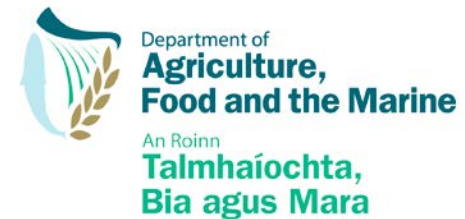


# Advancing the Irish Bio-Economy

## Developing An Integrated Bio Economic Development Strategy

[www.TCBB.ie](http://www.TCBB.ie)



TRINITY COLLEGE DUBLIN  
COLÁISTE NA TRÍONÓIDE, BAILE ÁTHA CLIATH





# Enhanced Bio Economic Development

## Progress Against Objectives



### **Economic Sustainability** - *investment, employment, tax base, balance of trade, competitiveness*

- **Economic Growth** - *Bio based industries back to pre-2009 levels of production*
  - *Targeting 25% - 40% growth in traditional Agri Food, Marine, Forestry & Muni Waste Outputs*
- **Resource Efficiency & Security of Commodity supplies** – *meeting energy efficiency obligations*
  - *heavily dependent on imported energy (€6Bn), pharma-chem organic materials (€3.5Bn), paper & plastics (€0.6Bn), fertilisers & feed (€2Bn)*

### **Environmental Sustainability** – *maintain the planet for future generations*

- **Drivers of Climate Change** -
  - *RES - Achieving c. 50% of 2020 displacement target (16%) – awaiting re structured REFIT & RHI*
  - *GHG mitigation – ETS sectors will meet obligations, Non ETS Sectors (Agriculture) will fall short*
- **Waste Management** – *meeting waste management obligations, increasing domestic processing capa*
- **Health and Wellbeing, Habitat Maintenance** – *meeting air/water/soil quality & biodiversity oblig's*

### **Societal Cohesion** - *wealth creation to maintain quality of life, social infrastructure*

- **Urban/Rural Divide** – *heavily dependent on taxation mechanism re wealth redistribution*



# Enhanced Bio Economic Development

## Add Value to Existing Sectoral Strategies



### Sectoral Development Strategies Incorporate 25% - 40% Growth in Traditional Outputs

- **Agri-Food-** Dairy & Dairy Processing – milk products growth on back of quota removal  
Beef, Poultry, Sheep, Equine & Meat Processing – growth on global population demographics  
Tillage/Orchard/Horticulture & Food, Beverage Processing – growth from global population demographics & sugar quota removal
- **Marine -** Fisheries & Shellfish – high growth in fish protein demand  
Algal – niche market opportunities
- **Silviculture & Forestry Processing** – growth in construction materials & sawn timber based on population demographics
- **Municipal Waste -** MSW Processing services & Municipal WWT processing services

**Add value with non traditional outputs - Leverage existing sectoral plans & strengths of traditional AMFM stakeholders to facilitate market entry**

**Compliment Rather than Cannibalise Existing Sectoral Value Chains**



# Systems Approach: Align Frameworks & Support Structures to Add Sectoral Value



- **Define Specific Sectoral Opportunities** – Integrate non traditional stakeholders into strategy development (Energy, Pharma Chem, Biomedical, Materials, etc) to address knowledge deficit
  - Prioritise products with relative mass conversion / mkt value relevance
- **Mobilise/Grow Raw Material Supply** – increase intensity/productivity, optimise efficiency/cost competitv.
  - Prioritise residue valorisation from existing supply chains
  - De-fragment raw material supply chains, mobilise under utilised land & residue utilisation
  - Introduce spatial planning, sustainability certification ... Adapt direct payments to monetise supports
- **Improve Technology Development** – adapt existing RD & D Prog's to directly align with sectoral plans
  - Integrated centres of excellence ... move up product development curve w/ lab to demo capacity
  - Increase direct funding of company RD&D to increase commercial engagement, impact
  - Increase leverage via collaborative prog's - adapt state particip'n to overcome state aid, recycle funds
- **Ease Infrastructure Deployment** – redevelop underutilised state infrastructure, brownfield sites
  - Expedite planning & licensing, adapt appeals process
  - PPP model to access public finance for early market deployments, overcome market deficits
    - *Public finance partner can introduce mobilisation measure & incorporate desired "societal" measures*
  - PPP model structured for exit, recovery & recycling of state funds



# Systems Approach: Align Frameworks & Support Structures to Add Sectoral Value



## ➤ Facilitate Market Entry with Mobilisation Measures to Overcome Market Inertia, Stimulate Demand

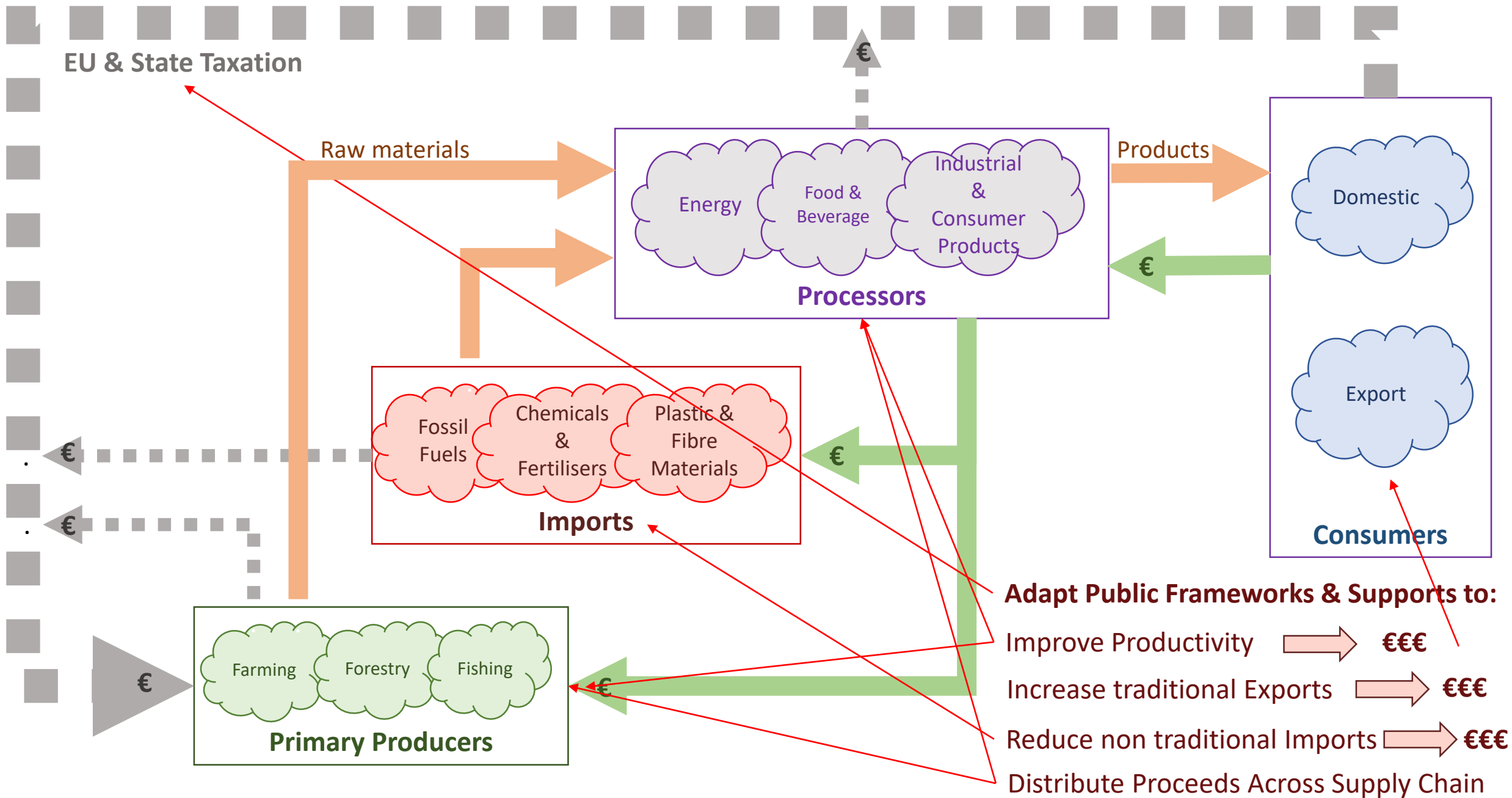
- Emphasize Import displacement for non traditional value add products
- Product Certification – Sustainability, Quality Assurance / Product Functionality
- Green Public Procurement (Underutilised) for both bio-products and bio energy (proximity principal)
- Targeted Bio Product “Pull” incentives to stimulate demand / market for bio-products transitioning to market led “push” measures (sustainability obligations) to sustain market penetration

## ➤ Business Models

- Traditional horizontal structures create risk allocations & price tensions between producer & processor that are difficult to overcome ... precludes supply chain development in immature markets



- Consider vertical structure to align interests of primary producer & processor, raise capital & secure efficient supply chain
- Consider Co op model, Corporate model or PPP – can be unwound as market matures



# Example Bioenergy Strategy: Community “Systems Based” Bioenergy Concept

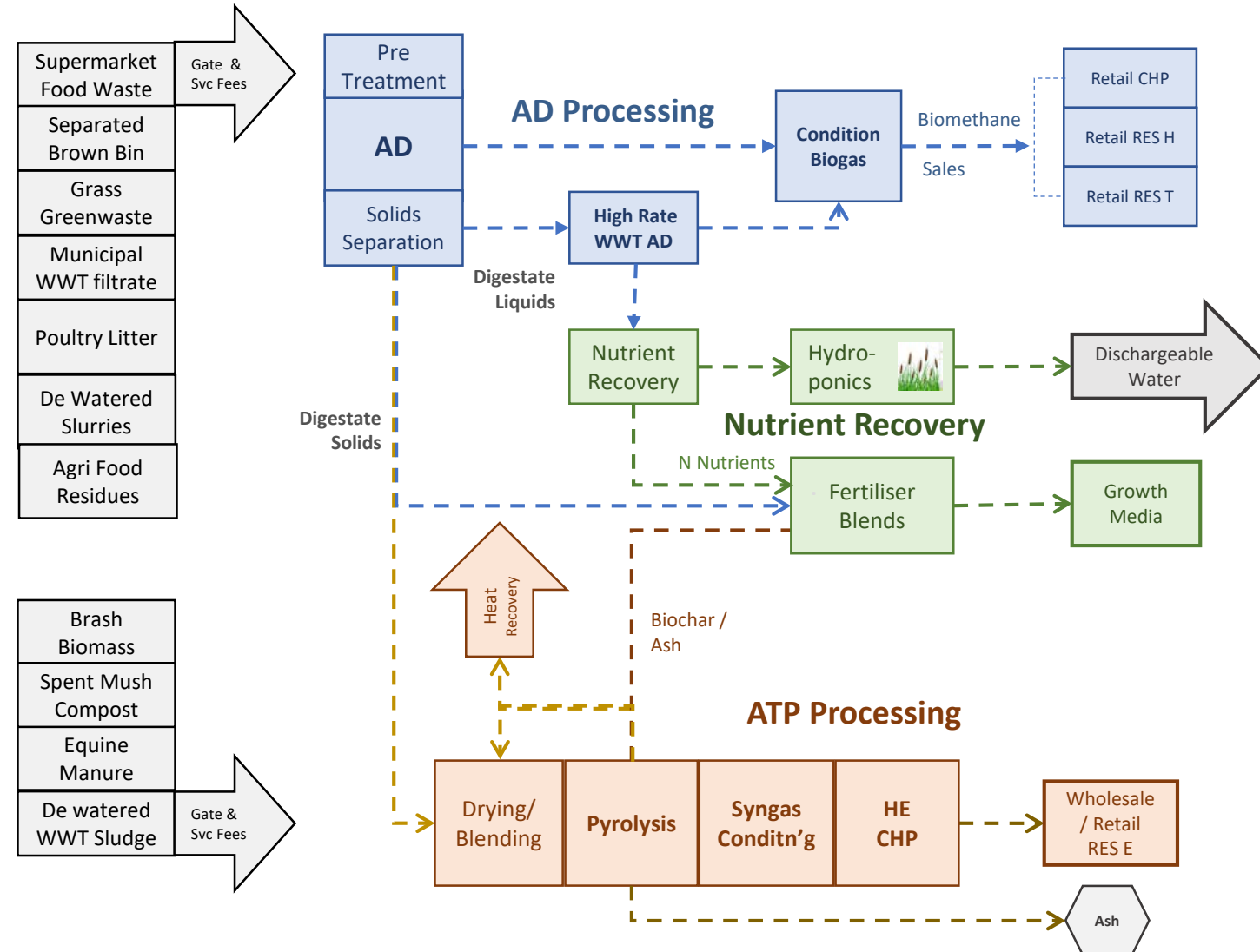
BAT for waste treatment. Waste Management Sustainability Certification programme to promote routing of OFMSW for energy recovery

Nutrient recovery will minimise environmental impact from manure disposal. Agri Sustainability Certification Prog, back by adapted direct payments, to promote routing of ag residues for energy recovery

Capacity to process multiple feedstocks creates scale in fragmented markets, optimises capacity to collect gate fees for waste disposal, maximises carbon conversion to energy carriers

Req'd Technology Development:

- Optimise ATP
- Inexpensive slurry dewatering
- Biomass drying using low grade heat
- Optimal nutrient recovery





# Example Strategy

## Community Bioenergy Concept



### Co Op Structured as Collaborative PPP to Engage Local Authorities & Private Stakeholders

- Local Authorities can contribute sites and influence routing of feedstock supplies
- Initially requires state supports for renewable energy – over time availability of infrastructure supports “push” obligations to be imposed
- Adapted ERDF Programmes can provide ongoing source of funding for sustainable projects
- Accepted means to encourage public/private collaboration, alignment of policy, regulation and market focus
- Mitigates state aid concerns over use of public funding
- Ability to replicate can attract private funds to match with EU contributions
- Privatised / refinance once business model de-risked – *Recycles public investment to additional projects*

### WWT Valorisation – consider organic load as resource, WWT plants as bio-economic facilities

- Anaerobic technology converts organic load in WWT to biogas
- Reduces sludge generation, reduces energy cost ... possible route to low cost capacity enhancement
- Sludge disposal generates biohazard concerns – dry & use as thermal feedstock
  - *WWT facilities as processing sites - ideally located, appropriate planning, available infrastructure*

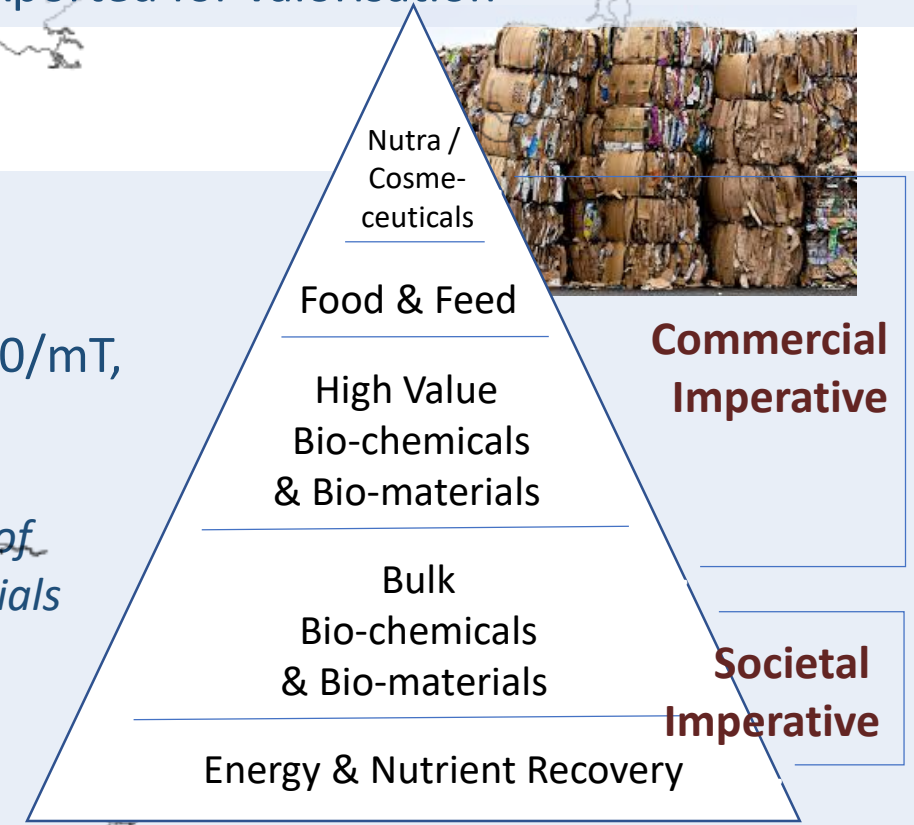


# Example Sectoral Strategies: Municipal Waste Processing Sector

**Position:** Consolidation in sector has resulted in dramatic improvements in municipal waste management. Multi operator system, however, is inefficient, precluding investment local renewable energy technology outside of largest metropolitan markets. Additionally, most recyclable material is exported for valorisation

## Value Add Opportunities / Challenges:

- **Renewable Energy Recovery** – as described in CSEC concept
- **Pulp Biorefinery** : Ireland exports 500KmT of recycled paper at c €100/mT, imports all paper supplies at €450 - €750 per mT
  - Raw materials supply: *available from waste management companies*
  - Target products: *market entry via fibre packaging expanding to biorefining of virgin pulp targeting polymer/fibre composites for construction materials*
  - Techn. Dev : *paper recycling technology is mature – need moderate scale LC Biorefining technology to be developed in collaborative programme*
  - Techn. Scale Up: *New COE to optimise/validate conversion economics*
  - Market Entry: *RD&D supports, PPP for small scale commercial demo plant supported by public procurement for sustainably produced paper and packaging to assist initial market deployment*

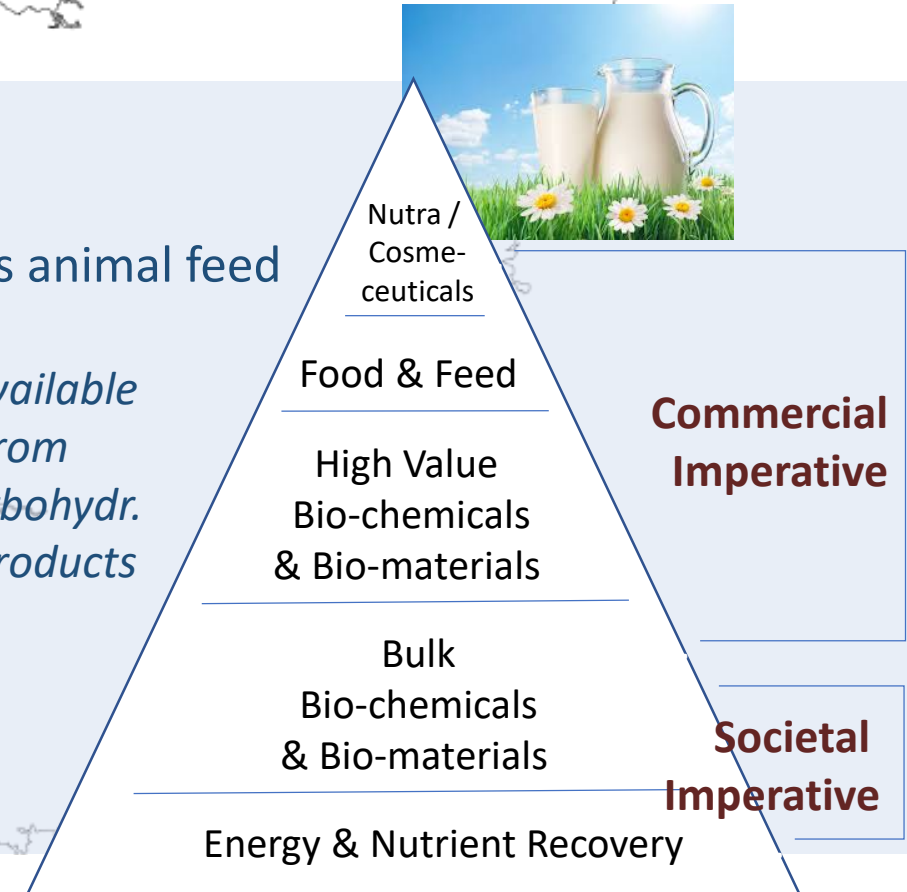


# Example Sectoral Strategies: Dairy & Dairy Processing Sector

**Position:** Milk production & processing is strongest of Irish agricultural outputs with strong growth potential on back of quota elimination. Grass based milk production generates highest returns at farm level. Concerns arise over GHG emissions generated by herd growth

## Value Add Opportunities / Challenges @ Processor Plants

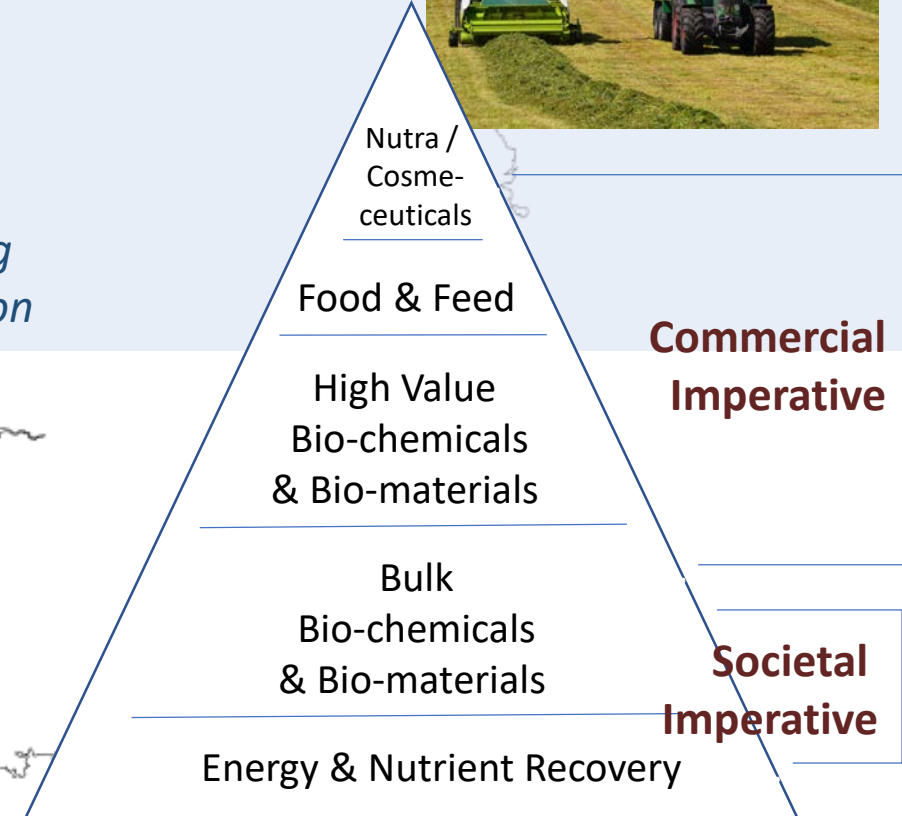
- **Whey Biorefinery:** substantial supplies of whey currently valorised as animal feed at low values
  - Raw materials supply: *complex matrix of lipids, proteins & carbohydrates available*
  - Target products: *market entry via nutra/cosmeceuticals / functional feeds from proteins, expanding to organic acids, biodegradable polymer from carbohydr.*
  - Techn. Dev: *develop system to better fractionate whey, convert & recover products*
  - Techn. Scale Up: *Adapt existing COE to validate conversion economics*
  - Market Entry: *assist with RD&D, capital for demo plant, certify functional foods*



# Example Sectoral Strategies: Dairy Farm Sector

## Value Add Opportunities / Challenges at Dairy Farms:

- **RES & Nutrient Recovery** from manure / silage waste / WWT Organics
  - *Develop slurry de-watering & nutrient recovery technology / protocol to route de watered solids to RES recovery, facilitate discharge of liquors.*
- **Intensive, low cost fodder production to support intensification of milk production**
  - *Develop low cost intensive growth system supported by nutrient recycling*
  - *Develop low cost means to process LC residues to facilitate cattle digestion*

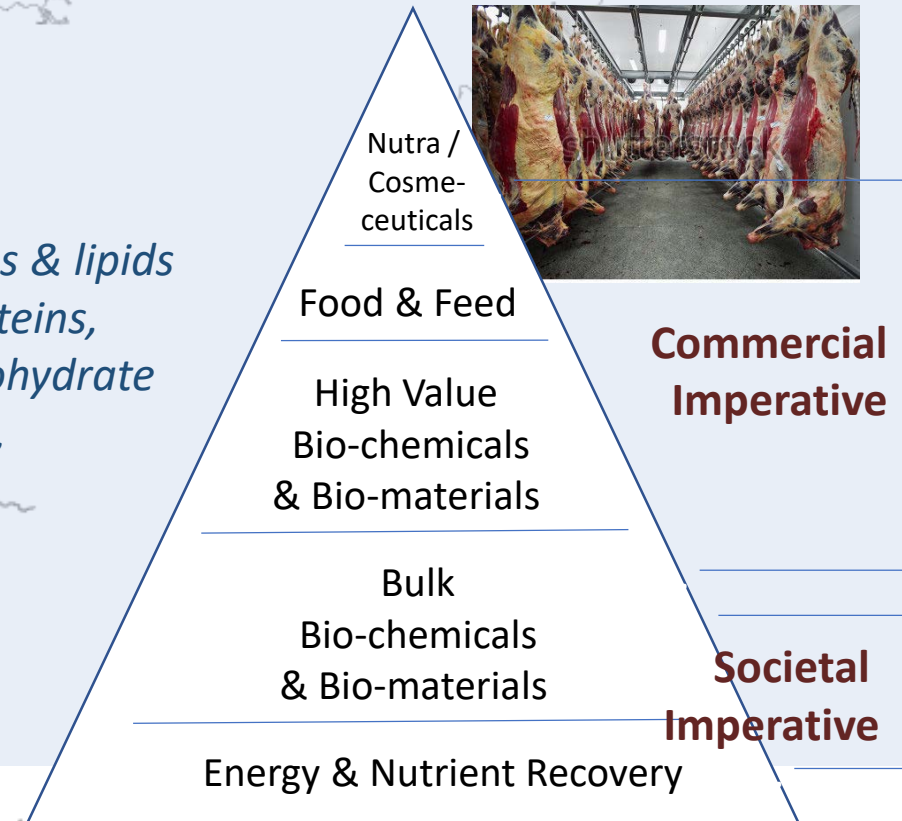


# Example Sectoral Strategies: Livestock & Meat Processing Sector

**Position:** Ireland processes & exports large volumes of meat. Value chain is very competitive however & generates low margins at primary producer level. Concerns over cattle GHG emissions, Class 1 ABP treatment

## Value Add Opportunities / Challenges for Processors:

- RES recovery from process residues (paunch contents, MBM)
- Protein biorefinery to extract higher value products from 5<sup>th</sup> Qtr
  - Supply chain: 5<sup>th</sup> Qtr from processing plant matrix of proteins, carbohydrates & lipids
  - Target products: Nutra/cosmeceuticals / functional foods / amines from proteins, cosmeceuticals/biofuels from lipids, organic acids / polymers from carbohydrate
  - Technology Dev: enzyme or acid system to fractionate compositional matrix, conversion & recovery for each fraction
  - Technology Scale Up: Adapt Meat Processing COE to optimise / validate conversion economics
  - Market Entry: RD&D supports, Capital support for demo, functional food certification, market entry mobilisation



# Example Sectoral Strategies: Cattle, Sheep, Pig & Poultry Farms

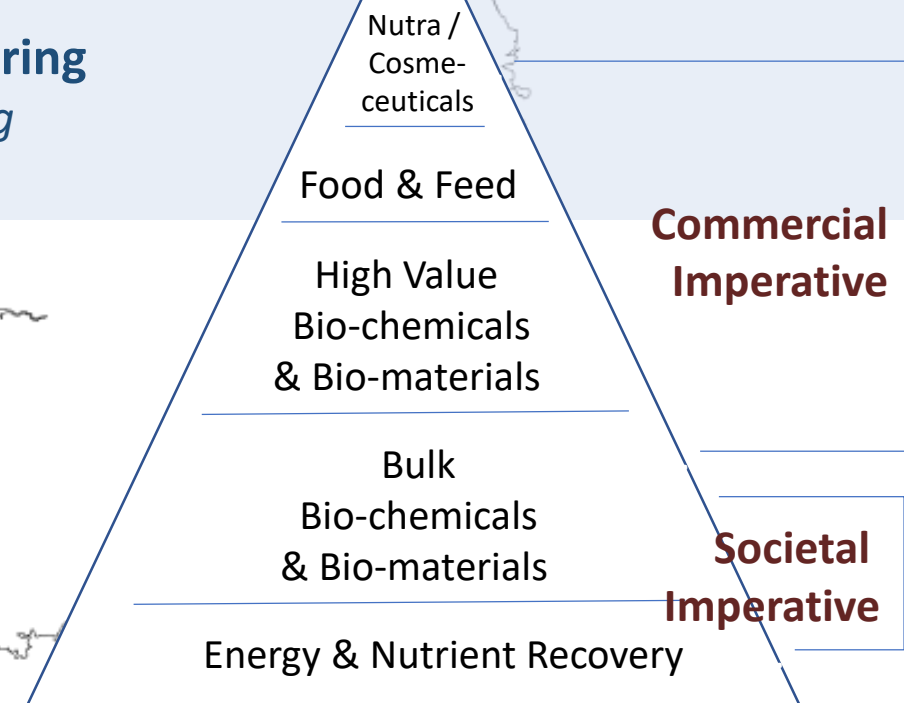
## Value Add Opportunities / Challenges at Farm Level

- **RES & Nutrient Recovery**

- Support technology to combust poultry litter for on farm RES - requires technology to recover P from ash, requires certification of equine manures as ABP rather than waste
- Develop technology to de water pig slurries, cattle slurries & treat water for on site discharge to reduce disposal cost

- **Intensive, low cost fodder production to support intensive cattle rearing**

- Develop low cost intensive growth system supported by nutrient recycling
- Means to process other organic residues for cattle feed

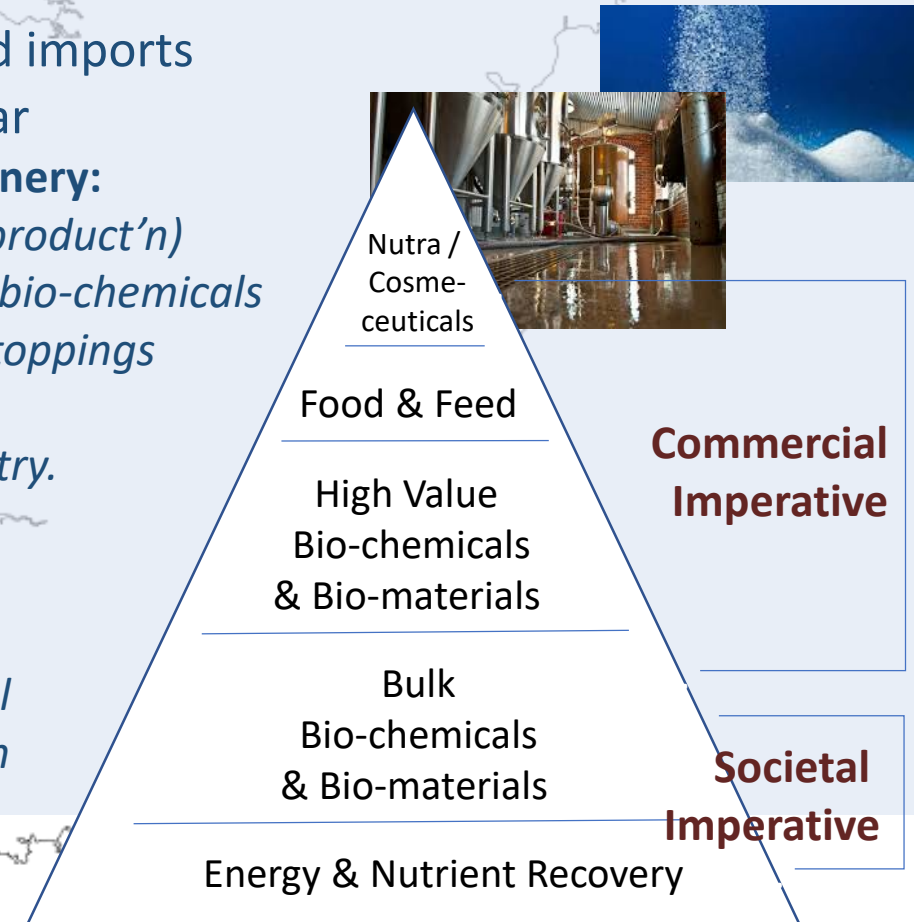


# Example Sectoral Strategies: Tillage, Horticulture & Food and Beverage Processing

**Position:** Tillage / Horticulture sector supplies fodder for animal feed and cereals for substantial food & beverage processing industries (brewers & distillers) as well as mushrooms, soft fruits and vegetables. Primary producers are subject to constant price pressure so returns to farmers are low.

**Value Add Opportunities / Challenges for Processors:** Ireland imports €3.5 Bn in organic pharma-chem raw materials and €250M in white sugar

- **Integrate Moderate Scale White Sugar Production with Starch/Sugar Biorefinery:**
  - Supply Chain: *farm supply chain to add sugar beet into rotation (historical product'n)*
  - Target products: *market entry via white sugar & sugar syrups expanding to bio-chemicals for pharma-chem raw materials from sugar/starch. Feed from pulp & toppings*
  - Techn. Dev: *1<sup>st</sup> Gen white sugar & bio-refining technologies exist, need modular scale sugar refining technology to facilitate staged market entry. 2<sup>nd</sup> Gen systems in commercial development requiring RD&D*
  - Techn. Scale Up: *new COE to optimise / validate conversion economics at pilot / demo scale*
  - Market Entry: *RD&D supports, DAFM support for initial supply chain, capital supports for demo, support measure to assist bio-product mkt penetr'n*



# Example Sectoral Strategies: Tillage, Horticulture & Food and Beverage Processing

## Primary Producers - Productivity / Competitiveness Opportunities & Challenges:

- **RES & Nutrient Recovery from Tillage/Horticulture/Food & Bev residues**
  - *Test technologies to recover RES & nutrients from SMC, Coir, Fruit Waste, Apple Pommace*
  - *Develop technologies to recover RES nutrients from WWT & Sludge*
- **Increased productivity/competitiveness in primary supply chain by expanding crop selection and productivity**
  - *Integrate sugar beet into crop rotation @ higher value than existing break crops*
  - *Sugar beet pulp & toppings - residue valorisation via animal feed*
  - *Cereals: Better valorisation routes for straw / horticultural residues*
  - *New PPP business model to promote producer participation in biorefinery*





# Example Sectoral Strategies:

## Forestry, Energy Crops & Timber / Pulp Processing



**Position:** Forestry supports timber products & panel board. Sawmills have excess capacity (currently import some timber). Peat power generators import some biomass fuels due to cost of indigenous supply. Brash not widely utilised. Forestry generates competitive return yet state is behind on afforestation targets. Private forestry holding very fragmented, supported by forestry companies (aggregators)

### Value Add Opportunities / Challenges

- **RES from Woody Biomass:** *RHI being introduced for RES market entry*
  - Finance for biomass boilers & district heating to support migration
  - Brash valorisation via ATP & Ash valorisation technology to minimise disposal
- **Lignocellulosic + Waste Paper biorefinery:**
  - Supply Chain: *Forestry producers / processors, waste management companies*
  - Target Products: *market entry via fibre packaging from waste paper, expanding to Biorefining of virgin pulp for fine chemicals from brash/bark, polymers for polymer/fibre composites, lignin residue to RES solid fuel*
  - Techn. Dev: *technologies available for 1<sup>st</sup> Gen fibre processing, need modular Scale. RD&D req'd for 2<sup>nd</sup> Gen biorefining*
  - Techn. Scale Up: *New COE req'd to optimise/ validate conversion economics*
  - Market Entry: *Capital support for RD&D and demo, DCCAE framework to route waste paper for processing, market support for fibre & bio-product penetration*



Nutra /  
Cosme-  
ceuticals

Food & Feed

High Value  
Bio-chemicals  
& Bio-materials

Bulk  
Bio-chemicals  
& Bio-materials

Energy & Nutrient Recovery



**Commercial  
Imperative**

**Societal  
Imperative**





# Sectoral Strategies:

## Forestry, Energy Crops & Timber / Pulp Processing



### Value Add Opportunities / Challenges: Silviculture & Energy Crops

- **Introduction of market opportunities and supports for short rotation energy crops**
  - *New application offer routes for valorisation and dramatically improve time to market*
  - *Establishment grants to support planting, structured to avoid market fragmentation in supply chain*
- **Means to increase afforestation, overcome fragmentation, increase return**
  - *Increasing output demand with new applications*
  - *Integrate brash valorisation into value chain*
  - *Spatial planning system to target/concentrate forestry, facilitate road programme*
  - *Supplemental support – repayable credit against harvest for conforming w/ plan*
  - *Increase establishment grant Ha limit to facilitate larger landholding*

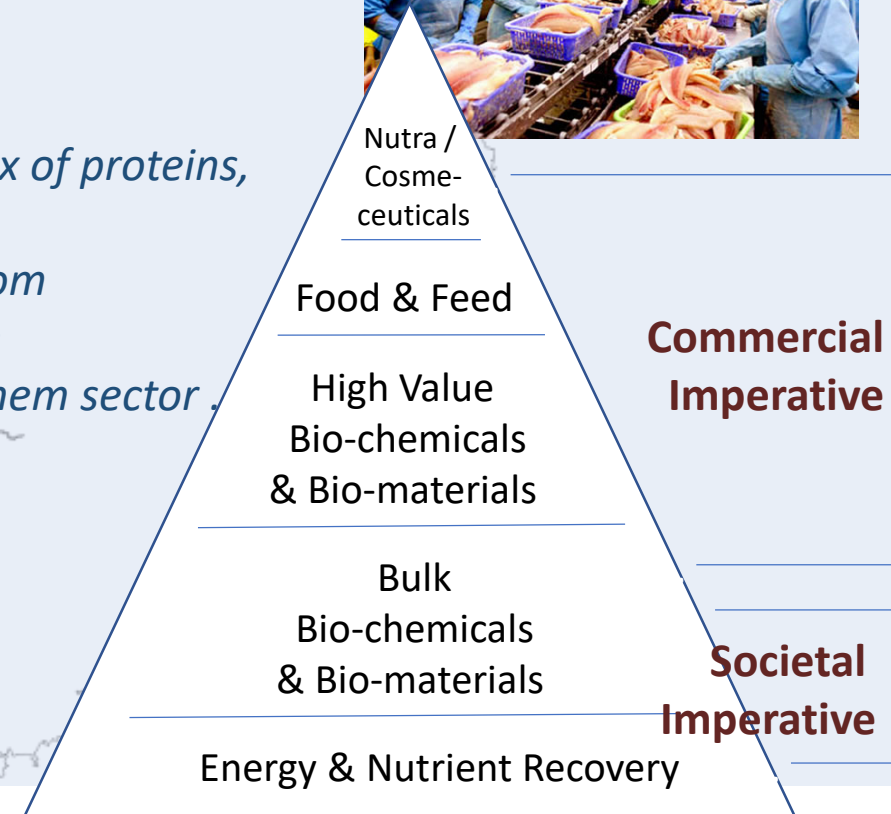


# Example Sectoral Strategies: Fish and Shellfish Processing

**Position:** Demand for fish protein is growing significantly . Ireland has long shoreline that offers potential for marine sector development however potential is limited by natural fish harvest quota constraints, weather barriers and fierce public opposition to ocean based fish farming as well as fragmented / informal structure of hereditary “licenses” in respect of algal harvests.

## Value Add Opportunities / Challenges for Processors:

- **Protein biorefinery to valorise disgrads and process wastes**
  - Supply chain: *fish processing plants generate fish wastes comprised of matrix of proteins, carbohydrates & lipids*
  - Target products: *market entry via Nutra/cosmeceuticals / functional foods from Proteins, biofuels from lipids & nutrient recovery from residues. Derive amine biochemicals from proteins & organic acids from carbohydrate for pharma-chem sector.*
  - Technology Dev: *enzyme or acid system to fractionate compositional matrix, conversion & recovery for each fraction*
  - Technology Scale Up: *New Fish Process COE to optimise / validate conversion economics*
  - Market Entry: *RD&D supports, Capital support for demo, certify functional foods and market entry mobilisation*



# Example Sectoral Strategies: Fish Production

## Value Add Opportunities / Challenges: Freshwater (Land Based) Fish Farming

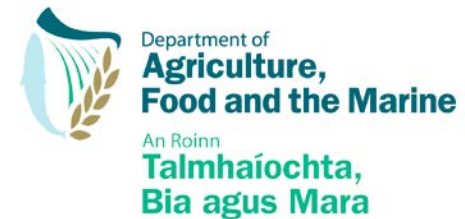
- Means to supply growing fish protein market
  - Somewhat more capital intensive – will require capital supports
  - Converts feed proteins more efficiently than livestock
  - Ample supplies of water, temperate climate
  - Integrate wastewater processing to process water to dischargeable standard
  - Integrate nutrient recovery to valorise organic nutrients - possibly use to fertilise intensive fodder supplies



# Advancing the Irish Bio-Economy

## Developing An Integrated Bio Economic Development Strategy

[www.TCBB.ie](http://www.TCBB.ie)



**TRINITY COLLEGE DUBLIN**  
COLÁISTE NA TRÍONÓIDE, BAILE ÁTHA CLIATH

