

Effects of Public Funding Systems on Research in the United Kingdom

Presentation at The Impacts of Impact Measurement, Vienna, 25
September 2014

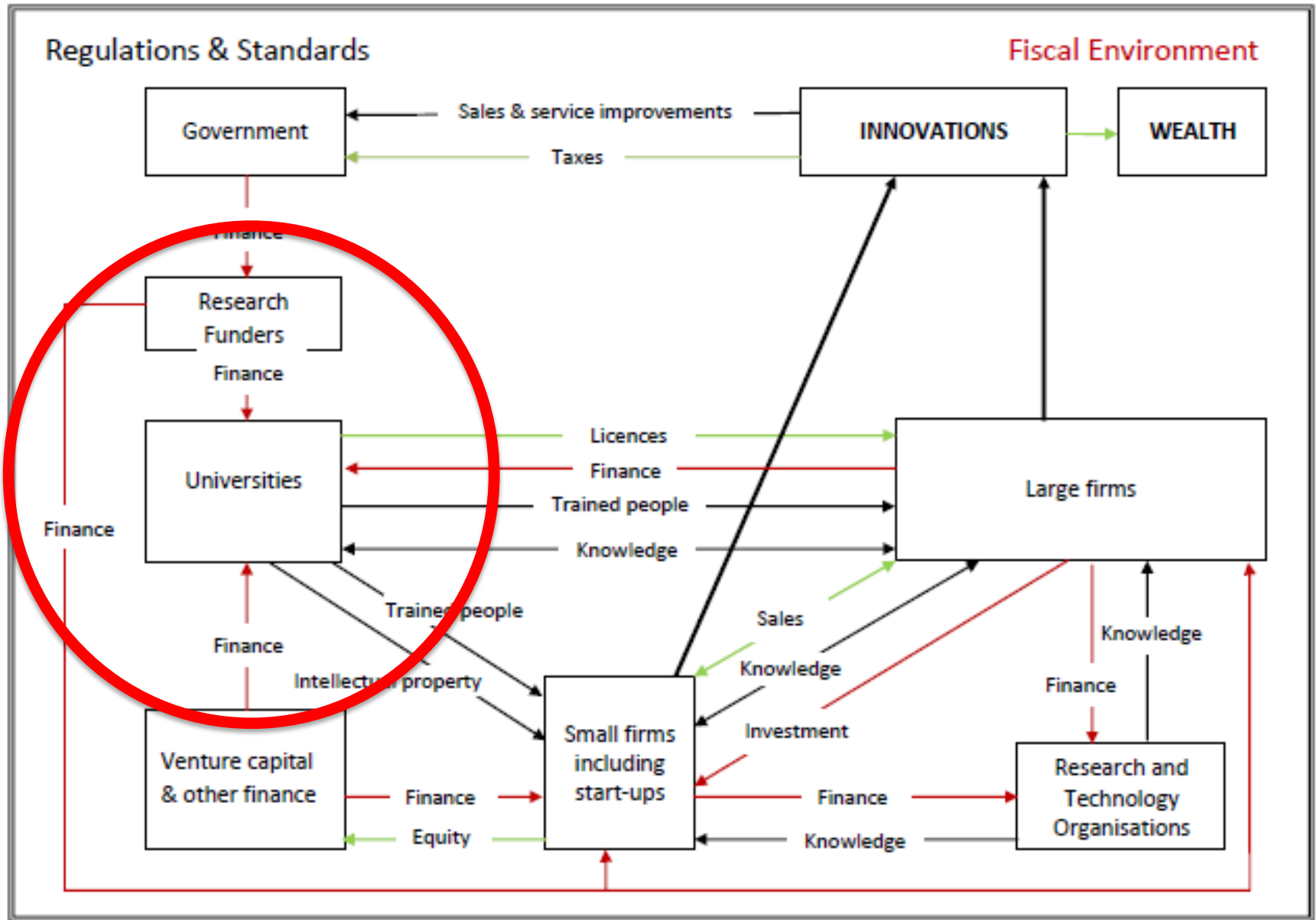
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Outline

- Universities in the UK research and innovation ecosystem
- Characterising the research system
 - Selectivity, concentration and sustainability
 - Grants versus institutional funding
- Linking research to impact
 - Effectiveness as impact - REF
 - Behavioural implications
- Stresses at the edge of the funding system
- Looking forward

UNIVERSITIES IN THE UK RESEARCH AND INNOVATION ECOSYSTEM

The Innovation Ecosystem

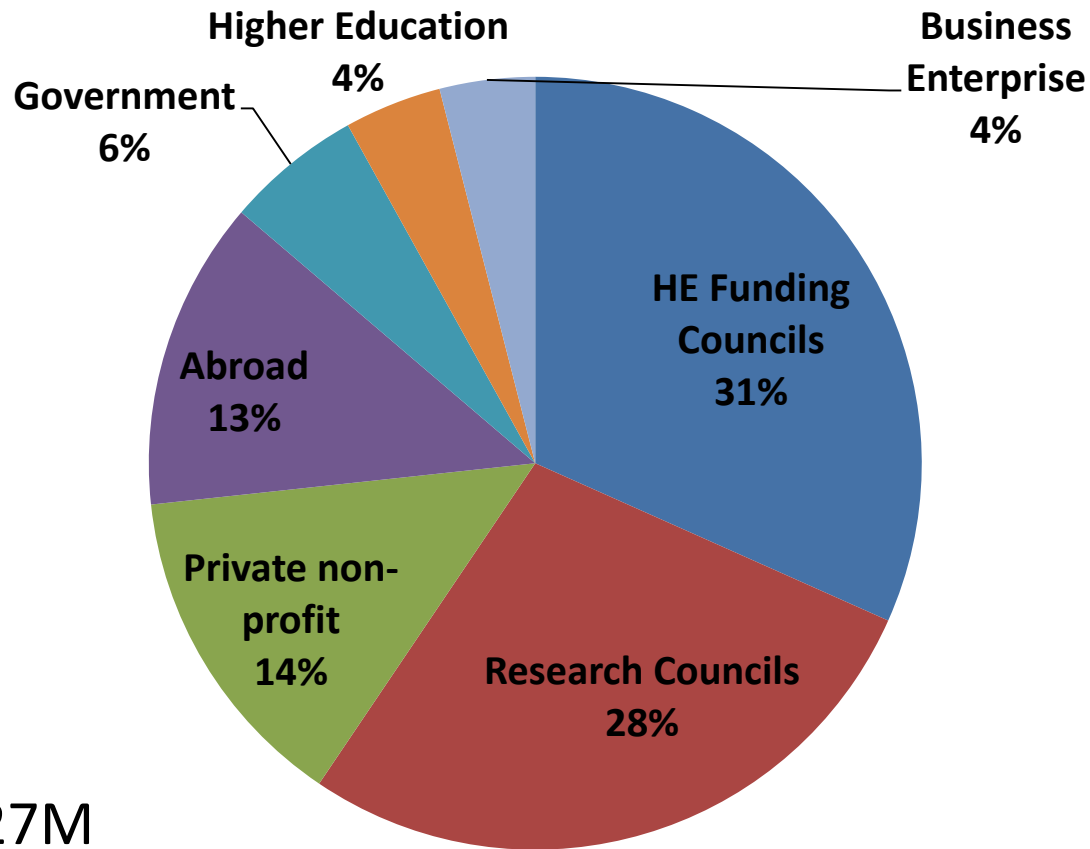


Source: L.Georgiou cited in House of Commons Select Committee on Science & Technology Report Bridging the valley of death: improving the commercialisation of Research, March 2013

Core role for universities

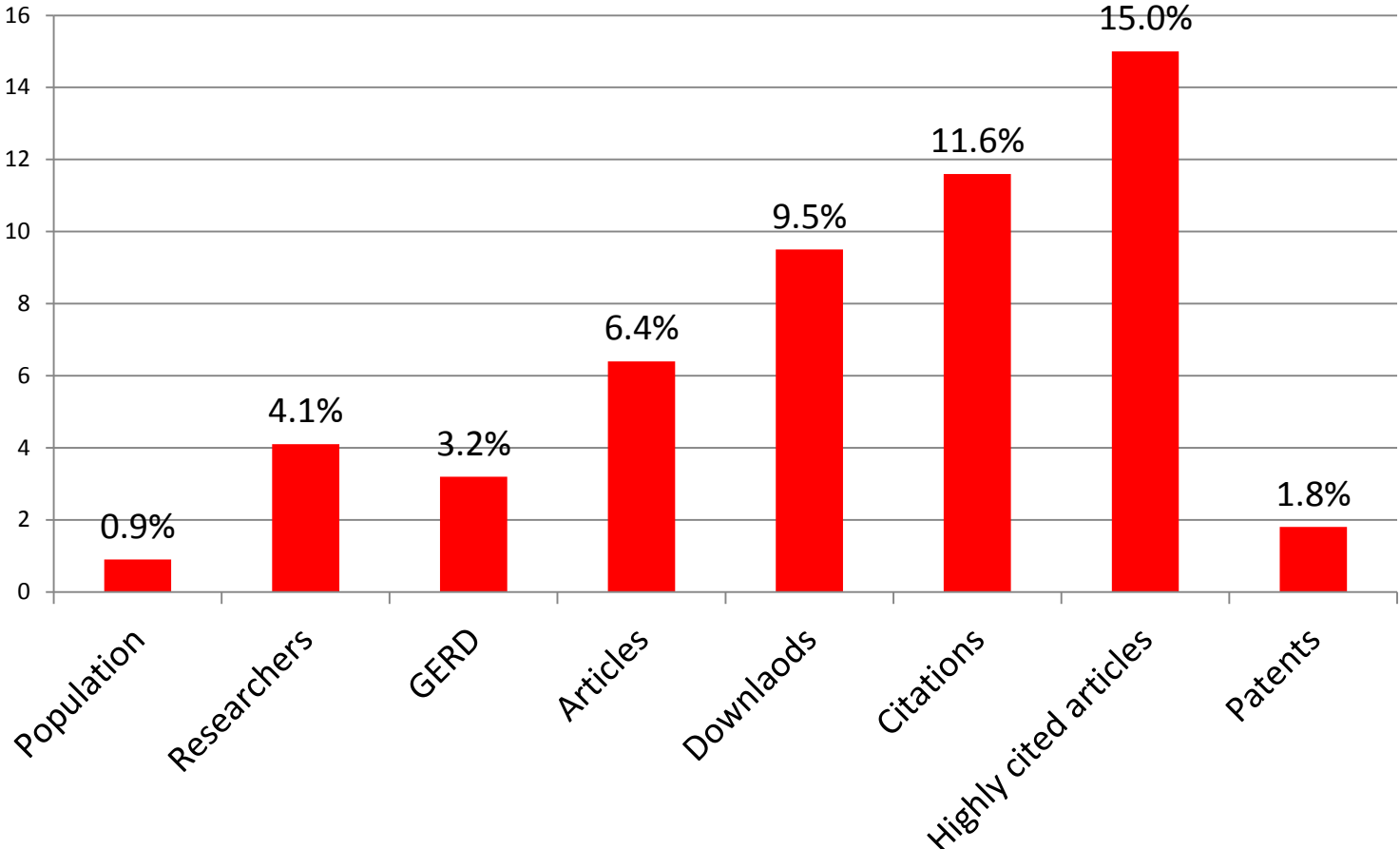
- Account for 27% of all R&D in UK c.f. OECD average of 19%
- Higher Education Institutions R&D increased in value by £3.3 billion (86 per cent) in real terms between 1995 and 2011
- World Economic Forum consistently ranks UK among best in the world for business-university collaboration on R&D

Funding for Higher Education Research (2011)



Total: £7,127M

UK research – Punching beyond its weight



World shares data derived from Elsevier - International Comparative Performance of the UK Research Base – 2013

CHARACTERISING THE RESEARCH SYSTEM

Fundamental parameters of a research system

- **Selectivity**
 - Which fields to support and how much focus to give priorities?
- **Concentration**
 - Which institutions or research teams to support and how concentrated should funding be on the best performers?
- **Sustainability**
 - Are the basic resources of people, money, infrastructure and institutions renewing themselves?

Selectivity

- Normally restricted to grant funding
- Defined as degree to which there is prioritisation between fields or challenge areas
 - Normally results in targeted competitions against pre-defined priorities
 - Criteria normally combine scientific promise with socio-economic potential
- Allow focus of resources and recognition of specialisation
 - Being institutionalised across Europe through ‘Smart specialisation’ concept
- Implicit choice of proportion of resources to be made available for ‘blue-skies’ or investigator-driven research versus those targeted strategically

Problems with prioritisation

- Establishing a meaningful level of granularity
 - how to avoid generic categories (eg 'environment') that cover large proportions of research
- Interdependence of priorities
 - one area may depend upon another that does not itself feature as a priority (eg mathematics)
- Reluctance among researchers to identify negative priorities
 - items to be cut to allow resources to be focussed on selected areas

Mixed reaction to efforts to prioritise UK funding

Positive – Ministers’ ‘8 Great Technologies’

- Announced in Ministerial speeches
- Linked to industrial strategy
- Generic – big data, space, robotics, life sciences, regenerative medicine, agri-science, advanced materials & nano, energy & storage
- Funding perceived as new and largely capital
- Requires very rapid response at short notice to large opportunities

Negative – EPSRC ‘Shaping Capability’

- Initiative of a Research Council in its Delivery Plan
- Aiming to define landscape it supports
- Focus science base around areas where UK is an acknowledged leader or shaper
- Affecting regular grant and doctoral training funding
- Cuts back as well as increases areas
- Includes plans for concentration

Extreme reactions

theguardian

Scientists stage mock funeral outside parliament in funding protest

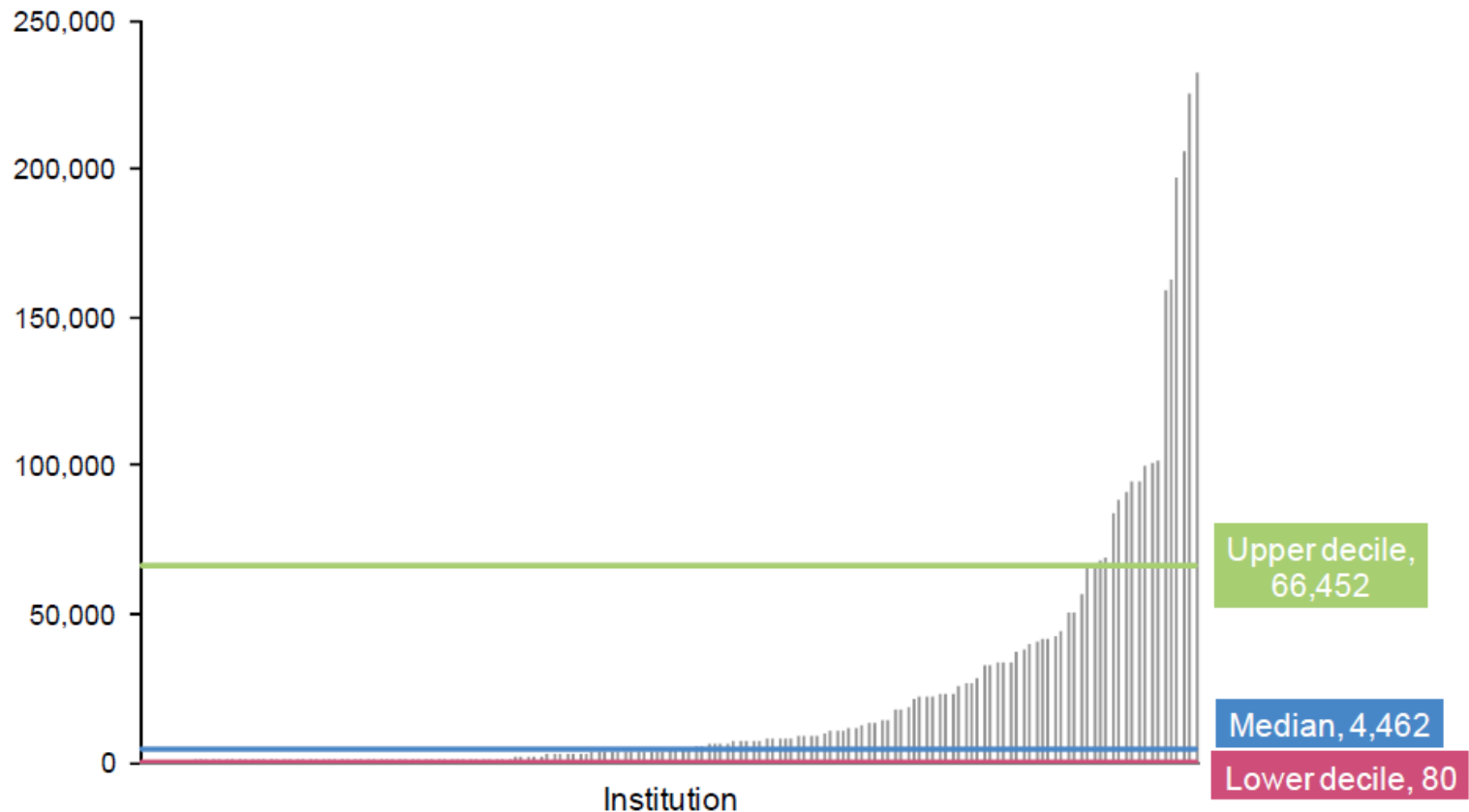
Science for the Future claims funding policies risk plunging British science and industry 'back into the Dark Ages'



Concentration

- Rationale for concentration lies in the assumption that scale and critical mass increase efficiency and effectiveness
 - Studies show that critical mass of a research group not very large <10
- Clear scale benefits when dealing with indivisibilities
 - eg large equipment or doctoral training schools
- Drive to interdisciplinarity creates economies of scope
 - Ability to configure several disciplines/capabilities around a scientific or societal problem
- Concentration driven in two modes
 - Institutional assessment (Research Excellence Framework)
 - Elite funding

Highly concentrated research funding in UK university system



Source: HESA Finance Return 2009/10

UK highly concentrated - Funding of research through the dual support system (£ thousands) by institution 2009/10 Source: UUK

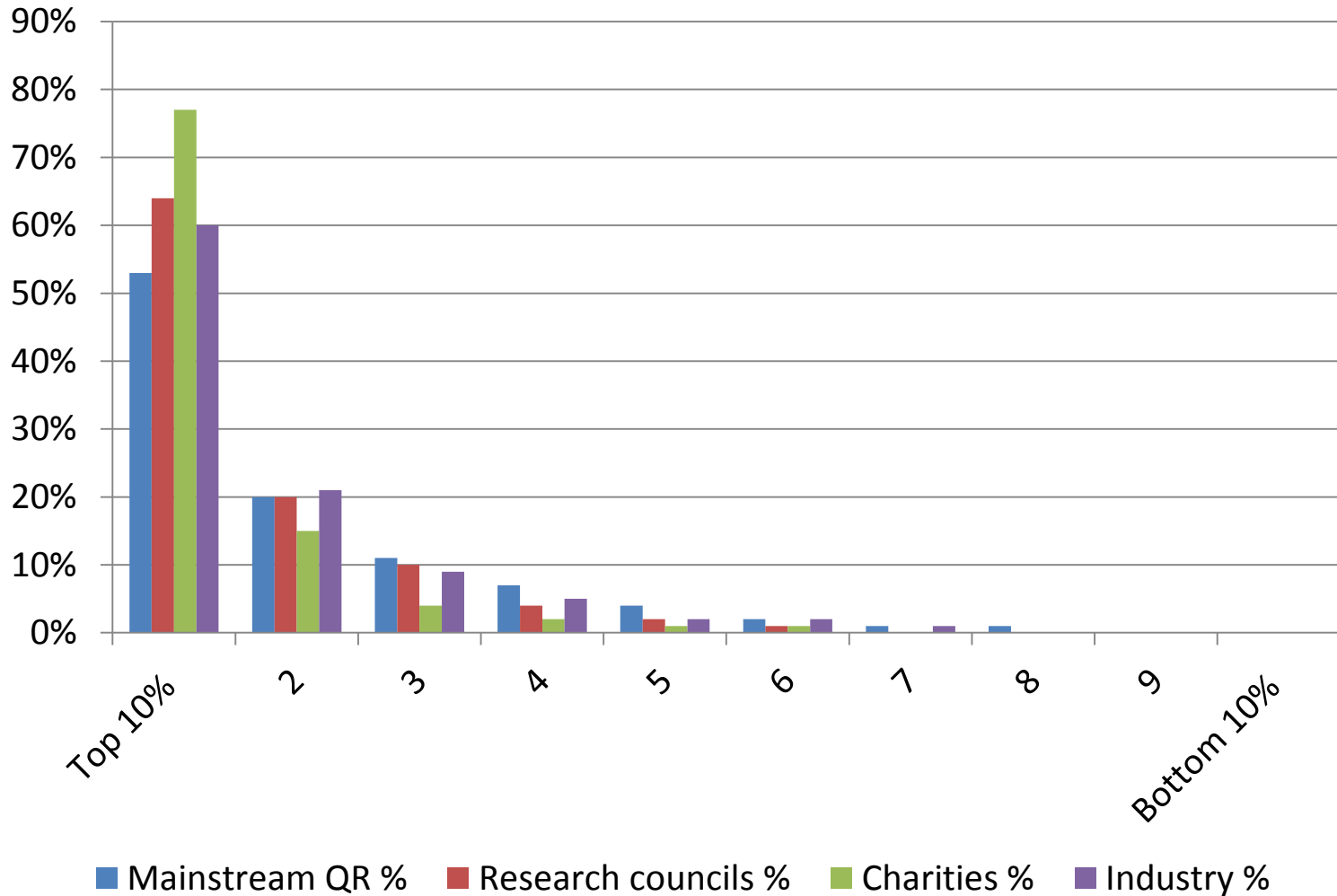
Elite funding

- Recent trend among funding agencies to drive concentration of research grants in an evolutionary manner by moving to elite funding model
 - Larger, longer grants going to fewer people
 - eg European Research Council, Wellcome Trust
- Based on observation that leading researchers are more productive
- Raises questions of sustainability
- Not clear that the elite either individually or collectively have long term absorptive capacity to support sustained concentration

Demand management

- Elite funding can be seen as a response to growing burden of peer review and desire for ‘demand management’
- Heavy cuts in administrative budgets forcing Research Councils to seek ways of reducing their workloads
- Mixture of monitoring and actual or implied sanctions to induce researchers and institutions to reduce number of applications
 - In theory bigger longer grants mean less frequent applications
 - Forced universities to adopt internal review processes to intercept under-prepared applications
 - Questionable whether system as a whole has reduced administrative burden
 - Side-effect is to raise quality of applications

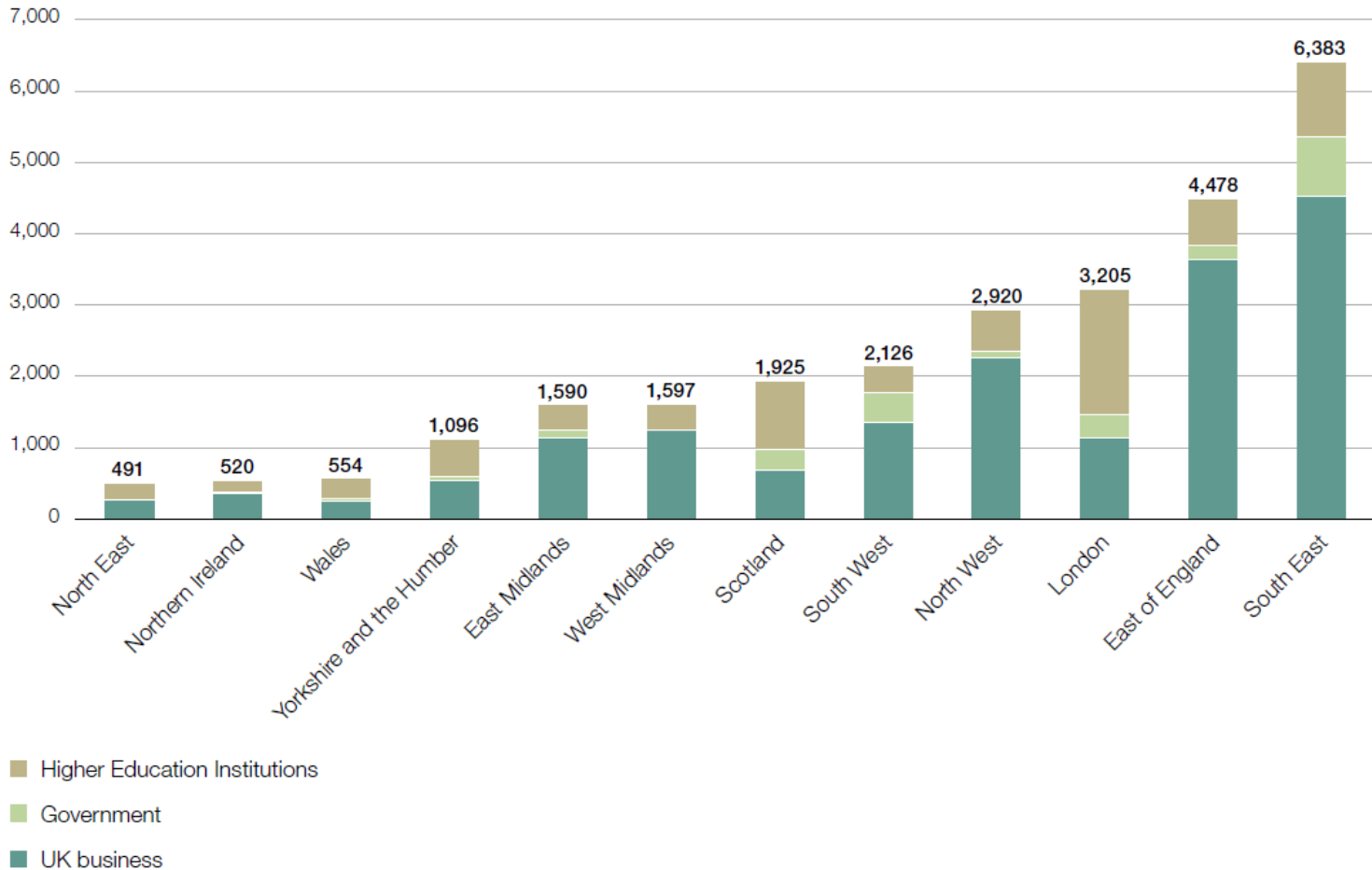
Concentration in UK by main funder by decile



Concentration has regional implications

Research and Development spending by sector of performance and UK region, as at 2011

R&D expenditure (£m)



Balancing grant and institutional funding

- Grants
 - Incentivise researchers
 - Prevent senior hierarchy from dominating resources
 - Shorter timescale and increased granularity allow flexible application of resources as science develops
 - Allows implementation of selectivity strategies
 - Can be adapted to influence behaviour in particular directions such as collaboration
 - Straightforward line of accountability for use of resources

...balancing

- Institutional funding
 - Cheaper to allocate block funding than grants
 - grants involve high transaction costs in preparation and review
 - relatively insensitive to the size of award
 - Provides space for researchers to develop ideas which may not be ready for exposure to external competition
 - Allows institutions to behave in a strategic fashion
 - reduces risk of converging on 'hot areas' with consequent loss of diversity in the wider research system
 - Pays for equipment and support services of generic benefit but not easily attributable to individual grants.
 - Long term shortfall of institutional funding leads to a 'hollowing out' of research institutions

So how much competition?

- Literature broadly links degree of competition with excellence in science
 - Eg Aghion et al found each percentage of a university's budget from competitive grants associated with rise of 6.5 rank points in ARWU
 - But other work eg Auranen and Nieminen confirms efficiency for high competition countries (UK, Australia, Finland) but also finds it in lower competition countries (Denmark)
- Wide variation in acceptance rates
 - UK overall 30% success rate in Research Councils
 - DFG-Germany 50/60%, Denmark and Netherlands 30%, ERC Synergy Grants 1.5%
 - Dawson et al suggest inverse U-shape relating competition and scientific performance

LINKING RESEARCH TO IMPACT

Effectiveness no longer defined in terms of excellence alone

- “It is right that, even at times of fiscal restraint, we find the resources to enable new scientific breakthroughs, to bridge the gap between discovery and commercialisation and to spread the economic and social benefits of scientific research.” George Osborne, UK Chancellor of the Exchequer, Speech to Royal Society, 9.11.2012
- . “Horizon 2020 is a radical departure from the previous Framework Programmes for Research because it will bring together, in a single programme, all EU funding for research and innovation, providing seamless support from ideas to markets, from research to product.....Overall, Horizon 2020 will mesh research and technological development with innovation in products, services, processes and systems.” Maire Geoghan Quinn, EU Commissioner for Research, Innovation and Science, Speech to Global Venture Capital Congress, 5.10.12

Meeting expectations – the ‘impact agenda’

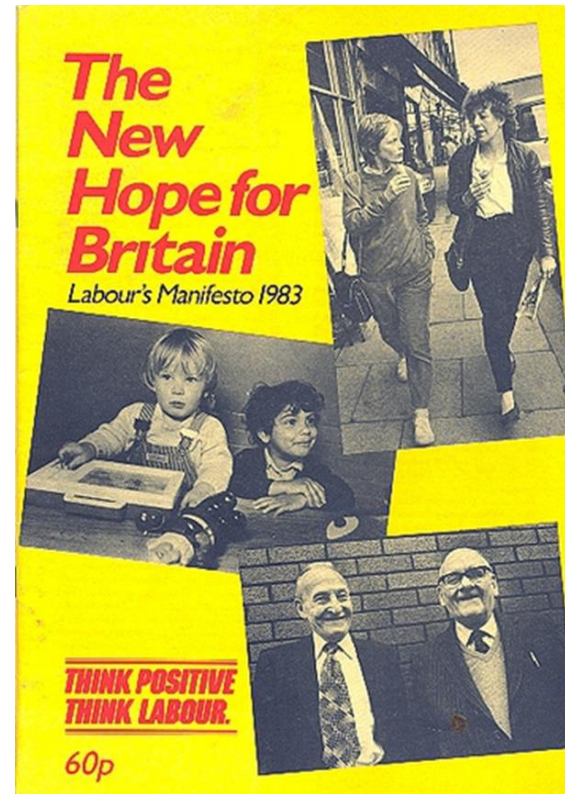
- Sustainability is also about convincing stakeholders of the need to continue investing in research
- Increased emphasis on demonstrating ‘impact’ as the price for ‘privileged investment’ in times of austerity
- Should be great opportunity for research and innovation policy community but perhaps has also exposed the relative immaturity of the concepts underpinning such evaluation
- Impact can be on health and welfare, society, culture, policy etc
 - Grand/societal challenges as a communication device to politicians and public as well as providing a coordination envelope
 - BUT strongest focus is on economic contribution



Petition decries 'impact' agenda in research

11 June 2009

Initial negative reactions



The Longest Suicide Note in History

UK Research Excellence Framework

- Large scale systematic attempt to to measure impact from entire University system
 - Will account for 20% weighting in directing institutional funding funding
 - Each Unit of Assessment (subject submission from a university) will need to enter
 - A general statement of its approach to impact, main user groups and types of impact and strategy to support impact; and
 - 4-page case studies detailing how any research done in the period from 2008 since 1993 has generated impacts beyond academia
 - Graded by modified peer review for “reach and significance”
 - System as a whole generated 6975 case studies to be assessed

Evaluation perspective

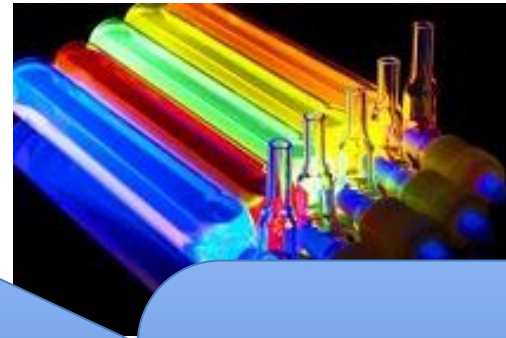
- Why case-studies?
 - No metric adequate to capture reliably the contribution made
 - Narrative provides best chance of dealing with classic problems of evaluation
 - Timing
 - Attribution
 - Widespread acceptance that ‘stories’ have the greatest political impact
 - Some evidence that highly skewed impact distribution means that selected cases will be good first approximation to total impact
- Placing great emphasis upon quality of evidence, especially for attribution

Difficulties

- Identification
 - Especially of impacts where key players departed
 - No systematic organisational memory
- Comprehension
 - Getting academics to understand the detailed criteria
- Verification
 - Assembling credible supporting evidence
- Uncertainty
 - No track record on how criteria will be interpreted or how “reach and significance” translate in to a scale across hugely different cases
 - Unclear boundaries – eg is it enough to demonstrate impact on a policy or should the policy also be evaluated?
- A new stretch for modified peer review
 - But do the underlying assumptions of peer review hold?

Impact example commercialisation - through spin-out: Nanoco Technologies

- Founded in 2001 following discovery of novel molecular seeding process in School of Chemistry
- Bulk manufacture of cadmium-free quantum dots for next generation TV screens, lighting, solar panels
- Exports and partnerships to major Asian firms – recent manufacturing deal with Dow
- AIM listed and capitalised c. £200-400m and employs 62 people



The linear model almost exists but it is relatively rare. Has great political value. IP crucial in this case

Impact example culture - Ground-breaking interpretations of Beethoven's 35 piano sonatas along with previously unheard music

- Decades of extensive research and re-examination of Beethoven's life and works led to widespread reinterpretations of his composing and fresh performances of his sonatas
- Complete performance edition of the 35 sonatas
- Reconstruction of the original lost slow movement for the String Quartet Op. 18 No. 2 based on Beethoven's sketches



Cumulative impact
– potentially toxic
in REF context!

Behavioural implications

- Challenge for universities to align individual incentives with new drivers
 - In Manchester we explicitly offer parity of esteem for applied research with curiosity-driven research for impact-generating, translation and knowledge transfer activities in promotion and PDR
 - Encourage outside work subject to regulations
 - Radical IP policy offering 85% initial share to originators up to £1m then 50%
- Annual staff research profiling exercise includes impact as well as outputs and research income

Infrastructure is important

- Developing regional innovation system and “Corridor” with multiple incubation & accommodation increasingly specialised
- Vectors
 - Policy@Manchester
 - Academic Health Sciences Networks
- Cultural institutions
 - Art gallery, Museum, Historic library
 - Jodrell Bank Science Centre
- Expertise in business engagement, commercialisation, market analysis



msp
manchester science park



STRESSES AT THE EDGE OF THE FUNDING SYSTEM

Haldane principle

- Named for early 20th Century minister R.B.Haldane but essentially formulated in 1960s
- Decisions on what to spend research funds on should be made by researchers not politicians
 - Underpins concept of autonomous Research Councils and Funding Councils
- Present Government reaffirmed support but reserved for Ministers
 - Overall size and distribution of budget between funding bodies
 - Setting key national priorities but **not** which projects ofrpeople to implement them
 - “Ministers have a legitimate role in decisions that involve long term and large scale commitments of national significance. These include the construction of large scale research facilities...”

New pressures for change – the regional agenda



- Regional concentration of research funding resulting from cumulative competition has created serious, systematic and enduring disadvantages for regional innovation ecosystems outside the South East of England
- Scottish Referendum and growing influence of City Regions, particularly in the North of England providing new emphasis to these arguments and an apparent political consensus that something must be done
- Key insight is that capital investment can be allocated on different criteria from resource budgets
- While “cathedrals in the desert” never work, if capital can be aligned around existing strengths outside the Golden Triangle new growth paths can be initiated

Manchester's Graphene Strategy – working out a new funding paradigm



Sir Andre Geim

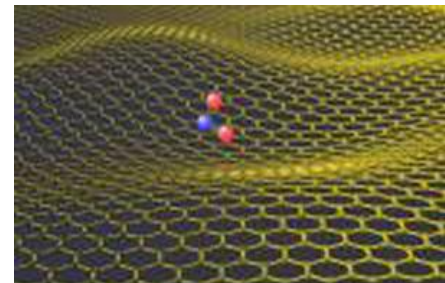


Sir Konstantin Novoselov

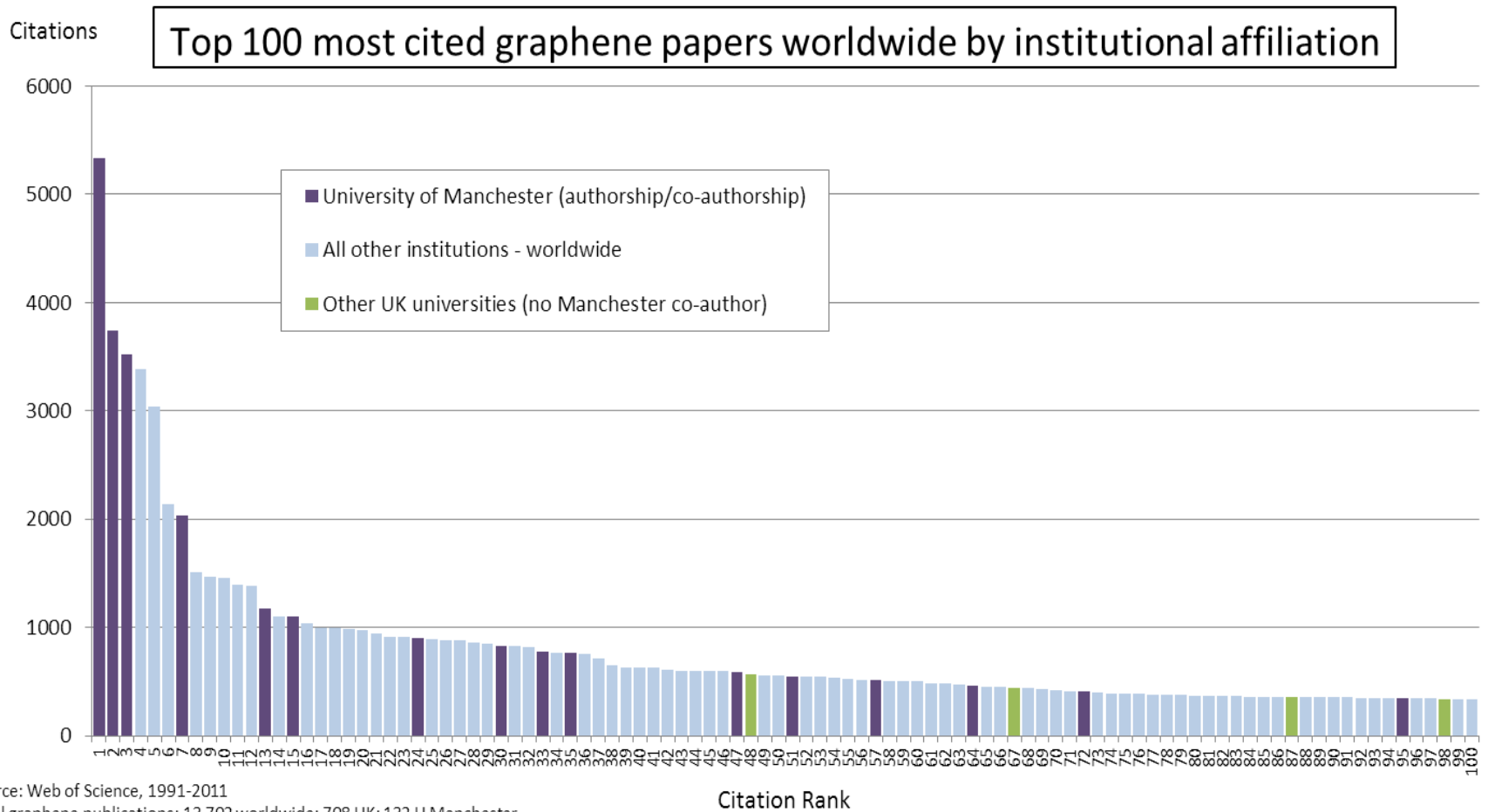
- Following Nobel Prize recognition at University of Manchester we are seeking to maximise economic impact of this highly disruptive technology

The technology

- Graphene is
 - thinnest possible material
 - strongest material “ever measured” (theoretical limit)
 - stiffest known material (stiffer than diamond)
 - most stretchable crystal (up to 20 percent)
 - record thermal conductivity (outperforming diamond)
 - highest electronic quality (100 times more than silicon)
 - best known conductor of electricity (outperforming copper and gold)
 - rich opportunities in composites – 2-D materials.



Scientific lead



Source: Web of Science, 1991-2011

Total graphene publications: 13,702 worldwide; 708 UK; 132 U Manchester

Core elements of our strategy

- Provide our leading researchers with the freedom & resources to pursue & publish breakthrough science
- Develop strategic business partnerships with two way flows of knowledge and presence in Manchester
- Commercialise intellectual property with incubation support and smart venture investment
- Train enough researchers with entrepreneurship skills to create labour market as underpinning of innovation cluster
- Build a regional innovation ecosystem!

Funding

- Initially the University made the investment to equip Andre Geim with state-of-art lab using own (institutional resources including block funding)
- Portfolio of grant funding
- Limited industry input to date but now changing
- In 2011 UK Chancellor of Exchequer announced extraordinary funding of £38m towards cost of establishing National Graphene Institute
- 2013 ERDF funds secured (£23m) to complete construction cost

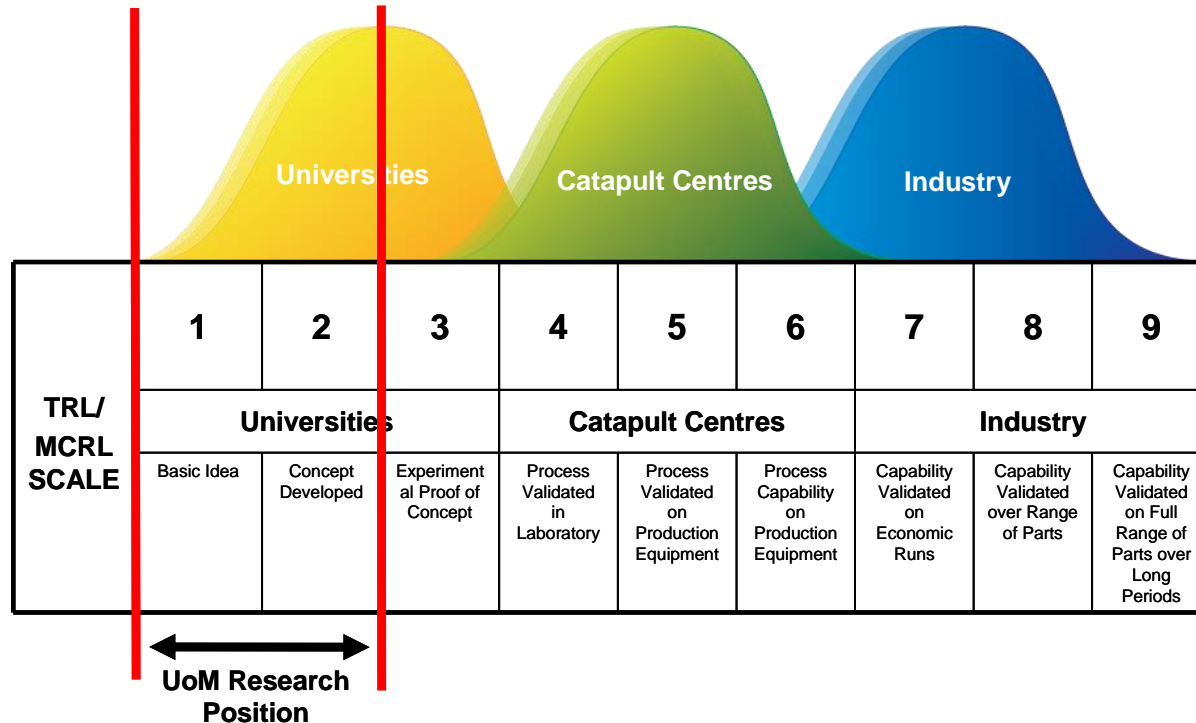


Funding portfolio 2013

- Capital for NGI Building: £61m
 - BIS/EPSRC, ERDF
- Basic Research: £16.2m
 - EU Flagship, ERC Synergy and Advanced, EPSRC, Royal Society etc.
- NowNano doctoral training centre (EPSRC): £4.9m
- Industrial projects: £21m
 - Advanced Materials, Membranes, Electrochemical Energy Storage
 - Includes inward investment by Bluestone Global Technologies with £5m research projects & pre-production facility and offices at the University before setting up larger European headquarters and a pilot production plant within Manchester

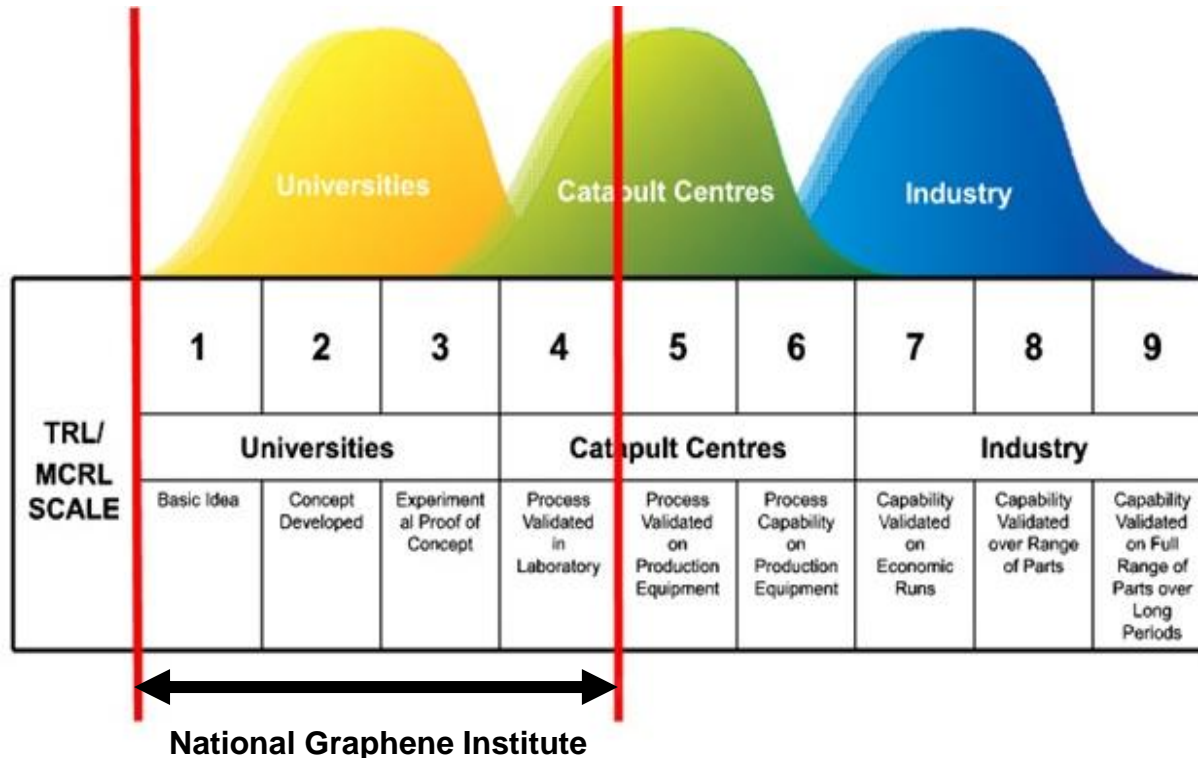


Incomplete innovation ecosystem



Current Position - Graphene is primarily a research activity characterised by a *Technology Push* approach

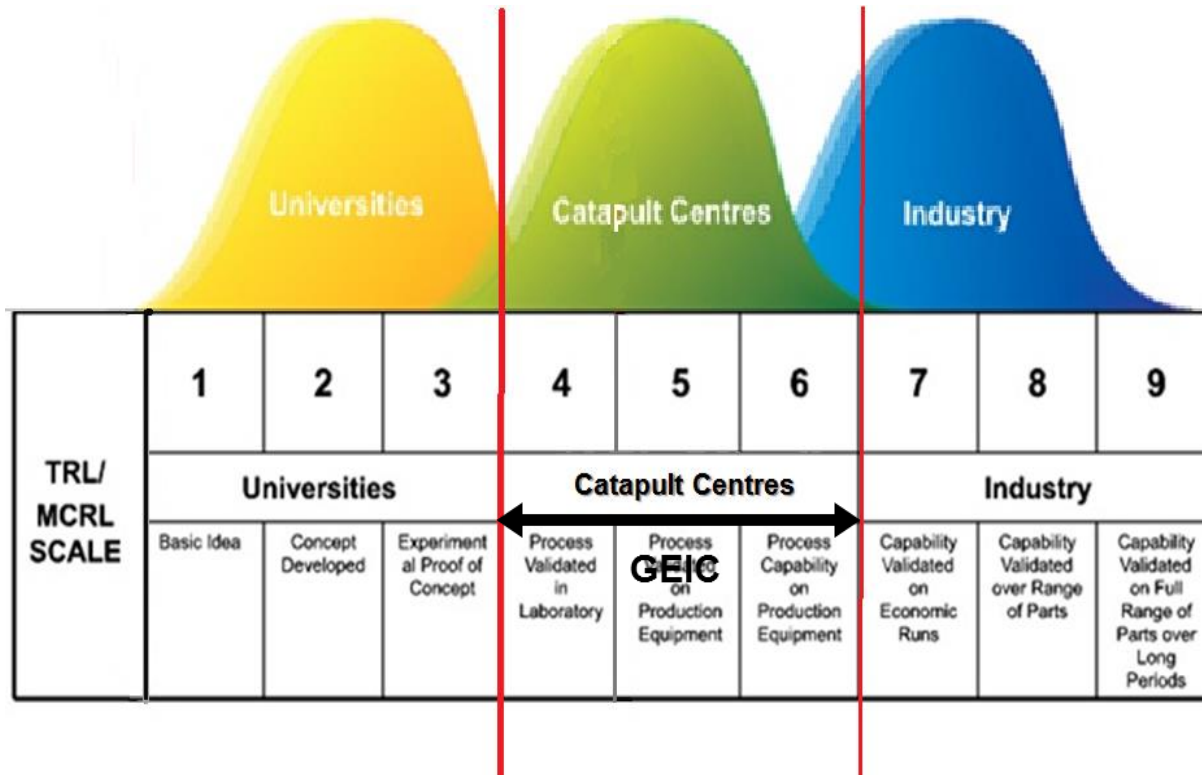
Extended by National Graphene Institute



Future Position (2020) – Graphene is characterised by *technology push* and *market pull*

Our next step – the Graphene Engineering and Innovation Centre (GEIC)

Pilot production and characterisation, together with application development



Graphene is characterised by *market pull*

Funding the GEIC

- £30m from Masdar the Abu Dhabi-based renewable energy company owned by Mubadala
 - Close relationship with City of Manchester
- £15m from the Higher Education Funding Council for England's UK Research Partnership Investment Fund (UKRPIF)
 - Competitive fund for large university facilities in context of strategic partnerships with private sector expected to contribute 2:1
- £5m from the Technology Strategy Board
- Further resource raised by University

Looking forward

- Selectivity, concentration and sustainability interact in most decisions
- Concentration has underpinned the UK's success in research but raises challenges of sustainability
- Impact agenda is now part of normal practice and has helped to make the case for research investment but measurement challenges remain
- Current funding system is unable on its own able to deliver major innovation-facing research investments
- Greatest breakthroughs come from supporting freedom and creativity in research but we then have to be prepared to move in with resources and support to capture those benefits

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