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Innovative Food Product Development Cycle: Frame for Stepping Up Research Excellence of FINS

European Commission

Side streams, residues, by-products, bioresources….

Use of processing waste streams in the future bioeconomy: opportunities and challenges for value chain development

Dr. Laura Devaney

22nd March 2016

Horizon 2020 | European Union funding for Research & Innovation
Grant Agreement number: 692276 — FOODstars | H2020-TWINN-2015

Context

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Context

Escalating global challenges relating to:

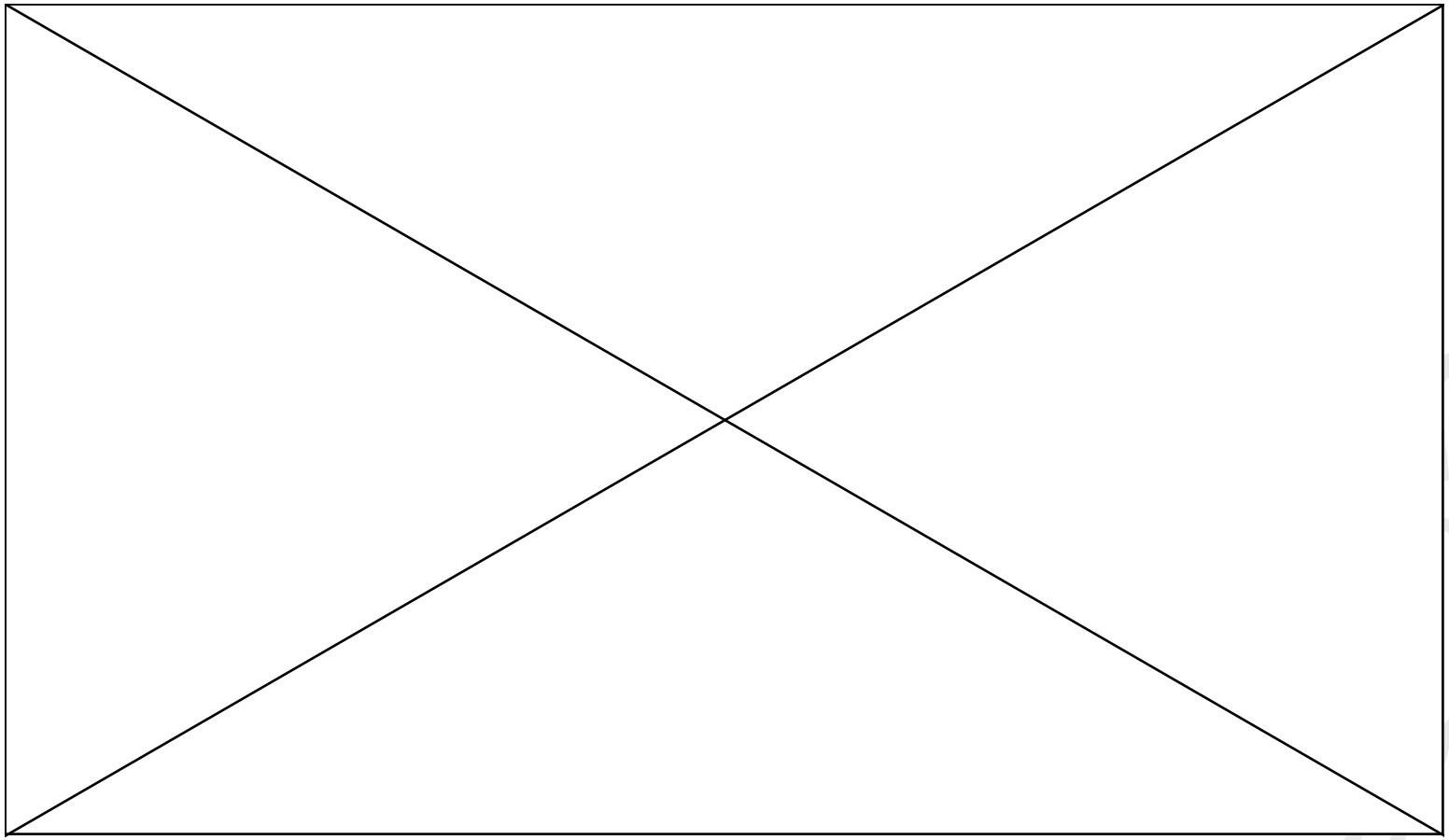
- Climate change
- Biodiversity loss
- Soil degradation
- Food and water security
- Resource scarcity….

Compounded by issues of:

- Growing populations
- Rising middle class
- Search for economic sustainability




New mode of sustainable growth and development required…the bioeconomy concept



Source: http://ec.europa.eu/research/bioeconomy/index.cfm

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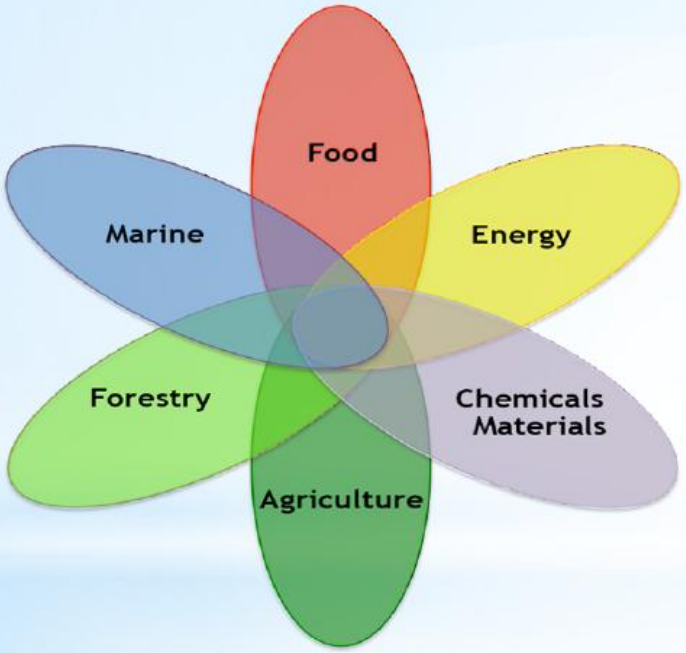
THE BIOECONOMY



THOSE PARTS OF THE ECONOMY THAT USE RENEWABLE BIOLOGICAL RESOURCES (BIOMASS) FROM LAND AND SEA SUCH AS CROPS, FORESTS, FISH, ANIMALS, MICRO-ORGANISMS, AND ORGANIC WASTE AND RESIDUES TO PRODUCE FOOD, FEED, MATERIALS, CHEMICALS, FUELS, AND ENERGY

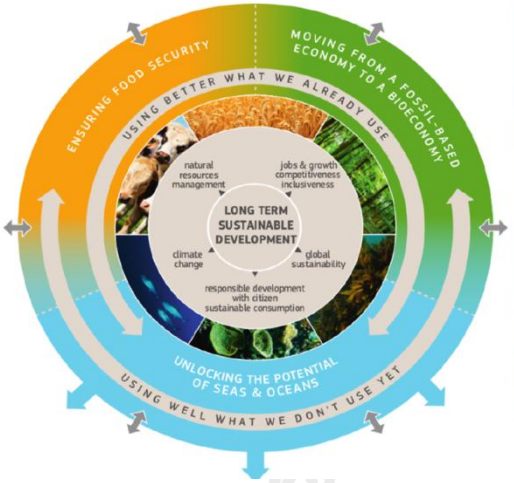
Source: SCAR (Standing Committee on Agricultural Research)

(Potocnik, 2015)

Towards a sustainable future…

Bioeconomy encompasses:

- "The **sustainable production** of renewable resources from land, fisheries and aquaculture environments and their conversion into food, feed, fiber bio-based products" (EC, 2015)
- "**Economic growth** driven by the development of renewable biological resources and biotechnologies to produce sustainable products, **employment** and **income**" (Rosegrant et al., 2013, p139)
- "A future in which we rely on renewable biological resources to **meet our needs** for food, materials and energy" (EC, 2014)
- "A **vision** for the future society" (Socaciu, 2014, p1)



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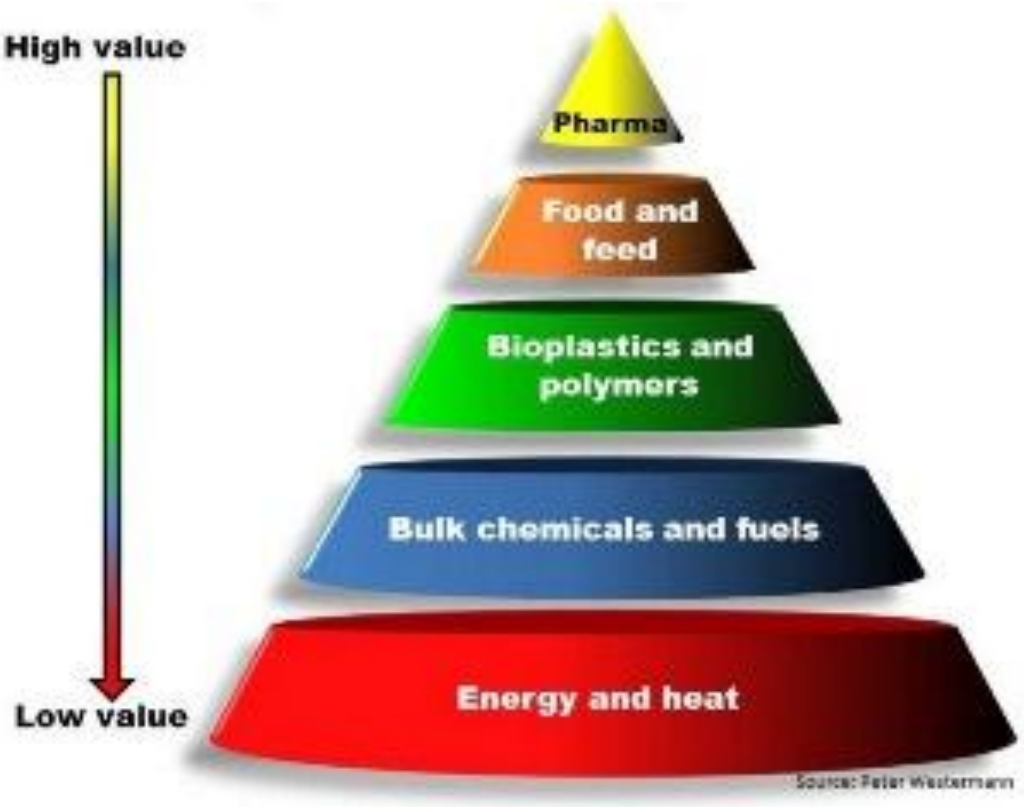
The Bioeconomy context for food processing side streams

- **Pull factors**
  - Opportunity for job creation and creation of new industries
  - New market opportunities
  - Environmental benefits
  - Consider non-food as well as food uses of biological resources

- **Bioeconomy principles (SCAR, 2015)**
  - Food first
  - Sustainable yields
  - Diversity
  - Cascading approach
  - Circularity

Cascading approach



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Use of processing side streams in the circular bioeconomy

PRINCIPLE

1

Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows

PRINCIPLE

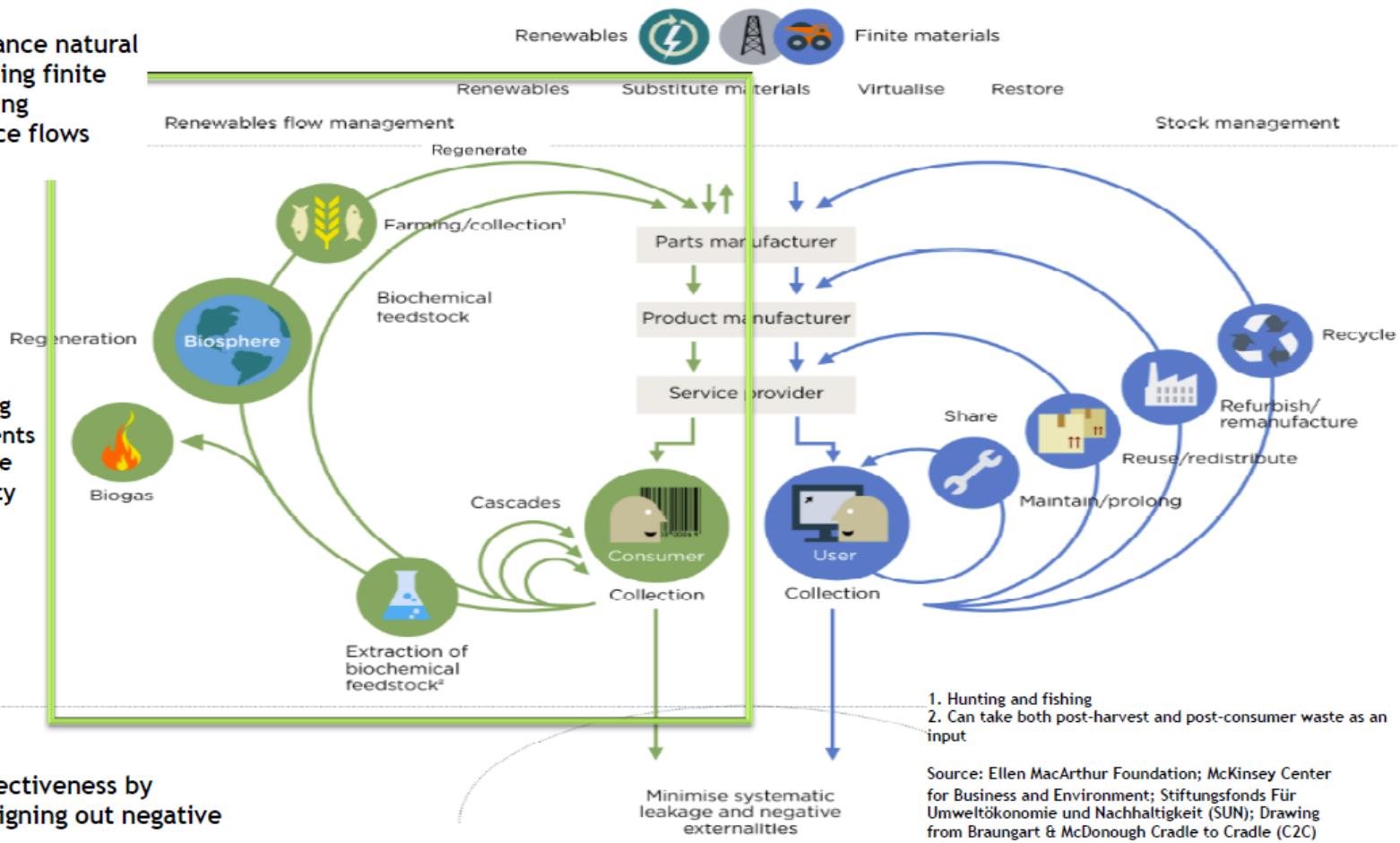
2

Optimise resource yields by circulating products, components and materials in use at the highest utility at all times in both technical and biological cycles

PRINCIPLE

3

Foster system effectiveness by revealing and designing out negative externalities



1. Hunting and fishing
2. Can take both post-harvest and post-consumer waste as an input

Source: Ellen MacArthur Foundation; McKinsey Center for Business and Environment; Stiftungsfonds Für Umweltökonomie und Nachhaltigkeit (SUN); Drawing from Braungart & McDonough Cradle to Cradle (C2C)

Towards a sustainable future…

*"The bioeconomy encompasses the production of **renewable biological resources** and their conversion into food, feed, bio-based products and bioenergy" (EC, 2012)*

- Use of processing side streams in the bioeconomy
  - Help society live within its limits – decoupling economic growth from environmental degradation
  - Political – realise existing policy or newly defined objectives
  - Economic – stimulate economic performance, generate new market power
  - Environmental – realise environmental objectives, e.g. GHG
- Data, knowledge and innovation as the feedstock instead of oil
- Gaining traction at global, EU and national scales….

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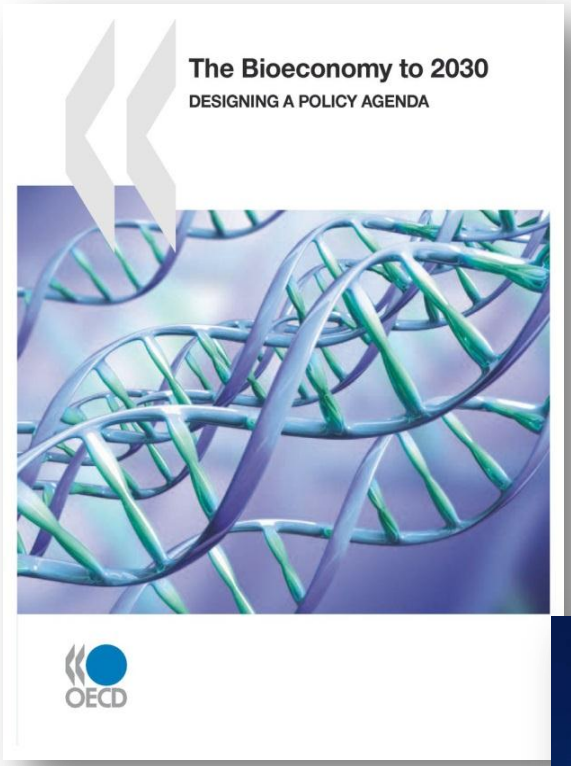
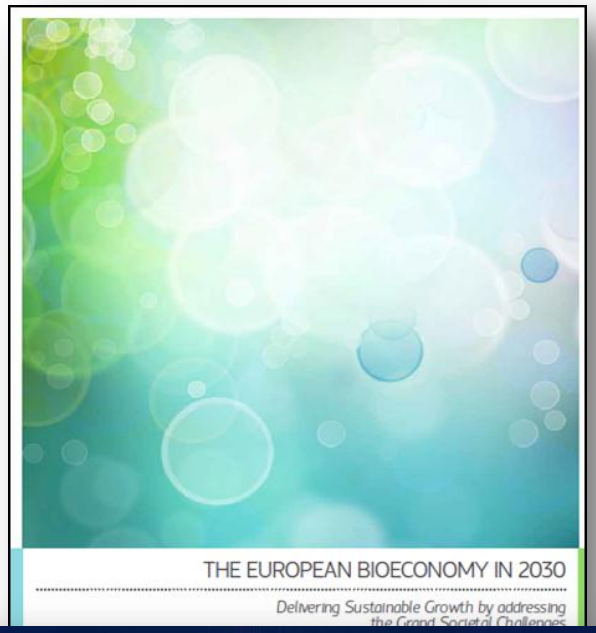
Existing international bioeconomy context





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Opportunities in the Bioeconomy

To address the challenges imposed by a changing climate and a world of increasingly limited resources

- Reduce dependence on non-renewable resources
  - Move towards a post-petroleum society
- Produce more from less and harness opportunities in processing side streams
- Reduce GHG emissions & environmental footprint
- Contribute towards future food security
- Provide employment
- Foster a new wave of economic growth
- Ultimately change how we produce, process and recover biological feedstocks

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Value Chain Approach…policy to practice

*"The value chain describes the **full range of activities** which are required to bring a product or service **from conception**, through the **intermediary phases** of production (involving a combination of physical transformation and the input of various producer services), **delivery to final consumers**, and final disposal after use"* (Kaplinsky, 2000, p121)

- Products pass through the activities of a chain, and at each stage the product increases in value – both physical transformation but also related support functions (Porter, 1985)

- Account for the increasing fragmentation of processes in the production and supply of goods, both within and across countries (Heery et al., 2015)

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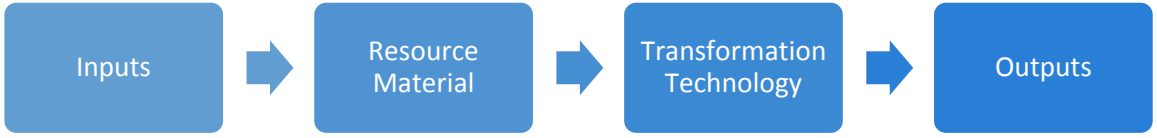
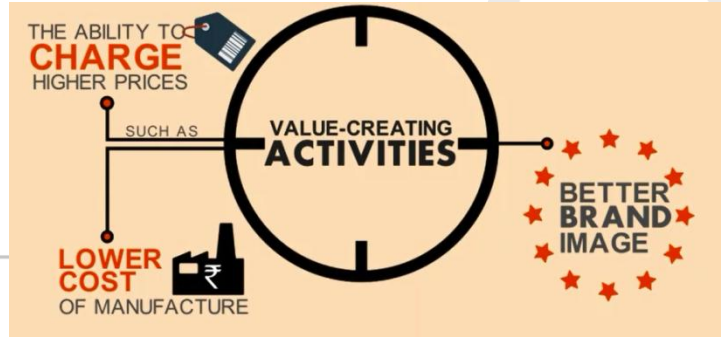
Bioeconomy Value Chains

- **Bio-based value chains** = "the sequence of processes from biomass production to bio-product along with its opportunities for value generation, including economic, social and ecological values. An integrated bio-based value chain optimizes the interaction of these processes and the material flows involved, with the objective of optimizing the overall performance in economic, ecological and social terms" (Lewandowski, 2015, p40)

- **Bioeconomic value chain nets** = "the interactions and interrelations of bio-based value chains, including the stakeholders involved, within the bioeconomic sector…[for] the optimal allocation and most efficient use of a limited biomass resource" (Lewandowski, 2015, p41)





Bioeconomy Value Chains

Bio-Based Industries Consortium (2013) ***= a structured approach via 5 Value Chains:***

- **Value Chain 1:** From lignocellulosic feedstock to advanced biofuels, bio-based chemicals & biomaterials
- **Value Chain 2:** Next generation forest-based value chains
- **Value Chain 3:** Next generation agro-based value chains
- **Value Chain 4:** New value chains from (organic) waste
- **Value Chain 5:** Integrated energy, pulp and chemicals biorefineries

- Development of one value chain not to impede another
- Missing marine focus at present
- Geographically sensitive value chain development

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Opportunities in Ireland

- Ireland as a high potential candidate in the bioeconomy arena:
  - Abundant renewable resources
  - Thriving agriculture and marine sectors
  - Growing forestry development
  - Well-respected food industry
  - Innovative research and development capabilities

- However, Ireland is only beginning to tap into new bioeconomic opportunities.

- Mainstream and niche opportunities….

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Potential Opportunities in the Irish Bioeconomy

Broad value chain examples

- Non-food opportunities in the agricultural sector e.g. slurry
- “Don’t waste seafood waste”!
- Use of wild & pest species e.g. broadleaf dock, thistles, grass

Food processing side stream specifics:

- Valorisation of spent distillers grain beyond animal feed e.g. use of Betaine for sports nutrition – research at Reading University
- Use of 5th quarter products e.g. whole parts or further processed
- Use of dairy side streams for HMO bioactives – to incorporate into infant formula for brain development and immune benefits
- Irish Whiskey renaissance - recover co-product for feed, biofuels and also opportunities to recover water

What opportunities for the Serbian bioeconomy?

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International best practice

Example case studies of many…new developments everyday

Conversion of fish waste to flavours could be commercially viable, say researchers

By Nathan Gray+
12-Oct-2015

Post a comment

FCRN
Food Climate Research Network

About FCRN Resources Network & collaborat

Methane: the future of fish feed?

From bread to bulbs: Food waste could ...entally sustainable

Companies collaborate on packaging made from agriculture waste

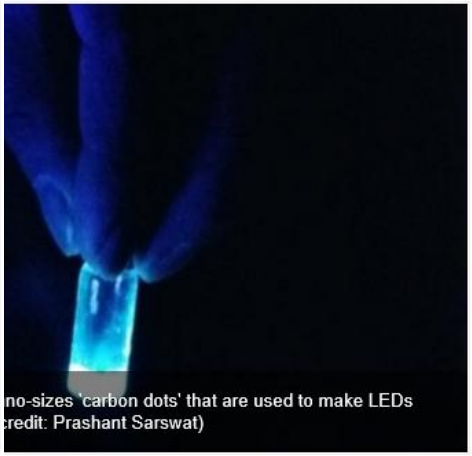
By Daisy Phillipson, 25-May-2015

2 comments

Post a comment

Trial mouldings are 250 x 150 x 50mm but different sizes will be offered

4:33 GMT



...no-sizes 'carbon dots' that are used to make LEDs
...redit: Prashant Sarswat)

Fibers from food w... option

By Elizabeth Crawford
05-Aug-2015
Last updated on 11-Aug-2015 at 19:

Business Challenges?

- Raw materials availability and logistics (to transport by-product)
- Market potential, economic impact, environmental impact
- Why prevent and reduce waste if it is a resource? Difficult to match up 'waste' from a policy perspective – waste hierarchy vs circular economy
- Looking for new products = long, laborious and costly – demands long term investment and expertise from a business perspective

- **Considerations:** utility cost, capital costs, environmental impact, co-product profit, geography and scale
- **Challenge:** focus on green chemistry of late – market demand for natural products, do consumers want complex chemical and extraction processes?

Wider challenges for the future bioeconomy

- Public acceptance and consumer demand
  - “Requirements include not only technology development, but holistic programme for market development” (Bonsall, 2015)
- Coherence in approach: politically and internationally
- Fostering cross-sectoral collaboration
- Ensuring uptake, diffusion and appropriate upskilling/reskilling
- Biosecurity
- Competition between generators and users of biomass
- Fragmented supply chains
- Need for demonstration projects - develop systems that do not require extraordinary scale to extract optimal value

- No one size fits all…

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European Commission

Policy, strategy and consumer implications: the Irish experience

Dr. Laura Devaney

22nd March 2016

Horizon 2020 | European Union funding for Research & Innovation
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Developments happening already BUT challenges remain….

- Key question/challenge now = what to focus on from a national perspective

- No coherent national bioeconomy strategy in Ireland (nor Serbia?)
  - Need to connect up quickly – innovation and ideas out there
  - Draw on domestic strengths
  - Identify priorities for development
  - Highlight stakeholder groups for engagement

- Value chain development (including use of food processing side streams) in the bioeconomy must be fully supported by suite of policy measures (e.g. taxation, public procurement, sustainability and safety criteria etc.)

Bioeconomy Policies around the World

(German Bioeconomy Council, 2015)

Ireland: cross-sectoral

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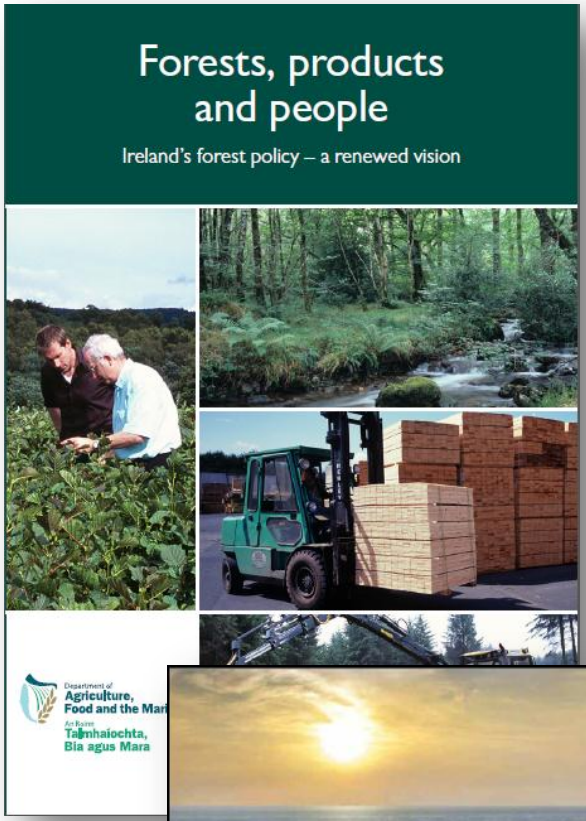
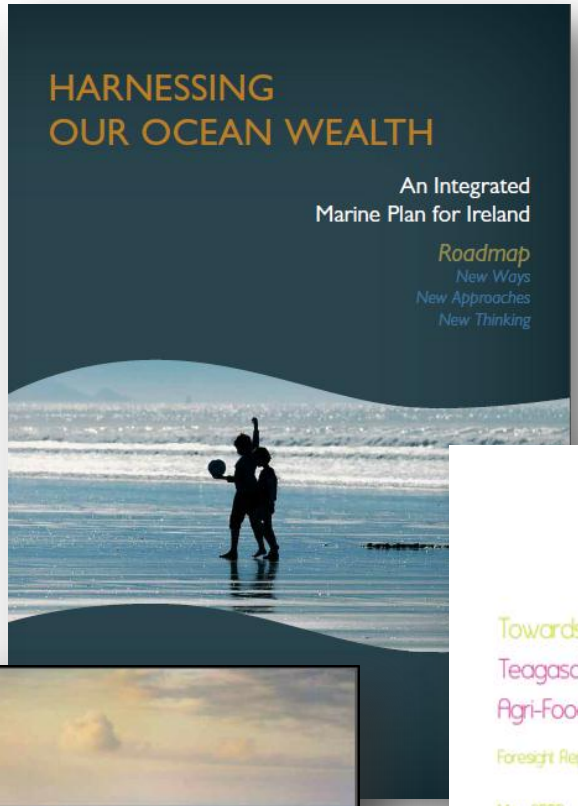
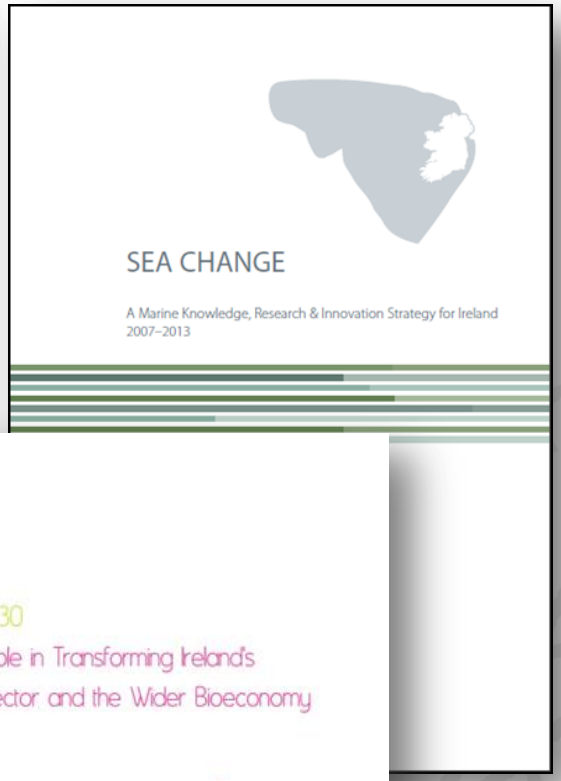
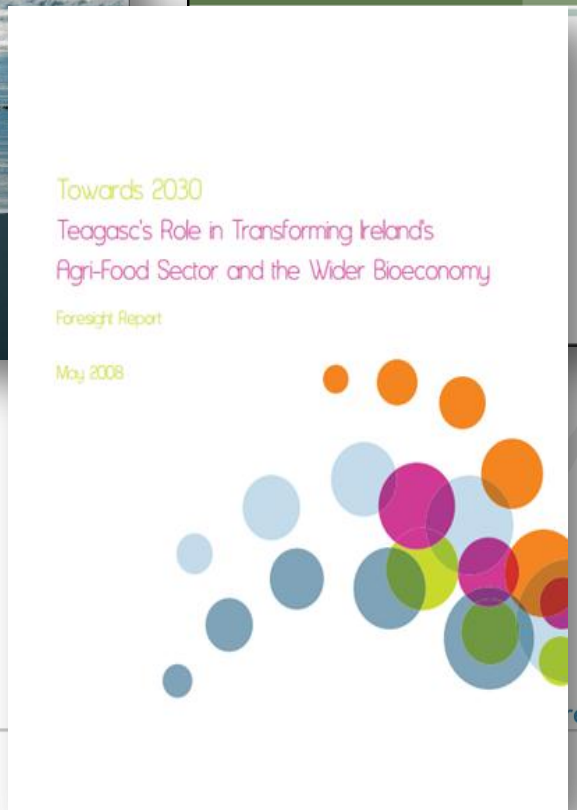
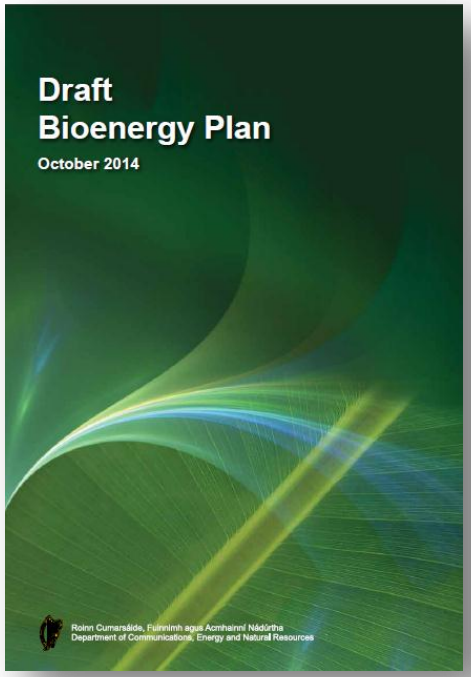
Ireland sectoral

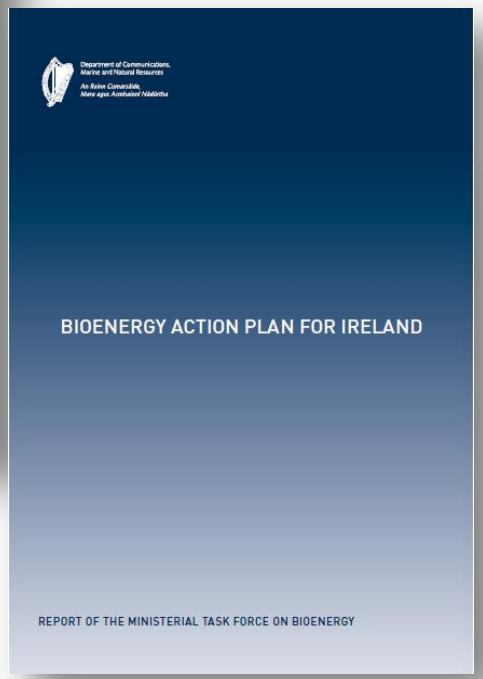


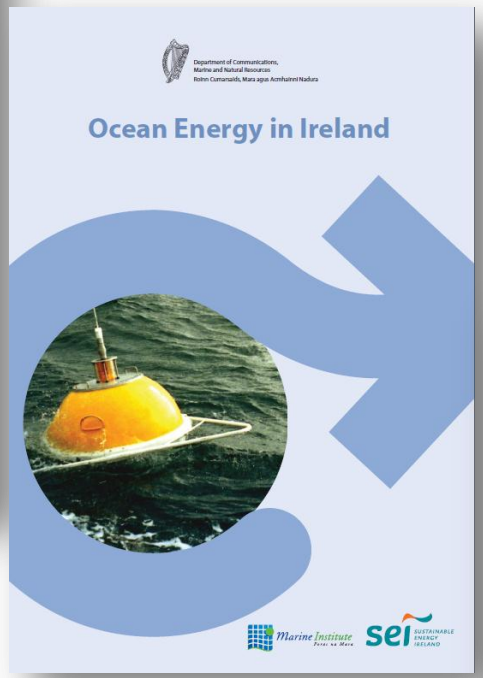


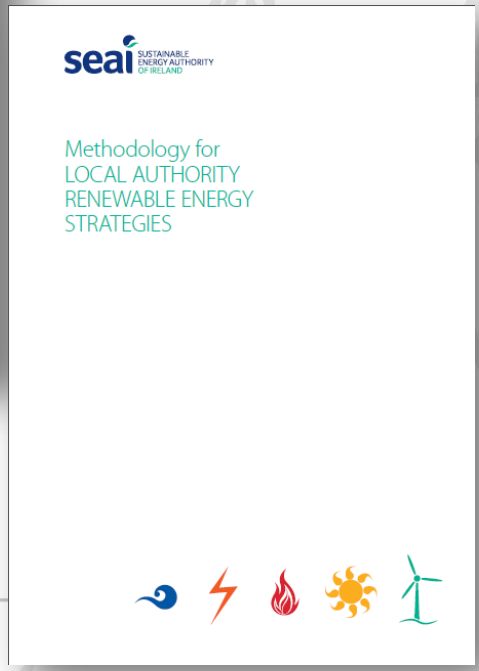












National sectoral

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Need for a cohesive national bioeconomy strategy?

Bioeconomy?

- Competition between generators and users of biomass
- Cross-sectoral synergies to develop new, innovative research areas and ensure policy is robust, coherent and sustainable
- Identify near-wins and priority areas
- Connect stakeholders with bioeconomy concepts e.g. from initiatives to engage producers, incentivise private sector and develop consumer trust and acceptance

National?

- Unique resources, opportunities and challenges
- Clearly defined NATIONAL objectives and guiding principles are necessary to enable those working in the bioeconomy sectors to contribute to a commons set of goals and assess progress
- Context specific economic growth, job creation and rural development

BioÉire: a bioeconomy for Ireland

- Launched April 2015 (DAFM/Stimulus Research Grant) to assess the feasibility and facilitate the pursuit of bioeconomy opportunities in Ireland

- Aims to evaluate the growth opportunities, policies and initiatives shaping Ireland's transformation to a sustainable, low carbon economy and **identify bioeconomy priorities** for Ireland to maximise national income, exports and job creation.

- To identify up to **8 commercial opportunities**, assess their technical, economic and environmental **viability** for future development

- Make recommendations on the **development frameworks** necessary to underpin their exploitation

- Knowledge base for national strategy

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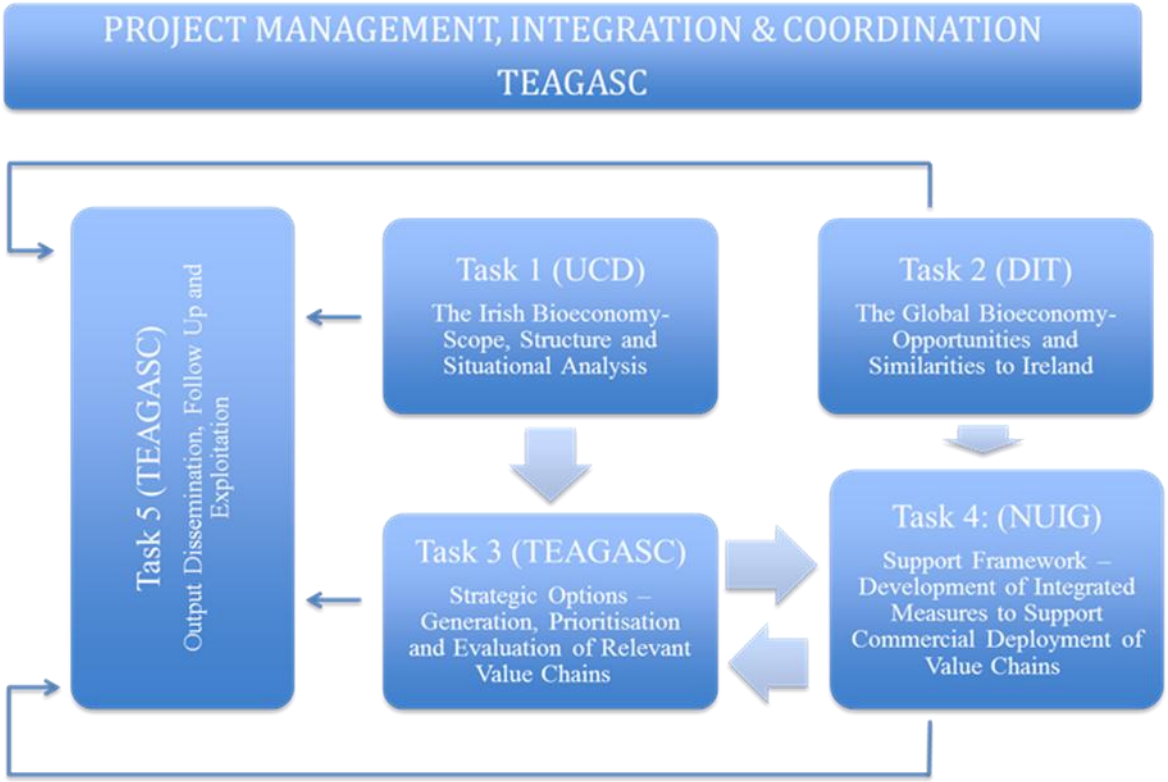
BioÉire workflow and responsibilities



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Teagasc Delphi study 2016…value chains for Ireland

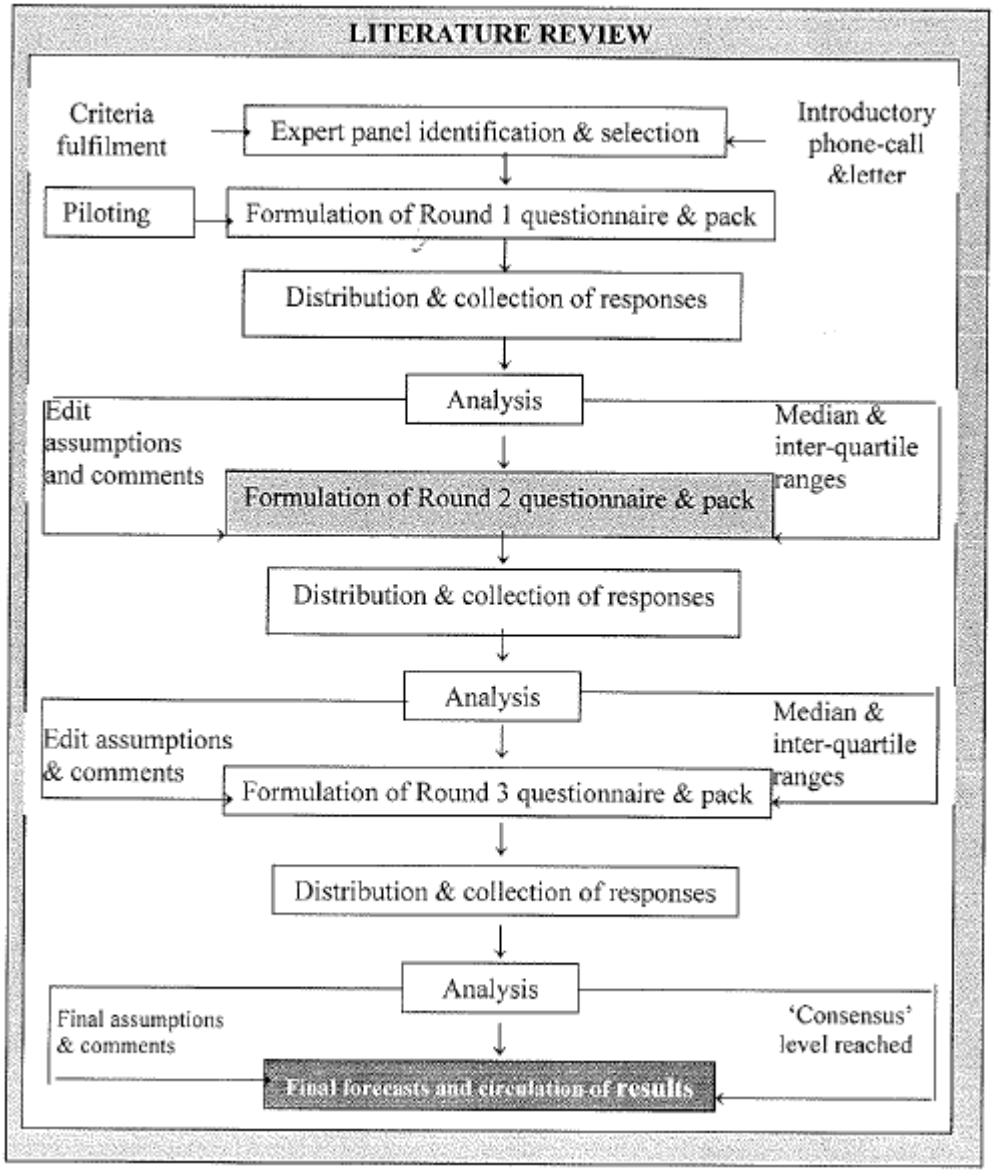
- Delphi as a forecasting tool based on rounds of surveys with the same group of experts
  - *"Anonymous forecasts made on two or more rounds by a group of independent heterogeneous experts who receive feedback between rounds"* (Armstrong, 1999, p351)

- Future is uncertain but can be *"approximated with reasonable accuracy by a group of knowledgeable individuals"* (Henchion and McIntyre, p3)

- Anonymity, iteration, controlled feedback and statistical aggregation of feedback as key features of Delphi methodology

- Allows for positive attributes of interacting groups to be obtained whilst diminishing negatives (e.g. pressure to conform, status incongruity)

Rounds within a Delphi Survey



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Challenges in developing a national bioeconomy strategy

- Potential conflicts of interest
  - Economic, social and environmental objectives
    - Use of biological resources for industrial purposes vs food security vs environmental safeguards

- Potential conflicts between sectors
  - Food, feed, fibre, fuel debate
  - Meat-based vs non-meat based food

- Unintended/unforeseen consequences
  - Rebound effect

- Complex policy environment

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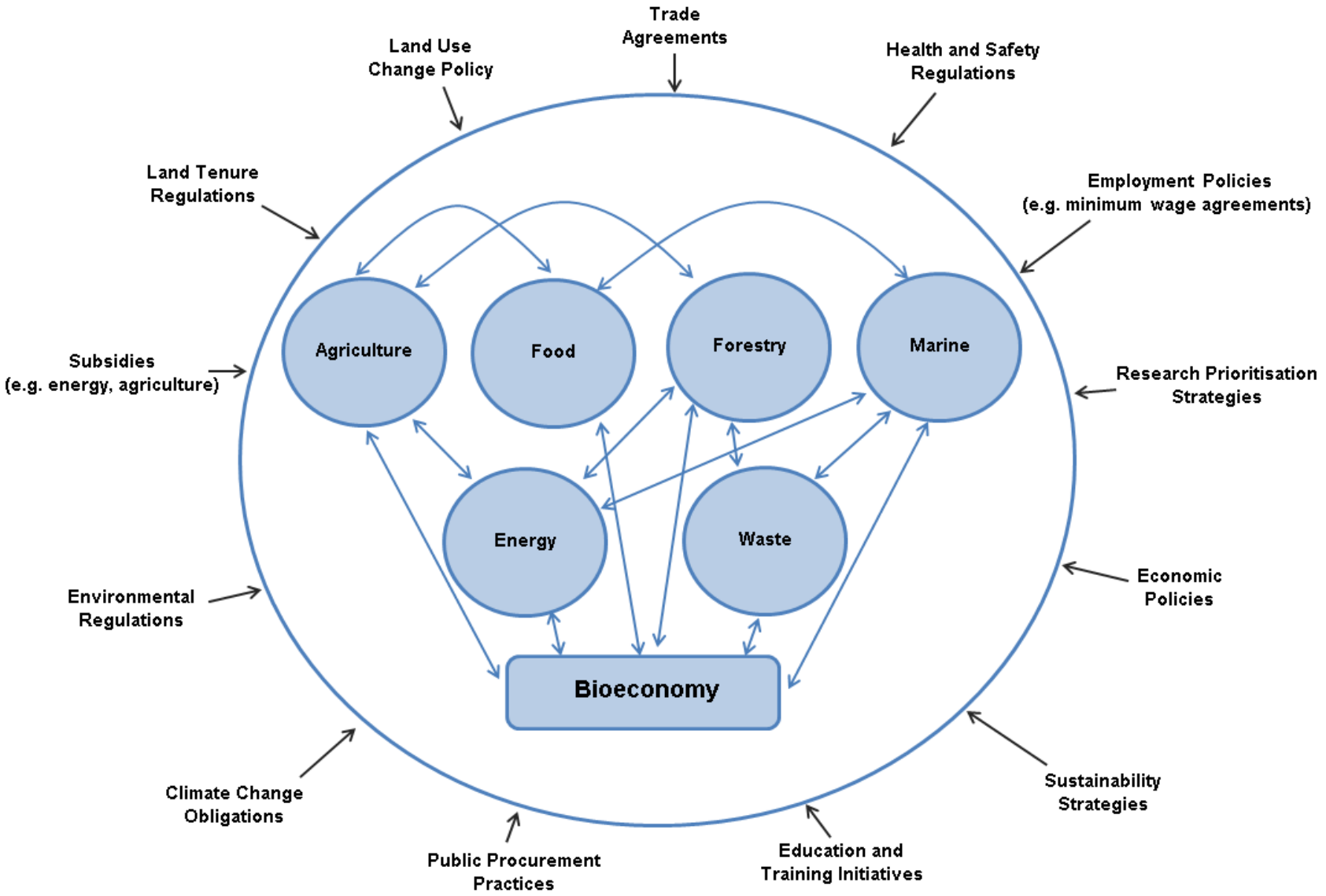
Complex policy environment



Thinking bigger…a global bioeconomy vision

2030 White Paper: ***First Action***

*"**Full cooperation and alignment** of strategies across the Bioeconomy landscape is needed. This should be **at all levels**; between relevant ministries in national and regional governments, between Member States and between and within EU institutions. As necessary, the alignment should go beyond national and European levels to be on a **global basis**"*

- Global Bioeconomy Summit, Berlin, November 2015
- Establishment of International Advisory Committee
- GBS Communiqué: http://gbs2015.com/home/
  - Shared agenda, international collaboration, mutual learning, established standards (e.g. trade), priorities, sustainable development

GLOBAL BIOECONOMY SUMMIT 2015

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Two sides of every coin…consumption dynamics

- Cannot focus on production and processing alone
- Tendency to focus on resource base and extrapolate value chains from here – what about the demand side?
- Industrial renaissance AND societal transition required to combat global challenges
- Consumer acceptance and sustainable consumption key to future bioeconomy success
    - Ultimate farm to fork approach

"The engagement of citizens is pivotal for enhancing participatory deliberation, and societal appraisal of the bioeconomy, allowing for a more robust development of science and technology in society" (GBS, 2015)

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Consumer acceptance of bioeconomy outputs is key

"Unless consumers can agree that the benefits of by-products management are equivalent to sustainable, desirable and acceptable food production practices, consumers are unlikely to recognise and realise many of the potential benefits of by-products management" (Frewer and Gremmen, 2007, p32)

- Consumer acceptance of products derived from processing side streams
  - Potential perceptions as "waste", "unnatural", "dangerous", "unhealthy" or of lower quality
- Consumer knowledge, perceptions, priorities and ultimate acceptance of such source materials, transformation technologies and resulting biobased goods
  - Risk and benefit perceptions

Consumer acceptance examples

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Consumer perceptions & acceptance: Use of food processing side streams

- ReValue Protein– acceptability of 5th Quarter
  - As a whole part? Export market opportunities
  - As part of a processed product? E.g. enriched protein mince or fortified cereal
  - Product form – mincing, mixing, freeze-drying, powdered?
  - Extracted elements in supplement/pill variety?
  - Product, consumer and environment-related factors influencing perceptions

- Biotechnology controversy: lessons from the past…

- Language editing
  - Not waste streams but by-product, residues or side streams

- True consumer engagement, beyond mere communication campaigns

"Consumer acceptance cannot be taken for granted"
(O'Callaghan et al., 2014)

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Conclusions: call for national strategies

- Plethora of disparate and sometimes conflicting policy strategies
  - ***Requirement now for more joined-up thinking and one cohesive strategy to guide the future development***
- Engagement, ownership and oversight important – particularly given investments required
- The Bioeconomy can be a useful forward looking framework to promote the better management and reduction of 'waste' in society as well as establishing new value chains and economic activity – NEEDS TO BE COMMUNICATED
- Focus on changing consumption habits and attitudes including consumer research – tends to be limited but required to create markets

Conclusions: thoughts for the day

Role for social sciences in the food processing arena: interdisciplinary research need

- Identifying value chain opportunities and national priorities
- Policy and strategy development
  - Translate science into policy and bridge communication gaps
- Consumer demand and acceptance
  - Understand the motives & drivers of consumer behaviours & decision making
  - Examine differences in the application, acceptance and suitability of any technology according to different scales and sectors (development of tailored implementation strategies)
  - Risk/benefit perceptions , understanding trust, managing controversy
- Wider support frameworks necessary to implement and succeed with any new processing technology
  - Regulatory, infrastructure, communication, financial, market supports….
  - Environmental, social and economic sustainability

Conclusions: bioeconomy development

- The bigger picture context: use of processing side streams as central to bioeconomy development and a more sustainable future
  - Unique opportunities and challenges
  - *"Bioeconomy has major development potential and could be at the heart of the transition to a new economic model BUT it has to be ecologically and socially sustainable, organised in a responsible and fair way"* (Potocnik, 2015)

- No silver bullet to societal challenges but a step towards a more sustainable future

- The need for R&D
  - Collaborative approaches to enhance impact
  - Value chains must be mediated by appropriate informational and policy supports to ensure ultimate success

- Towards a national bioeconomy strategy…what unique opportunities and challenges exist in Serbia???

"Everything has to change to remain the same"

Dr. Laura Devaney

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Questions?

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Funded by the Department of Agriculture, Food and the Marine's competitive research programme

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Department of Agriculture, Food and the Marine

An Roinn Talmhaíochta, Bia agus Mara

Next steps…

- A dedicated national strategy to set priorities, identify near-wins, incentivise private sector, bring consumer on board, educational programmes in schools, connect public and private sectors – establish on political agenda
    - Importance of evidence based strategy formulation: science policy before the strategy policy
    - Number of ministries involved
    - Establish National Bioeconomy Council
    - Start on consumer and behaviour change side
    - In Germany, took 6 Ministries, 2 years to develop 1 strategy
    - Importance of international link too – cautious of being overly domestic

"Embedding SSH research across H2020 is essential to maximise the returns to society from investment in science and technology"

European Commission, 2015

Sustainable Development Goals & the Bioeconomy

General observations

- Constituents mixed in with the mince found to be most acceptable form
- Incorporation of constituents in powder form not as acceptable
- Acceptance of extracted vitamins/minerals from constituents into mince
- Rejection of constituents in powder form into breakfast cereal
- Meat based ingredients into traditional non-meat product would affect product taste, texture etc.

Factors in the acceptance and rejection on the incorporation of constituents from the beef fifth quarter