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BioÉire: a
bioeconomy for

BioÉire
A Bioeconomy for Ireland

Key external stakeholders:

Policymakers, Department of the Taoiseach, Department of Agriculture, Food and the Marine, Local authorities, Bioeconomy Industries, Researchers, Farmers, Consumers

Practical implications for stakeholders:

BioÉire was established to identify and evaluate the most promising value chain opportunities for the short-medium term Irish bioeconomy having considered our natural resources and market opportunities. Results will form part of the knowledge base necessary to develop a national bioeconomy strategy for Ireland.

- Bioeconomy development is diverse and complex, encompassing biological resource sectors and stakeholder groups across agriculture, food, forestry, marine, chemicals, materials and energy industries
- These sectors are typically governed in isolation of one another with a need to establish connections between sectors, identify complementarities and potential conflicts and prioritise development opportunities for holistic bioeconomy development.
- BioÉire is the first project of its kind to objectively assess development pathways across the breadth of the bioeconomy. This knowledge base is essential for informed, evidence-based policy development and realisation of commercial opportunities.

Main results:

- BioÉire identified the most promising value chain opportunities for the Irish bioeconomy and the regulatory, infrastructural, market, research and innovation supports necessary to underpin their exploitation.
- The Irish resource base is subject to challenges of scale and a fragmentation of feedstock that will need to be addressed for successful bioeconomy development. Regulatory restrictions associated with the definition, recovery and use of waste will also need to be addressed to realise bioeconomy opportunities.
- Bioeconomy markets are diverse and hold potential globally but public engagement from the outset will be essential to mitigate any consumer acceptance concerns. Public procurement has an important role.
- Top value chains identified through BioÉire include the use of second-generation feedstock for the production of bio-chemicals, dairy processing sidestreams for sports nutrition products (beyond whey), horticultural by-product for bio-compostable packaging, marine discard for functional food and feed applications, agricultural and food waste for bioenergy production, seaweed use for food, healthcare and cosmetic applications and forestry residues for decentralised heat generation.
- Progressing beyond linear value chain thinking to establish complementarities between sectors, bioeconomy value chains and support frameworks now need to be connected into a more comprehensive bioeconomy value web, with potential to apply cascading and circular economy approaches to determine the most sustainable resource uses and address fuel, feed, food, fibre debates.

Opportunity / Benefit:

- BioÉire results have gained traction with the national Department of the Taoiseach and the Interdepartmental Group on the Bioeconomy, culminating in a collaborative design thinking workshop in February 2017 that will help to shape a national bioeconomy policy statement.
- Project results have been made available to relevant stakeholders through multiple dissemination formats including Delphi and workshop results reports, peer-reviewed papers and media outputs.
- Further industry-academic research projects are being undertaken to advance the prioritised value chains.

Collaborating Institutions:

Teagasc, UCD, DIT, tcbb RESOURCE

Teagasc project team:	Dr. Maeve Henchion (PI); Dr. Laura Devaney; Prof Cathal O'Donoghue; Mr. Ultan Shanahan
External collaborators:	Dr. Kevin McDonnell, UCD; Mr. Paul O'Reilly, DIT; Mr. Bart Bonsall, tcbb RESOURCE; Dr Eilín Walsh, UCD, Mr. Pádraic Ó'hUighinn, tcbb, RESOURCE; James Gaffey, tcbb Resource Teagasc Bioeconomy Working Group (TBWG)

1. Project background:

With escalating global challenges related to climate change, biodiversity loss, resource scarcity, food security, economic sustainability and growing populations, the concept of the bioeconomy has emerged worldwide, coming to the forefront in transnational and national policy documents in recent years (OECD, 2009; EC, 2012; Staffas et al., 2013). According to the EC (2012, p9) the bioeconomy includes “*the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products and bioenergy*”. Representing an opportunity to reduce reliance on fossil fuels whilst still achieving economic growth, the bioeconomy calls for radical innovation across agriculture, food, forestry, marine, energy, chemical and material sectors as stakeholders collaborate and diversify production systems to meet food, feed, fuel and material needs in more sustainable ways. Such innovation includes new technologies, practices, values, beliefs, configurations of actor groups, networks and policies (Darnhofer, 2015). Ireland does not as yet have a coherent national bioeconomy policy that identifies complementarities between resource sectors, highlights priorities for development, engages stakeholders and ensures the sustainable allocation of biological resources across food, feed, fibre and material applications. Key sub-sectors of the bioeconomy are typically governed independently of one another, each with their own, and potentially competing, strategy for development. There is a need to connect the objectives of these roadmaps through one coherent bioeconomy strategy that maximises return from natural resources in an environmentally and socially sustainable way. The BioÉire project was established to conduct an evaluation of the most promising value chain opportunities for the Irish bioeconomy and provide part of the knowledge base necessary to construct a national strategy. This included from supply, demand, business and support framework perspectives

2. Questions addressed by the project:

- From an input perspective, what does the supply base and Irish bioeconomy capacity look like?
- From a demand perspective, what are the bioeconomy market opportunities worldwide and what factors would influence consumer demand and willingness to buy bio-based products?
- Regarding development pathways, what value chains should be prioritised in the Irish bioeconomy?
- Finally, what support frameworks are required for the implementation and success of appropriate bioeconomy value chains?

3. The experimental studies:

BioÉire identified the most promising value chain opportunities and necessary support frameworks for the Irish bioeconomy through a series of interconnected research tasks. Examining opportunities across agriculture, food, marine, forestry and energy sectors, the first workpackage involved a situational analysis of the Irish biological resource base, alongside a strategic assessment of Ireland's capabilities in the bioeconomy arena (including an assessment of national strengths, weaknesses, opportunities and threats). Detailed literature and policy reviews, semi-structured key informant interviews, a SWOT analysis and brainstorming workshops with researchers external to the project formed the central research components of this analysis.

Once supply side and industrial capacity issues were established, a second key research phase examined international best practice to determine market opportunities for the Irish bioeconomy. A review of international bioeconomy strategies and consumer behaviour literature was completed as part of this research task, alongside an examination of international markets and patents focused on the relevant value chain opportunities identified for Ireland. The third BioÉire research phase involved the strategic generation, prioritisation and evaluation of relevant bioeconomy value chains, with the aim of identifying up to eight specific applications for the Irish bioeconomy. A diverse range of experts were engaged through an online Delphi study where participants were asked, through rounds of surveys, to score the potential of sixteen value chains and provide a rationale for their response. The top rated value chains were subsequently subjected to a technical, economic, social and environmental feasibility review drawing on qualitative Delphi

analysis, the established literature as well as a series of project team and external stakeholder consultations (including the TBWG).

The final research activity in BioÉire focused on designing and identifying the support frameworks required to ensure the success of bioeconomy value chains in Ireland. This included an assessment of policy, regulatory, financial, technical, infrastructural and market measures, among others, utilising semi-structured interviews and stakeholder interactions. All of the BioÉire research work packages were supported by a wider project management and dissemination work package. In addition to the agreed outputs and objectives, an additional collaborative design thinking workshop was organised with the Department of the Taoiseach within the project timeframe. Utilising BioÉire results as a springboard for the discussion, this workshop engaged 58 high-level stakeholders from research, support agency, policy and industry representative backgrounds to co-design a shared vision and a collaborative approach to creating a successful Irish bioeconomy. The BioÉire results launch, held in March 2017, represented another key dissemination event in the course of the project. All of the presentations from the launch, as well as additional reports, papers, magazine articles and related outputs from the project, are now hosted on a dedicated page within the Teagasc website (see: <https://www.teagasc.ie/publications/2017/bioeire-results-launch.php>).

4. Main results:

BioÉire was established to identify and evaluate the most promising value chain opportunities for the short-medium term Irish bioeconomy as well as the support frameworks required for their implementation and success. Headline results include:

- The Irish resource supply base is renowned worldwide in terms of its quality and abundance, however is subject to challenges of scale and a fragmentation of feedstock that will need to be addressed for successful bioeconomy development. The potential for new business models, centralised facilities and indeed decentralised options may provide some solutions across diverse opportunity areas.
- Bioeconomy markets are diverse worldwide but hold significant potential tapping into consumer demands for healthy and more sustainable products. However, public engagement from the outset of bioeconomy development will be essential to mitigate concerns of consumer acceptance and risk perceptions particularly regarding the use of waste streams in the bioeconomy.
- Top value chains identified through the BioÉire Delphi study include the use of second-generation feedstock for the production of bio-chemicals, dairy processing sidestreams for sports nutrition products (beyond whey), horticultural by-product for bio-compostable packaging, marine discard for functional food and feed applications, agricultural and food waste for bioenergy production, seaweed use for food, healthcare and cosmetic applications and forestry residues for decentralised heat generation.
- Overall, the use of by-product and co-product streams held particular appeal in the BioÉire Delphi highlighting the potential to valorise previously designated 'waste' streams. Regulatory issues need to be addressed however to realise these opportunities, including regarding environmental licencing.
- Progressing beyond linear value chain thinking to establish complementarities between sectors, bioeconomy value chains and support frameworks now need to be connected into a more comprehensive value web, with potential to apply cascading approaches and circular economy thinking to determine the most sustainable resource uses and address fuel, feed, food, fibre debates.
- The bioeconomy can be successful economically, environmentally and socially IF developed under certain conditions including consideration of integrated value web approaches, robust feasibility assessments, on-going environmental evaluation (including life cycle assessment) and clear support frameworks that address supply, demand, technology, business and research considerations.
- Due to the fact that bio-economic sectors derive most of their inputs nationally, and because they employ relatively more people per unit of output, growth in bioeconomy sales, and in particular exports, will result in a bigger impact on the economy than most other sectors.
- Key support frameworks required are varied and complex driven by the complicated integration requirements across numerous disciplines and sectors but span regulatory, infrastructural, market stimulation and research and innovation mechanisms.
- A detailed bio-economic strategy might be developed by adapting existing sectoral strategies (e.g. agri-food, marine, forestry, municipal waste) targeting incremental modular value from non-traditional outputs (e.g. functional foods, bioenergy, bio-chemicals, biomaterials) while maintaining and growing traditional outputs (e.g. food & beverage, timber products)
- As the definition and policy direction for the Irish bioeconomy is established, there is a need for a systematic deliberation of all options available backed by coherent and objective evidence base.

5. Opportunity/Benefit:

The bioeconomy, as a practical, tangible and realisable development pathway, holds potential to benefit numerous stakeholder groupings if developed in a sustainable and objective manner. For example, this ranges from its ability to diversify rural income and benefit rural areas, support SMEs, benefit large industries and provide sustainable and desirable products for society. Key external stakeholders to benefit from the BioÉire project thus include policymakers (charged with developing national bioeconomy policy), bioeconomy SMEs and multinational corporations, local authorities, researchers, farmers and consumers. Project results have been made available to these stakeholders through multiple dissemination formats including a dedicated results launch website, Delphi and workshop results reports, peer-reviewed publications, national and international academic and industry presentations and media outputs.

The identification of appropriate and feasible bioeconomy value chains promises economic, societal and environmental impacts providing a new direction for economic growth and job creation as well as environmental and social benefits shifting society away from a reliance on fossil fuels in a way that has the potential to also enhance rural development and livelihoods. The project's contribution to policy-making holds direct policy and public service impact, with ongoing interactions with DAFM colleagues and the Department of the Taoiseach as to the best bioeconomy development pathways in Ireland. Human capacity impacts have also been achieved by the project including through bioeconomy-related lecturing in national and international universities, the supervision of two international interns and provision of training to international research visitors based on the work of BioÉire.

6. Dissemination:

Results of the BioÉire project have been communicated and disseminated through multiple formats including peer-reviewed publications, popular media and online magazine articles, national and international presentations and a dedicated project results website (<https://www.teagasc.ie/publications/2017/bioeire-results-launch.php>)

Main publications:

- Devaney, L., Henchion, M. and Regan, A. (2017) "Good Governance in the Bioeconomy", *Eurochoices, Available Online Early View*, DOI: 10.1111/1746-692X.12141.
- Devaney, L. and Henchion, M. (2017) "If opportunity doesn't knock, build a door: reflecting on a bioeconomy policy agenda for Ireland", *The Economic and Social Review*, forthcoming 2017.
- Devaney, L. and Henchion, M. (under review) "Selecting expert participants in a Delphi study – who is the bioeconomy 'expert'?", *Futures* (to be submitted May 2017).
- Devaney, L. and Henchion, M. (in prep) "Consensus, caveats and conditions for bioeconomy development: results of an online Delphi study", *Journal of Cleaner Production* (first draft completed March 2017)

Popular publications:

- Devaney, L., Regan, A. and Henchion, H. (2016) "Imagine the Future", *Taste of Science* [online magazine] Available at: <https://www.tasteofscience.com/articles/609/imagine-the-future.html>
- Devaney, L. and Henchion, M. (2015) "The future is bio", *TResearch* [online magazine] Available at: <https://www.teagasc.ie/media/website/publications/2015/3788/TResearch-Winter2015.pdf>
- Devaney, L. and Henchion, M. (2016) "BioÉire: a bioeconomy for Ireland - Delphi Study Integrated Results Report", November 2016, Teagasc, Dublin. Available at: https://www.teagasc.ie/media/website/publications/2017/Combined-BioEire-Results-Report_DevaneyHenchion.pdf

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