Critical Mass UK (C-Mass)

A Distributed Infrastructure to Consolidate and Advance the UK's Capability in Mass Spectrometry for 21st Century Research Challenges

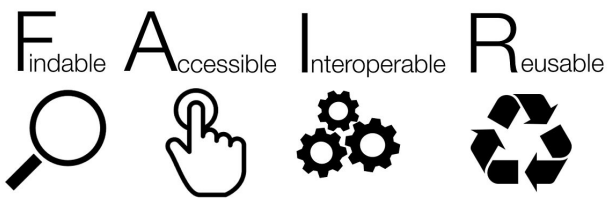
Background to the bid

- Members of the UK scientific community invested in MS have long discussed the need for a UK-wide MS infrastructure
- This work started in 2017, led by the BMSS, resulted in a Vision white paper and Statement-of-Need that was submitted to EPSRC in Feb. 2021
- EPSRC accepted the Community Statement-of-Need and invited a bid to the UKRI Large Infrastructure Fund
- Aim of the C-Mass proposal: a connected infrastructure to integrate and advance the capabilities of the UK MS community for maximum societal benefit
- Engagement with stakeholders has gone beyond the BMSS community, including a MRC facilitated meeting (August 2021 c. 85 participants) and UK-wide Town Hall (Feb 2022 c. 245 participants)
- A distributed infrastructure model with a Hub to coordinate activities, sign post to expert labs and to act as a data curation and data management site has been developed
- Documentation can be found at the BMSS website

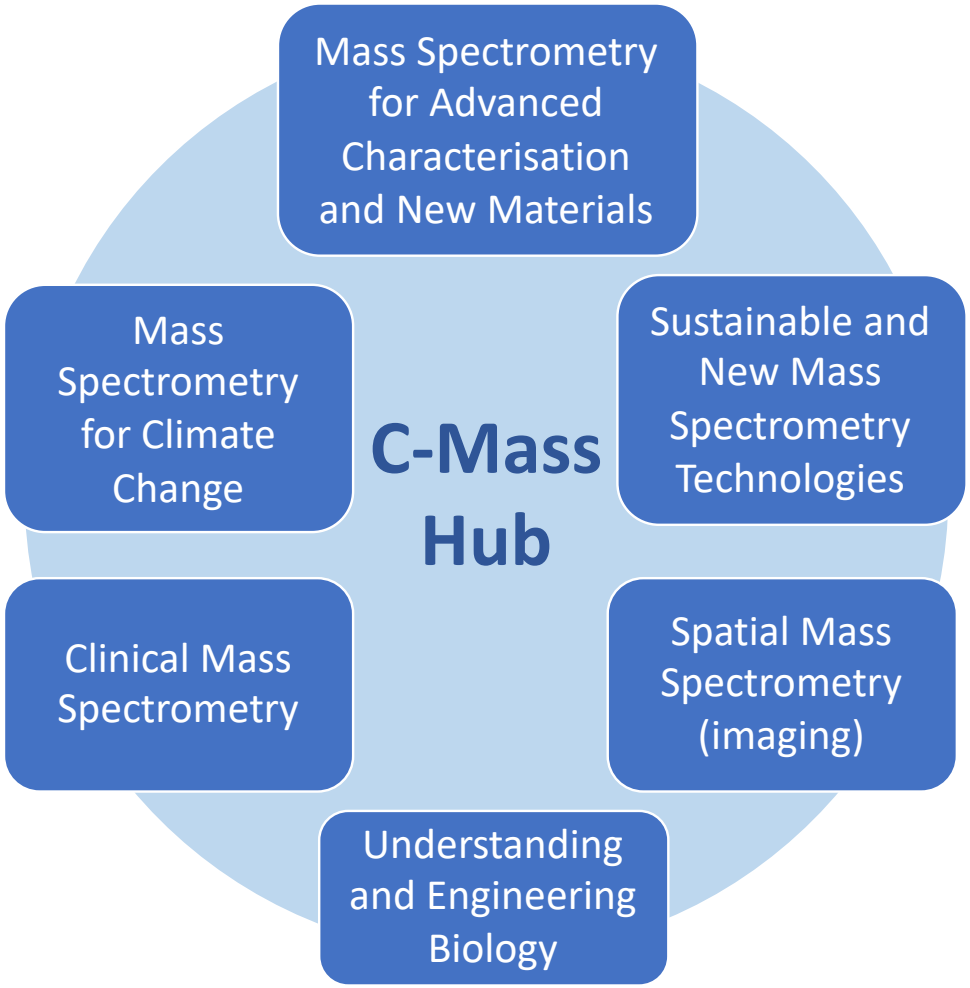
https://www.bmss.org.uk/about-us/ukmass-spectrometry-vision/

What will the Infrastructure look like?

- Distributed infrastructure throughout UK
- The Hub will coordinate activities, triage research challenges and connect to expert labs
- The Hub will catalogue data according to FAIR principles and community standards



- The challenge activities organised in similar way as EURAMET (www.euramet.org)
- Expert labs will work to common cost recovery models
- Access to infrastructure, hardware, expertise and data will be open



Developing the thematic challenge areas

- In continuation from the Town Hall meeting, further details were sought from the six challenge areas

Mass Spectrometry for Advanced Characterisation of Molecules and New Materials

The ultimate goal is unequivocal structure determination.

- New approaches to full structural characterisation in timely manner (directly from complex mixtures), with smaller sample quantities (improved sensitivity and selectivity) for all classes of molecules.
- AI and machine learning to take data interpretation to the next level. This needs better software compliance and QC protocols to ensure high quality, reliable data.

Sustainable and New Mass Spectrometry Technologies

Ultimately, the main benefit/impact will be the creation of an excellent knowledge and innovation base in sustainable MS instrumentation, taking the UK to the forefront of MS innovation. Concrete benefits will be the support of our industry and organisations that need innovation in analytical sciences such as the NHS, governmental departments such as DEFRA.

Better, faster, and cheaper MS analyses will help all (industry and society), including the treasury by saving money in the long run, and moving towards net zero.

Spatial Mass Spectrometry

Idealistic goals include:

- Generation of high throughput screening of personalised patient derived organoids all new cases of cancer in the UK by 2035.
- Improved cancer treatment in an aging and susceptible population.
- Improved patient quality of life by reducing their experience of adverse events by choosing a therapy suited to the patient's disease profile.

Developing the thematic challenge areas

- In continuation from the Town Hall meeting, further details were sought from the six challenge areas

MS for climate change, environmental research, food and energy

- Understanding of atmospheric chemistry from combustion of synthetic fuels and biofuels
- Waste-water epidemiology to track and trace human health in environmental samples
- Food authenticity and safety together with real-time process and manufacture improvement
- Combining with AI solutions to realise SMART environmental monitoring platforms

Understanding and engineering biology

- Routinely identify and quantify biomolecules in low abundance.
- Enhanced access to biological mass spectrometry nationwide
- Driving development of tools required by a broader set of bio/clinical researchers
- Dissemination of best practice across a wide range of researchers
- Access to cutting edge computational approaches, AI, and machine learning
- Training for early career researchers
- Demystification of mass spectrometry.

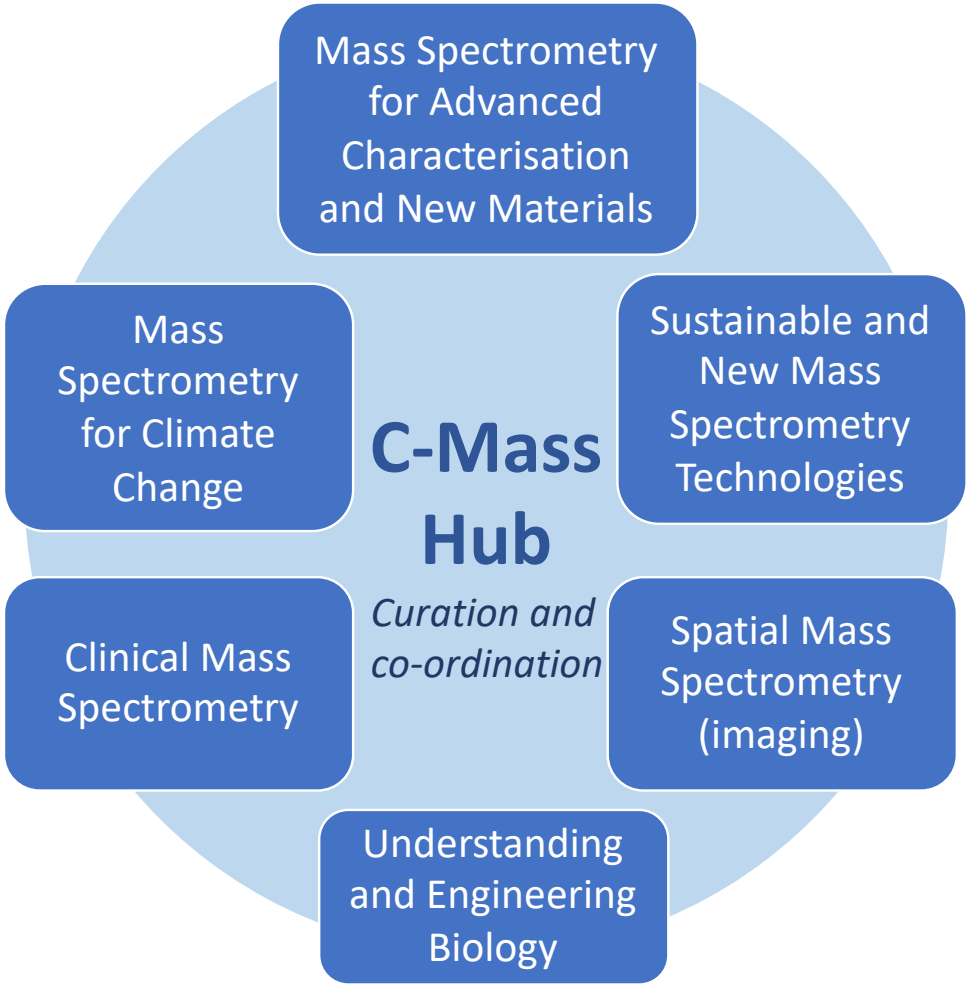
Taken together the creation of hub and distributed infrastructure will promote a step change in biological science to better link phenotype with cell status and improve our functional knowledge of the components of living systems.

Clinical Mass Spectrometry

- Make the UK an international beacon of precision medicine diagnostics.
- Improve the UK diagnostics infrastructure and expertise.
- Increase NHS expertise for novel assays through extensive training (funding raised elsewhere)
- Increase patient benefit by better diagnostics which are linked to appropriate selection of therapies and improved survival.
- Successful implementation of preventative medicine inherently leads to more successful treatment of under-served communities (a critical aim of the NHS).
- Enable infrastructure to be established to help with a coordinated response to future pandemic

What will the Hub Deliver?

- Focal point to coordinate MS networks and provide expertise
- Standardisation, and ensuring comparability and usability of data
- Source for open data catalogue, and unrestricted access to anonymised data (access to centres, -omics knowhow etc.)
- Avoiding duplication of experiments and sharing of best practice
- Sign posting to expert labs and promoting appropriate equipment use



Next Steps

- **Continue to work with wider community and stakeholders**: UKRI, HEIs, Industry, Research Institutes, Manufacturers, including clinical stakeholders such as NHS, UK-BioBank and NHIR
- **Establish Governance model** for the Hub and Challenge areas – this distributed infrastructure must be accessible to all
- **Develop thinking around data repositories, processing and hardware,** including EBI, Elixir, Turing, Hector, and PSDI proposal
- **Determine mode of delivery**
  - Envisage Hub as a competitive call and funding for challenge areas to be distributed via hub with UKRI oversight following an open call and competitive review
- **Outline nationwide CDT** to provide talent pipeline

Communications with stakeholders

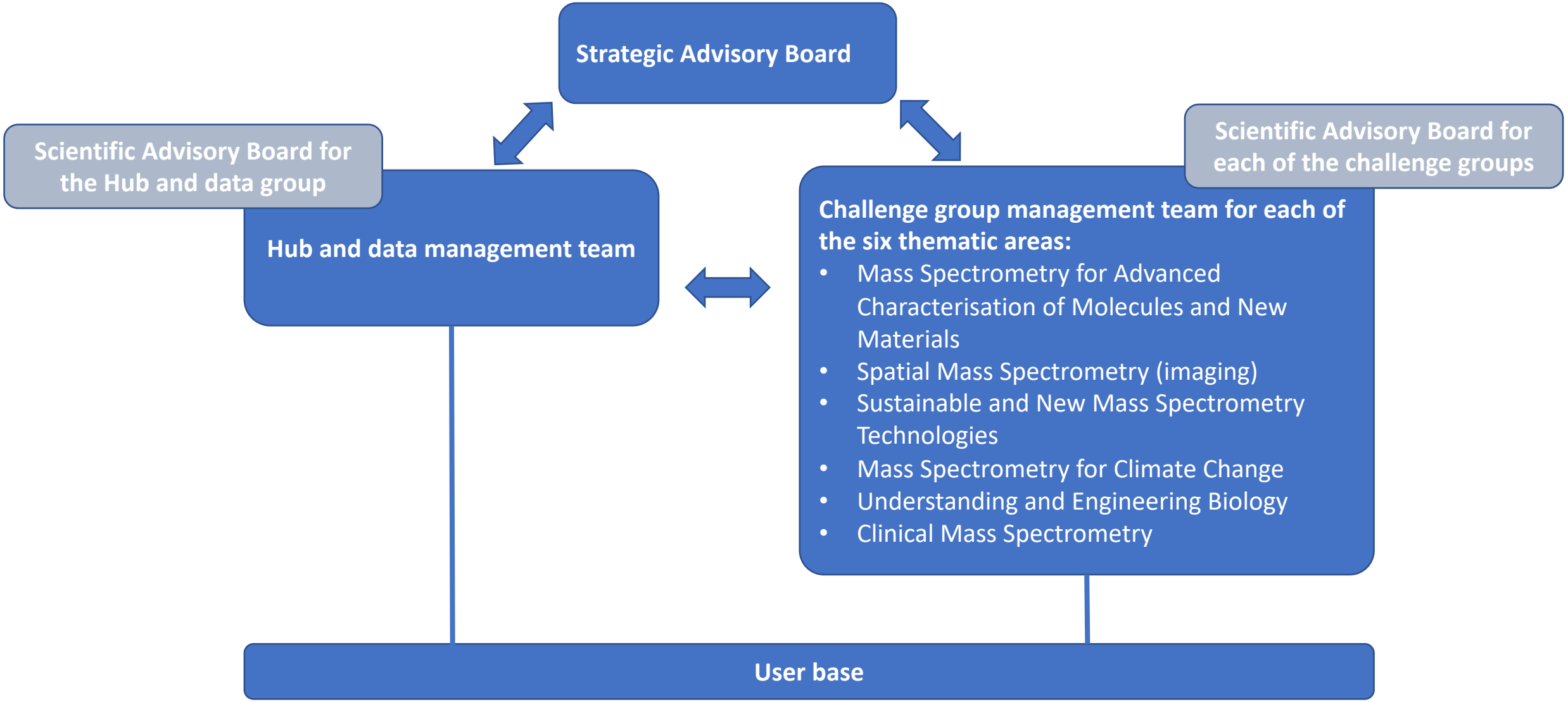
- Manufacturers
  - Communicated C-Mass project outline
  - Requested letters of support, specifically calling for information about their strategic investment in areas that align with C-Mass proposal

- HEI's, Institutes and Industries
  - About to reach out in the same manner as with the manufacturers to request letters of support
  - Letters of support to include how C-Mass aligns with their strategic priorities and investments.

A UK-wide Critical Mass CDT

- The infrastructure bid cannot provide PhD studentships
- Clear need as PhDs are essential for this infrastructure to be successful and to fill the talent pipeline going forward
- We have been been encouraged by the RC's to develop a cross-disciplinary nationwide CDT bid
- We welcome insight into what is expected by reviewers and panelists regarding CDT bids.
- CDT call for proposals is not yet announced, expected in 2023 with a rapid turnaround.

Outline proposal of governance structure



Modes of Engagement with C-Mass Infrastructure

If you are …	Mode of Access	What will you do?	What might you obtain?
An MS service lab in an HEI or UKRI institute	• Opt-in to be a named spoke to the hub. • Your capability will be signposted by the hub. • Common TRAC-costed cost recovery model for researcher access.	• Provide routine MS access and training to researchers in one or more specialist areas. • Undertake to provide metadata for cataloguing back to the hub. • Take part in generation of SOPs for common MS analyses. • Take part in thematic strategic challenges.	• Increased capacity in terms of equipment • Enhance capabilities if shown to benefit user base • Increase in the expertise required to support your lab. • Better signposting of your capability through the Hub. • Ability to focus on activities that you have strengths in and pass to others when you do not.
An MS research group in an HEI or UKRI institute	• Be a member of a thematic metrology network • Help direct, run, or lead one of the centres or hub.	• Work on strategic challenge • Undertake to provide metadata for cataloguing back to the hub.	• Membership of network and hub to enable work that cannot be done just by your lab • Increased capability to solve the strategic challenge
A research group from HEI or UKRI institute dependent on routine MS OR Industrial user	• Apply through hub for access to Expert spokes • TRAC-costed fee for service access to routine services	• Undertake to provide metadata (when possible) for cataloguing back to the hub.	• Targeted access to expert laboratories • Opportunity for collaboration on strategic challenges