
>1%	Bio-based electricity

Based on DataM – Bioeconomics, database elaborated by the EC, JRC IPTS & Nova Institut

FOOD Systems Research and Innovation: Food2030 - 4 Priorities

Reducing hunger & malnutrition, addressing food safety and diet-related illnesses, and helping citizens adopt sustainable diets and healthy lives

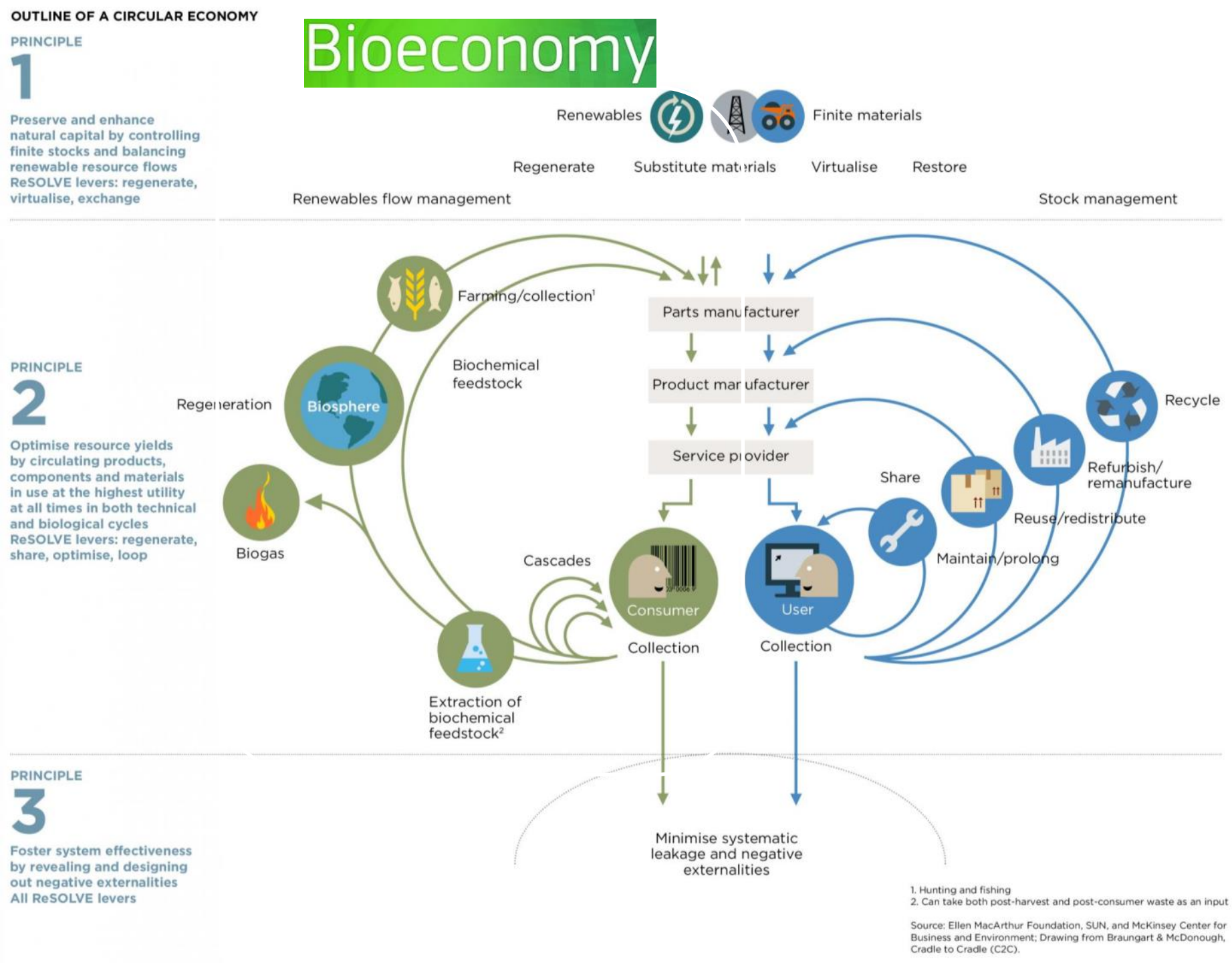
Building a climate and global change-resilient primary production system – e.g. PRIMA, EU/Africa HLPD

Implementing sustainability and circular economy principles across the whole food system – e.g. Food Waste

Boosting market creating innovation and investment, while empowering communities – e.g. FOOD KIC


A variety of crops and livestock products will have current models and locations of production challenged by climate change in the coming decades. Examples include:
• Bananas - Half of the current global banana growing area is likely to become unsuitable for banana cultivation by 2060.
• Nectarines - Warming temperatures are expected to mean that certain regions can no longer provide enough "chill hours" to set fruit.
• Fish - Temperature changes will have a mixed effect on fisheries as waters warm across the globe. Some species will be negatively affected and others positively.
• Wheat - Global wheat production has been estimated to fall by 6% for each °C increase of local temperature, barring adaptation. Yields will also become more variable, creating more volatility.
• Sheep - Bluetongue virus, a sheep disease, is spreading into northern Europe with rising temperatures.
"Food quality is declining under the rising levels of atmospheric carbon dioxide that we are experiencing."
Professor Arnold Bloom, University of California, Davis
Higher levels of contamination of vegetables from microorganisms such as E. coli and salmonella are likely due to flooding events and temperature changes.
Wheat contributes approximately 25% of the protein in human diets and a number of manufacturing processes, such as baking, require sufficient levels of this nutrient. Researchers have shown rising carbon dioxide levels in the atmosphere inhibit the conversion of nitrates into protein in wheat growing.
Agriculture
"Some of the most productive agricultural land in England is at risk of becoming unprofitable within a generation due to soil erosion ... Without further action the natural environment will be severely harmed by climate change."
Committee on Climate Change 2015 Report to Parliament
Processing
Intense and disruptive storms as well as droughts and rising food prices may undermine the stability of supply routes (e.g. Suez Canal).
Logistics
"Climate change is expected to challenge the effectiveness of current food safety management systems in the near future."
Editorial in Food Research International special issue on the impacts of climate change on food safety
Increased carbon-dioxide levels have the potential to impact upon the quality of oilseed rape and have implications for industrial processing. Researchers predict significant reductions in the concentration of healthy unsaturated fatty acids in the crop. As a major ingredient in the food industry, this has implications for household diets.
Household
RESTAURANT
Mycotoxins are highly toxic chemical substances produced by mould that grows on crops such maize, wheat, and rice. With climate change they may become of increasing concern to food processors in the EU.

Bioeconomy


OUTLINE OF A CIRCULAR ECONOMY
PRINCIPLE
1
Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows
ReSOLVE levers: regenerate, virtualise, exchange
Renewables
Finite materials
Regenerate
Substitute materials
Virtualise
Restore
Renewables flow management
Stock management
PRINCIPLE
2
Optimise resource yields by circulating products, components and materials in use at the highest utility at all times in both technical and biological cycles
ReSOLVE levers: regenerate, share, optimise, loop
Farming/collection[1]
Biochemical feedstock
Regeneration
Biosphere
Biogas
Parts manufacturer
Product manufacturer
Service provider
Recycle
Refurbish/ remanufacture
Share
Reuse/redistribute
Maintain/prolong
Cascades
Consumer
User
Collection
Collection
Extraction of biochemical feedstock[2]
PRINCIPLE
3
Foster system effectiveness by revealing and designing out negative externalities
All ReSOLVE levers
Minimise systematic leakage and negative externalities
1. Hunting and fishing
2. Can take both post-harvest and post-consumer waste as an input
Source: Ellen MacArthur Foundation, SUN, and McKinsey Center for Business and Environment; Drawing from Braungart & McDonough, Cradle to Cradle (C2C).

EU Bioeconomy Strategy & Action Plan

Investment in R&I

- **Horizon 2020 (€3,8b SC2)**
- European Structural and Investment Fund (ESIF) - Smart Specialisation

Policy interaction & stakeholder engagement

- EU Policy coherence
- Regional and national bioeconomy strategies
- Bioeconomy SCAR Foresight
- Bioeconomy Observatory
- International cooperation

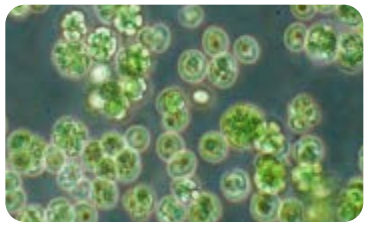
Enhancement of markets & competitiveness in bioeconomy

- Sustainable intensification of primary production
- Expansion of new markets
- BBI JU
- **FACCE Surplus**

Creation of new bio-based value chains

Primary sector

Sugar beets



Algae

Wood residues

Waste

Biological waste

Fish waste

Cosmetics

Plastic bottles
Natural colourants for candy

Car dashboards

Bio-based plastics

Oils
Pharmaceuticals

Bioeconomy vs. EU Strategy for Growth and Jobs (2014)

1. **A new boost for jobs, growth and investment**
2. A connected digital single market
3. **A resilient Energy Union with a forward looking climate change policy**
4. **A deeper and fairer internal market with a strengthened industrial base**
5. A deeper and fairer EMU
6. A reasonable and balance free-trade agreement with the U.S.
7. An area of justice and fundamental rights based on mutual trust
8. Towards a new policy of migration
9. A stronger global actor
10. A Union of democratic change

EU BIOECONOMY STRATEGY REVIEW

European Commission

ROADMAP

1st SEMESTER 2016:

Jan: Stakeholder interviews (NL Presidency)

Mar: Member States workshop

Apr: Stakeholders Panel, Utrecht Conference
Competitiveness Council

May: Agri- Council

Jun: Stakeholders Panel
New Bioeconomy Observatory web-site

2nd SEMESTER 2016:

Sept: Expert Group BioE Review

Nov: MANIFESTO
Workshop OECD/FAO
Competitiveness + Agri Council

Dec: Expert Group Final Report

1st SEMESTER 2017:

Mar: **BioE ACTION PLAN – Draft**
WORKSHOP OECD/FAO/EUROSTAT/JRC

Apr: Member States Workshop

Jun: **BioE ACTION PLAN – Final draft**

2nd SEMESTER 2017:

Sep: **BioE CONFERENCE (?)**
COUNCIL CONCLUSIONS

EUROPEAN BIOECONOMY STAKEHOLDERS MANIFESTO

European Commission

BIOECONOMY UTRECHT 2016

BIEU2016 4th BioEconomy Stakeholders' Conference EU 2016

CHALLENGES & OPPORTUNITIES FOR EU REGIONS: (POINT 8)

- Need to revitalise **rural and coastal areas**.
- **Bioeconomy** for high-value production in the **regions**,
- New opportunities & jobs for farming, forestry and aquaculture.
- The **marine environment potential** as part of the circular bioeconomy.

GUIDING PRINCIPLES: (POINTS 16 & 17)

- Europe's **cities & regions** should play a key role for the BioE.
- We should fully **utilise the available biomass** and **better valorise the use of agricultural land..**.
- **Marine production and aquaculture** offer new possibilities.

ACTIONS: (POINT 22)

- **Mutual learning** within & between regions, **peer-to-peer exchanges** at the EU
- **Link** between **regional bioeconomy strategies** and **smart specialisation**
- Creation of **new value chains**, **stairways of excellence**, **jobs and growth**
- **Redesign current agricultural-, energy and waste policies**

Source: German Bioeconomy Council, Maisei/fotolia.com (flags), jktu_21/fotolia.com

IN EUROPE:

Several MS have adopted **national Bioeconomy Strategies**.

More than 10 Regions are investing in Research on Bioeconomy (ESIF)

Finland and **Poland** the most involved countries

(Source: eye@RIS3)

Next steps for the EU Bioeconomy policy: ..with the support of the EU Regions

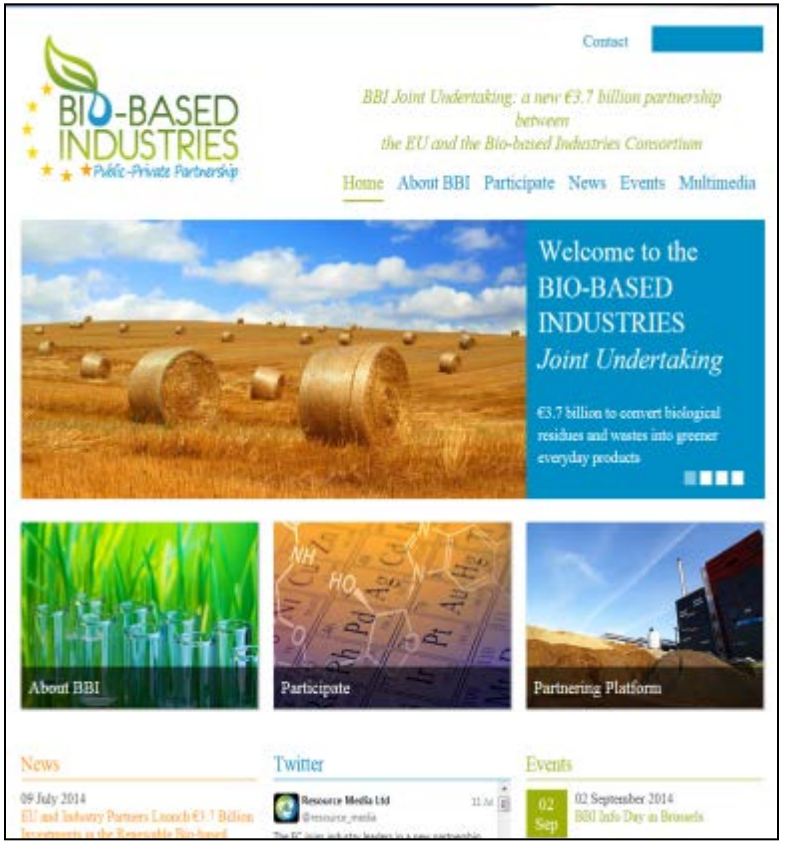
PRIORITIES	ACTIONS
Boost investments	- Financial Instruments - **EIB / InnovFin** - Synergies with **ESIF** *(SoE, Widening participation)* - Link with other programmes (**EFSI**, COSME...)
Favorable policy environment	- Identify and address **regulatory & financial or other** barriers /gaps/needs **(REGIONS' INPUT!!!)**
Address Knowledge gaps	**- Study** to map EU regions BE Plans – RIS3 (2016) - **Bioeconomy Knowledge Centre**
Increase stakeholders engagement	**- KEP-Knowledge Exchange Platform** - Bioeconomy Stakeholder Panel - Smart Specialisation Platforms, Networks *(ERRIN, ERIAFF)*

http://s3platform.jrc.ec.europa.eu/guides

Bio-based Industries Joint Undertaking (BBI – JU)

Public Private Partnership **supporting R&I for bio-based industries:**

- Partners: **European Commission and Biobased Industries Consortium (BIC)**
- Budget: **€ 3.705 billion** (about 75% from industry)
- Implementation:
  - Principles of **openness, transparency and excellence**
  - Horizon 2020 rules for participation
- Objectives: At least **5 new bio-based value chains** for Europe based on **2nd generation/advanced biorefineries**



www.bbi-europe.eu

FLASHLIGHTS: BIOECONOMY TODAY, OR MAYBE TOMORROW?

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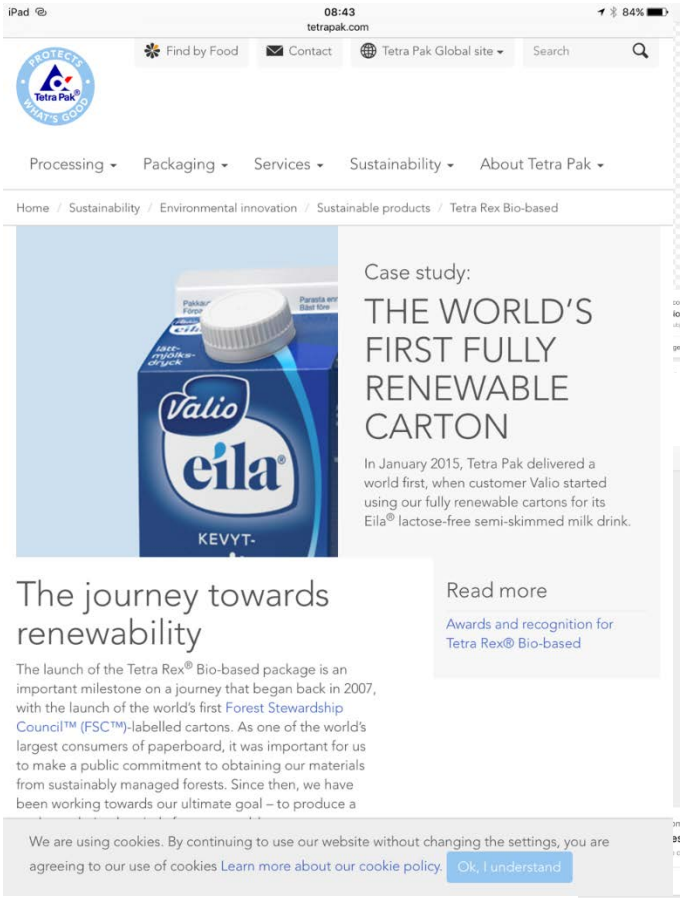
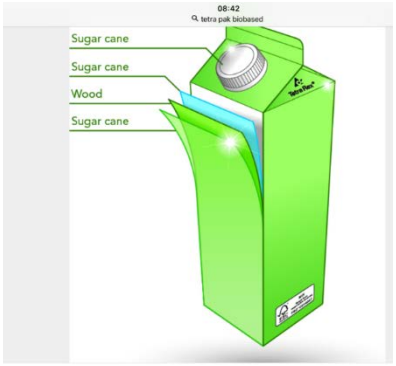
Wood-based packaging





's world's first' 100% plant-based carton

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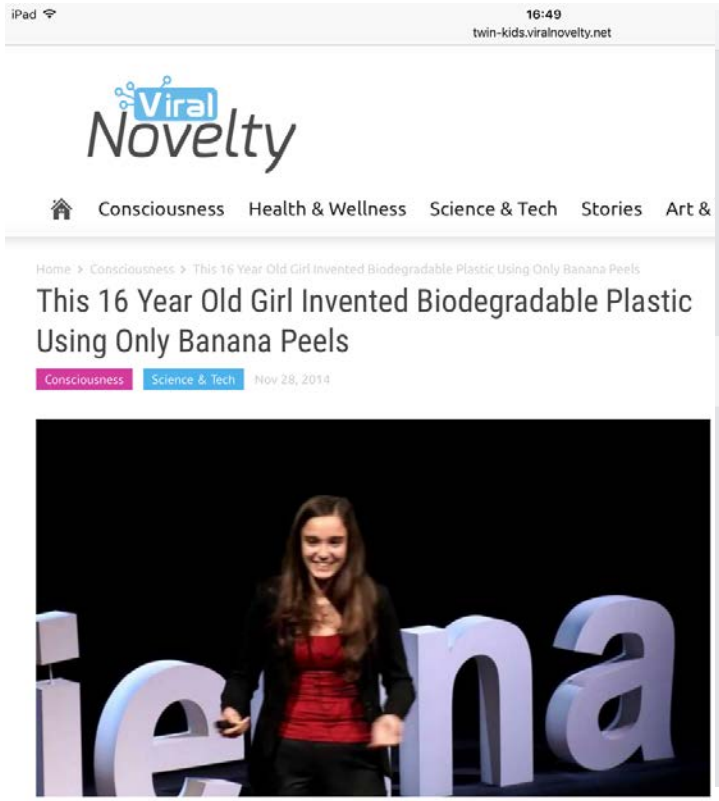
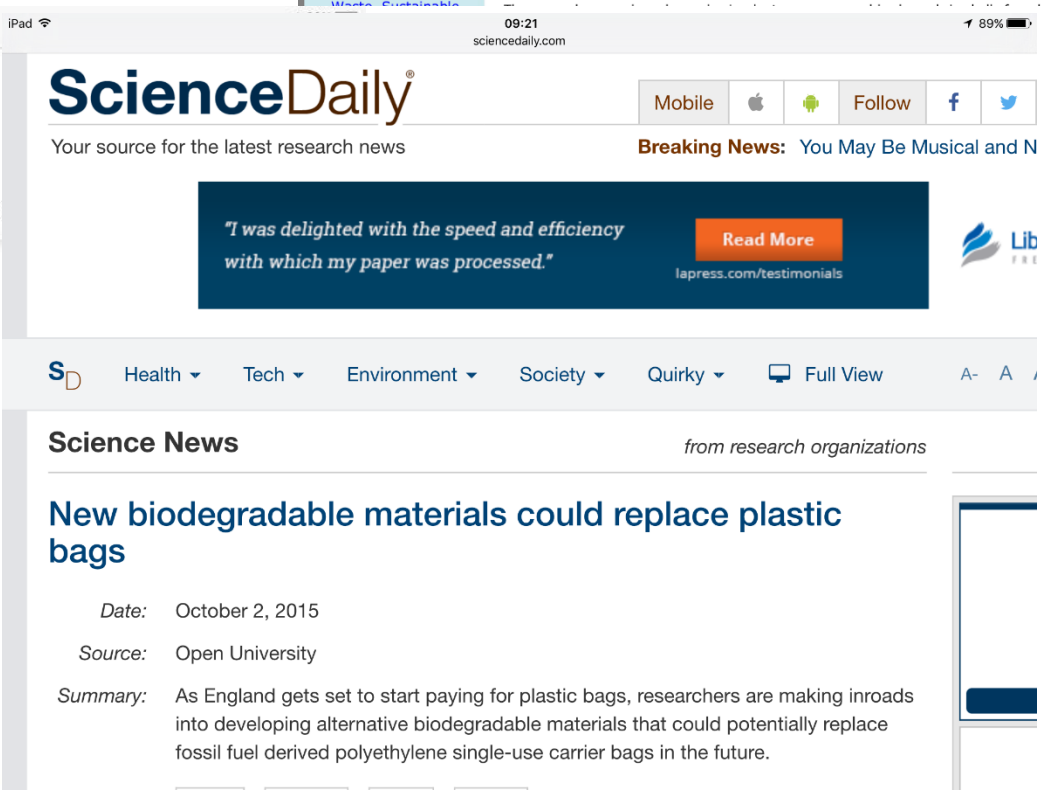
Plastics – biobased not always biodegradable and vice versa





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Biodegradable versus durable

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The Push for Bioplastics and the Myth of Biodegradability

by Tom Szaky January 7, 2015

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*This is the first of a three-part series by **TerraCycle** CEO **Tom Szaky** that examines the benefits, risks, misconceptions and long-term viability of bioplastics.*

Since the relatively recent rise in conscious consumerism, bioplastics — plastics made from biomass such as plants and algae – have been receiving significant attention. With the bioplastic market projected to grow in the next few years, many are pointing to plant-derived plastic alternatives as the ultimate solution to our unsustainable dependence on fossil fuel-based plastics. But one particular type of bioplastic has recently mobilized a torrent of misinformation, misplaced optimism and confusion: plastics labeled "biodegradable."

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Why Durable Bioplastics, Not Biodegradable, May Be the Answer

by Tom Szaky January 21, 2015

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The ArboSkin bioplastic façade created by Stuttgart University's ITKE (Institute of Building Construction and Structural Design) demonstrates the possible architectonic and constructional applications of bioplastic materials. | Image credit: Institute for Building Construction and Structural Design

Related: Packaging, Terracycle, Building/Construction/Real Estate, Chemicals, Consumer Products, Manufacturing, Natural Resources,

To conclude this series about bioplastics and the biodegradability (or lack thereof) of plastic products and packaging, I want to discuss the future of what I consider to be one of the only viable alternatives to plastics derived from non-renewable resources: durable bioplastics.

The key word here is *durable*, because biodegradable plastics of any composition are not the long-term sustainable solution we need. When you compost a biodegradable plastic cup, that polymer can no longer be reused and maintained, meaning all of the energy and material inputs are lost in the soil. They can make sense in certain circumstances, particularly in countries that have large volumes of organic landfill waste. India is a prime example, where about 50-60 percent of the waste sent to landfills is organic and could be composted, but only as a short-term waste-reduction strategy.

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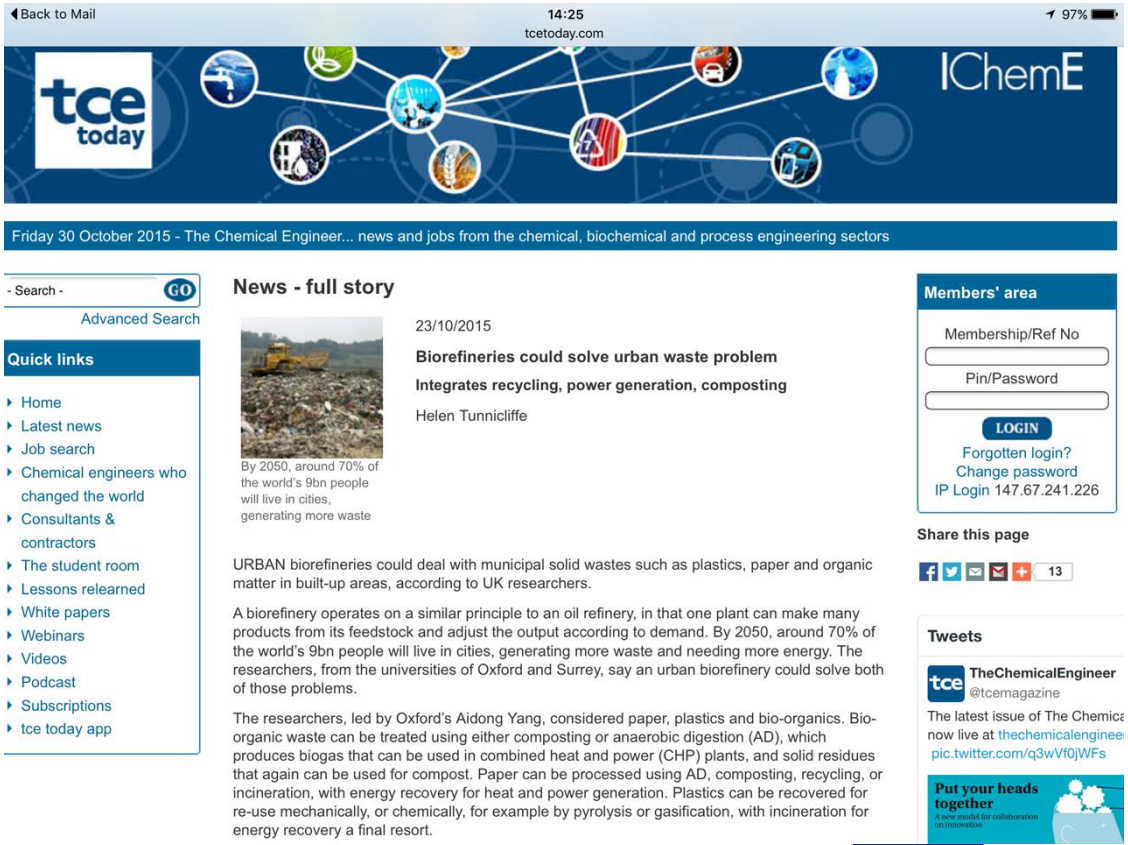
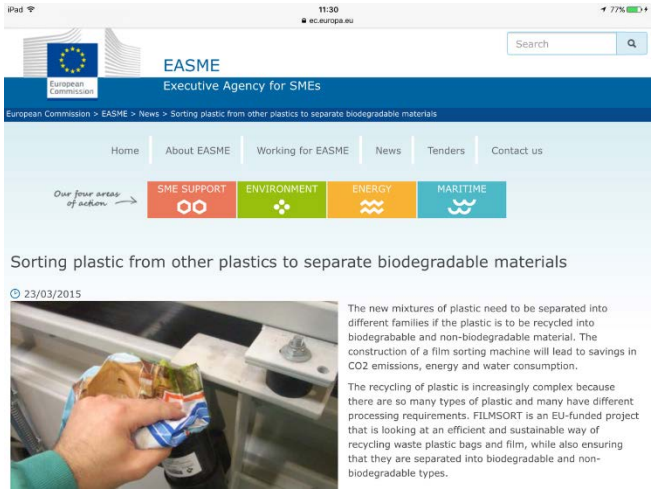
Re-thinking waste management





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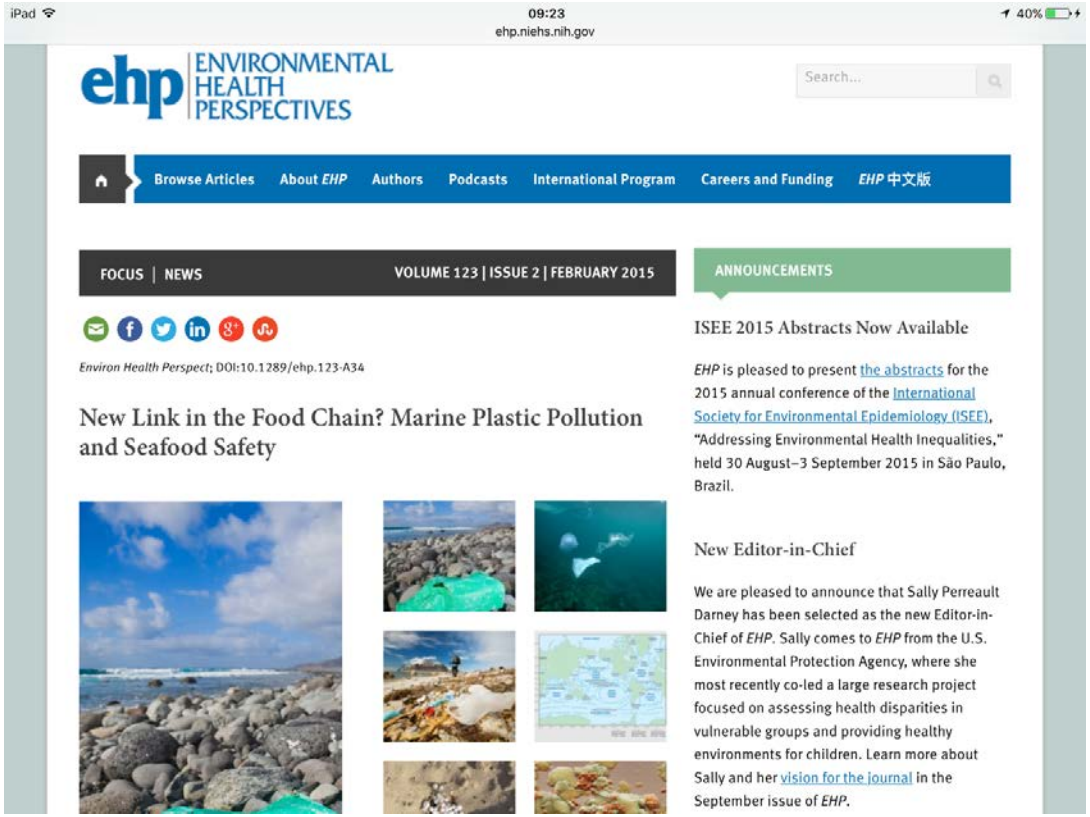
Fighting marine pollution



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Re-inventing cosmetics
Chasing micro-plastics

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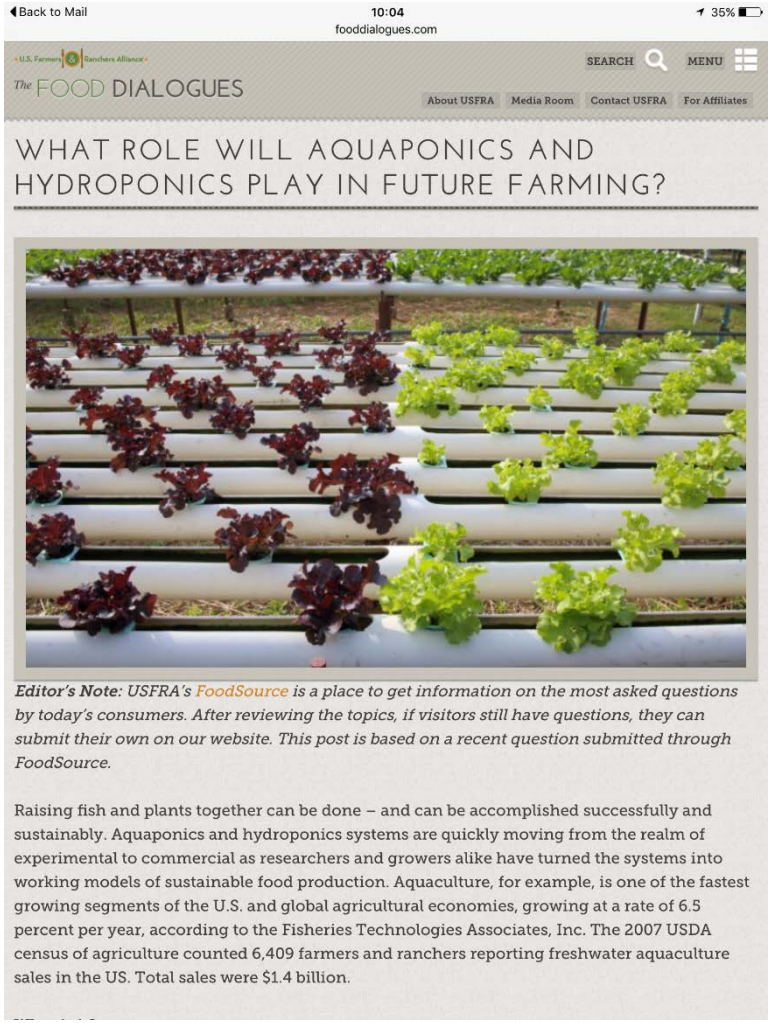
Aquaponics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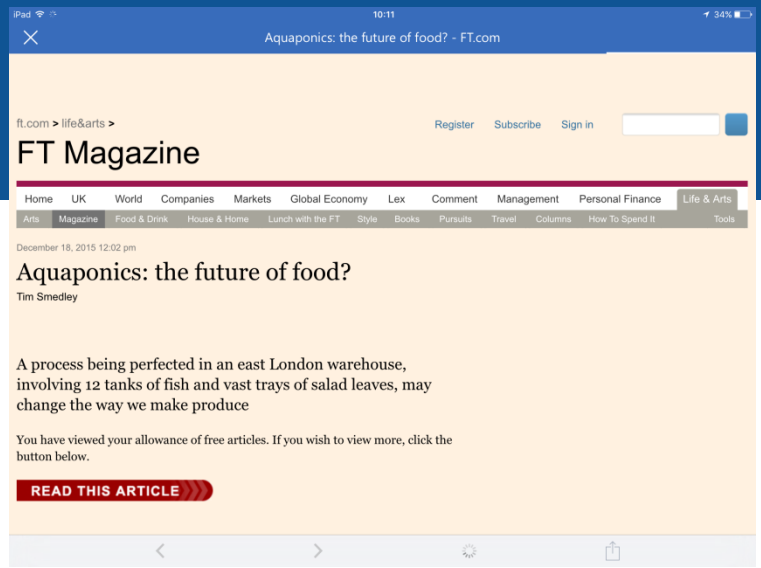
WHAT ROLE WILL AQUAPONICS AND HYDROPONICS PLAY IN FUTURE FARMING?

Editor's Note: *USFRA's FoodSource is a place to get information on the most asked questions by today's consumers. After reviewing the topics, if visitors still have questions, they can submit their own on our website. This post is based on a recent question submitted through FoodSource.*

Raising fish and plants together can be done – and can be accomplished successfully and sustainably. Aquaponics and hydroponics systems are quickly moving from the realm of experimental to commercial as researchers and growers alike have turned the systems into working models of sustainable food production. Aquaculture, for example, is one of the fastest growing segments of the U.S. and global agricultural economies, growing at a rate of 6.5 percent per year, according to the Fisheries Technologies Associates, Inc. The 2007 USDA census of agriculture counted 6,409 farmers and ranchers reporting freshwater aquaculture sales in the US. Total sales were $1.4 billion.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Aquaponics: the future of food? - FT.com

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December 18, 2015 12:02 pm

Aquaponics: the future of food?

Tim Smedley

A process being perfected in an east London warehouse, involving 12 tanks of fish and vast trays of salad leaves, may change the way we make produce

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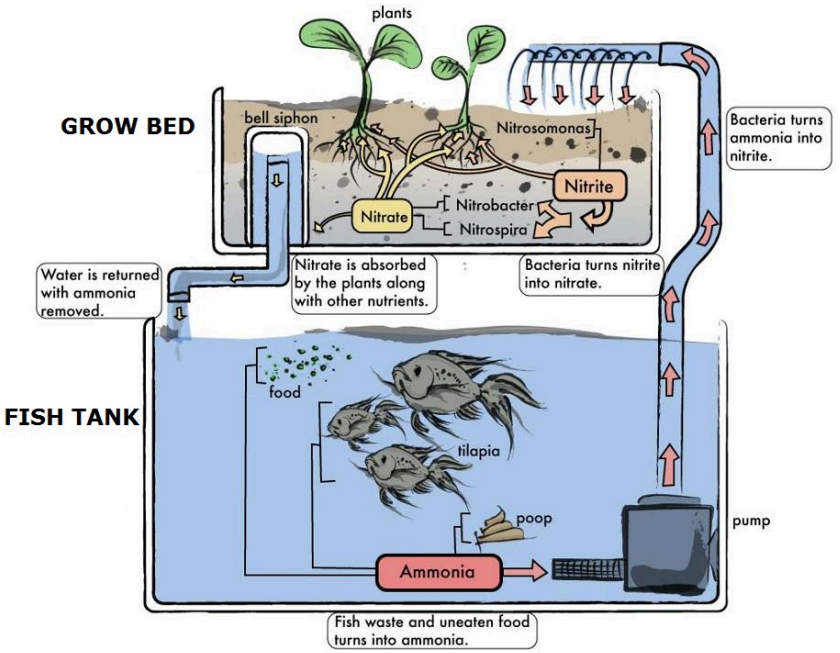
AQUAPONICS BASIC DIAGRAM

http://kanat.jsc.vsc.edu/student/grzyb/main.htm



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Edible landscapes and food sharing

Incredible Edible
Todmorden unlimited

http://pm22100.net/pages/enercoop/I/Incredible_edibles.html

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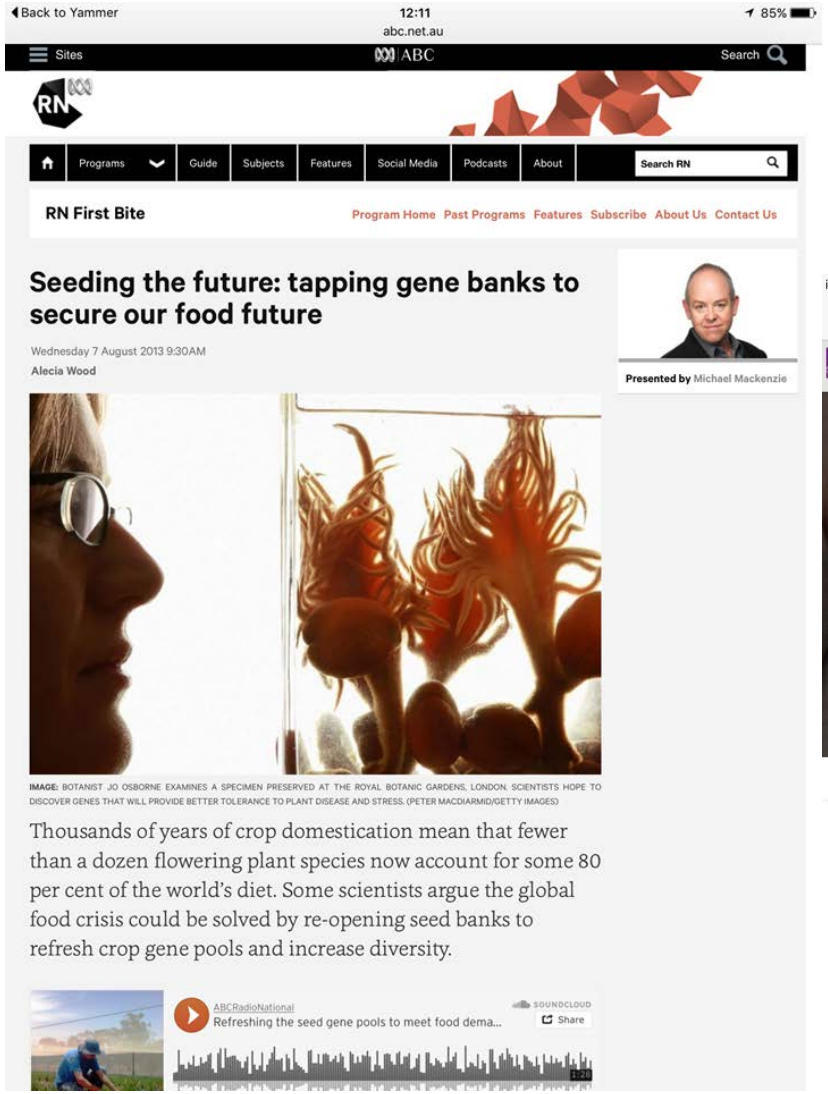
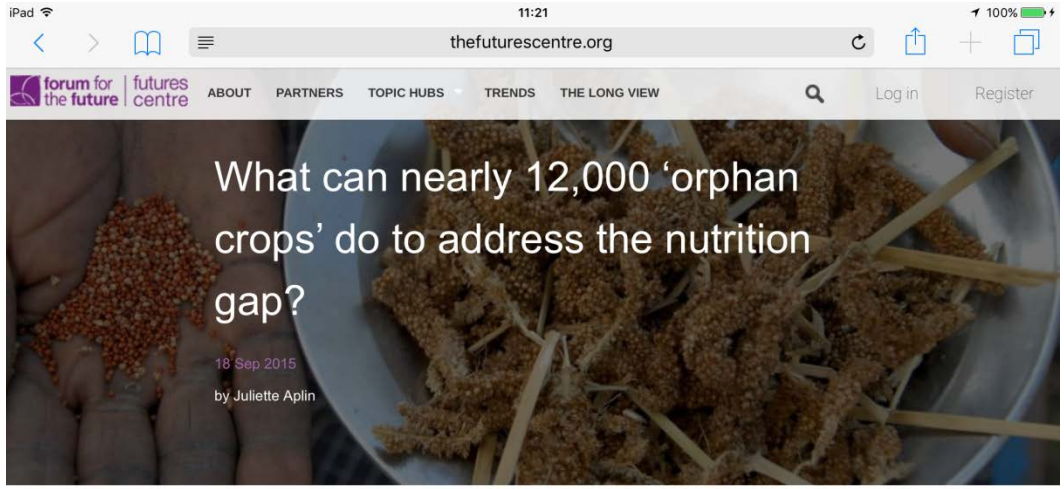
Neglected and forgotten crops revolution





Could 'orphan crops' become a food security and income generation solution for the world's poorest communities?

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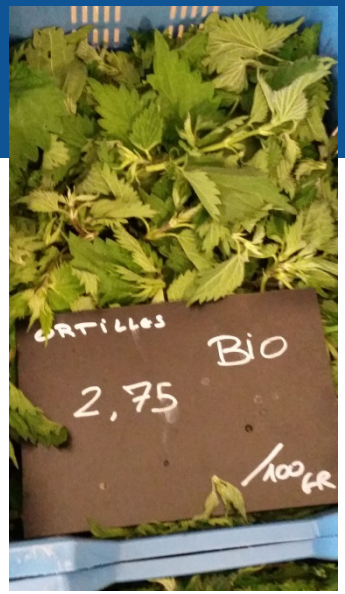

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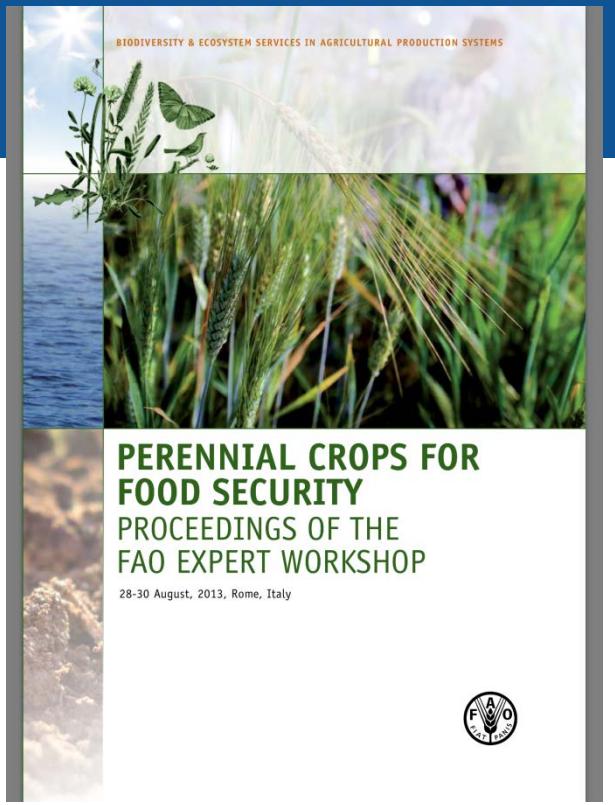
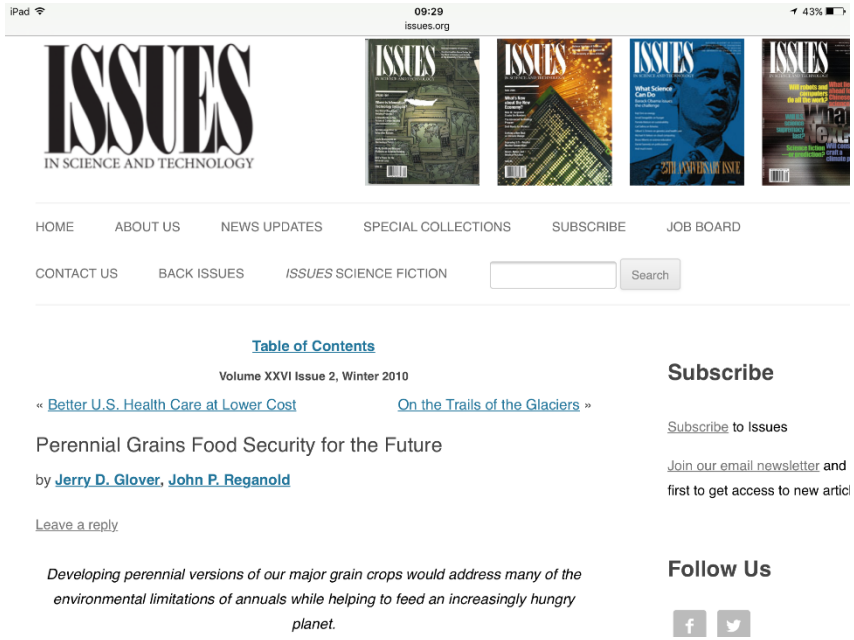
Perennials





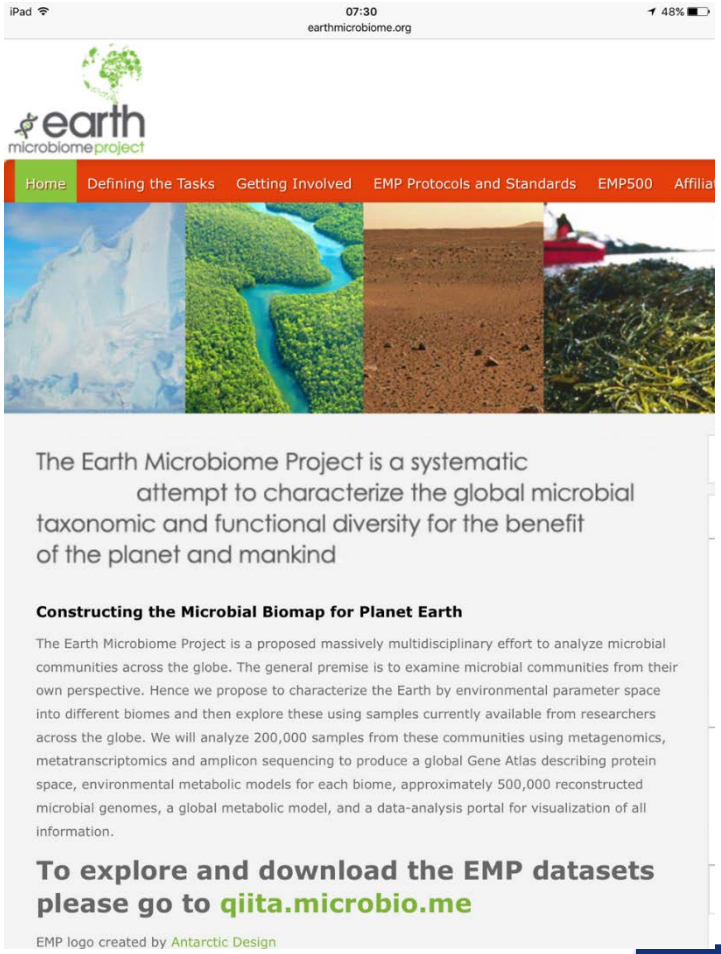
"Perennial cereals, legumes and oil species *represent a paradigm shift in agriculture and hold great potential to move towards sustainable production systems. today, most agronomic practices used to grow annual crops require excessive water consumption, significant amounts of synthetic mineral fertilizers, labour, emissions of co2 and disrupt natural biological processes. Perennial crops instead are more rustic, improve soil structure and water retention capacity and contribute to increase climate change adaptation and mitigation practices and promote biodiversity and ecosystem functions."*

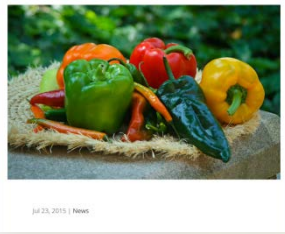
http://www.fao.org/3/a-i3495e.pdf

European Commission

Is this Bioeconomy?

Mapping the puzzle of microbiome potentials





European Commission

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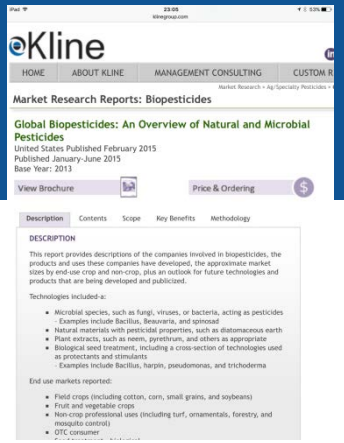
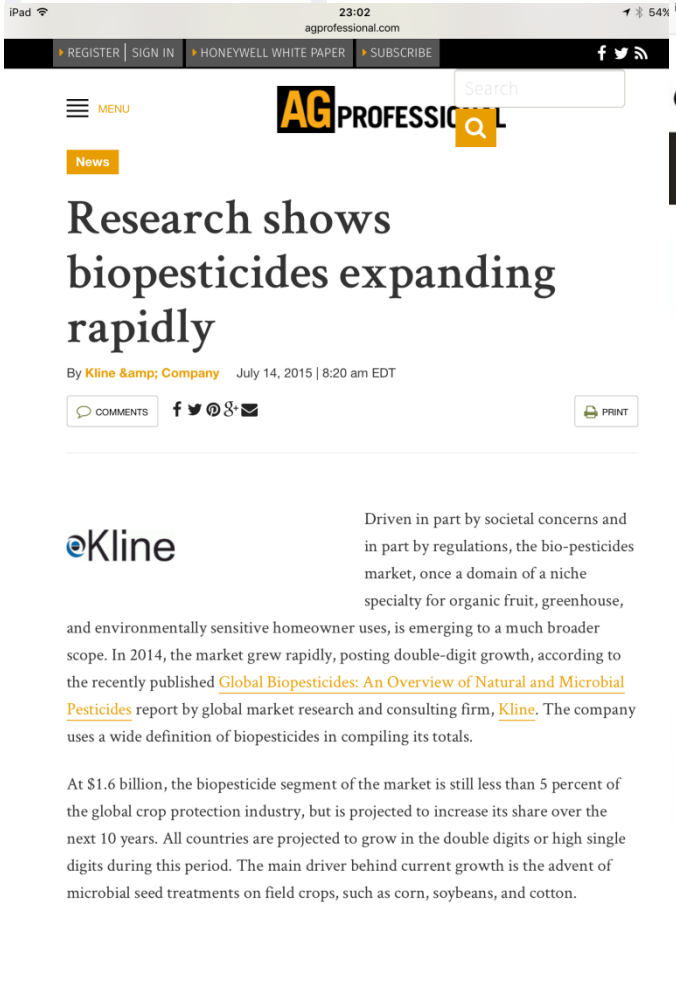
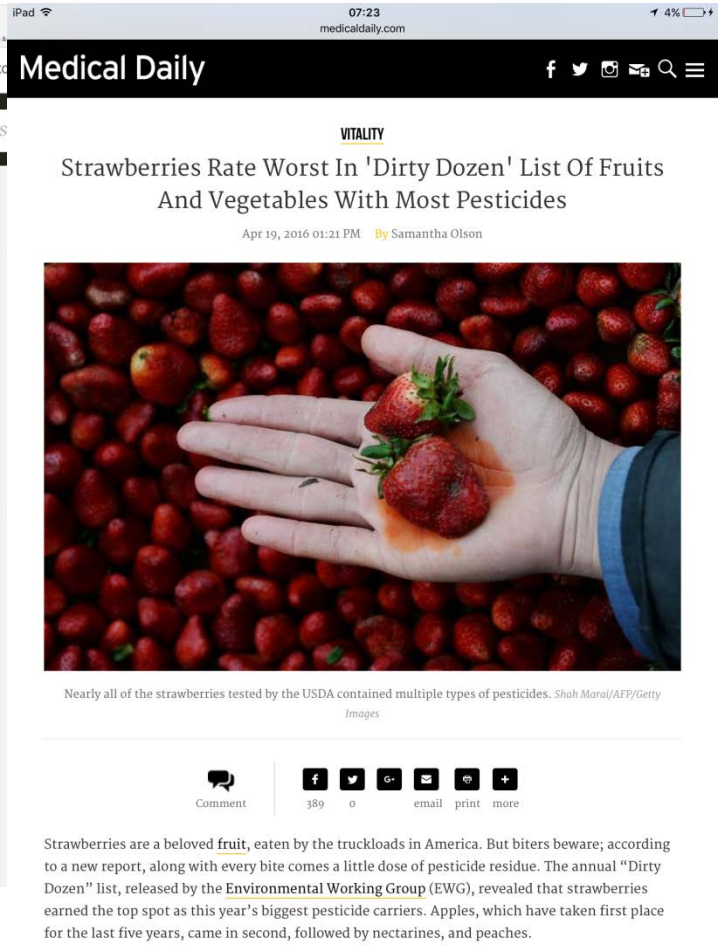
Re-thinking plant protection







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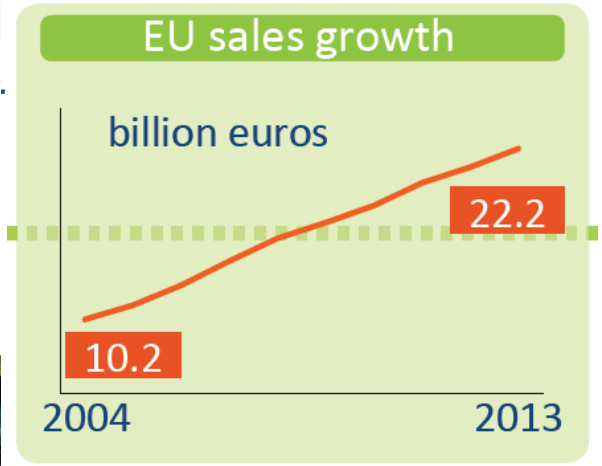
Organics



Source; European Parliament Research Service
https://epthinktank.eu/2015/05/20/organic-food/

Marché bio les Tanneurs, Bruxelles

European Commission

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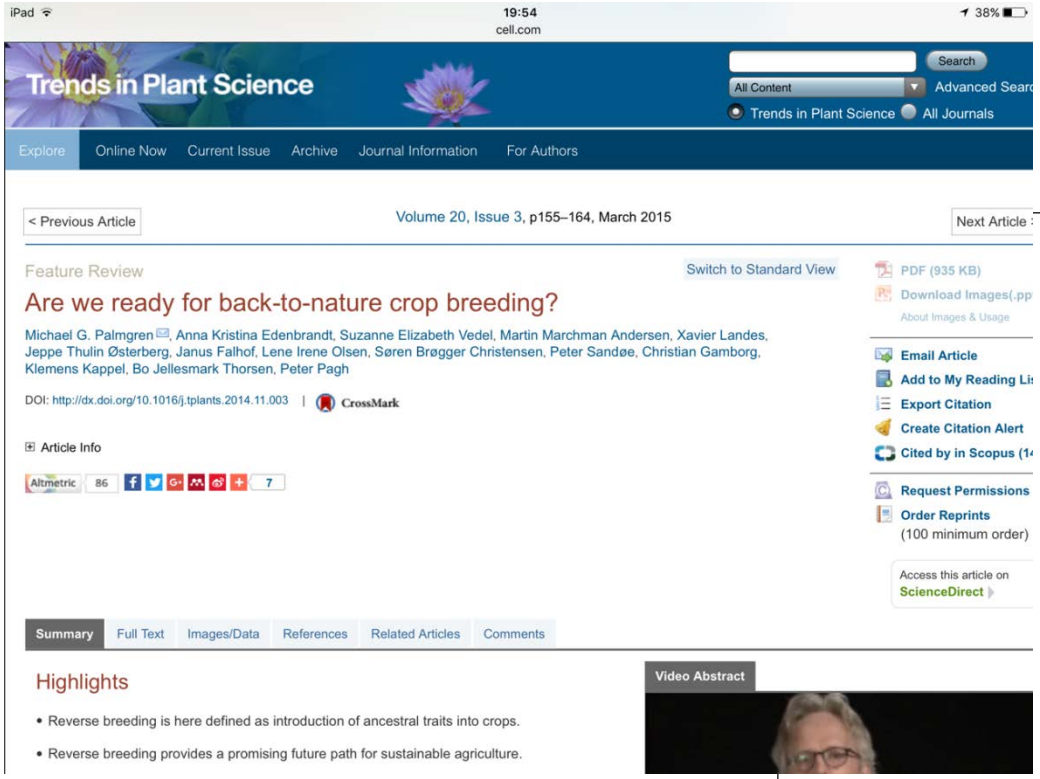
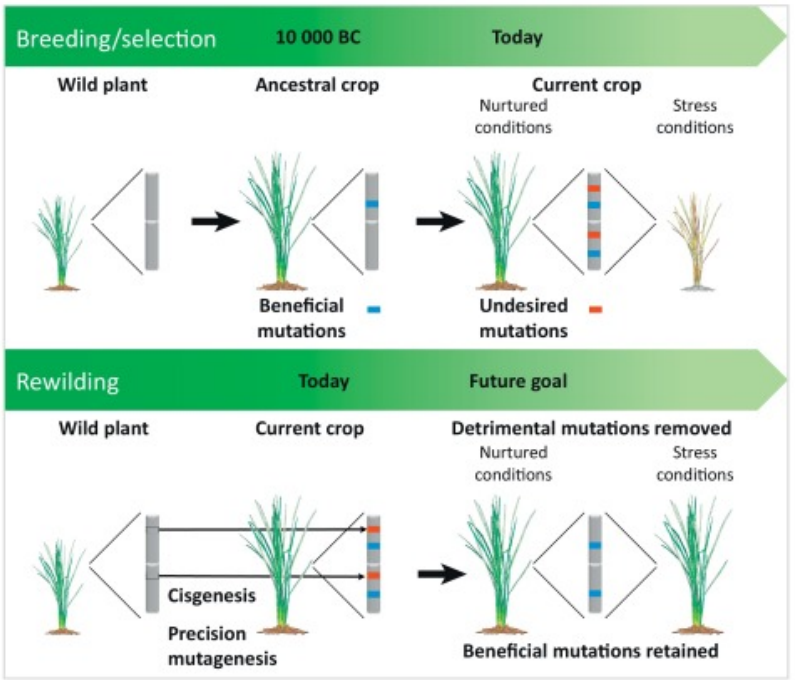
Rewilding





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Marketing uglies and recycling food waste

Delhaize, Drôles de legumes

Brussels Beer project, Beer from recycled bread

European Commission

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Low-impact foods

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What's Next

Why low-impact diets are the next big opportunity

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Matt Loose and Aimee Watson
Wednesday, November 5, 2014 - 4:00am

Window Farm.

Matt Loose
Director
SustainAbility

Aimee Watson
Analyst
SustainAbility

What if everyone could have access to food that meets their dietary needs without preventing future generations from meeting theirs? That's the idea at the heart of sustainable nutrition. Increased attention to the environmental impacts of food types drives interest in sustainable nutrition, helping spur innovation and interest in those foods that can deliver nutritional value with a reduced environmental footprint.

The agricultural footprint — the land required to grow the

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Earth's first superfood? Solazyme's whole algae protein gains traction as formulators seek more vegan options

By Elaine Watson+
10-Sep-2015
Last updated on 10-Sep-2015 at 18:58 GMT

AlgaVia whole algae protein - which contains 63% protein, along with fiber, lipids and micronutrients such as lutein and zeaxanthin - has a slightly nutty taste similar to crushed pistachios.

Related tags: Algae protein, Solazyme, Algae, AlgaVia, Protein

New sources of protein from edible insects to hemp are being incorporated into a growing number of products from bars to beverages. But does microalgae have what it takes to become a serious player in the so-called 'alternative proteins' market?

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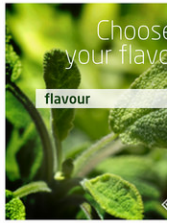

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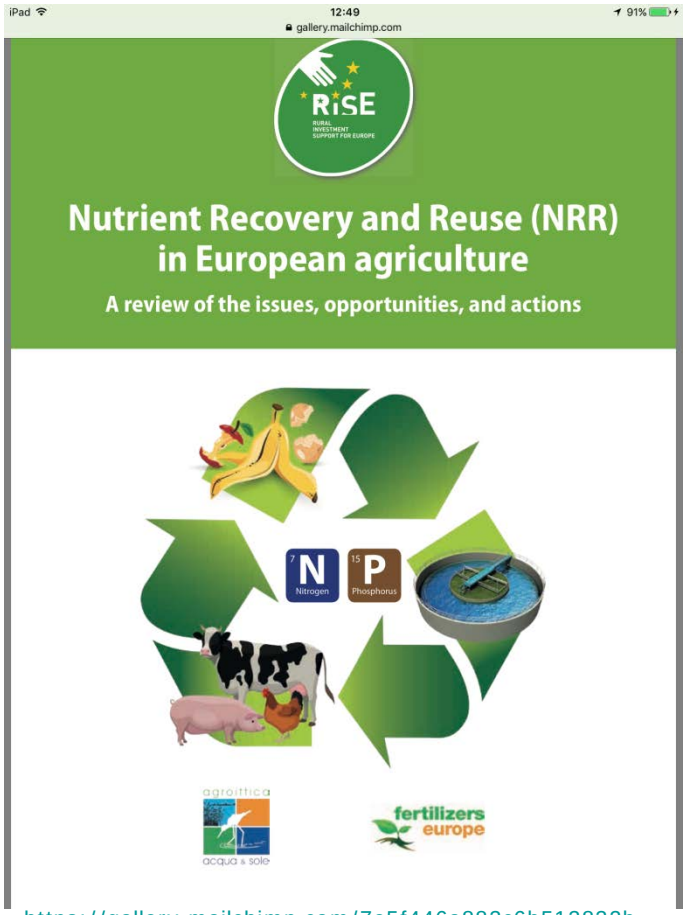
Is this Bioeconomy?

Mainstreaming Nutrient Recovery and Reuse globally



https://gallery.mailchimp.com/7e5f446a883c6b513832bd781/files/NRR_RISE_2016.pdf?mc_cid=3c2d1f1d16&mc_eid=04e2ad0549

"**Every ton of nutrient which is intercepted from a waste flow and processed into a form suitable to be used to fertilize crops represents a ton less which would have leaked into water, the air, or the atmosphere, or ended up in land fill.**

Europe can perform a leadership role in improved nutrient management. Since the transition is unavoidable this would also create first mover advantage and economic opportunities."

European Commission

Is this Bioeconomy?

Re-thinking human waste and toilet technology

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HORIZON
The EU Research & Innovation Magazine

29 October 2015

by Michael Allen

Urine can be turned into commercially available fertiliser. Image credit: Shutterstock/ Peter Gudella

Office blocks and universities could turn pee into commercially available phosphorus and nitro fertilisers, thanks to a bioelectrical reactor in development by researchers across the EU.

Fresh urine contains approximately nine grammes of nitrogen and one gramme of phosphorus per litre, a average person produces between one and one-and-a-half litres a day which currently goes to waste. Researchers believe human urine could provide 18 % of the phosphorous and 25 % of the nitrogen currer used for soil fertilisation in the EU.

By extracting these compounds rather than flushing them down the sewer, we could reduce energy-intensive ammonia production and cut our reliance on imported phosphorous ore.

'We require phosphorus to ensure the production of crops and, with a growing human population and almost no phosphorus reserves in Europe, we rely on imports,' said Dr Philipp Kuntke, from Dutch water research firm Wetsus, who was involved in the project, known as ValuefromUrine.

It's possible thanks to urine-separation toilets and urinals, which stop it being diluted by other wastewater streams.

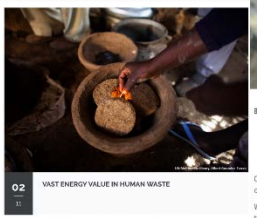
It means the EU-funded project, which finishes next year, has been able to develop a three-step process that uses a bioelectrical

> 'With a growing human population and almost no phosphorus reserves in Europe, we rely on import
>
> *Dr Philipp Kuntke, Wetsus*

Salt

The innovation turning human waste into a powerful stink-free resource

This story is part of an Ashoka series in collaboration with Salt, spotlighting leading young innovators to support the Unilever Sustainable Living Young Entrepreneurs Awards, a global competition launched by Unilever in partnership with Cambridge Institute for Sustainability Leadership. To follow the conversation on Twitter, search #GlobalGoals for a #bright



02 VAST ENERGY VALUE IN HUMAN WASTE

Vast Energy Value in Human Waste

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From The Editor | May 22, 2014

'Peecycle' Please: Will Urine Separation For Nutrient Recovery Take Off?

By Kevin Westerling
@KevinOnWater

Is it feasible to separate nutrient-rich urine before it reaches the wastewater treatment plant?

It might be a pipe dream, but researchers are investigating the potential of keeping urine separate from the rest of the wastewater we humans produce. The urine would be diverted as close to the source as possible — at the toilet, via dedicated plumbing — and then stored, treated, and converted into fertilizer. While it's not realistic to expect urine-diverting (UD) toilets in every home, they could reasonably be installed in high-occupancy buildings.

Fertile Ground For Research

The goal is not only to make fertilizer, but to decrease the amount of nutrient removal required at the wastewater treatment plant (WWTP) — or the "water resource recovery facility" (WRRF), which is the term the Water Environment Research Federation (WERF) prefers. The new moniker certainly fits in this case, as the WERF-sponsored research project is right in line with its mission to capture and

Making wealth from waste

In Ghana, fertilizer pellets from fecal sludge are becoming a reality

By Jeff Smith on October 8, 2015

Construction workers wearing yellow hard hats and rubber rain boots were recently laying cement blocks in a dirt-leveled field near the busy port town of Tema, Ghana.

Work was in the early stages of a low-cost, mostly open-air plant that eventually is anticipated to produce 500 metric tons a year of fertilizer powder and pellets for the agriculture sector under the trademarked name "Fortifer."

But what will be unusual about this fertilizer plant is the raw material that will be used: human waste from septic tanks and latrines in the area. To be more precise — 12,600 cubic meters a year of waste when the plant is at full operation.

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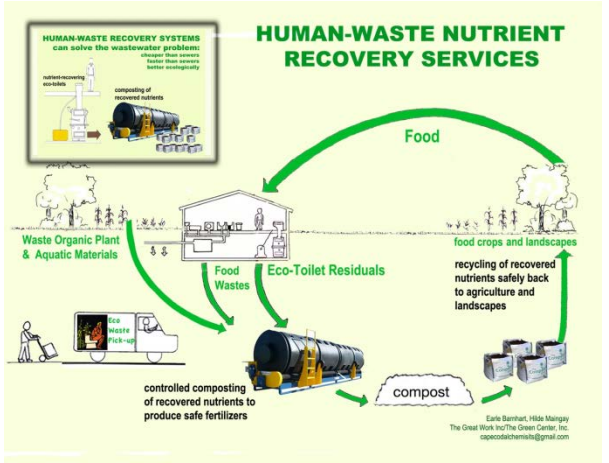
Renewable energy

Power to the poop: one Colorado city is using human waste to run its vehicles

Renewable natural gas is a growing industry for fuel, electricity and heat, but advocates says it's a largely untapped market in the US

Melanie Sevcenko



European Commission

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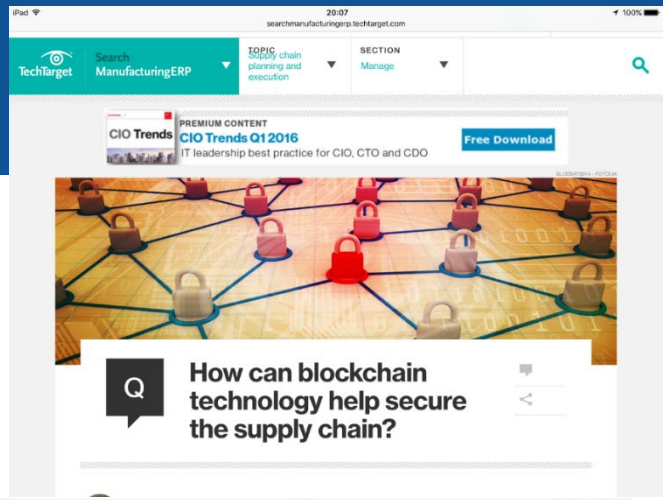
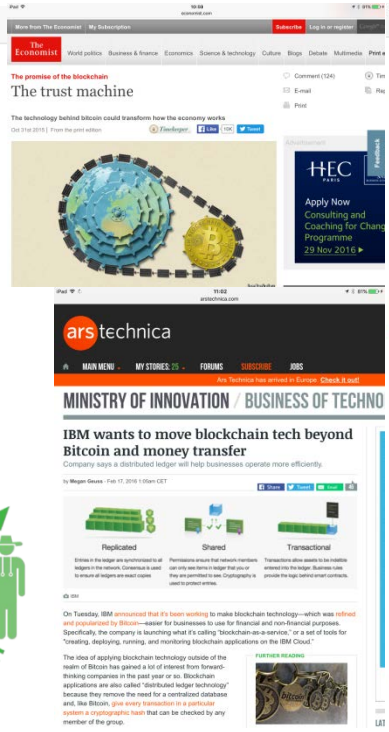
Provenance technology for supply chain traceability





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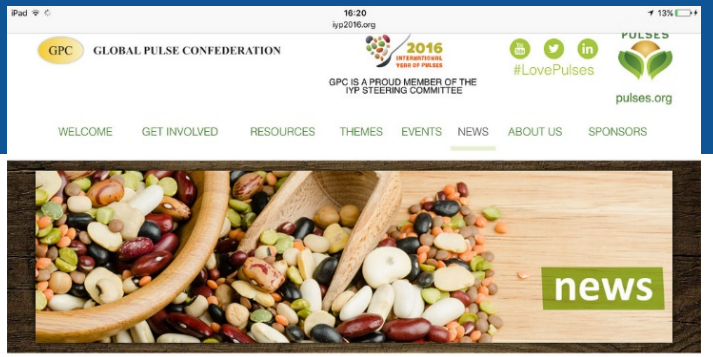
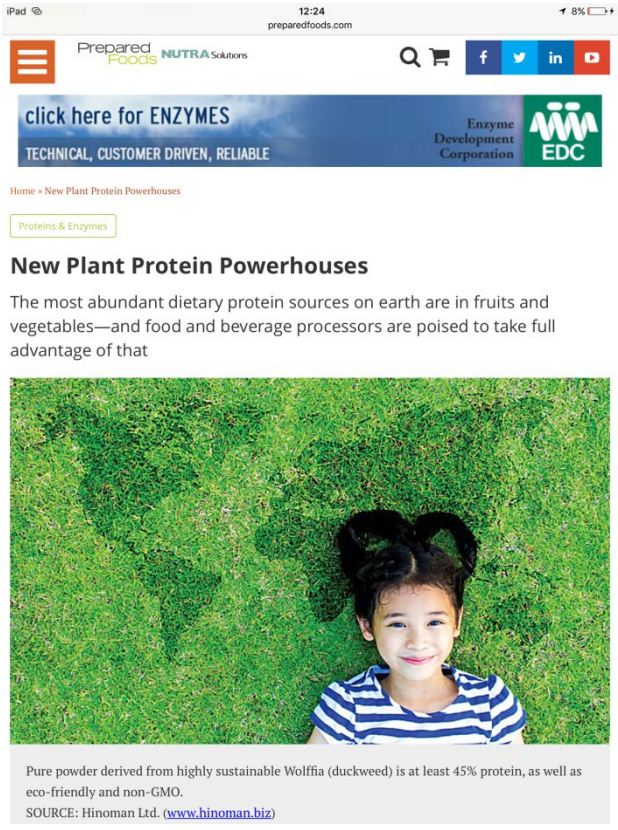
Alternative sources of protein

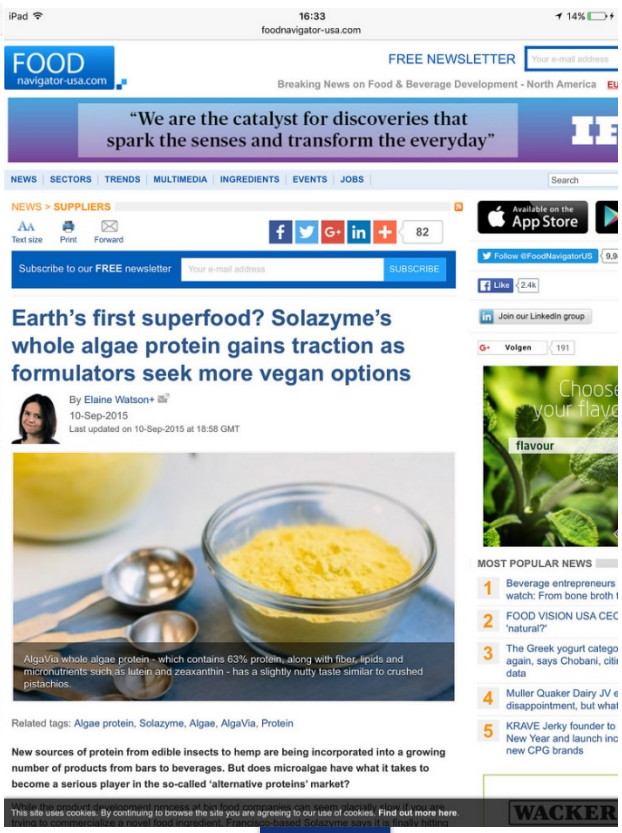


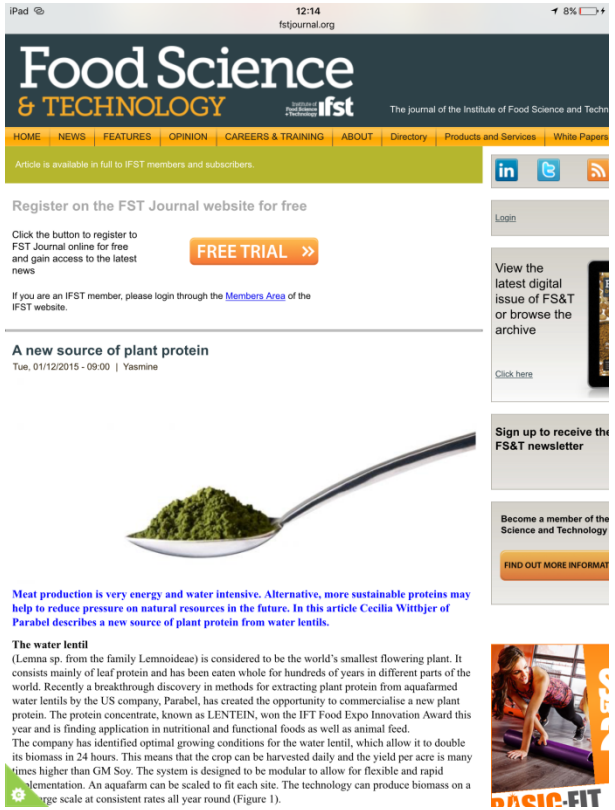
Food Research: High Quality Plant Proteins

Published: 17 March 2015

Plant-derived proteins provide an ideal answer to the increasing demand for nutritious protein-rich food, now and into the future as population growth further increases the need for proteins. However, many plant proteins available today have lost functionality during the isolation and drying processes. Scientists around the world are trying to find ways to

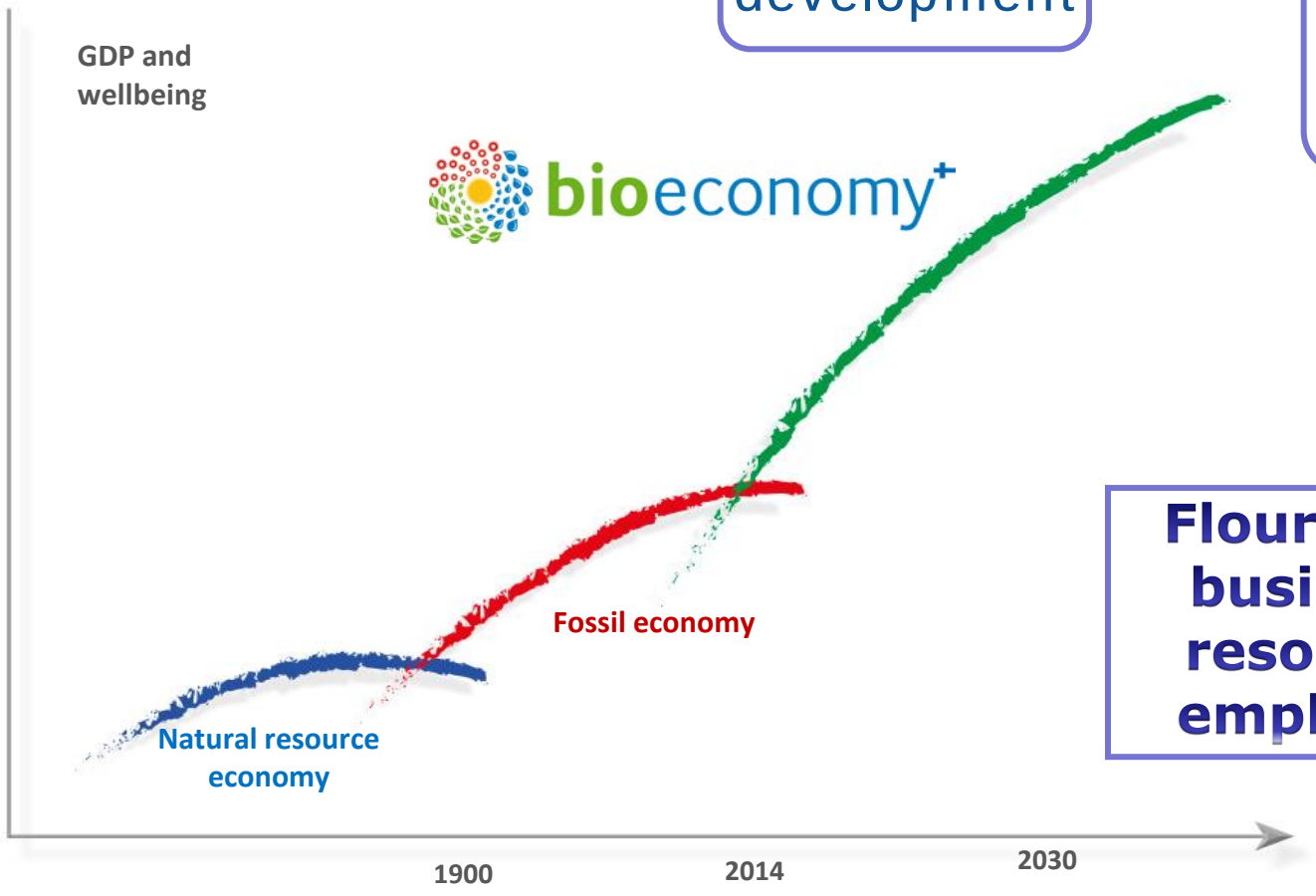






Sustainable development

Non-fossil, post-petroleum society



Flourish local businesses, resources & employment

Source: Finnish Bioeconomy Strategy, 2014

FOOD 2030 R&I Framework

1. To promote a **systems approach to research and innovation**,

2. To better **structure, connect and scale-up EU R&I**, in a global context

3. To **step-up EU investment** ambition (public and private)

4. To mobilise international stakeholders to **tackle global societal challenges**

Food 2030 Conference, Brussels 12-13 October 2016

http://ec.europa.eu/research/conferences/2016/food2030/

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