



**HVB Bioactives Workshop:**  
*sharing expertise, building consortia and capacity*

**11-12 July 2022**

**REPORT**

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## HVB Bioactives Workshop: sharing expertise, building consortia and capacity

This workshop aimed to explore how we could utilise our network to exploit our research excellence in bioactives to progress to new capability for industrial applications.

The workshop provided opportunities for networking and some research updates were presented. Discussions were structured to enable a greater understanding about the drivers for industry and what their targets are for bioactives. This was followed by exploring strengths and opportunities for industrial biotechnology and identifying barriers. Finally, the workshop concluded with a discussion on ways forward. A full list of participants is provided as Appendix A.

### 1. Discussion on industry targets

This discussion aimed to explore if we could identify targets which could be used to direct new research areas or could be applied to previous research.

#### ***i. What are the drivers for industry in determining bioactive targets?***

The circular economy, net-zero and sustainability are key drivers for industry, particularly due to consumer preference for environmentally friendly products. However, these must be considered in the context of cost, quality of products as well as consumer acceptability (for example, certain products made from waste may not be favourable). It was noted that industry is not only looking for drop-in chemicals but new products that also could add value, perhaps through new functionality or multi-functionality. This novelty aspect is important to industry. Evidence for these aspects should come from Life Cycle Analysis (LCA) or Techno Economic Analysis (TEA), yet a common framework for these methods appears to be lacking.

Examples of targets: replacement chemicals for fragrances that are renewable and biodegradable yet with long shelf-life, bioactives that disrupt biofilms, pigments that can be used as stable dyes for the textiles industry. It was noted that companies have different approaches to targets: often SMEs have the freedom to explore different molecules whereas larger companies may be more focussed on specific targets.

Utilising waste as a feedstock is important to industry, particularly if platform chemicals can be extracted which can then be further processed to make a series of useful compounds.

Regulatory matters were noted as being important – Nagoya was mentioned: this seems to be a knowledge gap. High Value Chemicals from Plants Network did substantial work around Access and Benefits Sharing including a dedicated training workshops and talks at other events.

#### ***ii. What are the obvious targets for bioactives which enable quick wins?***

Potentially, work on closing information gaps could enable the community to make more rapid progress – for example understanding where to access screening services or compound libraries. Furthermore, access to natural diversity collections is important.

Markets without long drawn out regulations were obvious targets such as personal care products or textiles etc. (compare to highly regulated areas such as the pharmaceutical industry). However, access to information on regulations or consultancy services in this area would enable researchers to understand processes and assess potential.

Research on mixtures of compounds/ crude extracts could be a quick win. For example, developing generic methods for rapid purification of extracts and samples to enable faster screening would be beneficial to the wider community.

Other areas that were mentioned: repurposing of existing drugs for new applications, multifunctional dyes, mining waste streams for bioactives (e.g. blackcurrant waste where some data already exists) could offer a route to quick results.

The wealth of research funded by the NIBB over the last seven years could be mined in some way to look for bioactives research ideas. The output data from the phase 1 NIBB (2014-2019) was 628 small grants supported, 491 of them had company involvement and overall 277 unique companies were involved. BBSRC are currently looking at this body of research.

Supporting work around communications so that consumers understand bio-based materials may also be a factor to consider.

### ***iii. What are the most important, perhaps longer term, targets?***

Several targets were noted that fall into the longer term research category but which are of huge economic and societal importance:

- Anti-microbial targets
- Targets in farming – opportunities around novel bio-stimulants to increase nitrogen fixation, replacement pesticides (particularly to address changing regulations)
- Waste biomass – understanding composition and value to contribute to a circular economy
- Microbiome modulation for drug discovery
- Wealth of secondary metabolites – using them in a modular way and creating novel building blocks
- Products which tackle health related issues such as mental-health and well-being, obesity prevention, products for the ‘worried-well’
- Specific classes of molecules such as flavonoids were mentioned and their potential as a platform chemical

It was noted that alongside targeted research, blue skies research is still incredibly important to provide the pipeline that feeds innovation in academia and industry, as well as offering opportunities for training research scientists, etc.

## **Summary of targets discussion**

Screening is an issue for many – access to screening for different bioactives is important in identifying potential lead compounds. The screening offers around the UK and internationally vary considerably in their cost, how much IP/ information you have to share and what sorts of samples they need. This indicates that some infrastructure to connect these would be appropriate and serve to further our research ambitions.

Obtaining funding for screening is difficult and the case needs to be presented in the context of a wider programme. There are numerous issues around funding: the NIBB do not fund screening projects although can fund screening within the context of a project; free screening programmes require

sharing of information which may be difficult for longer term commercialisation; CRO screening programmes can be very expensive and researchers need to ensure they have accounted for this cost at the start of a larger programme. Furthermore, academic/non-commercial laboratories that offer screening services often experience difficulties with regards to having staff time to dedicate to this from handling paperwork to undertaking the assays etc.

Other considerations around screening are the differences in the purity and quantity of compounds required for different assays.

HVB have a technology offer site on their webpages – this service is only available to HVB members and is not available for general view:

Search for a service:  
Eg. title or organisation

Submit a new service



Biocollections



Biomanufacturing



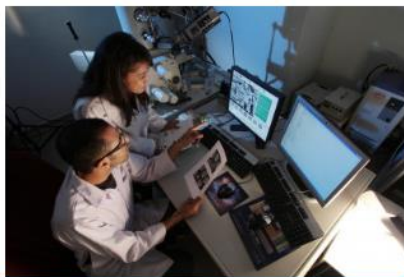
Business services



Facilities



Products/feedstock



Scientific services

Submit a new service

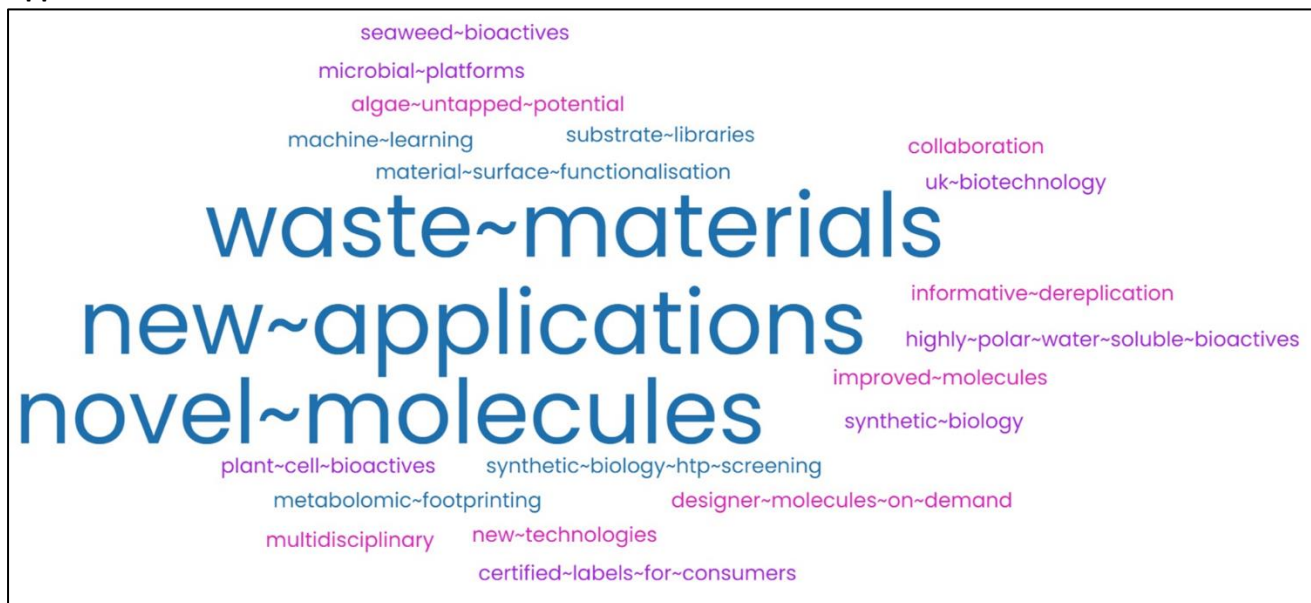
My Services

A dedicated screening page could be developed but currently this activity is combined with other activities under scientific services.

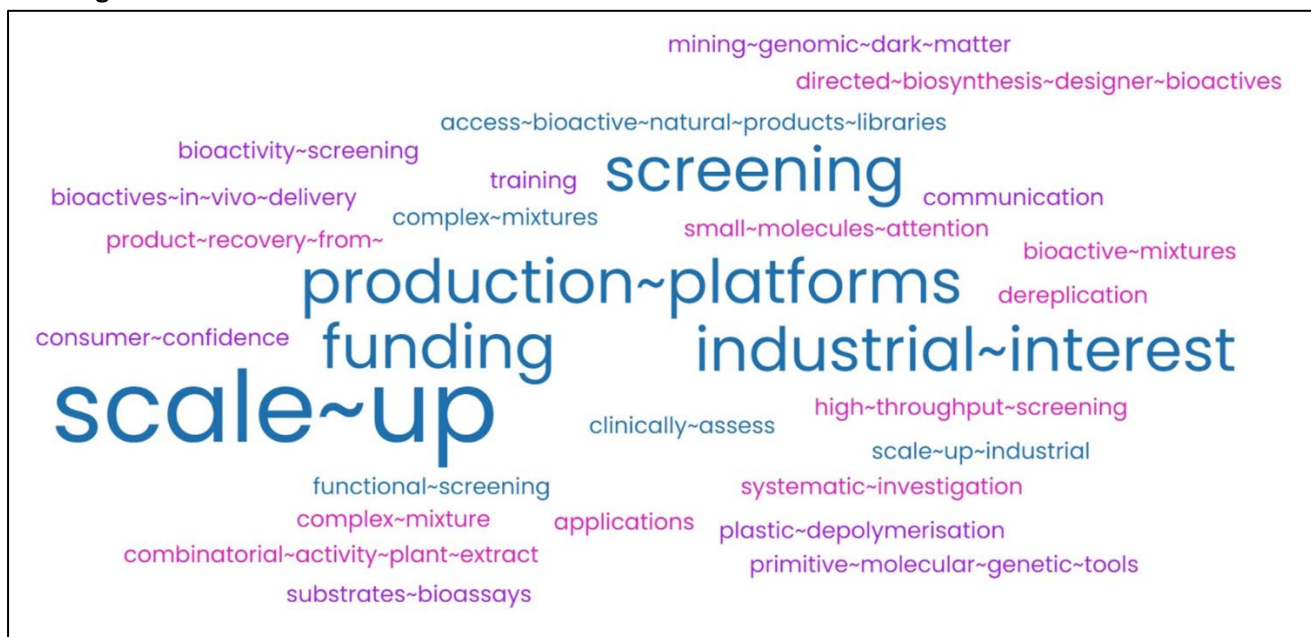
## 2. Discussion on opportunities and challenges

This discussion aimed to identify opportunities and barriers or challenges in the bioactives area. The two word clouds below illustrate data gathered from participants as they registered for the event.

### Opportunities:



### Challenges:



#### i. UK Expertise – strengths and gaps

The UK has good physical facilities and strong expertise in key areas but access to both is frequently challenging, possibly due to: no mechanism to allow access, high cost, lack of time and/or resource to understand what services are available, etc. It was agreed that a database of physical facilities would be beneficial.

The DNA Foundries were highlighted particularly their capacity to synthesise new to nature molecules but there was perhaps a wider need to understand their capabilities.

Chemical engineering was identified as a weak area: more expertise is needed in this area. The Institution of Chemical Engineers is a possible organisation to collaborate with. Biophysics was another area mentioned as needing more people. In general, scientists need to be equipped to handle and integrate large datasets.

Some academics are not well prepared for the commercialisation journey, again lack of resource to dedicate to this is a feature either within institutions or for the academic.

The wealth of 'omics' technologies is well recognised but handling big data remains a challenge: how do we design work to input data into AI systems – the need to be proactive in considering data types from the outset was raised as a potential issue. Computing power was mentioned as a limiting factor. There is potential for high throughput chemistry with models for predicting activity and screening.

## **ii. UK infrastructure gaps and opportunities**

There was some concern about the funding continuum beyond TRL3. The UK was considered to be quite poor at early venture capital investment with a risk adverse approach compared to the US. Support for writing big grants, and clarity over EU funding were mentioned in the funding context. The IB Catalyst programme was mentioned and how important it was in developing projects across the TRL with industry and academia.

Multidisciplinary teams are needed for effective projects but it can be difficult to find the funds for a large team.

Connecting mechanisms for sharing information and resources etc. this was mentioned in other discussions too.

One barrier mentioned was the management of interactions between industry and universities: particularly around contracts and regulatory aspects.

The idea that many people were still working in siloes – some sort of mechanism to pool resources could be powerful. It was suggested that as well as Business Interaction Vouchers, Academic Interaction Vouchers could be helpful in enabling sharing of expertise and providing resource to fund lab interactions.

Regulatory affairs were mentioned: UK waste is a big opportunity but there are barriers connected with classification of this which limits its potential. Again, there are gene editing issues which may limit exploitation. Legislation was considered to be very slow in the UK – regulations around hemp and seaweed were given as an example.

The urgency around the net zero targets was highlighted – we do not have long to achieve the ambitious targets set and more funding will be needed for bioscience research and not just biomedical.

Screening was mentioned again in this session – with the ideas relating to some form of national facility for screening which does not require rights to information or IP to be shared. Could this form part of the Darwin Tree of Life project – with screening information integrated.

Black box screening was mentioned – the concept being lots of candidate molecules screened at once across a range of activities which could then directly link the academic with industry.

Several discussion points revolved around the organisation and access of data. One group mentioned that a database of natural products with potential for *in silico* screening would be helpful. There

seemed to be a lot of support for some sort of national database which could combine many different data streams from information on biological specimens (e.g. plant variety), genomic and metabolomics data and bioactivity screening.

[Post-meeting note the LOTUS initiative for open knowledge management in natural products research - <https://lotus.naturalproducts.net/> Natural Products Online is an open source project for natural products storage, search and analysis. The website hosts LOTUS, the natural prOducTs occUrrence databaSe, one of the biggest and best annotated resources for natural products occurrences available free of charge and without any restriction. LOTUS is a living database which is hosted in parallel at Wikidata. The Wikidata version allows for community curation and addition of novel data.]

Vulnerability of supply chains for R&D was discussed from enzyme and media supplies and the cost of such items. This also extends to feedstocks for biomanufacturing.

Scale up and scale down: the strengths in scaling up were mentioned – with UK facilities able to advise on taking research from the bench to pilot scale. However, the lack of open access biorefining facilities to enable bioactive extraction was noted. Scaling down was mentioned as a possible opportunity – scaling down for local processing of feedstock.

The ambition to develop a large, externally facing pitch for funding a bioactives programme was raised in the final discussion. The content of this should be further explored by interested parties and HVB could organise an additional workshop to discuss and define a pitch.

## **Summary of discussion**

There is an urgency to make progress to net zero and therefore more funding is needed to support bio-based products. The type of funding is also important to ensure there are no gaps across the TRL.

There is a significant expertise in the UK and good infrastructure resources but there is a need for connectivity across academia and industry but also within academia – sharing of resources and data would be powerful. There is potential for a co-ordinating role within the UK.

Databases exist for storage of information about bioactives – these should be examined and discussed at future meetings. Integration of projects from the Darwin Tree of Life would be of interesting to the industrial biotechnology community.

There are opportunities around waste for high value bioactives but these need to be understood from a regulatory perspective.

Aspects such as supply chains and scale-up etc. remain important – LCA and TEA can contribute to an understanding of these.

HVB could support a pitch for an externally funded consortium to work on bioactives but further work would be needed on the targets, challenges and outcomes.

Appendix B has photographs of all discussion flip charts.

## HVB Actions

As a community we should emphasise the need for development in this area and the positive impact – we should not focus on the difficulties. HVB has a full-time Network Manager and with regular activities to deliver such as events and funding, our ability to undertake actions is somewhat limited but we can offer to co-ordinate network members and their activities.

Suggested direct actions include:

1. Funding - Flexible Fund call for bioactive projects – to include updated wording on screening that will be confirmed with BBSRC to ensure projects are not rejected on screening clause. (Also see point 6).
2. Information on accessible technologies - screening facilities and open access centres will be described in the on HVB website under *Technology Offers*.
3. Communications to different stakeholders are currently in progress: a Bio-based Products policy briefing will be produced targeted at UK Government; and a report entitled UK Grown has researched the opportunities for industrial biotechnology and UK crops. Both documents will be ready by October and a plan to circulate and publicise will be defined.
4. Joint event or activity with the Institution of Chemical Engineers – to increase visibility of this area to network members – this could include a focussed workshop or inviting them to ECR events, linking to their events or contributing to their programmes.  
<https://www.chemengevolution.org/sustainability-environment>
5. A meeting on high value opportunities from waste or by-products could be helpful to enable networking in this space.
6. HVB should incorporate regulatory aspects into meetings where possible to continue to advocate good practice in areas such as Access and Benefits Sharing (Nagoya).
7. A further bioactives workshop with participants ready to develop a concept which could be circulated to potential funders. Participants would need to be clear on what area of work they think a consortium could focus on, for example, workpackages on bioactives screens, bioactives from waste/by-products and new to nature molecules, industry partners etc.  
There may not be obvious funding possibilities, therefore it may require direct approaches to funding bodies to see if they can offer assistance. Potentially pilot scale projects that build in scope might be more attractive in the first instance. HVB could provide some Flexible Fund to support this.

A provisional development plan for this is available on request.

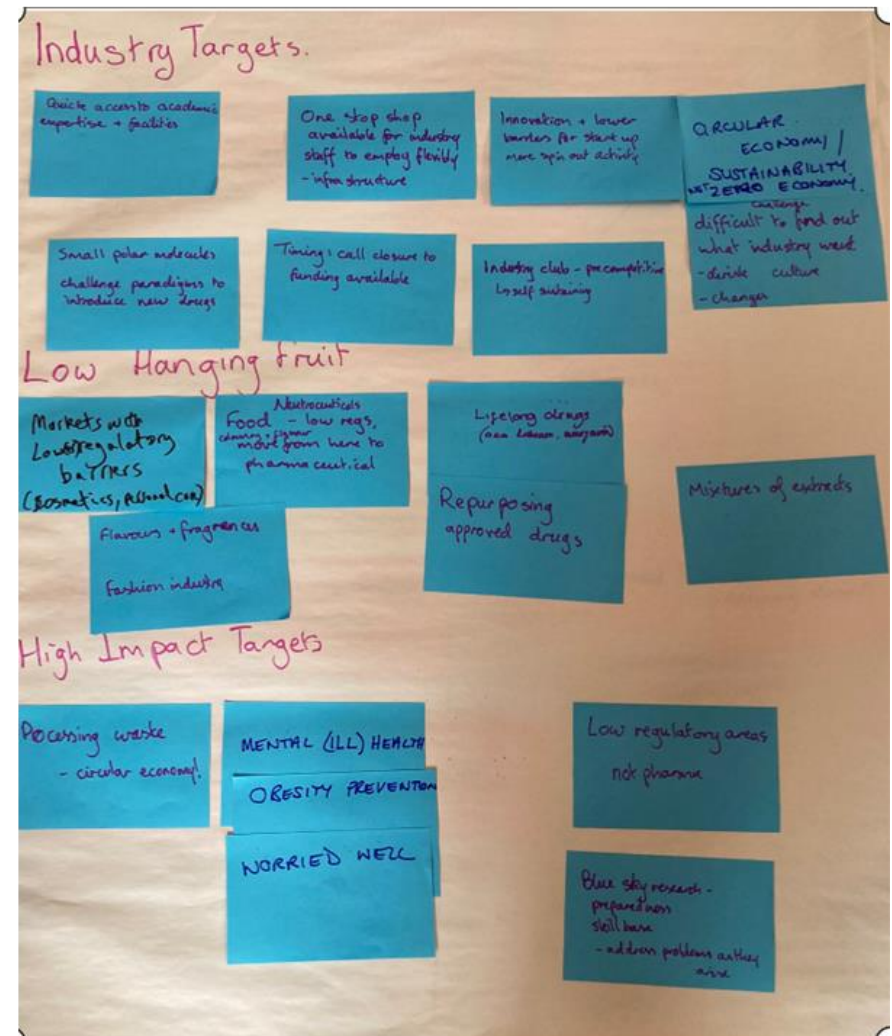
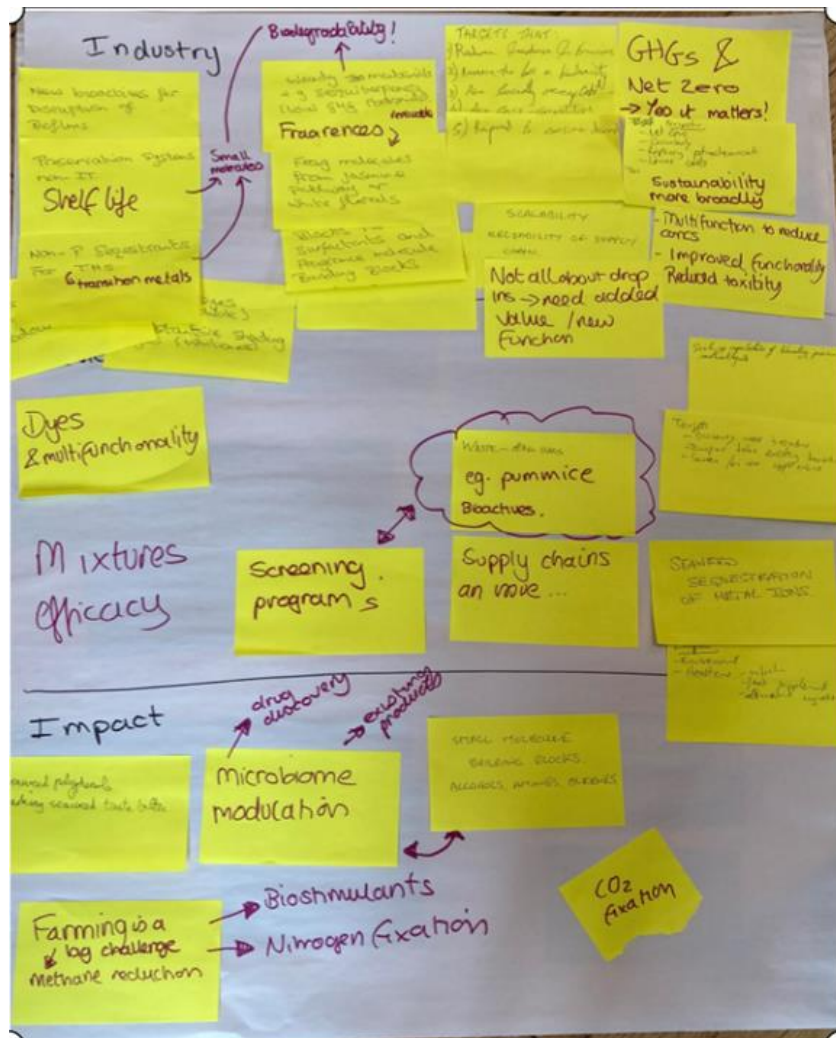
## APPENDIX A: PARTICIPANT LIST

| <b>Participant</b>               | <b>Affiliation</b>                   |
|----------------------------------|--------------------------------------|
| Jessica Adams                    | IBERS, Aberystwyth University        |
| George Ashton                    | Myconeos Ltd                         |
| Mike Beale                       | Rothamsted Research                  |
| Katherine Duncan                 | University of Strathclyde            |
| Genni Enfissi                    | RHUL                                 |
| Alfred Fernandez-Castane         | Aston University                     |
| Rob Field                        | University of Manchester             |
| Ian Graham                       | University of York                   |
| John Heap                        | University of Nottingham             |
| Wael Houssen                     | University of Aberdeen               |
| Jude Huggan                      | NCIMB                                |
| Craig Jones                      | Unilever R&D                         |
| Andy King                        | Jazz Pharmaceuticals                 |
| Benjamin Lichman                 | University of York                   |
| Gary Loake                       | University of Edinburgh              |
| Ioana Lock                       | AgrifoodX                            |
| Ray Marriott                     | Bangor University                    |
| Martin Michaelis                 | University of Kent                   |
| Colin Miles                      | BBSRC                                |
| Simon Moore                      | University of Kent                   |
| Anne Osbourn                     | John Innes Centre                    |
| Ross Overman                     | Leaf Expression Systems Ltd          |
| Daniele Parisi                   | Croda                                |
| Jeffrey Pearson                  | Newcastle University, Aelius Biotech |
| Joe Ross                         | Biorenewables Development Centre     |
| Harry Ross                       | Bell & Loxton Innovations            |
| Joanna Sparks                    | Ashton University                    |
| Alicia Russell                   | Colorifix                            |
| Sebastian Vaughan                | Phytome Life Sciences Limited        |
| Cherry Wainwright                | Robert Gordon University             |
| Christopher Wallis               | Royal Botanic Gardens, Kew           |
| Jane Ward                        | Rothamsted Research                  |
| <b>HVB Team and Facilitators</b> |                                      |
| Joyce Bennett                    | HVB                                  |
| Caroline Calvert                 | HVB                                  |
| Alice North                      | BioVale                              |
| Gail Shuttleworth                | HVB/ BDC                             |

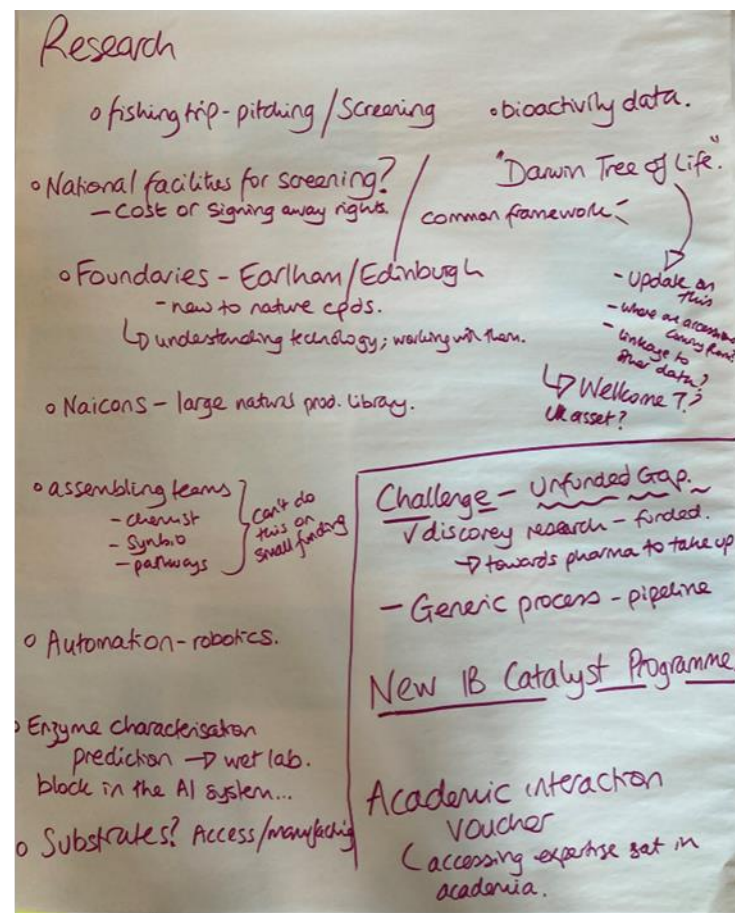
## APPENDIX B1 Flip Chart Images –Targets: Industry drivers, quick win and long term bioactive targets



**APPENDIX B1 continued...**



## APPENDIX B2 Flip Chart Images - Expertise, opportunities and challenges



**APPENDIX B2 continued...**

