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Final Report

Appendix E. IBioIC.

ADDITIONAL RESEARCH

March 2023

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Appendix E. IBioIC (Industrial Biotechnology Innovation Centre).

1 Introduction.

The Industrial Biotechnology IC (IBioIC) is a champion for the Industrial Biotechnology (IB) sector in Scotland and at the heart of the academic-industry interface. IB is a means to manufacture chemicals, pharmaceuticals, consumer products, polymers, fuels and numerous other materials, using innovative manufacturing processes, sustainable raw materials and thereby reducing the carbon footprint[1]. Scotland has all the ingredients to become a global leader in IB-led innovation given its strong academic and intellectual capabilities, supportive policy environment, industrial base and abundant natural resources. IBioIC was launched in February 2014 to help harness Scotland's IB potential.

The main report and appendices draw on a range of evidence, primarily MEF data, survey evidence, stakeholder feedback, and case studies. For some individual ICs, the number of survey responses is comparatively low, and the associated results are indicative. Please see Appendix A for further detail.

2 Development and approach.

2.1 Main elements of Phase 1 proposal.

IBioIC was established to take advantage of the 'industrial base, intellectual horsepower, infrastructure and unique resources' that provide the rationale for developing IB in Scotland[2]. The IC's stated vision since its outset has been to "accelerate and de-risk the commercial exploitation of IB in Scotland"[3]. It sought to achieve this through:

i. creating a connected industrial community - a suite of activities including an Annual conference, IBioIC led events, trade trips, advocacy work and helping develop the National IB plan and inward investment proposition. This strand included the SE and ERDF supported cluster builder project to build strong links with other sectors.

ii. supporting industrially led innovation in academia - facilitating access to two Scale-up Equipment Centres (initially termed Equipment Centres), the Rapid Bioprocess Prototyping Centre (at Strathclyde University) and Flexible Downstream Bioprocessing Centre (FlexBio) at Heriot Watt and supporting a range of collaboration, core, technical and 'fact-finding' projects. Collaboration projects are competitions involving business-academia collaboration; core projects larger projects identified by IBioIC with industry and fact-finding projects are desk-based or short lab-feasibility proof of concept studies to lead larger scale research.

iii. providing the skilled workforce to the industry - supporting PhD, MSc and HND programmes, as well as STEM engagement and Continuous Professional Development (CPD).

[2] *IBioIC Phase 2 Business Plan, 2018.*

[3] *IBioIC Phase 2 Business Plan, 2018.*

2.2 Main findings from Phase 1 due diligence.

The Phase 1 due diligence report provided very positive feedback on IBioIC. The key findings were that:

- IBioIC had "established itself as the focal point, driving force and leader of the Scottish industrial biotechnology sector"[4] reflected in the fact that the IC was named as a delivery partner in the National Plan for Industrial Biotechnology.
- The IC was praised for making a strong contribution to a number of its targets, notably in relation to engagements and SME involvement in projects, both in and outside Scotland and for further strong progress in relation to developing a membership base, its strong skills developing programme and UK and international profile-raising work.
- That IBioIC however had not met its targets in relation to impact at that time (at around 20% of GVA and 26% of total employment targets). The authors of the report said this was not surprising, given the relatively low TRL of project activity, and that impacts may be expected 5-10 years after project activity (rather than the four years maximum at the time of reporting). It also stated the impacts were overestimated, given full attribution to benefits to IBioIC.
- That overall, positively, the IC "has been successful so far and has made a significant contribution to the development of industrial biotechnology in Scotland. The [due diligence] evaluation considers that the continuing development of industrial biotechnology in Scotland is critically dependent on IBioIC, an observation that was strongly endorsed by the industry representatives and key stakeholders that were consulted"[5].

2.3 Main elements of Phase 2 business plan.

The rationale for IBioIC therefore remained for Phase 2. A programme of activities was subsequently developed for the Phase 2 Business Plan to fully meet the needs of the sector and to deliver the National Plan for IB.

The Phase 2 Business Plan makes provision for five key themes:

1. Providing Strategic Leadership and Developing New Value Chains.
2. Investing in Value Chains using Biotechnology.
3. Skilling the Necessary Workforce.
4. Accelerating Commercialisation.
5. Cross-cutting engagement.

2.4 Evaluation Logic model.

The logic model for the IBioIC, reflecting Phase 2 anticipated inputs, activities, outputs, outcomes and impacts is presented below (Figure A. 1).

[4] Technical and Commercial Due Diligence, IBioIC Phase 2 Business Plan, Scottish Enterprise, 2017.
[5] Technical and Commercial Due Diligence, IBioIC Phase 2 Business Plan, Scottish Enterprise, 2017.

Figure A. 1 IBioIC logic model.

Source: adapted from IBioIC Phase 2 Business Plan, 2018.

3 Market failure and strategic fit.

3.1 Market failure rationale.

Section 2.2 of the main report identifies a strong *equity rationale* at the Programme level. For IBioIC there is also a strong equity rationale in that the IC is supporting several sectors with low levels of BERD (including food and drink, textiles) and that the IC is supporting SMEs (primarily) as opposed to large firms. IBioIC is also supporting, in the main, indigenous firms, as opposed to foreign-owned firms. There is less evidence to suggest the IC is specifically benefitting Local Authorities with lower levels of BERD spend per population head, other than to raise BERD per head levels across Scotland as a whole.

In terms of the *efficiency* rationale, IBioIC creates *positive externalities* though supporting research and development leading to the development of new products, services and processes which delivers wider economic, environmental and societal benefits that are not exclusively received by the businesses and organisations that innovate. IBioIC also addresses *information failures* by helping businesses connect with academics, a key benefit to members of the IBioIC who may not have the capacity and/or knowledge to engage with universities and colleges. Similarly, IBioIC addresses the issues of *market power* by supporting SMEs to innovate, a particular factor for IB where the costs of innovation for SMEs is high. Finally, in relation to public goods, IBioIC provides a range of activities that cannot provide a commercial return including network development, shaping/ influencing public policy and providing advice and signposting support to businesses.

IBioIC has a very strong focus on helping to achieve net zero ambitions for Scotland, given its objectives to convert manufacturing processes to biology-based approaches. The 2022 update to the National IB Plan is entitled "Realising our Net Zero Ambitions'[6]. There is therefore a strong *environmental* market failure rationale here; many of the links IBioIC is able to make between different sectors (e.g., new uses for waste streams) would not easily be achieved by the market alone. It is also addresses *coordination* market failures in this way, with IBioIC is uniquely placed to create new value chains through the application of academic expertise to established processes. As on IC representative put it 'IBioIC is very much about the whole value chain, and creating value in it' [14]. The IC can look across sectors to see where value can be created, say, in new animal feedstock from waste from food and drink sub-sectors.

A survey of IBioIC clients emphasises that the costs and finance availability are particular factors in constraining their establishment's innovation activities before working with IBioIC (these were broadly consistent with IC clients as a whole). '**Direct Innovation Costs** are too high' was the most frequently cited (36%), followed by '**Availability of finance**, including awareness of funding opportunities' (29%). These were followed by '**lack of access to academic expertise** or other partnership opportunities' (17%) and by '**lack of qualified personnel**, or specialist project / programme support' (also 17%). In this regard, 'market power', followed by 'information failure' are the most significant market failures.

Fewer than one in five of IBioIC clients (18%) report that there were no market failures for them at the time of their involvement with the IC, the lowest proportion of all the ICs, suggesting market failures are significant in the IB sector. Encouragingly, more than seven in 10 (72%) of IBioIC clients report the IC helped them overcome the high direct costs of innovation and more than eight in 10 (82%) considered that IBioIC had helped them overcome the constraints of finance availability.

3.2 Strategic fit.

It is clear that IBioIC has demonstrated a strong strategic fit with Scottish Government priorities, and this continues to be the case with IB (and IBioIC) specifically mentioned in the 2022 National Strategy for Economic Transformation. There is evidence that IBioIC has even helped to shape these priorities

[6] National Plan for Industrial Biotechnology — IBioIC

and IBioIC is a partner in the delivery of the National Plan for IB. The Phase 2 Business Plan, including the budget identified, was designed to deliver the National Plan. The Ministerial forward to the 2022 update of the National Plan for IB namechecks and praises the role of IBioIC.

Initially, the 2014 National Plan for IB "Towards a Greener, Cleaner 2025' was developed by Life Sciences Scotland and Chemical Sciences Scotland. The mission of the National Plan was to grow IB related turnover in Scotland to £900m by 2025 through:

- Increasing awareness of IB as a transformational tool.
- Increasing company adoption of IB via company growth and improved turnover.
- Addressing skills requirements through a programme of targeted training and development.
- Encouraging collaboration with overseas partners.

In 2015, Scottish Enterprise published an update to the strategy through The National Plan for Industrial Biotechnology 2015-2025 – Building on Success.[7] This update highlighted the achievement since the first release and provided more detail on the proposed milestones. The latest (2022) update stretches the ambitions for the IB sector even further: for 220 active IB companies by 2025, generating £1.2bn in turnover and directly employing 4,000.

Given that IB seeks new manufacturing processes using sustainable raw materials and by reducing carbon footprint, through innovative processes, there is a very strong strategic fit with Scottish Government priorities related to addressing harmful climate change and the policy imperative of a Just Transition to a net zero economy. IBioIC therefore makes a direct contribution to the implementation of:

- Scotland's 2018-2032 Climate Change Plan[8], which sets out the Scottish Government's pathway the targets set by the Climate Change Act 2019 of net zero emissions of all greenhouse gasses by 2045. The Plan makes provision for major decarbonisation targets for industry, waste and electricity. At the time of the IBioIC Phase 2 Business Plan development, this was a draft Climate Change Plan.
- Scotland Just Transition - ending Scotland's contribution to climate change in a way that is fair and leaves no one behind and led by the Just Transition Commission[9].

Multiple stakeholders noted the way in which IBioIC is working with an increasing range of sectors [14][66][37]. These include textiles, food and drink and human health, as well as more typical IB-focused life sciences and chemical sciences and so IBioIC is contributing to the objectives and policies of many sectors, too numerous to mention here. For many of these sectors, IBioIC are helping 'join the dots' and make linkages between producers, consumers and the academic research to find new solutions [14]. These solutions are typically making use of waste streams (e.g., pot ale from whisky) and/or replacing carbon-based materials with biological ones, all of which contributes to individual sectors' net zero ambitions (e.g., in food and drink) and the overarching objectives of the Climate Change Plan.

3.3 Covid response.

In line with all ICs, IBioIC experienced a challenging operating environment during the period 2020-22 as a consequence of the Covid-19 pandemic. IBioIC responded positively to this challenge, in particular supporting its membership via virtual events and delivering project support activity remotely. IBioIC delivered their 7th Annual IBioIC Conference during Covid in February 2021 via a virtual platform with 798 delegates from the UK, EU and further afield. IBioIC also worked with the other IC's to deliver the

[7] Scottish Enterprise, "The National Plan for Industrial Biotechnology 2015-2025, Building on Success," (2015).
[8] Securing a green recovery on a path to net zero: climate change plan 2018–2032 - update - gov.scot (www.gov.scot)
[9] Just transition - Climate change - gov.scot (www.gov.scot)

Countdown to COP26 Conference in November 2020 contributing to cross-IC working to tackle global challenges, increasing its presence at COP26 itself.

Importantly, IBioIC contributed to the emergency response to Covid in Scotland. IBioIC used its biotechnology and laboratory operations experience to support the Glasgow Lighthouse Diagnostics Lab alongside the PMS-IC, the Scottish Manufacturing Advisory Service (SMAS), ScotCHEM and Forth Valley College to "assist with identification of relevant cohorts of potential staff that could be recruited, the training needs, workflows and the establishment of COVID-free training facilities to upskill the workforce"[10]. This enabled rapid response Covid testing greatly needed in the early days and throughout the pandemic and associated lockdowns.

In addition, IBioIC worked with others on specific Covid responses. They worked with industry partners to prepare Safe Return to Labs Guidance which was developed quickly to inform lab-based research about best practice in the industry at a time when there was great uncertainty in 2020 which had wider applicability across sectors. The IC also helped with the reshoring of manufacturing of reagents and enzymes needed to support the UK's diagnostics efforts, engaging with GSK, LifeArc and Sekisui Diagnostics to progress this. IBioIC was also a partner in the Roslin CT-led Training Centre for Cell and Gene Therapy Manufacture, one of only three across the UK.

The review has highlighted the connectedness of IBioIC with industry and public funders, which enabled the IC to play these important roles in Scotland's Covid response. IBioIC was also able to continue its skills development programme effectively during the pandemic, delivering the BBSRC-fund PhD training support online in 2020 and 2021 and the IBioIC supported MSc programme in IB, although, not surprisingly, there were greater challenges identifying MSc placements during pandemic.

Overall, IBioIC continued to build momentum in the delivery of its activities, despite the pandemic. An example was the start of the BioEconomy Cluster Builder 3-year ERDF project, which commenced in May 2020, just a couple of months after the first Covid lockdown.

4 Inputs, activities and outputs.

This section presents the main findings from the MEF data and then from the survey of beneficiaries. The survey of beneficiaries draws on 66 IBioIC client responses. The delivery and VfM section discusses available population level data for the IC.

4.1 Funder Inputs.

The table below confirms the funding that the Scottish Funding Council (SFC), Scottish Enterprise (SE) and Highlands & Islands Enterprise (HIE) have provided to IBioIC across Phase 1 and Phase 2 to date. This indicates total funder expenditure of £21,006,460 to date over Phases 1 and 2, the largest proportion (88%) of which has been from SFC. Neither SE nor HIE made a financial contribution to Phase 1.

Table A. 1 IBioIC inputs to March 2023.

Level	Phase 1 Actual (£)	Phase 2 Award*	Phase 2 Actual to date (£)	Actual to date
SFC	£11.8 million	£9.1 million	£7.0 million	**£18.8 million**
SE	-	£3.4 million	£2.2 million	**£2.2 million**
HIE	-	£0.6 million	£0.4 million	**£0.4 million**
Total	**£11.8 million**	**£13.0 million**	**£9.6 million**	**£21.4 million**

*Source: SFC, SE, HIE correspondence ('Summary funders awards and drawdowns to date', excel spreadsheet, Feb 2023). * includes extension to bring IBioIC into line with other IC since it had started at an earlier date.*

[10] IBioIC Response To Scottish Funding Council Activity To Support Post-Covid19 Recovery 2020 – 2022n.

The £21,006,460 in expenditure to date does not include other funding for projects secured in the form of commitments[11]. Additional funding has been secured from industry, Higher Education Institutes, other government agencies, research institutions and the like, and at times this funding has been considerable. Industry contributions include those monies paid for membership.

4.2 Activities and outputs.

The IBioIC has supported many events over the two Phases. The Annual Conference delivered by IBioIC is of national and international importance and substantially raises the profile of IB in Scotland [67][62]. As well as the Annual Conference, IBioIC is active in leading engagement events (55 anticipated in Phase 2 under the Strategic Leadership strand). Each quarter IBioIC leads a raft of events, from Industry Insight events to events relevant to other sectors (e.g., How Biotechnology Can Help Deliver Net Zero Construction). It also has representation and speaks at a wide range of external conferences. As the Table below highlights, there has been a considerable increase in this activity in Phase 2, as the profile of IBioIC (and IB) continues to rise.

Table A. 2 IBioIC: number of engagement events led or delivered by IC.

Level	Phase 1	Phase 2 (to Year 4)	Total
> 100 Attendees	4	17	**21**
10-100 Attendees	25	109	**134**
< 10 Attendees	0	0	**0**
Total	**29**	**126**	**155**

Source: MEF.

IBioIC delivers a strong skills development programme. This is considered a key benefit of the work of IBioIC and one that delivers considerable benefits both to the supported students and the Scottish economy as a whole [14] [62]. To date, some 451 students have benefited from PhD, MSc, HND or STEM engagement support. Some 122 PhD students have been supported by IBioIC to date, and 201 through the IBioIC MSc programme. MSc students are given a range of wrap-around supports called "Ready for Industry" covering topics such as finance, communication and how to cost processes, as well as a 10-week industry placement at the end. Whilst the 10-week placement is not long enough for students to undertake detailed project research, employers find this extremely useful as a form of trial for interview, with many students taken on at the end of their placement [14].

There have been challenges in delivering the skills programme in Phase 2, not least the effects of both Brexit in reducing the number of international students considerably, and the Covid-19 pandemic, which affected delivery. For IBioIC Phase 2 also has not seen the continuation of BBSRC funding which supported several MSc students in Phase 1. Despite this, IBioIC have sustained their master's programme through a variety of funding routes.

Table A. 3 IBioIC: number of entrants to education/training.

Level	Phase 1	Phase 2 (to Year 4)	Total
PhD/EngD	45	77	**122**
MSc	92	109	**201**
HND/HNC	15	68	**83**
Other	30	15	**45**
Total	**182**	**269**	**451**

Source: MEF.

[11] For example, the Phase 2 Business Plan stated that in Phase 1 IBioIC "had leveraged this into a £27.4 million direct activity and a further £23.4 million of indirect activity, exceeding by over £5 million, its initial Business Plan promise of £45 million total activity".

IBioIC is involved in a considerable volume of collaborative project activity and again Phase 2 has seen a large uplift in the number of project supported. For Phase 1, a total of 85 collaborative projects were supported, of which the majority of these projects were academic/IBioIC to business projects that involved at least one Scottish business as a partner. This is consistent with the ethos of IBioIC which very much sees the business as the 'customer' and the academic/IC support as the supplier (of expertise) [14]. A much smaller proportion were business collaboration projects where the businesses were not Scottish businesses, and a smaller proportion still did not involve businesses but were rather academic/IC to public sector collaborative projects. This trend has continued in Phase 2, where the majority of projects involve academic/IC collaboration with Scottish businesses, very much in line with IBioIC delivering support for Its industry membership. As of Year 3, the number of completed projects was close to the full Phase 1 total.

Table A. 4 IBioIC: collaborative projects.

Level	Phase 1	Phase 2 (Year 3)		
	No. of collaborative projects (including completed)	No. of new collaborative projects	No. of continuing collaborative projects	No. of completed collaborative projects
Academic/IC to business (involving at least 1 business in Scotland)	64	97	0	60
Academic/IC to business (involving no businesses in Scotland)	12	15	0	15
Academic / IC to Academic	0	0	0	0
Business to business (involving at least 1 business in Scotland)	0	0		0
Academic/IC to public sector (involving no businesses in Scotland)	8	12	0	7
Academic/IC to public sector to business (involving at least 1 business in Scotland)	1	6	0	2
Individual Projects	0	0	0	0
Total	**85**	**130**	**0**	**84**
Collaborative projects in the pipeline	-	-	-	-

Source: MEF.

The latest MEF data provided by IBioIC does not provide a breakdown of completed collaborative projects, however it shows that 90% of collaborative projects between industry and academia (direct involvement) have led to follow-on activity. Applied to the number of completed collaborative projects at the end of Year three (84), this equates to 76 projects.

During Phase 1, 30 new or improved products and services were developed, or processes implemented, although a breakdown is not provided between these three. A target of 12 was set for Phase 2.

Of the 451 entrants, 336 of those undertaking IBioIC supported PhD, MSc, HND and CPD courses have already gained new qualifications. This number will rise as Phase 2 course entrants continue to complete their courses and secure their qualification. This is a considerable input to the IB workforce in Scotland. Again, this reinforces the strength of IBioIC support for the developing the IB skills pipeline.

Table A. 5 IBioIC: number of individuals gaining new qualifications/skills.

Level	Phase 1	Phase 2	Total
PhD/EngD	45	35	**80**
MSc	92	104	**196**
HNC/HND	15	30	**45**
Other	0	15	**15**

Total	**152**	**184**	**336**

Source: MEF, Phase 2 (till end of 2021/22).

In terms of engagement with IBioIC, just under half of respondents (49%) first interacted with the IC in or before 2018 (broadly consistent with Phase 1) . Some 94% of client respondents were still involved with IBioIC.

There are good levels of collaborative project involvement activity with clients. For IBioIC, more than four in 10 respondents (44%) were involved in a collaborative project between more than one partner and 53% were in collaboration projects between themselves and one partner**.** In all, 14% were involved in consultancy projects. More than half were involved with IBioIC as members (56%), by far the highest proportion of all ICs (the next highest was SAIC at 30%).

Client involvement in skills development is evident, with IBioIC 42% of respondents taking postgraduate internships/ placements/secondments (second only to 61% for TDL). Many clients have also accessed lower intensity support e.g., almost two thirds (64%) conferences and events, 30% for advice and signposting and 26% training and development support. Overall, 17% had accessed lab, test or demonstration facilities, the highest of all ICs, reflecting the importance of the IBioIC supported equipment centres.

For collaborative project support, 27% had accessed four or more rounds of IBioIC funding. More typically clients accessed one or two rounds of IC support (51%). Survey beneficiaries have often engaged with engaged with other ICs, particularly SAIC, TDL, CENSIS, IBioIC.

The client survey demonstrates there has been some form of client engagement with a wide range of universities, well beyond the two Universities that host the scale-up facilities (University of Strathclyde and Heriot-Watt University). Clients are most engaged with the University of Edinburgh and Universities with biotechnology expertise, including the University of Abertay. In all, 5% of client respondents had engaged with the University of the Highlands and Islands, although 11% of client projects are within the Highlands and Islands, just above the expected pro-rata share.

Engagement with colleges is on a smaller scale (just under one in 10). Client respondents had worked with Glasgow Clyde College, Scotland's Rural College and North East College.

A small number of students provided survey responses (6) which is not reflective of the large number of students supported. These students were largely involved in process, product and service improvements, with a smaller proportion involved in developing business and societal solutions.

5 Outcomes and impacts.

5.1 Main findings from MEF.

The substantial increase in activities between Phase 1 and Phase 2 is reflected in a corresponding increase in outcomes. In total, there were 120 new and safeguarded jobs in Phase 1, and by November 2022, there were 494 new and safeguarded jobs reported in Phase 2. A total of £16.2m in increased or created turnover was achieved in Phase 1, which by November 2022 in Phase 2 was an estimated £435.6m, a 27-fold increase, as reported in the MEF. The Phase 2 targets have already been exceeded (see below), although it should be noted that the jobs and turnover reported here are gross figures and attribute all increases to IBioIC support.

Table A. 6 IBioIC Outcomes.

	Phase 1			Phase 2*			Total
Level	Planned	Actual	%	Planned	Actual	%	Actual
[Anticipated] Jobs Supported and/or Created							
Created	-	-	-	-	-	-	-
Safeguarded	-	-	-	-	-	-	-
Total	-	**120**	-	-	**494**	-	**614**
[Anticipated] Turnover Supported and/or Created							
Created							
Safeguarded							
Total		**£16.2m**			**£435.6m**		**£451.7m**
Posts Created in Scottish HEIs, Colleges and the Public Sector							
Posts in HEIs to support A2B Projects	-	-	-	-	-	-	-
Posts in Colleges to support A2B Projects	-	-	-	-	-	-	-
Posts in Public Sector to support A2B Projects	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-

Source: MEF; * is to November 2022.

5.2 Main findings from survey of beneficiaries.

5.2.1 Outcomes.

IBioIC has played a significant role in developing client relationships with a wide range of bodies relevant to the innovation ecosystem. Selected highlights are:

- 36% of respondents indicate IBioIC has significantly supported relationships with universities or colleges. This is a strong reflection of the effectiveness of IBioIC in connecting industry to academia, with academic expertise flowing through collaborative projects with business.
- 30% of respondents indicate the IC has significantly supported relationships with clients or customers from the private sector, indicating the strong network and sector supporting role of the IC in connecting businesses with other businesses.
- 29% of respondents say the IC has significantly supported relationships with conferences, trade fairs and exhibitions.
- 21% of respondents say the IC has significantly supported relationships with professional and industry bodies.
- 15% of respondents indicate the IC has significantly supported relationships with other public sector innovation funding programmes.

IBioIC play a major role in the implementation of a range of innovation activities, with client establishments investing in a wide range of innovation activity. Almost two thirds of all client respondents (64%) have carried out internal R&D since they started working with IBioIC (and in 27 of the 42 cases, the IC has helped significantly with the implementation of internal R&D). More than a quarter have acquired machinery and equipment, computer hardware and software for innovation (26%), and a similar proportion have implemented training or skills development for innovative activities (26%), In terms of training, in 10 out of the 17 cases, IBioIC had helped significantly with this implementation and in seven out of 12 cases, IBioIC had significantly helped the client to make introductions of innovation.

Further, one in five (20%) IBioIC clients have introduced new or significantly improved goods. A further 18% had introduced new processes and 15% new or significantly improved services. The IC has played a significant role in the introduction of new or significantly improved goods in particular (in 11 out of 13 cases), and in the other cases cited the role of the IC has been significant in at least half of all cases. In all, almost one in three (28%) had introduced new or significantly improved goods, services or processes, attributed to IBioIC. A small proportion of clients (6%, four cases) had started new start-up

and spin out businesses and 3% (2 cases) had made patent applications, where IBioIC had played a significant role in both cases. Just over one third (36%) of respondents did not introduce any of the listed innovation outcomes.

IBioIC clients respondents (some seven out of 10) reported high level of **networking benefits** (where the IC played a significant role). In particular, benefits were cited in relation to:

- New business contacts - 56% of clients saying this.
- New academic contacts – 50% of clients saying this.
- Joint venture with business – 38%.
- Joint venture with academic institution - 24%. This is a strong proportion, showing the depth of business/academic relationship, as well as volume.
- New public sector contacts - 21%.

Clients also identified a range of **knowledge benefits**:

- Improved technical understanding of priority technology areas in my sector – 48%.
- Improved cross-industry collaboration – 33%.
- Improved market understanding of priority technology areas in my sector- 32%.
- Improved awareness of academic capabilities – 32%.
- Improved awareness of societal goals – 24%. This is a high proportion, reflecting the positive role of IBioIC in helping to develop bio based solutions across a range of different sectors as an alternative to non-bio based approaches.
- Improved employee skills and ways of working – 23%
- Improved industry or technology foresighting – 21%.

The positive findings above are echoed by more than a third of clients who praised IBioIC in open text responses, which included the specific role of the IC in connecting business to academia, with one private sector manufacturer of non-hydrocarbon feedstock client citing “IBioIC has been at the forefront of bringing together the IB community in Scotland and increasing awareness of IB to the wider community in Scotland and beyond”. Academics too have praised IBioIC, with one, for example, stating “IBIOIC has been fantastically supportive for my work, and via their projects my group alone has impacted 10+ biotech SMEs in Scotland”.

Those clients involved in collaborative projects through IBioIC have typically started at the lower end of the TRL scale (it is noted this may include project work before IC involvement), with 59% at TRL 1-2 at the start. However, following IBioIC supported the TRL is (or is expected to be) higher, although still typically at TRL 3-4 \. The proportion at TRL 3-4 is expected to increase from 29% to 69% (and TRL 1-2 fall from 59% to 17% following IBioIC support). The IC is therefore playing a strong role in moving clients from basic research and technology concept formulation (TRL1-2) to proof of concept and small scale prototyping (TRL3-4).

Within three years, six in 10 expect to be at TRL4 and above, although the majority of these (55% of the client respondents) expecting to be at TRL4 and 5. This shows the relatively long timescales for IBioIC product development and industry validation requirements. It also demonstrates the support required for businesses in moving from small scale laboratory technology validation to large scale industry-validated technologies.

Respondents were also asked to indicate **sales benefits** gained as a result of working with IBioIC. A relatively small proportion reported benefits, compared to some of the other ICs. The most cited benefits were:

- 5% entered or grew in Scottish market.
- 5% entered or grew in international markets.
- 3% entered or grew in other UK market.

Finally, respondents were also asked to indicate **financial benefits** gained as a result of working with IBioIC. The most cited benefits were:

- 13% secured cost savings or more efficient and effective processes.
- 8% gained improved investment readiness.
- 5% secured new public sector investment.
- 5% secured new equity investment (e.g., venture capital, angel investors).

5.2.2 Impact.

This section discusses the impacts of IBioIC in terms of employment and Gross Value Added (GVA). The analysis of impacts includes an assessment of additionality (as outlined in appendix A).

Analysis of the employment data provided by respondents to the client survey reveals a net employment peak of 62, or 112 with the addition of a suitable multiplier. When these figures are grossed up to the total businesses supported by IBioIC it delivers net additional employment of 476, or with the multiplier 858.

Gross Value Added was calculated using the net additional employment figures and IBioIC will facilitate £21.6 million of cumulative net additional GVA or £38.8 million with the multiplier. As explored in the value for money section, this represents a good return on public expenditure on IBioIC, and total expenditure including private sector sources. It is however emphasised that the reported results relate to a relatively small sample of beneficiaries and that the grossed up figures presented are indicative.

A further question on additionality was included in the client survey. For IBioIC, just 3% said they would have achieved exactly the same range of benefits at the same time and scale, . Conversely, 23% say they would not have achieved any of the benefits without IBioIC support (absolute additionality).

However, the majority of additionality is through increasing the scale of benefits, or bringing forward the timing of benefits. The greatest percentage of respondents (26%) say they would have achieved a significantly smaller range of benefits, at a reduced scale, and it would have taken longer to achieve them. A further 18% report more limited scale benefits and 18% report they would have achieved the same benefits, but it would have taken longer to achieve them.

5.2.3 Wider impacts.

IBioIC has delivered a wide range of further impacts, beyond its core objectives. Whilst the IC seeks to influence policy, it is clear its role here has been far wider than a narrow interpretation of this influence. The IBioIC has helped to shape, and subsequently deliver, the National Plan for IB - and has played a key role in the 2022 IB Plan update. The IC has ensured that Government understands - and acts on - the important role IB can play and has ensured IB is part of the NSET. The IC has raised the profile of Scotland on the international stage, as one of the places to do business in IB, working with Scottish Development International to play a role in attracting inward investors.

The wider impacts identified by stakeholders include a considerable contribution to the net zero agenda. Whilst this has been a core purpose of the IC i.e., seeking innovative process that utilise sustainable raw materials it is clear that stakeholders consider that the IBioIC has gone beyond simply identifying technical solutions. Rather, the IBioIC has been creative and imaginative in making links between and within sectors; a testament to its visibility and well connectedness across Scotland.

Major employers recognise the value of IBioIC in supporting and extending the ecosystem. Global players are active in the membership and on the Board, seeing value in the way that IBioIC finds and explores solutions [67]. Some also employ the IC to manage their own skills programmes, finding value in the employability wraparound support that IBioIC delivers [14][51].

In considering the wider benefits of IBioIC support of clients, clients were asked which, if any, of the UN Sustainable Development Goals (SDGs) had their establishment made a significant contribution to,

as a result of working with the Innovation Centre. IBioIC support to clients led to a significant contribution for all 18 of the SDGs, reflecting the cross-sectoral work and breadth of impact of IBioIC. A wide range of benefits are cited by IBioIC clients, particularly in relation to:

- Industry, innovation and infrastructure (e.g., adoption of new medium-high, and high technologies) (33%).
- Good health and well-being (e.g., ensuring healthy lives, promoting wellbeing, COVID response) (23%).
- Responsible consumption and production (e.g., reducing waste, industrial pollution) (18%).
- Climate action (e.g., reducing CO2 emissions) (18%).

The positive impact of IBioIC support in relation to health and well-being, as highlighted by the contribution of the IC to the COVID response and to the environment are clear. The IC plays a positive role in reducing waste (through enabling companies to utilise others' waste streams) and by reducing CO2 emissions by promoting the use of alternative bio-based solutions.

The case studies below provide further insights into the nature of wider impacts derived from IBioIC activities.

5.3 Assessment of innovation ecosystem benefits.

The evaluation objectives include an assessment of how effective each IC has been in building engagement in its own ecosystem. The approach to assessing the role of ICs within the wider innovation ecosystem is set out in Appendix A, and summarised for IBioIC in Figure A. 2 (authors' scoring).

Figure A. 2 IBioIC innovation ecosystem benefits.

Source: authors

System Leadership.

Leadership.

- As described in in the strategic fit section, IBioIC has demonstrated strong leadership for the sector, being instrumental in the development of the National Plan for IB update 2022 and acting as a strong champion for industry. The IBioIC is the envy of other parts of the UK which do not have an equivalent of this scale [45] [48][12]. A representative of the Scottish BioEconomy

[12] Although it is noted that CPI locations across the UK supporting IB https://www.uk-cpi.com/technologies/biotechnology

Council praised IBioIC very highly, considering IBioIC leadership (alongside the BioEconomy Council) to be very effective [50].

- When questioned directly, some 38% of IBioIC clients stated that IBioIC had been a significant source of support for the wider innovation ecosystem in terms of in terms of providing strategic leadership for the sector or technology area. In addition, half of IBioIC clients (50%) stated that IBioIC had been a significant source of support for their establishment in terms of acting as a source of sector or technology expertise.

Influence.

- The strong leadership role translates into strong influence, with IBioIC communicating the messages around IB effectively to the Scottish Government, so that various departments know the value of IB to Scotland [51]. IBioIC benefited from a very good Public Affairs manager [46] so that there was a widespread understanding of IB amongst not only Government but amongst other stakeholders. Quarterly returns via the MEF and Board updates report on the progress made with Scottish Policy leaders on IB friendly-policy. As an example, IBioIC recently engaged with Scottish Government Ministers to ensure IB was included as an opportunity for economic growth and net zero carbon impact in Scotland's National Strategy for Economic Transformation.

- Questioned directly, 23% of IBioIC clients stated that IBioIC had been a significant source of support for the wider innovation ecosystem in terms of in terms of effective policy or strategic influence.

- There are direct examples of IBioIC's influence on the sector and national policy. IBioIC have played a key role in helping to develop the Grangemouth/Falkirk Growth Deal programme to further expand bio-economy scale-up facilities. The ICs input has also secured additional funding such as via SE on the Bioeconomy Accelerator Pilot Plant. Stakeholders report this is due to IBioIC being the leader in IB knowledge in Scotland, and that without them a huge information gap would exist [51].

Partnerships.

- IBioIC are effective at working in partnership, and there are numerous examples where the IC has worked well with sector trade bodies to explore and develop solutions [51][62]. The SE and ERDF supported cluster builder project (Bioeconomy Cluster Builder) has been extremely important in this regard. IBioIC has also worked well with national organisations, notably Zero Waste Scotland, with which it is pursuing strategic projects. The Whisky CoProducts partnership project is a good example, with the IBioIC FlexBio team extracting academic expertise to integrate the bioprocesses of the three technical partners, Horizon Proteins (itself a spin-out from Heriot Watt University), MiAlgae and Biopower Technologies, with reports submitted to Zero Waste Scotland on the technology transfer work and the logistic analysis undertaken and with case studies developed.

- Stakeholders frequently cited the effectiveness of IBioIC in terms of partnership working [14, 37,67], one saying "IBioIC runs a lot of events – it is known as part of the bioeconomy landscape"[49]. Another, that "There are so many project ideas that IBioIC are almost inevitably good at making partnerships to take projects forward"[14].

- The MEF indicates more than 200 collaborative projects over Phases 1 and 2, indicative of the strong partnerships built up between IBioIC and industry and academia. As noted above, a third of clients have been involved in significant cross-sector collaboration, and a similar proportion of clients report significantly enhanced relationships with academia and other private sector businesses.

- Similarly, when questioned directly, a third of IBioIC clients (33%) report that IBioIC has acted as a strategy partner e.g., developing or sustaining new strategic or longer-term partnerships. Again, one third of clients report that IBioIC has supported the development of trust between the client's organisation and other organisations in their sector/technology area. In addition, as noted above, 38% have developed a joint venture with academia, and 24% a joint venture with business.

System Strengthening.

- System strengthening is also evident. IBioIC has continued to grow its membership base in Phase 2 (138 at the time of reporting autumn 2022). The Annual Conference is another very good way in which IBioIC is strengthening the IB sector in Scotland, and more widely. It is regarded as the 'go-to' UK event for IB for industry. The MEF indicates some 155 IBioIC-led engagement events, with the vast majority of these delivered in Phase 2. These cover a very wide range of sectors, from the SULSA Health Innovation Seed Funding Workshop (health sector), to the 'Circular Approach to Use of Marine Growth on Decommissioned Offshore Infrastructure' (energy) to HIE Food & Drink Webinar and HEI Showcase Event (food and drink).
- When asked directly, almost half of all IBioIC clients 47%) stated that IBioIC had been a significant source of support for the wider innovation ecosystem in terms of fostering synergies and networking within their sector or technology area. The survey of IBioIC clients also pointed to engagement with a wide range of higher education institutions, particularly across Scotland, including the North East (Robert Gordon University and University of Aberdeen).
- The survey of IBioIC clients also demonstrates a positive contribution to a collaborative culture with IBioIC playing a significant role in helping clients develop new contacts. Some 56% reported new academic contacts and 50% new business contacts, both the highest reported by ICs, evidence of the strong networking opportunities facilitated and created by IBioIC.

System Resources

Visibility.

- The IC is very visible in a Scotland (and increasingly UK) context and there is scope to raise its profile even further internationally [62]. IBioIC is therefore viewed by Scottish Government as pivotal in catalysing the reduction of Scotland's reliance on petrochemicals to produce many of its key products such as energy, fuel, materials and chemicals whilst also supporting the uptake of biotechnology into many other sectors [66]. IBioIC has some of the largest sector companies as paying members (e.g., GSK), demonstrating the ICs profile, alongside Scottish SMEs.
- When questioned directly, some 58% of IBioIC clients stated that IBioIC had been a significant source of support for the wider innovation ecosystem in terms of raising the profile of the sector/technology area within Scotland. In addition, 26% of IBioIC clients stated that IBioIC had been a significant source of support for the wider innovation ecosystem in terms of in terms of raising the profile of the sector/technology area internationally. Further, half of IBioIC clients (50%) stated that IBioIC had been a significant source of support for their establishment in terms of supporting improved visibility within sector/ technology area.

Resources.

- There are good resources available through IBioIC through the two Scale-ups Centres [62, 37] with the desire for even larger scale-up facilities to take businesses the next stage which is a current gap [66]. Only the database mapping available waste streams for use in IB has been

less effective, requiring as it does ongoing maintenance and better inputs (some of which need to remain confidential).

- Just under a quarter of IBioIC clients (23%) reported that IBioIC has supported the sharing of common resources (e.g., joint infrastructure, initiatives for skilled labour development, procurement expertise, support for specialist service providers).

Leverage.

- IBioIC has proved very effective during the course of Phase 1 and 2 at meeting the relevant criteria, including securing Scottish and other UK funding public sector research funding, supporting application for funding, and attracting new investment to Scotland.

- IBioIC was unlucky not to have secured even more in the form of a second tranche of BBSRC funding and to have missed Strength in Places funding, where only one sector-related project was supported in Scotland (a dairy project in Dumfries). Nonetheless, the very process of leading the large-scale Strength in Places bid, for example, has helped to build the IB ecosystem in Scotland and may lead to future IB development at Grangemouth in particular.

- Private sector leverage has been secured, including industry match funding to supports the ICs skills development work. IBioIC estimate the total industry contribution to the skills programme to date is in the region of £6.3m simply in terms of supporting the 300+ HND and PhD students over Phases 1 and 2 (with IBioIC estimating a total of £24m has been levered in for skills investment against an average annual cost of £1.7m).

- Questioned directly, more than a third of IBioIC clients stated that IBioIC had been a significant source of support for the wider innovation ecosystem in terms of promoting investment and leverage of resources into the sector/ technology area from within Scotland, In addition, 23% of IBioIC clients stated that IBioIC had been a significant source of support for the wider innovation ecosystem in terms of promoting investment and leverage of resources into the sector/ technology area from outside Scotland.

Knowledge.

- IBioIC has been active across a number of skills development areas, including: The IBioIC CTP PhD training programme; the MSc in Industrial Biotechnology at Strathclyde; HND Industrial Biotechnology; Research Pools; STEM Engagement, principally in Phase 1, with schools and Colleges; and Continuous Professional Development, with an increased programme of activity in Phase 2.

- As highlighted elsewhere, the MSc programme is particularly valued, including the student placement which increases the employment readiness of participants. The 10-week placement at the end of the MSc involves seven different Scottish Universities, even though the student graduates from the University of Strathclyde. The placement provides invaluable lab skills knowledge for the student and often acts as a trial/interview for the business or organisation, leading to recruitment.

- In response, a range of knowledge benefits are identified by IBioIC clients, as discussed above, for example, 48% indicate improved technical understanding of priority technology areas in their sector. In addition, 38% of IBioIC clients stated that IBioIC had been a significant source of support for the wider innovation ecosystem in terms of supporting knowledge development and dissemination (e.g., new courses, university or college networks, attraction of talent).

- Further, 42% of IBioIC clients stated that IBioIC had been a significant source of support for their establishment in terms of supporting diffusion of knowledge and good practices. At a programme level, this includes innovation benefits accruing to universities. IBioIC has been highly effective at extracting knowledge from academic partners and making this accessible and of use to industry and, as highlighted earlier, more than for in 10 (41%) report improved access to knowledge benefits, including better relationships with academia.

Commercialisation.

- With regard to supporting activities leading to commercial or public sector exploitation, the client survey has demonstrated a wide range of innovation investment by IBioIC clients, with, for example, around 64% indicating IBioIC played a significant role in investment for internal R&D. More than four in five IBioIC clients (84%) say that IBioIC has been important in helping them increase their TRL level, with 48% saying IBioIC was 'very' or 'extremely' important in this regard, with clients principally reporting progress to prototyping and laboratory testing of their research.

- IBioIC maximise the opportunities for businesses to access other funding and to start-up or spin-out their business. IBioIC has continued its engagement to support Royal Society of Edinburgh Enterprise Fellowships and supported successful IB-relevant spin out companies from academia as part of the Scottish EDGE competition. IBioIC supported three new academic spin outs via EDGE in 2020, for example, namely OGI BIO from University of Edinburgh (see case study); TENBIO from University of Dundee and MI:RNA from SRUC.

- Questioned directly, 36% of IBioIC clients said that IBioIC encouraged experimentation and commercialisation in Scotland (e.g., start-ups, spin-outs, testing of new technologies, demonstrating new technology or processes), the second highest proportion for ICs. This reflects that strong role IBioIC plays in supporting scale-up activities, notably via its two equipment scale-up centres.

- In addition, 15% of IBioIC clients stated that IBioIC had been a significant source of support for the wider innovation ecosystem in terms of encouraging foreign companies to establish in Scotland, the highest of all the ICs.

- The MEF and survey of IBioIC beneficiaries both indicate that the IC is supporting job creation and additional GVA in the Scottish economy.

6 Delivery and value for money.

6.1 Governance and management arrangements.

IBioIC was established in 2014 and has been hosted by the University of Strathclyde throughout that period, providing a continuity of host arrangements. In common with other ICs, the University of Strathclyde, as host institution, employs all IBioIC staff.

IBioIC is subject to University of Strathclyde policies and procedures on Human Resources and Finance and falls within the scope of University of Strathclyde audit and compliance arrangements. All matters of strategy and operation are under the control of the IBioIC Governing Board, which governs IBioIC activities and ensures legal compliance, financial oversight, risk management and the formulation of future strategy. The University of Strathclyde is represented on the IBioIC Board. The Governing Board governs IBioIC activities and ensures legal compliance, financial oversight, risk management and the formulation of future strategy.

In addition, there is the Commercial Advisory Board and the Scientific Advisory Board. The Commercial Advisory Board reviews the project competitions; reviews the strategic goals and commercial opportunities available to IBioIC. It considers how IBioIC can meet these goals and exploit these opportunities and reports to the Governing Board. The Scientific Advisory Board oversee the education program of IBioIC and work with each of the academic institutes to ensure projects are delivered to commercial standards. It also works to enhance the technical reputation of IBioIC. The primary purpose of the Scientific Advisory Board is to provide independent and informed scientific opinion on IBioIC sponsored projects to the officers or IBioIC Governing Board.

The IBioIC Management Group is responsible for delivering all programmes, whether core-funded, jointly-funded or fee-for-service. Quality control personnel are contracted by IBioIC if required for delivery of programmes. Terms of Reference exist for all Boards and are reviewed to be fit for purpose on an annual basis.

The total head count in Phase 2 was anticipated to be 30 (equivalent to 28.45 FTE), split in to 20 positions fully funded through the Centre core costs (18.45 FTE), three positions 50 % funded through the Centre core costs and 50% funded through centre income (Scottish, UK and EU awards) and seven positions that will be fully funded by Centre income. The positions associated with the equipment centres were to be funded by income from the equipment centres, initially three positions expected to grow up to six positions as and when demand of the equipment centres requires it.

As with other ICs, stakeholders noted challenges in recruitment and retention (a common theme across) with host university and ICs working to resolve personnel structures, and resourcing of posts at competitive salaries, a challenge given private sector comparative salaries. Stakeholders also commented on the difficulties for recruitment posed by the short-term nature of funding rounds, and time taken for IC funding approvals.

The management of IBioIC was regarded positively by stakeholders, notwithstanding the recruitment and retention challenges noted [45, 47, 48]. The team is regarded as very capable [62, 37] and solutions-driven, able to make links across sectors, and being proactive and professional in approach [67]. This enables IBioIC to work collaboratively with the largest players in IB, as well as with SMEs.

In general, it was the view of stakeholders that it would be beneficial for the organisation to have a longer funding window to ease planning and staffing considerations [51, 62], particularly given the length of time taken to secure funding approval, and, in the case of IBioIC, the funding extension. One commented that it had “we constantly lose momentum, and capacity” when there are delays to funding approvals, with staff moving to other positions whenever uncertainty over continuation of funding occurs [62].

Despite some challenges for the IC, there are very good satisfaction levels with IBioIC support from IBioIC clients right across the board, notably:

- 93% satisfaction with post-graduate placements.
- 92% satisfaction with collaborative project support (more than one partner).
- 89% satisfaction with collaborative project support (one partner).
- 88% satisfaction with training and development support.
- 88% satisfaction with IC conferences and events.

The positive role of IBioIC in facilitating and taking forward project ideas, through collaborative projects and other networking activities, was cited by a number of stakeholders [43], for example.

Marginally lower levels of satisfaction (although still high):

- 83% satisfaction with advice and signposting.
- 82% satisfaction with lab, test or demonstration facilities (small number of cases).
- 77% satisfaction with IC membership (paid or free).
- 72% satisfaction with consultancy support projects.

- 66% satisfaction with support for a consultation process.

6.2 Monitoring and evaluation.

Throughout Phases 1 and 2, the funders received quarterly progress reports, and monitoring data were readily available. IBioIC has provided funders with a framework of quantitative metrics providing both internal and external stakeholders regular KPI updates, generally at appropriate levels of detail. The Board generally consider the management information provided to them as timely and good, enabling appropriate decision-making to be undertaken.

A stakeholder recognised that there was a challenge in developing a MEF that supported adequate governance at the same time as being consistent across ICs and straightforward enough for practical use. Further, in line with other ICs, reporting of often significant wider benefits is solely qualitative in nature at this time and the programme MEF would benefit from revision to capture wider benefits though the identification of appropriate qualitative and quantitative indicators and methods.

IBioIC report on a number of additional indicators to the MEF, including investment in R&D and scale-up (equipment centre) income. These are useful additions. The reporting of jobs and turnover are 'gross', and are those reported by projects closing "within five years of the project close". In common with other ICs, the jobs and turnover reported in the MEF are those forecast by projects over the 5 years from project close; as such a reasonable degree of optimism bias is inherent in the forecasts.

6.3 Value for money.

6.3.1 Introduction.

This section of the report sets out the main findings of the evaluation with regard to value for money.

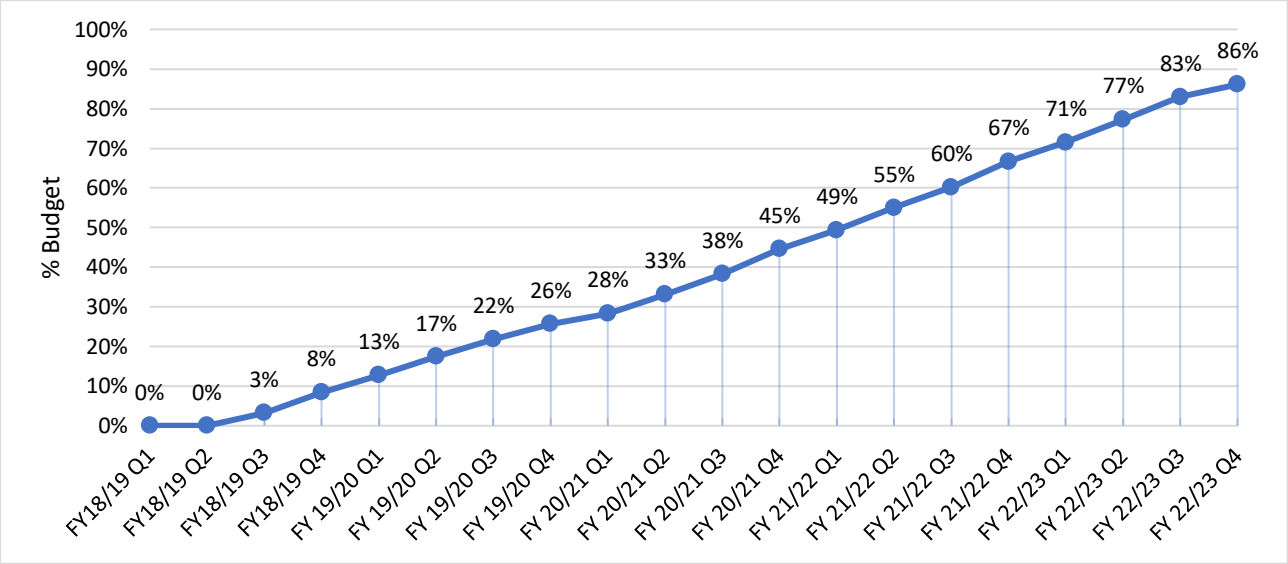
6.3.2 Limitations.

The overall programme MEF provides a limited framework of quantitative metrics that can be used to assess VfM. The main body of the report discusses the limitations in greater detail. This report uses the latest financial data available, i.e., to Dec 2023 and /or March 2023.

6.3.3 Budget execution.

Total Phase 1 spend is as £11.8 million. Funder budget drawdown is used as a proxy for expenditure. Phase 2 budget execution is noted in the table below (see Table A. 12). Quarterly drawdown is approximate. Some 86% of the funder budget has been drawn down for the period up to March 2023 with IC spend on track for the remainder of Phase 2.

Table A. 7 IBioIC budget execution.



*Source: SFC, SE, HIE correspondence ('Summary funders awards and drawdowns to date', excel spreadsheet, Feb 2023). * funders indicate awarded at outset of Phase 2.*

6.3.4 Finance mobilised.

Finance mobilised (public or private) is not recorded as a specific MEF indicator. Here, it is assessed as all recorded MEF commitments (project and centre combined), excluding all funder commitments. MEF commitments are presented as supplied by the IC.

On this basis, some £24.2 million was mobilised over Phases 1 and 2. Of this, 49% was industry finance. Comparing funder inputs (to Dec 2022) to finance mobilised, this indicates an estimated favourable leverage of £21.0 million to £24.2 million, or 1.2:1 (benefit to cost ratio). For industry finance mobilised this 0.6:1 (see Table A. 22).

Table A. 8 IBioIC, finance mobilised, to Dec 2021/22.

	Phase 1	Phase 2	Total
Higher Education Institutes	£2,660,000	£1,512,000	£4,172,000
Other Public	£3,617,000	£1,530,000	£5,147,000
Industry	£4,946,000	£6,934,000	£11,880,000
Other	£3,000,000	£-	£3,000,000
Total	**£14,223,000**	**£9,976,000**	**£24,199,000**

Source: MEF.

6.3.5 Cost per impact measure.

It is important that value for money assessments consider programme effectiveness, that is, the relationship between the intended and actual results of public spending. In other words, what are the higher-level outcomes / impact of the programme and at what cost. In this regard, two impact measures are examined: jobs and GVA. It is acknowledged that all ICs to a greater or lesser extent, have a focus on wider environmental, health, social benefits, and therefore these impact measure do not capture all of the benefits of ICs.

However, assuming costs as funder inputs of £21.0 million to December 2022, IBioIC net additional peak employment of 858 equates to £24,483 per additional job. Similarly, funder input to net additional GVA equates to a benefit to cost ratio of 1.8:1.

Table A. 9 **Cost per job,** IBioIC.

	Employment	Cost per job
Net Additional Employment (peak)	858	££24,483
Net Additional Employment (peak) (no multiplier)	476	£44,118

Source: authors.

Table A. 10 **GVA ratio, IBioIC.**

	GVA	Benefit: cost Ratio
Cumulative Net Additional GVA , Constant Prices, Discounted	£38,823,117	1.8:1
Cumulative Net Additional GVA (no multiplier), Constant Prices, Discounted	£21,568,399	1.0:1

Source: authors.

6.3.6 Equity.

Analysis of responses to the client survey reveals that respondents operate principally across manufacturing (36%) and professional, scientific and technical activities (33%). A further 23% are from 'other sectors' which include several clients that work across a number of sectors. Manufacturing clients are in pharmaceuticals and health-related products, amongst others.

The respondents were also distributed across Scotland. Whilst just over a third (35%) are from the cities of Edinburgh and Glasgow, 10% were from Aberdeen City and Shire and 12% from the six Local Authority areas within the Highlands and Islands (a greater proportion than the Highlands and Islands per capita or per business share).

7 Progress against targets and objectives

7.1 Targets.

As of Phase 2, year four, IBioIC has already exceeded the majority of its KPIs for the full Phase 2 (see Table A. 11). This includes exceeding full 5-year Business Plan targets for all engagement activity, and anticipated jobs, turnover and secured investment in R&D. IBioIC is also on track to easily exceed its 5-year target for collaborative projects.

Despite the challenges in delivering its skills development programmes through Covid, and a result of Brexit and reduction in external funding via the BBSRC, the IC has still exceeded its 5-year target for PhD entrants and is expected to be close to/ or exceed its full 5-year target for PhDs gaining qualifications. Although lower than expected, IBioIC has continued to deliver an extensive HND and MSc programme of activity.

Meeting the 5-year target for industry membership (of 250) does not look likely. Although new members continue to be attracted, some existing members have indicated they wish to take a break in their paid membership, expecting to re-join, although as the IC is undergoing a membership renewal process so a clear picture is difficult to establish at this point in time.

Although no target was set for scale-up income, the £588,000 generated to date in Phase 2 represents a strong achievement. This is income generated by clients paying to use the two Scale-up facilities.

Table A. 11 IBioIC, Progress against targets.

KPI	Year 4 achievement	full-life target	Status
Industry membership	138	250	Not yet achieved
SAIC led events < 100 attendees	109	50	Exceeded
SAIC led events >100 attendees	17	5	Exceeded
External Conferences	134	125	Exceeded
External Seminars/ Workshops	401	375	Exceeded
Investment in Scottish R&D (£m)	23.2	20.0	Exceeded
Collaborative Projects between industry & academia (direct involvement)	95	100	On track
% completed projects with follow-on activity	90%	70%	Exceeded
Anticipated Jobs Created/ Supported	494	302	Exceeded
Anticipated Turnover Created / Supported (£m)	435.6	30.2	Exceeded
MSc Students (Entrants)	109	165	Not yet achieved
PhD Students (Entrants)	77	73	Exceeded
HND (Entrants)	68	150	Not yet achieved
PhD (Gaining qualification)	35	44	Not yet achieved
MSc (Gaining Qualification)	104	139	Not yet achieved
HND (Gaining qualification)	30	78	Not yet achieved
CPD Activities	15	20	On track
Scale up Centre Income ('000s)	588	-	n/a

Source: IBioIC, 2022

7.2 Assessment of achievements against objectives.

As outlined in the main report, the author's identified 10 objectives at programme level, taking the objectives set out in the Phase 1 Call for Proposals and Phase 2 Business Planning guidance as a starting point. The table below explores IBioIC's focus on these 10 programme objectives (see table below).

Table A. 12 IBioIC achievements against objectives.

Objectives and strength of focus		Explanation of rating
O1: Direct businesses to support	High	IBioIC provides direct support to businesses in the form of collaborative projects (through competitions) and by giving access to two Equipment Centres. It also gives a range of other member benefits (including access to students). This support has increased markedly in Phase 2.
O2: Build and promote ecosystems & sectors	High	The Scottish BioCluster Builder has worked well to build links with a raft of sectors. IB necessarily touches on many different sectors many of which are seeking to reduce carbon emissions. IBioIC is working within and across many different sectors to build the IB ecosystem.
O3: Drive business growth	Medium	IBioIC has two Equipment Centres which are highly important for businesses wishing to scale-up. This enables research to be applied, tested and trialled en route to larger-scale manufacturing. The IBioIC through this and project activity enables - rather than drives - business growth and there may be more than the IC can do to ensure business growth is a result of its support activities (e.g., larger scale-up, further investment leveraged to businesses).
O4: Win external funding	High	IBioIC was very successful in Phase 1 in leveraging other external funding. It has continued this in Phase 2 although it has been unlucky on a couple of occasions to secure more.
O5: Solve industry problems	High	The IC is very much about identifying solutions, whether this is looking at biological approaches to generating fuel from sugar, reducing the carbon footprint of pharmaceutical processes or finding uses (and value) in diverting waste streams. Each of these examples has made use of academic expertise from a wide range of Scotland's Universities, academic expertise that has been instrumental to the industry solution.
O6: Address major policy priorities	High	The IC is effective in communicating the benefits of IB (and Scotland's strengths in IB) in tacking harmful climate change.
O7: Secure inward investment	High	IBioIC has secured considerable industry contributions and inward investment through its membership model and support for new start-up/spin out activities

		benefiting from the scale-up Equipment Centres. More strategic projects may increase inward investment levels further still.
O8: Enhance public services	Medium	The IC works extensively with industry, and this is its principal focus. Nonetheless, there are projects which have benefited public services. Going forward, some strategic projects could be developed that explicitly look at societal issues and public service provision.
O9: Develop skills	High	The skills development programme of IBioIC is a major area of work for the IC and one that is valued by both students and industry.
O10: Develop next generation	High	The IC is looking constantly at innovative process that enable Scotland to realise its net zero ambitions. It is harnessing academic and industry expertise in support of this.

Source: authors

8 Impact case studies.

8.1 Case 1. OGI Bio.

Introduction.

The OGI Bio seeks to make microbial culturing easier for the user, providing simple to use tools that can be tailored to user needs. The concept is to help microbes "work for customers, consistently and minimal cost" which then allows them concentrate on other activities. The tools are designed to reduce errors from manual pipetting, increase throughput of culture handling and to vastly reduce the costs via OGI Bio's Modular Automation system, turbidostat and temperature modules. The company's Mission is to provide *"affordable automation and increased analytics for the microbiology community."*

Engagement.

OGI Bio first engaged with IBioIC in 2019, prior to the formation of the company. The IC helped the build the case for spinning out from the University of Edinburgh and helped with the collaborative project between the business and academic, providing financial support for a feasibility study. IBioIC went on to put OGI Bio forward for the inaugural 2020 Scottish Edge awards, the first time the IC had done this for a supported company. More than three years on, the company is still engaged with the IC as a member - although as a successful business the nature of their involvement has changed, attending and supporting events and networking, including taking a stand at the last IB Conference.

Support for collaboration.

OGI Bio report that IBioIC have provided support "for all sorts of things" from the pre-company formation stage through to the present, including access to the IBioIC networks and other interested parties, supporting introductions. The financial support for the feasibility study allowed the company to demonstrate the technology could work through the use of a post-doctoral student. "It was really useful for us [at that time] to get time for collaboration with the University". The technology proved successful, although not in the ways the business expected, resulting in system launch in 2022.

Market failure rationale.

OGI Bio have benefited from IBioIC facilitating access to scientists who are not always "front facing". The IC crucially addressed financial barriers to innovation at the stage the company was ready to leave the University, but also "information failures" in the form of connecting to IB industry players.

Satisfaction.

OGI Bio have been highly satisfied with the support from IBioIC which has been instrument to the success of the company. The company provided positive feedback on all aspects of the support they have received, from their membership, to attending events and conferences, to the initial collaborative project, to the work of the post-doctoral students. It is the connections facilitated by IBioIC, as well as the financial support, most often cited.

Although benefiting from the financial support at the start of their journey, OGI Bio report that this was "close to the wire" in terms of the timescales for completing the feasibility study, and that the funding available was "at the low end" of what was required given the fees charged by the University to access staff. The company acknowledges this is not a criticism of the IC but rather a comment on the innovation funding landscape. Now that the company is established, the sums available for feasibility studies would not interest the company (they say £5k-£15k is too small to make a project worthwhile) and that there is a gap between this and larger sums of funding for innovation projects (typically at £100k+). Nonetheless, the company cannot praise the efforts of IBioIC highly enough in terms of their support.

Innovation benefits.

The company now has eight employees, three years after starting up, with gross turnover in 2022/23 expected to be £750,000, with growth aspirations for £250,000 profit from sales by 2024. Employee numbers have doubled in the last year, and the company is delivering six new products. As a tool manufacturer, the company does not need access to the IC's scale-up facilities, but it does continue to benefit from IBioIC's connections in the IB sector. OGI Bio reports a range of innovation benefits, from increased internal R&D to acquisition of equipment for innovation to market introductions of innovations.

The relationship between OGI Bio and the IC has been so successful that the company is now co-sponsoring a PhD student to explore new technology that has the potential to pave the way for the next phase of growth over the next 5-10 years.

Wider benefits.

There has been a raft of wider benefits for the business which included ongoing relationships that were brokered by IBioIC in the company's early stages of development, including those with leading players such as GSK. Ongoing membership of IBioIC has brought benefits to the business who are able to benefit from members' openness to new ideas, facilitated by the IC. The company reports a wide range of benefits, from 'Improved awareness of wider societal goals' to 'Improved cross-industry collaboration' to 'Improved industry or technology foresighting',

Impacts and additionality.

IBioIC has been instrumental in the success of OGI, from the feasibility stage to facilitating its growth through, for example, putting the company forward for the Scottish Edge award proving validation for early stage investors. The success of OGI Bio has meant they have been able to pay off loans early, increasing their ability to finance growth.

The company reports that it would have achieved the same benefits without the IC but 'that these would have taken longer to achieve". Given the competitive nature of the sector, without timely support from IBioIC the company would not be at its current scale or be on its current growth trajectory. OGI Bio reports that the real benefit of IBioIC has been its ability to help the company develop relationships with customers in the IB sector, and of making these links through personal introductions and the like, facilitating sales growth. "The IC are always looking for ways to help", report the business and "are on top of their game" when it comes to the IB sector.

Conclusion.

OGI Bio have benefited hugely from the support of IBioIC, not just with financial support at a critical stage of their early development but through the ICs network of wider connections with the IB community. The company has spun out of the University utilising IC support to demonstrate the initial technology and using IBioIC's networks and contacts to grow into an established Scottish business.

8.2 Case 2. ENOUGH.

Introduction

ENOUGH is a commercial company that produces ABUNDA, a mycoprotein the company describes as "delicious, nutritious and sustainable". It has nine essential amino acids, zinc and iron and is based on a novel process that involves the continuous fermentation of fungi to create edible protein. The company's website says, "the fibrous nature of the product gives an outstanding meaty texture, naturally…it is an essential protein ingredient in any diet whether vegan, vegetarian or flexitarian". To produce a ton of Abunda protein uses 93% less water, 97% less feed and produces 97% less CO2 than an equivalent ton of animal protein.

Engagement.

The genesis of ENOUGH was work of three academics at the University of Strathclyde, all involved in various aspects of fermentation research. In 2014, they filed a patent on a novel process they had come up with, using continuous fermentation of fungi to create edible protein.

The company started in 2015 and the three academics were involved in scoping and establishing IBioIC. The businesses has been involved in three collaborative projects with IBioIC, joining the IC has soon as the company was formed. At an early engagement event led by IBioIC, the company met a future investor.

Support for Collaboration.

Through the three collaboration projects, the business was able to use the open access facilities both at Strathclyde (fermentation) and Heriot Watt (downstream processing) during the critical early years. The company was also able to benefit from a couple of small grants with academics looking at transcriptomics and hyphal length measurement to help their scientific development.

"We received great support, including development grants to allow us to patent the new process developed at the University and then to launch a spin-out company. These things always take longer than you think but we were supported throughout, both by commercialisation colleagues at Inspire and through networking support from the University hosted, IBioIC".

Market Failure.

The support from IBioIC helped to overcome market failures in the form of innovation costs "the support in the early stages was critical as we had little cash" and the 'Lack of access to academic expertise or other partnership opportunities'. IBioIC directly helped address these market failures. The IC support helped to prove the technology and progress the company along the journey to full product commercialisation. IC support directly helped the company move from TRL 3 to TRL 7 and above.

Satisfaction.

ENOUGH report satisfaction with all elements of support received from IBioIC, from the collaborative project support to IC membership, to events and conferences. The business considers that the IC has helped to provide strategic leadership for the IB sector in Scotland, raised the profile of the sector and acted positively as a strategic partner.

Innovation Benefits.

ENOUGH report a wide range of innovation benefits from IBioIC support, from increased internal R&D to market introduction of innovations to new design activity. The IC has significantly helped the company to introduce new processes. ENOUGH also report further positive benefits from IBioIC in the form of 'diffusion of knowledge and good practices' and 'supporting improved visibility within sector/ technology area'.

"It has taken that mix of science and entrepreneurship to get us to where we are now, on the brink of changing the way people eat across the globe, and reducing our dependency on animal farming for consumption." A senior company representative also cites support from Scottish Enterprise, from Zero-Waste Scotland, Innovate UK and investors, describing the whole journey as benefitting greatly from the breadth of the "Strathclyde Entrepreneurship ecosystem".

Wider Benefits

The company positions itself as providing protein rich food, which is an alternative to meat, and so environmental benefits are at the heart of the business. "We set up our first 'Farm and kitchen' in Kinning Park in Glasgow to support process development, new product demonstration and initial supply. Our aim throughout, however, is to achieve zero-waste production".

The company current manufactures in the Netherlands. "We need a working bio-refinery to recycle fermentation waste products into fuel. There are none yet available in Scotland so, to manufacture at scale, we have sited production in the Netherlands." Manufacturing in Scotland is the ambition, although it is clear the company has benefited (and continues to benefit) considerably from its involvement with IBioIC. This continues in a variety of forms and the company has recruited from the IC-supported MSc talent pipeline. ENOUGH have also contributed to the ecosystem through involvement in commercial advisory boards, supporting events and speaking at landmark IBioIC conferences.

Impacts and Additionality

2023 is a big year for the company, which is now at a stage to mass-produce the product, "which has a ubiquitous, meaty texture but contains no animal products", to a commercial market already familiar with similar vegan sources, such as Quorn. The company now employs 60 people and is growing footprint in UK and Netherlands. The company has just invested 40 million Euros in a production facility based in the Netherlands.

Importantly, one of the Founders says, "none of this would have happened if not for the amazingly supportive environment at the University of Strathclyde and IBioIC". Additionality of the impacts are therefore very good indeed, with the company saying they would have achieved impacts of a reduced scale, and at a later date, without IBioiC.

Conclusion

ENOUGH is a tremendous success story and a testament to the strong academic expertise in IB that exists in Scotland. The support of IBioIC has helped to translate the academic expertise into commercial product generating significant jobs and turnover in Scotland. The case study supports the rationale for increased scale-up and manufacturing facilities in IB in Scotland as a means of supporting further company growth and expansion.

8.3 Case 3. ScotBio.

Introduction.

ScotBio is a biotechnology company producing 'everyday all-natural ingredients and colourants' in innovative ways that are 'good for people and the planet'. The company manufactures products from spirulina, meaning they are 'natural, healthy and traceable'. They have a 'unique' scalable, controlled production process which means ScotBio can meet demand 'in a reliable way'. Unlike other producers who grow spirulina in outdoor ponds, ScotBio's indoor production facility is protected from the elements and operates to GMP standards, increasing their ability to meet high quality standards.

Engagement.

ScotBio have been involved with IBioIC since 2014, when the IC was established, and continue to engage with IBioIC as a paying member. The company has benefited from multiple collaborative projects involving the 'buy out' of academic input (on eight occasions) and has participated in IBioIC's skills development programme. It has engaged with IBioIC's scale-up centres and attended multiple conferences and events, as well as benefiting from the IC's advisory and signposting activities and wider networking support.

Support for collaboration.

Through the collaborative projects, ScotBio has worked extensively with the University of Edinburgh, the University of Strathclyde and Robert Gordon University. ScotBio report that IBioIC have played 'a significant role' in establishing these relationships. Examples of collaborative projects:

- Collaborative Project 1: ScotBio were able to successfully demonstrate the recovery of natural antiviral compounds from commercial process waste water streams.
- Collaborative Project 2: ScotBio were able to demonstrate ability to purify high value compounds to analytical grade without costly and wasteful intermediate processing steps.
- Collaborative Project 3: demonstration of how stable natural colours could be produced at scale to offer solutions for major established food applications and processes.

Many of ScotBio's projects have been supported by MSc/placements students. promoting skills development.

Market failure rationale

The company has been on a journey and has evolved over the last eight years to be an established player in natural protein manufacture. In earlier stages it faced multiple barriers to innovation, including excessive perceived economic risks, the high direct costs of innovation, the cost and availability of finance, a lack of specialist skills and a lack of information on markets and technologies. IBioIC has played 'a significant role' in helping ScotBio overcome the perceived economic risks, high costs of innovation and access to specialist skills.

Satisfaction

ScotBio has been satisfied with all elements of support from IBioIC, namely the collaborative projects, the placements, conferences and events and advisory and signposting activities. Only for the support of 'a consultation process on strategy in your sector or technology area' was the company neither satisfied nor dissatisfied.

Innovation benefits

Several innovation benefits are reported by ScotBio as a result of working with IBioIC, including greater levels of internal R&D, training and skills development for innovation, recruitment for innovative activities, design activities and market introductions of innovation. The company reports it received 'significant' levels of support from IBioIC in the introduction of new products and processes, as well as for new patent applications. The company has made new business, academic and public sector contacts from working with the IC and developed joint ventures with businesses and academics.

Wider benefits

ScotBio also positively reports a range of wider benefits from working with IBioIC, including improved:

- market and technical understanding of its priority technology areas,;
- understanding of growing the business;
- awareness of other public sector support;
- awareness of academic capabilities;
- employee skills and ways of working;
- cross-industry collaboration;
- industry or technology foresighting; and
- awareness of wider societal goals.

Impacts and additionality.

ScotBio report that 'we would have achieved a significantly smaller range of benefits and at a reduced scale and it would have taken longer to achieve them' without IBioIC support. Of critical importance has been the ability of the IC to connect the company to relevant academic input, and to increase the

(skills) capacity to develop new products and processes, with financial costs supported. IBioIC has been 'extremely important' in helping the company move along the TRL scale, acting as a source of technology expertise.

The support of IBioIC has directly led to a range of financial benefits, including increased investment readiness and ability to secure new equity finance. The company has grown from three employees in 2017 to some 20 employees in 2022 and is expected to grow further in the next couple of years, with a circa 10%-15% of this employment growth directly attributable to IBioIC.

Conclusion.

ScotBio has benefited considerably from IBioIC and the companies involvement in multiple collaborative projects. It has been able to extract extensive academic expertise from a range of Universities in Scotland and to apply this technological expertise to growing a successful business. ScotBio has benefited from both the academic inputs and the capacity and knowledge arising from the MSc placement programme. "The support of IBioIC continues to have an enabling and transformative effect on our business. We remain an enthusiastic member and commend the excellent team and leadership of the IBioIC".

9 Conclusions.

The conclusions and lessons are structured around the seven high level objectives of the evaluation.

Assessing the extent to which ICs have delivered routes to economic benefits through increased levels of collaboration between industry and academia.

IBioIC has successfully delivered routes to economic benefits through increased collaboration between industry and academia, proving itself to be highly effective in this space. It has established itself as an important player in the development of IB in Scotland. IBioIC has successfully translated academic expertise into economic benefits for clients, demonstrated through the 858 net additional job creation and £38.8 in net additional GVA.

Specifically, IBioIC has been very successful and facilitating industry-academia collaboration, and on bringing different businesses together around solutions. It has extracted academic expertise from the University sector. There are multiple examples of IBioIC helping one client benefit from and utilise the waste stream from another through the use of academic solutions. This cross-sector collaborative work has been a major feature of IBioIC activity.

The IBioIC is unique in the UK and reflects Scotland's competitive advantages in terms of its academic research base, industrial base and access to renewable energy. The IC takes advantage of the fact that Scotland is 'the right size to do business' and is networked strongly. It has the potential to grow further still, with larger scale-up facilities to take businesses to the next stage, and to further increase its presence on the international stage. It can drive even more value from its support by demonstrating IB's potential to investors and working with even more sectors and subsectors.

Assessing the role each IC has played in supporting colleges and universities to maximise their value to Scotland.

The IBioIC programme of activity has evolved from Phase 1 into Phase 2, with a more conscious focus on activity higher up the TRL scale and on scale-up activities to deliver greater impact. It has built on the Phase 1 where IBioIC was successful in raising the profile of IB in Scotland and in engaging with businesses (via its membership model and more broadly through events) and delivering project activity. IBioIC has continued to positively influence policy (with success) and has continued to grow, evolve and deliver its wide-ranging skills development programme of activities.

The IC has proven that its Scale-up facilities are a valuable resource for new businesses to test and trial processes and for more established businesses to trial new ideas. These are a key mechanism for extracting academic expertise through joined projects and facilitating a route to market, allowing

clients to move along the TRL scale. There is a case for increasing the size of these scale-up facilities, and to make more on-Campus laboratory facilities available so that academics can be involved in more start-up and spin-out activities. IB is effective in making the links between and within sectors and between academia and industry, meeting its objectives to create value chains where they would not otherwise have existed. As with much innovation support, it takes time for clients to realise commercial benefits, and IBioIC should be supported to continue to help clients realise the potential from their research and development activities.

As IBioIC has matured, it has increased the levels of activity from Phase 1 in terms of project activity, and it has continued to grow its membership base. There have been challenges continuing to deliver the MSc Programme as a result of the pandemic, Brexit and external funding constraints, however IBioIC continues to deliver an important skills programme, giving students important industry-ready skills, and acting as a pool of talent for Scottish businesses. Despite the challenges, the scale of the IBioIC skills development support has increased in Phase 2, with positive feedback from the small numbers of students surveyed.

Examining performance against targets and achievement of objectives.

IBioIC has performed strongly against targets, performing well in Phase 1 and improving on this performance in Phase 2 against the majority of indicators. Evidence from the client survey suggests strong jobs and GVA performance for clients, and additionality is good. More than one in four would not have achieved any of the benefits without IBioIC support. Some nine in 10 (92%) report full or partial additionality.

In all, there has been considerable levels of industry and academic engagement with IBioIC, and this has increased from Phase 1 into Phase 2. The Annual Conference led by IBioIC has become the premier IB conference in the UK. The number of IBioIC-led engagement events, as reported in the MEF has increased fourfold in the second phase, with the number of collaboration projects also increasing, as IBioIC strengthens its business and academic networks.

IBioIC continues to deliver a strong skills development support programme and the level of skills support offered via IBioIC remains a strength of their approach. Despite the challenges noted above, IBioIC has increased the scale of its skills development support activity in Phase 2, and more have gained qualifications already to date in Phase 2 than in Phase 1. The MSc programme of support, including industry placements, is highly valued by industry and by participating students. Businesses frequently recruit the MSc student following their 10-week placement which provides the opportunity for direct laboratory experience.

IBioIC responded effectively and positively to the Covid-19 pandemic. The IC was able to actively contribute to safe lab testing and to Covid-19 diagnostic testing, drawing on its strong industry connections. It was also able to continue to deliver (and in many ways) increase its engagement and project activities despite the challenges presented by Covid.

Exploring how effectively each IC builds engagement with the innovation ecosystem.

IBioIC has continued to play a key role in developing the IB sector in Scotland and in broadening and deepening the IB ecosystem. Notably, the IC has contributed to, and is a key delivery partner for, the National IB Plan for Scotland, including the most recent 2022 update, and IB (and the work of IBioIC) is cited in the 2022 National Strategy for Economic Transformation.

Working with the Scottish BioEconomy Council, IBioIC supports industry through its offer to members, including collaborative project support, access to specialist expertise and kit, skills development and value chain activities, all strengthening the innovation ecosystem for IB.

The IC provides a strong leadership role for the sector, and is the envy of other parts of the UK given its unique scale of operation in supporting IB at the geographic level of Scotland. No other part of the UK, including prominent centres such as Cambridge, have a corresponding organisation working on

behalf of the IB sector at the interface of academia and industry. IBioIC has a strong profile within the UK.

Further, IBioIC has demonstrated an ability to transfer academic knowledge into solutions for business, through its collaboration activity and ability to bring different sectors together. The IC has strong links to industry and partners, and has successfully leveraged considerably private and other public investment.

Identifying wider impacts learned.

The evaluation has identified a raft of wider, more qualitative benefits arising from IBioIC activities, including benefits to clients that are not easily quantified, notably increased networking and knowledge of other IB innovation. IBioIC has brought societal and environmental benefits, including a major contribution to the net zero agenda through reduced carbon emissions arising from the transfer to bio-based solutions across many sectors. This is a tangible benefit from increased levels of IB. The IC has also played a strong role in the public health agenda, including Scotland's response to the Covid pandemic.

The work of IBioIC is making a direct contribution to net zero emissions targets in multiple ways, whether through supporting projects which utilise waste streams which may otherwise have been burnt or landfilled and by replacing fossil fuel with sustainable raw materials. This is the essence of most IB which is underpinning swathes innovation in relation to the sustainability agenda. IBioIC is explicit in these objectives, although there is arguably even more that IBioIC can do in this sphere if further supported to do so. There is a clear market failure in terms addressing market power and IBioIC is directly helping SMEs overcome the high director costs of innovation. The IC is also removing the constraints of information barriers for businesses to access the research and to undertake the scale of innovation required to meet Climate Change targets and the move to a net zero economy.

Assessing the degree to which IC benefits have reached all parts of Scotland.

IBioIC has strengthened the IB sector across Scotland, with an above-average number of clients from the Highlands and Islands and increased industry-academic collaboration beyond the Central Belt. Client engagement is with a wide range of universities, well beyond the two Universities that host the scale-up facilities (University of Strathclyde and Heriot-Watt University) and include strong engagement with Universities with specific biotechnology expertise, including the University of Edinburgh and the University of Abertay.

The strong skills development support programme works across Scotland's Universities, again extending reach beyond the Central Belt. At a Programme level, the IC programme benefits clients across Scotland, and IBioIC contributes to this picture.

Identifying lessons learned from IC operations.

As IC moves into its next phase, it must continue to evolve to meet the needs of industry and to develop the IB sector further. The collaboration projects and Scale-up Facilities have been effective in supporting clients, extracting academic expertise and in moving clients along the TRL scale, and there is a case for creating the next size up in terms of larger scale-up facilities, utilising existing facilities at Grangemouth, if this proves workable. This potentially increases the amount of IB processing very considerably, and partners should support these efforts.

IBioIC developed and strengthened its links across sectors. IBioIC already works well with a number of Trade Associations, and this work can be extended. The BioCluster builder network integrator project has been successful, and this type of activity should continue.

As the case studies demonstrate, there is value in the larger, strategic projects in terms of utilising academic expertise to build economic and wider benefits for Scotland. IBioIC should look for opportunities to undertake larger strategic projects and to continue to look at opportunities to drive

IB through the Grangemouth project and Falkirk Growth Deal. This type of project requires resourcing (in bid development), and consideration should be given as to how best to fund this activity.

IBioIC has built and established a growing reputation 'as all things IB'. This is growing in a UK context, which can be extended to a wider audience i.e., beyond Scotland. The Annual Conference is the most important IB event in the UK, and the IC can champion IB more broadly in the UK and internationally. It is important, however, that the IC does not lose sight of what has worked well to date, including extracting academic knowledge and expertise, the creation of the industry-ready skills pipeline, its effective communication of what IB is to Government and support for its membership. IBioIC should continue to find ways of supporting non-members, to grow the pool of IB-active businesses if membership is not appropriate for them.