A Mission-Oriented Vision for Innovation-Led Economic Growth

Budget Representation to HM Treasury by the
Commission on Mission-Oriented Innovation & Industrial Strategy (MOIIS) hosted by UCL Institute for Innovation & Public Purpose (IIPP)
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UCL Institute for Innovation & Public Purpose

UCL Institute for Innovation and Public Purpose (IIPP) is a department in University College London and part of The Bartlett faculty, known internationally for its radical thinking about space, design and sustainability.

IIPP's mission is to change how public value is imagined, practiced and evaluated to tackle societal challenges and achieve economic growth that is more innovation-led, sustainable and inclusive. Our research and teaching programmes aim to shape a dynamic and bold public sector driven by public purpose. Markets can be shaped by purposeful policy making. Markets can be designed so that dynamic collaborations between public, private and actors in civil society together deliver public value.

IIPP hosts the **UCL Commission for Mission Oriented Innovation and Industrial Strategy** (MOIIS). MOIIS was formed to help the government use a mission-oriented lens to approach the 4 grand challenges in the Industrial Strategy. The work of MOIIS builds on our prestigious report on Mission Oriented Innovation for the European Union and the Commission. Co-chaired by Prof Mariana Mazzucato and Lord David Willetts, MOISS is made up of world-leading academics, policy makers and leaders of civil society organisations.

Institute for Innovation and Public Purpose

Point of contact: Professor Mariana Mazzucato, Director of IIPP, and Dr George Dibb, Head of Industrial Strategy & Policy Engagement

g.dibb@ucl.ac.uk – 07741 670979

1. Introduction

A cornerstone of the UCL Institute for Innovation & Public Purpose's (IIPP) research is that economic growth depends on innovation, and that innovation has not only a rate but also a direction. IIPP's research also demonstrates that markets are not created out of thin air: they are outcomes of the interactions between different actors in the economy, operating in the public, private and voluntary sectors.[1] The structure of public and private investments and market interventions affect both the rate and direction of innovation.

To increase the rate, or magnitude, of innovation and economic growth we support increases in research and development (R&D) spending. We welcome the government's commitment to reach 2.4% gross investment in research & development within the decade.[2]

To better direct innovation to align with the government's strategic aims of greater productivity, growth and earning power, we advocate a mission-oriented approach to the industrial strategy. Missions combine a bold and inspirational top-down direction, with interdisciplinary, cross-sectoral bottom-up innovation. Government's create the space in which innovation can occur by setting the goal, defining a stable policy environment, and incentivising innovation towards the mission through multiple bottom-up innovations. Missions provide a framework for state investment in innovation and R&D.

Our work shows that if innovation spending is structured and targeted in the correct way that the net effect on the economy is greater. A mission-oriented approach to investment can therefore increase the economic "multiplier" of spending through the government's Industrial Strategy.[3]

In this context a broader, cross-government notion of the 'innovation budget' is required. Innovation is not just the purview of the department for Business, Energy & Industrial Strategy (BEIS) but spread between UK Research & Innovation (UKRI) as well as all government departments. Other government spending, e.g. through procurement policies, have potential to drive innovation via demand-side effects which requires little additional funding commitment.

The following document represents key inputs for the Treasury from IIPP but also informed by the work of the UCL Commission on Mission Oriented Innovation and Industrial Strategy (MOIIS).

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[1] Mazzucato, M. (2017) 'Mission-oriented Innovation Policy: Challenges and Opportunities', UCL Institute for Innovation and Public Purpose (IIPP) Working Paper Series, (IIPP 2017-01). Available at: https://www.ucl.ac.uk/bartlett/public-purpose/sites/public-purpose/files/ moip-challenges-and-opportunities-working-paper-2017-1.pdf

[2] Industrial Strategy: building a Britain fit for the future (2017). UK Government. Available here: https://www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future

[3] Kattel, R., Mazzucato, M., Ryan-Collins, J., Sharpe, S. (2018). The economics of change: Policy appraisal for missions, market shaping and public purpose. UCL Institute for Innovation and Public Purpose, Working Paper Series (IIPP WP 2018-06). https://www.ucl.ac.uk/bartlett/public-purpose/wp2018-06

2. Recommendations

Below are the recommendations that the MOIIS commission and IIPP make to the Treasury ahead of budget 2018. These recommendations are supported by the full submission.

2.a. Rate of Innovation

IIPP-MOIIS welcome the government's Industrial Strategy and a comprehensive focus on how economic growth can be delivered through innovation. We welcome the government's commitment to increase the rate of UK innovation through new spending in fundamental and applied R&D. We strongly welcome the aspiration of reaching 2.4% gross investment in research & development within the decade and recommend the treasury to urgently publish a roadmap of how this target will be achieved.

2.b. System of Innovation

A higher R&D spend must also be matched by increased funding for the 'system of innovation' (e.g. catapult centres, business incubators) and attention to the different components of Gross Expenditure on R&D (GERD). Recent evidence shows that Business Expenditure on R&D (BERD) remains below average, Government Expenditure on R&D (GovERD) has been falling, and the Campaign for Science & Engineering (CASE) have also claimed that 'real' spending on Higher Education R&D (HERD) has also been falling.[4,5] We recommend that the roadmap on increasing GERD includes considerations of the structure of the system of innovation, ensuring an interconnected networked entrepreneurial state.[6,7,8]

2.c. Direction of Innovation

IIPP-MOIIS welcome the government's adoption of a mission-oriented framework to direct innovation in the UK where it can deliver the greatest impact. The missions' approach, upon which we have provided thought-leadership, argues that policies should be motivated by challenges, but be structured in more concrete ways around targeted problems that bring together bottom-up solutions from different sectors and different disciplines. We have been working with BEIS around the formation of missions within the Grand Challenges set out in the Industrial Strategy and we eagerly await the announcements of the policies developed in each of these areas. The missions are bold and will require significant funding, of all different types, to achieve them.

IIPP and MOIIS commission therefore recommend that the Treasury adopt a mission-oriented approach to the Industrial Strategy (which will require new funding) and commit to supporting this approach to drive areas of UK competitive advantage.

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[4] Tooze, J. (2018) Reflections on the UK's R&D funding landscape, CaSE blog, available here: http://www.sciencecampaign.org.uk/news-media/case-comment/reflections-on-the-uk-s-r-d-funding-landscape.html

[5] UCL Response to EPSRC consultation on government commitment to boost R&D spending to 2.4% GDP, 28/8/2018, copy available on request

[6] Willetts, D. (2016) UK Science and Innovation Policy – Three Barriers to applying research better, speech given at Whitehall Lectures, 3/11/16

[7] Dibb, G. (2018) How can the UK's public research laboratories support a mission-oriented industrial strategy?, IIPP Blog available here: https://medium.com/iipp-blog/how-can-the-uks-public-research-laboratories-support-a-mission-oriented-industrial-strategy-60ede8261e6d

[8] Mazzucato, M, Lazonick, W, (2010) Limits to 3% R&D Target, FINNOV Position Paper available here: http://www.finnov-fp7.eu/publications/related-publications/finnovpositionpapermay2010.html

2.d. Aligned Government Approach

For a mission-oriented approach to innovation to succeed in remodelling the UK economy, it must be an effort that is coherent across government departments. It should go beyond the industrial strategy and affect the way that procurement policy, regulation, competition policy and fiscal policy is envisioned and implemented. Such an approach should help break down siloes between government departments.

In the short term, we recommend that all the announcements in the Budget 2018 align to the stated ambitions of the government's Industrial Strategy white paper – creating the world's most innovative economy with good jobs and greater earning power for all through a mission-oriented approach. In the long term, we recommend that an independent body is formed to assess all government policies and budget announcements in their alignment to the broader economic goals of the Industrial Strategy.

2.e. Patient Finance

Innovation is uncertain and takes a long time, so one key component of an innovation strategy is the rethinking of the UK's financial eco-system to provide long-term, patient investment in new technologies. There is an opportunity for a closer dialog between the Industrial Strategy and the Treasury's Patient Finance Review to ensure these parallel efforts are co-ordinated. On 14th June 2018 IIPP organised an event in Parliament that brought together key players in this field.[9] IIPP-MOIIS recommend that a mission-oriented approach be applied to the Business Investment Bank, and that this bank be restructured as a fully-fledged public bank.[10] This is informed by IIPP's instrumental role in the formation of the Scottish National Investment Bank.[11] As the Treasury may be aware, currently only around 10% of all UK bank loans support non-financial firms with the majority flowing in to existing real estate or financial assets.[12] A powerful public investment bank would help reverse this process and help 'crowd-in' more private sector finance to support industrial strategy goals.

2.f. Dynamic Policy Evaluation

As set out below, to deliver a mission-oriented Industrial Strategy it is essential that HM Treasury go beyond the traditional 'market failure' framework for the justification of government intervention - derived from neoclassical welfare economics - to a 'market shaping' role. This will involve adopting a mission-oriented approach to policy evaluation that moves beyond conventional Cost Benefit Analysis and Net Present Value methods, based on comparative statics, to adopt a more dynamic approach. [3] This requirement is acknowledged in the Green Book and work is currently ongoing to provide an underpinning framework.

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[9] IIPP Patient Capital and Industrial Strategy workshop in UK Parliament, 14/6/18, IIPP website: https://www.ucl.ac.uk/bartlett/public-purpose/news/2018/jun/iipp-holds-patient-capital-and-industrial-strategy-workshop-uk-parliament

[10] Mazzucato, M, Macfarlane, L, (2017). "Patient strategic finance: opportunities for state investment banks in the UK". UCL Institute for Innovation and Public Purpose, Working Paper Series (IIPP WP 2017-05). https://www.ucl.ac.uk/bartlett/public-purpose/wp2017-05

[11] Brooks, L. "Scottish government to launch national investment bank" The Guardian, published 28/2/18, available here: https://www.theguardian.com/uk-news/2018/feb/28/scottish-government-to-launch-national-investment-bank

[12] Turner, A. (2016) *Between Debt and the Devil*, Princeton: Princeton University Press

2.g. Direct vs Indirect Innovation Incentives

Business investment is driven by the expectations of future growth opportunities. Direct, well-structured innovation funding tends to provide more additionality than indirect tax incentives as they can be used to steer expectations in these new areas. A systemic approach to innovation needs both direct and indirect funding and subsidy from the public sector, and a holistic and well-devised set of policies must drive the optimal outcomes.

IIPP recommends that Industrial Strategy Challenge Funds focus on mission oriented problems, rewarding cross-disciplinary collaborations, and the use of instruments (e.g. prizes) to foster bottom-up solutions. While we advocate the focus on ambitious problems for multiple sectors to solve (rather than the focus on individual sectors), attention should also be paid to the ability of new *general purpose technologies* (that are not easily allocated to missions at early stages of development) to transform production and distribution across sectors.

IIPP recommend that the Treasury conducts research to assess the effectiveness of indirect innovation funding, such as the R&D tax credits, and develop alternative models that could drive greater impact.

We also recommend the withdrawal of the 'patent box' policy and the redirection of increased tax revenues to be diverted to further Industrial Strategy funding.[13,18]

2.h. Health Funding in the Industrial Strategy

IIPP-MOIIS recognise the huge pressures upon the National Health Service (NHS) and the logical call to increase front-line spending. However, we believe that whilst reducing front-line pressures on the NHS is clearly a priority, the opportunity to address systemic challenges to the health service should not be missed. IIPP recommend that the government views the Industrial Strategy as connected to the ways in which the NHS can be better aligned with health innovation and seize this opportunity to direct innovation towards solutions to the structural problems faced by the health service such as an ageing society and the use of data in healthcare. The work of IIPP and MOIIS on utilising data for disease diagnosis and 'Healthy Ageing' has attempted to provide thinking on how the mission projects can drive cost savings for the NHS.

[13] Gaessler, F., Hall, B.H., Harhoff, D., (2018) "Should there be lower taxes on patent income?" IFS Working Paper W18/19 https://www.ifs.org.uk/uploads/publications/wps/WP201819.pdf

3. A Mission-Oriented Approach

3.a. Rate & Direction of Innovation

IIPP hosts the MOIIS commission to develop the concept of a mission-oriented industrial strategy to drive economic growth and prosperity, as well as improving national productivity, whilst directing the UK towards an innovation-driven economy. It is the view of the MOIIS commission that the public sector should take a strong market-shaping rather than market-fixing role, and the government can create inclusive public value. The MOIIS commission is chaired by IIPP director **Prof Mariana Mazzucato** and former Minister for Universities and Science, **Lord David Willetts**. The Commission is made up of key UCL academics and world-leading industry experts from cross-disciplinary institutions.

This missions-led approach is based on pioneering though-leadership from Professor Mazzucato and IIPP. Our recent report published by the European Commission sets out the economic rationale of missions and a clear framework for the development and framing of missions.[14] This approach has been recognised by the Prime Minister Theresa May in her recent speech on science in innovation: "There is huge potential in a missions-based approach to drive faster solutions – and it is an approach being pioneered here in the UK, by University College London's Commission on Mission-Oriented Industrial Strategy."[15]

Missions set clear and ambitious objectives that can only be achieved by a portfolio of research and innovation projects and supportive measures, such as policy interventions and involvement of end-users.[16] Missions should be broad enough to engage the public and attract cross-sectoral investment; and remain focussed enough to involve industry and achieve measurable success. By setting the direction for a solution, missions do not specify how to achieve success. Rather, they stimulate the development of a range of different solutions to achieve the objective. The figure below shows how a grand challenge (or UN Sustainable Development Goal) can be broken down into clear missions which are supported by a portfolio of projects.[14,17]

By actively creating new areas of growth, mission-oriented innovation is also able to 'crowd in' business investment by increasing business expectations about where future growth opportunities might lie.[18] Mission-oriented investments are 'direct' (e.g. grants, investments, etc.) and tax incentives are 'indirect'. Direct investments that create new technological and industrial landscapes tend to crowd-in private investment more than indirect tax incentives.

A mission-oriented approach to innovation should thus create a higher economic multiplier than funding for a single technology or sector as it leverages in private sector R&D and investment spending across multiple sectors in to new, high growth areas of the economy. The systemic effect also creates a stronger link between manufacturing and services.[3,19, 20]

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[14] Mazzucato, M., (2018). Missions: Mission-Oriented Research & Innovation in the European Union. European Commission. Available online at https://ec.europa.eu/info/sites/info/files/mazzucato_report_2018.pdf

[15] PM speech on science and modern Industrial Strategy: 21 May 2018 Available at https://www.gov.uk/government/speeches/pm-speech-on-science-and-modern-industrial-strategy-21-may-2018

[16] Nelson, R. (2017). "Thinking About Technology Policy: 'Market Failures' versus 'Innovation systems'". UCL Institute for Innovation and Public Purpose, Working Paper Series (IIPP WP 2017-02). https://www.ucl.ac.uk/bartlett/public-purpose/publications/2018/jan/thinking-about-technology-policy-market-failures-versus-innovation-systems

[17] Kattel, R., Mazzucato, M. (2018). Mission-oriented innovation policy and dynamic capabilities in the public sector. UCL Institute for Innovation and Public Purpose, Working Paper Series (IIPP WP 2018-5). http://www.ucl.ac.uk/bartlett/public-purpose/wp2018-05

[18] Mazzucato, M., (2013). The Entrepreneurial State: Debunking the Public vs Private Myths in Risk and Innovation. Anthem Press.

[19] Deleidi, M, Mazzucato, M, (2018). "Putting austerity to bed: Technical progress, aggregate demand and the supermultiplier." UCL Institute for Innovation and Public Purpose, Working Paper Series (IIPP WP 2018-01). https://www.ucl.ac.uk/bartlett/public-purpose/wp2018-01

[20] Deleidi, M, De Lipsis, V., Mazzucato, M., Ryan-Collins, J. & Agnolucci, P., (2018). 'The macroeconomic impact of different types of fiscal policy'. UCL Institute for Innovation and Public Purpose policy report for Innovate UK (forthcoming).

By setting the direction for a solution, missions do not specify how to achieve success. Rather, they stimulate the development of a range of different solutions to achieve the objective. As such, a mission can make a significant and concrete contribution to meeting a societal challenge.

We set out 5 criteria for the development of missions[14] – missions should:

- Be **bold**, inspirational with wide societal relevance
- Set a clear direction: **targeted**, measurable and time-bound
- Be **ambitious but not unrealistic**
- Be **cross-disciplinary**, cross-sectoral and cross-actor innovation
- Involve multiple, **bottom-up** solutions

Below we give examples of how the MOIIS commission envisage the implementation of the mission-oriented framework to the government's Grand Challenges.

Figure 1 - From Challenges to Missions from European Commission report[14]

A **full policy report** on this topic titled *Mission-Oriented Innovation Policy: Challenges and Opportunities* is available here: https://www.ucl.ac.uk/bartlett/public-purpose/publications/2018/jan/mission-oriented-innovation-policy-challenges-and-opportunities

4. From Challenges to Missions

The MOIIS commission welcome the announcement by Theresa May of 4 missions[15] - one within each Industrial Strategy Grand Challenge - and have interacted directly with policy teams in BEIS to help develop these missions into viable project plans. Our role has been to restructure missions to make sure they are more inter-sectoral, and also to help thinking on new missions. The government's 4 missions are:

- **AI and the Future of Data**: Use data, Artificial Intelligence and innovation to transform the prevention, early diagnosis and treatment of chronic diseases by 2030
- **Ageing Society**: Ensure that people can enjoy at least 5 extra healthy, independent years of life by 2035, while narrowing the gap between the experience of the richest and poorest
- **Clean Growth**: At least halve the energy use of new buildings by 2030
- **Future of Mobility**: Put the UK at the forefront of the design and manufacturing of zero emission vehicles, with all new cars and vans effectively zero emission by 2040

The MOIIS commission have been analysing each of the missions and have concluded that each area has significant potential for UK economic growth. In each of the missions there is potential for a large global market of which the UK could capture a significant segment. All the missions therefore offer strong long-term potential for job creation and sustainable economic growth in directions that will also benefit wider society.

4.a. Framing of missions

Missions must be framed using the 5 principles described above, and whilst most of the government's 4 missions satisfy these conditions, in the view of the MOIIS commission there are some lessons to be learnt ahead of the development of future missions.

Unlike Challenges which are purposefully broad in nature, missions should be more concrete, and either be quantifiably true or binary in nature. Looking at the current government missions, the Future of Mobility mission does not achieve this criterion and should be more specific about the exact meaning of being at "the forefront". This also applies to the framing for the "narrowing the gap between … the richest and poorest" in the Ageing Society mission.

The MOIIS commission also expressed concern that the ambition of some of the missions was lacking, and they were not bold enough to inspire societal engagement with the policies. For example, in the Clean Growth missions around building efficiency, why is the mission restricted to just new buildings and not the retrofit of existing buildings? Why is the mission restricted to only energy efficiency and not the resource efficiency which includes water and waste in a holistic approach?

4.b. Projects & Policy Deployment

The MOIIS commission have used the mission-oriented framework described above to envision bottom-up projects to foster innovation towards each of the missions announced by the government. Later in 2018 we will be publishing the outcomes of this work as brief policy papers, and we have been consulting with BEIS policy teams on this issue.

Taking as an example the 'Clean Growth' mission to improve building efficiency, the MOIIS commission produced the mission "map" below that sets out how the mission can be broken down into different bottom-up projects that cut across a variety of relevant sectors.

Be bold, inspirational with wide societal relevance: Tackling climate change is a huge societal challenge with a myriad of causes and contributing factors, yet it is also an issue that citizens recognise as a huge challenge for the future.

Set a clear direction: targeted, measurable and time-bound: The target is timebound with a significant measurable target of energy and resource efficiency reduction.

Be ambitious but not unrealistic: Climate change is a huge challenge but by breaking it down in to a smaller mission - dealing with building efficiency – provides a manageable way forward. The projects suggested are commensurate in difficulty to the mission, and necessary. They also have significant overlap with the existing UK research base and other government interventions such as the Construction Sector Deal.

Be cross-disciplinary, cross-sectoral and cross-actor innovation: The projects proposed cover a broad range of issues bringing together sectors as diverse as housing associations, data analytics, construction and finance.

Involve multiple, bottom-up solutions: Whilst all these projects are feasible there is no guarantee that all of them will succeed, but by allowing multiple bottom-up innovations to occur the possibility of achieving such a bold mission is realistic.

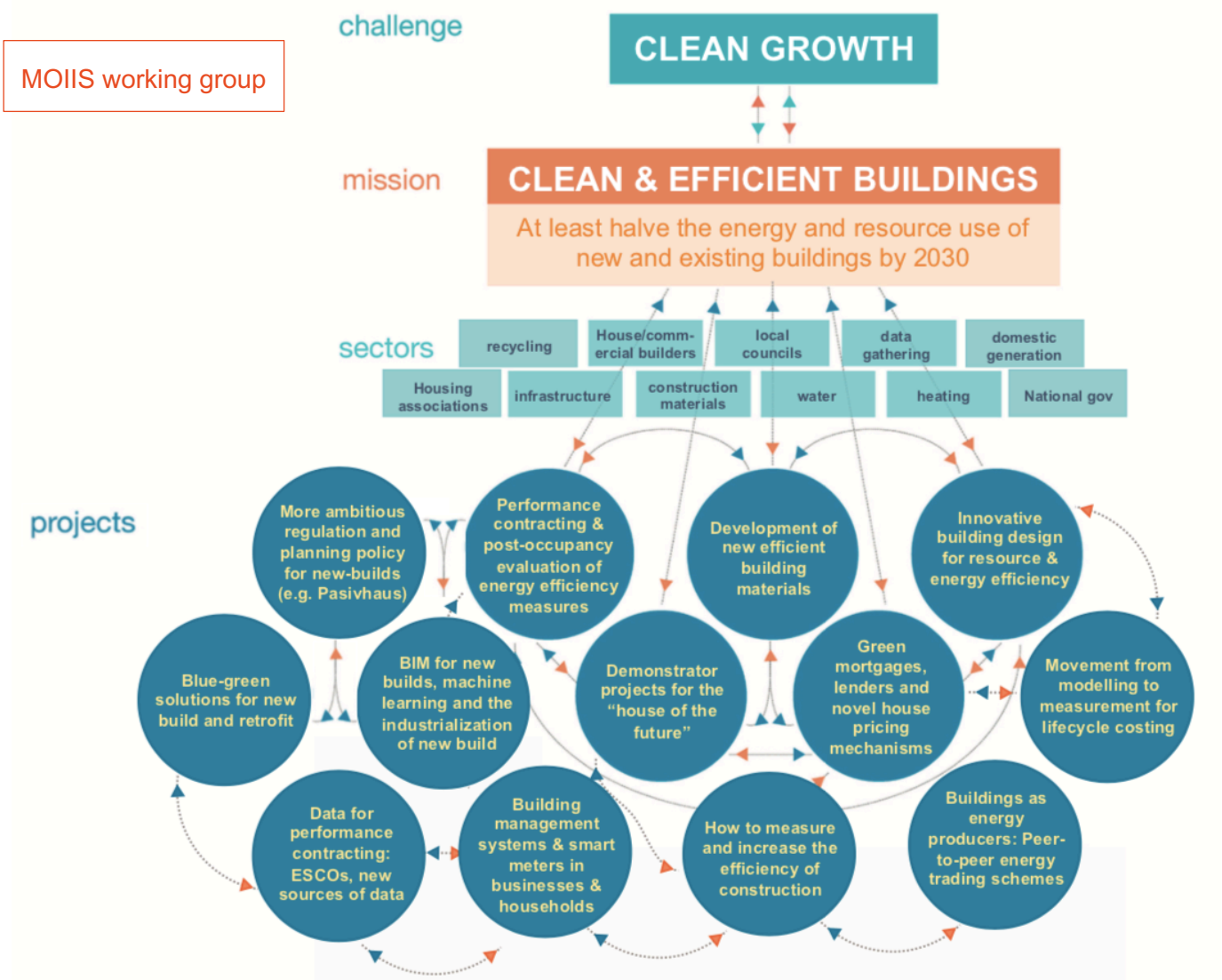

Figure 2 - Developing projects for a Clean Growth mission produced by the working group of the MOIIS commission.

5. How to Implement Missions

The MOIIS commission have explored the many issues involved in how to actually implement a mission-oriented framework for innovation across government, including how to develop missions and how to enhance public sector capabilities. The MOIIS commission is planning to report these findings in full in March 2019. However, ahead of this final publication we develop some of these issues that are most relevant to HM Treasury here.

5.a. Dynamic Policy Evaluation

To enable a shift towards challenge-led policy that uses industrial and innovation policy to tackle the 'grand challenges', a fundamental reappraisal of the role of the public sector is required that goes beyond the traditional 'market failure' framework derived from neoclassical welfare economics to a 'market co-creating' and 'market-shaping' role. This new role would enable shifting focus from marginal improvements in allocative efficiency driven by notions of 'value for money' to a broader notion of public value creation driven by public purpose. Such a change in policy focus requires a different kind of analytical framework for policy appraisal and evaluation that is able to capture the dynamic aspects of market shaping or 'mission-oriented' policy (see Table 1 below). Such a framework needs to be able to capture spill-over effects and structural changes to the economy that result from policy interventions.[3]

Table 1: Market-fixing vs Market-shaping analytical frameworks

	Market fixing	**Market shaping**
Justification for the role of government	Market or coordination failures: • Public goods • Negative externalities • Imperfect competition/information	All markets and institutions are co-created by public, private and third sectors. Role of government is to ensure markets support public purpose, also by involving users in co-creation of policy
Business case appraisal	*Ex-ante* CBA – allocative efficiency assuming static general relationships, prices etc.	Focused on systemic change to achieve mission – dynamic efficiency (including innovation, spillover effects and systemic change)
Underlying assumptions	Possible to estimate reliable future value using discounting. System is characterised by equilibrium behaviour	Future is uncertain because of potential for novelty and structural change; system is characterised by complex behaviour
Evaluation	Focus on whether specific policy solves market failure and whether government failure avoided (Pareto-efficient)	Ongoing and reflexive evaluation of whether system is moving in direction of mission via achievement of intermediate milestones and user engagement. Focus on portfolio of policies and interventions, and their interaction
Approach to risk	Highly risk averse; optimism bias assumed	Failure is accepted and encouraged as a learning device

Influenced by the market failure framework, policy appraisal techniques are currently usually based upon a static form of **ex-ante cost-benefit analysis** (CBA). The Green Book recognises that CBA is not appropriate in all situations. It notes that: 'Social CBA and Social CEA are "marginal analysis" techniques. They are generally most appropriate where the broader environment (e.g. the price of goods and services in the economy) can be assumed to be unchanged by the intervention. These

techniques work less well where there are potential non-marginal effects or changes in underlying relationships.' This limitation is of crucial importance.

To enable market-type price comparison of interventions whose return will vary in terms of time, CBAs typically make use of a 'discount rate' that reflects the time preference of users of the service for having money now rather than in the future. After adjusting for inflation and discounting, costs and benefits can be added together to calculate the net present value (NPV).

The overall framework remains rooted in the idea that creating a 'market price' for interventions will enable the most accurate decision to maximise welfare and public value. CBA and NPV are mostly aimed at preventing costly government failures; by their very nature, they cannot tell us very much at all about proactive market creating and shaping.

Theoretical and practical approaches to policy evaluation should be considerably enriched and diversified in order to create the capacities needed to deliver challenge-driven policies. Governments should embrace new tools and techniques from service design research that focus on user experience and co-creation practices, and from evolutionary economics and related disciplines that focus on shifting and shaping technology and innovation frontiers and managing complex systems in contexts of uncertainty. This report suggests that market-shaping, mission-oriented policies should be evaluated on three levels: enhancing user experience and engagement; expanding technology frontiers; and increasing macroeconomic multiplier effects.

Further research, in particular based on practical policy experience, is needed to flesh out mission-oriented policy evaluation frameworks at both the microeconomic- and macroeconomic levels.

A **full policy report** expanding on this topic titled *The economics of change: Policy and appraisal for missions, market shaping and public purpose* is available here: https://www.ucl.ac.uk/bartlett/public-purpose/publications/2018/jul/economics-change-policy-and-appraisal-missions-market-shaping-and-public

IIPP hosted a workshop with BEIS and Treasury staff to discuss and develop the work published in our working paper[3] on 20th June 2018 and the work to develop this into a formal framework for evaluation continues, including engaging with Green Book officials.

5.b. Aligned Government Approach

From public transport to disease diagnosis, from broadband to the environment, the Department for Business, Energy and Industrial Strategy (BEIS) are overseeing the development of an Industrial Strategy that reaches across other departments. It is essential that all government departments, including HMT, align with this strategy and support the aims of the Industrial Strategy.

We believe this requires an independent advisory body oversee the interdepartmental aspects of the strategy and assess alignment of all policy announcements with the Industrial Strategy. In the government's Industrial Strategy white paper released in November 2017, a commitment was made to form an Industrial Strategy Council; this council could fulfil this role if placed upon a statutory footing. This role may take a similar form to that of the Office for Business Responsibility.

The Industrial Strategy is an opportunity to look at whole-government approaches to increasing innovation, and for this to work the government must actively break down siloes of knowledge and responsibility that exist across Whitehall. We were pleased to see missions including cross-disciplinary approaches such as using artificial intelligence to help diagnose disease, but this ambition must not just lie within BEIS, but also responsible departments such as the Department for Digital, Culture, Media & Sport (DCMS) and the Department for Health.

We would also encourage an approach of viewing the innovation budget as not just a small subset of spending, but how *all* government budget can be leveraged to drive maximum investment, additionality, and innovation. Particular opportunities, such as using current government procurement spend to incentivise innovation and alignment with strategic industrial objectives, can

provide significant results with minimal additional spend. This was discussed at a BEIS/Department of Transport workshop on the Future of Mobility grand challenge at which Prof Mazzucato gave a keynote talk on 4th July 2018. The government's approach to competition policy and regulation and fiscal policy more generally should also be also informed by the industrial strategy.

5.c. Direct vs Indirect Innovation Incentives

We recommend an increase in funding for missions and policy deployment under the remit of the Industrial Strategy. How should this funding should be structured? Systemic innovation policy requires both highly targeted funding calls into the development of specific technologies – directed funding – and general subsidies for innovation across the economy through tax incentives for example – indirect funding.

Direct funding should be the most important form of state investment in R&D as it creates real additionality.[18,21] Companies invest in R&D not because of profit margins, but because of expectations about future growth and market opportunities. Direct funding structured through a truly mission-oriented framework of broad-based interdisciplinary innovation is the optimal way the Industrial Strategy should be deployed.

IIPP and MOIIS recognise the transformational potential of *general purpose technologies* that, in the earliest stages of their development, are not easy to incorporate into a missions framework as their final use is not clear. Good examples of such technologies would be synthetic biology or machine learning.[22] These *general purpose technologies*, like "blue sky" laboratory research, must continue to be supported, as it is these novel technologies that will be applied to solve grand challenges through a mission-oriented framework.

To date, funding directed via Innovate UK into Industrial Strategy Challenge Funds (ISCFs) has been highly directed and focussed upon the implementation of specific technologies in a grand challenge structure. Taking, for example, the Faraday challenge around the development of battery technology for electric-powered automotive vehicles, which is firmly in the territory of applied technology development. Whilst these challenges have undoubtedly led to developments in the field, arguably they have only partially solved the issues around adoption of electric vehicles. For example, there are many related, but less prominent non-technologic barriers to the adoption of such technologies, such as: provision of charging infrastructure and city planning required, the development of a "smart" electricity grid to balance and smooth supply and demand, novel business models for the shared ownership of vehicles, and many more. This is an example of taking a problem focussed lens and not a sectoral lens.

Missions need to be chosen to address clear challenges that stimulate the private sector to invest where it would not have otherwise invested ("additionality" in business terms). Missions will not normally be achieved by following a single development path, or by a single technology. They must be open to being addressed by different types of solutions. A mission-based approach is clear on the expected outcome. However, the trajectory to reach the outcome must be based on a bottom-up approach involving multiple potential solutions — of which some will fail or have to be adjusted along the way.[14]

Indirect funding of innovation often takes the structure of tax incentives across the entire private sector aimed to stimulate investment in R&D, such as the R&D tax credit. Whilst it makes sense that there is a link between the decision to engage in commercial R&D and its cost, qualitative studies of the effectiveness off the R&D tax credit provide little evidence that it played a part in the decision to engage in R&D, rather than simply providing a welcome cash transfer to firms that have done so.[23]

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[21] Jacobs, M. & Mazzucato, M., (2016). Rethinking Capitalism. Wiley.
[22] Willetts, D., (2013). Eight Great Technologies, publishes by Policy Exchange.
[23] HMRC, (2010) An Evaluation of Research and Development Tax Credits, obtained here: https://www.gov.uk/government/publications/tax-credits-evaluation-of-research-and-development

That said, there is a role for well devised indirect funding to increase marginal spend in R&D and to develop the networks of innovation that enable knowledge to be transferred between organisations and individuals.

Recently, the Netherlands has introduced a tax credit based on specific numbers of employees engaged in R&D activities, rather than the income from research which can be vaguely defined. This has been found to be more effective at creating additionality that conventional tax credits do not.[24]

In 2010 George Osbourne introduced a 'Patent Box' policy that reduces the rate of corporation tax on all income derived from patents to 10%. This implies that investment and innovation can be incentivised via taxation, when in fact businesses invest when they determine an opportunity for future growth and earnings potential. The patent box policy has many flaws, but the foremost among them is that the policy benefits large companies who can afford patents and incentivises patent wars and patenting of new technologies simply for the sake of patenting them. This stifles – rather than fostering – innovation.[18] It also serves to reduce government tax revenue that could be instead diverted to other direct R&D support within the Industrial Strategy.[13]

6. Health Funding in the Industrial Strategy

IIPP recognise the huge pressures upon the National Health Service (NHS) and the entirely logical call to increase front-line spending. We also see that many of the causes of these same pressures relate to structural and systemic issues in our society, be that an ageing population or increasing costs of treating chronic illness. Within the government's Industrial Strategy two of the Grand Challenge missions relate to pressures upon the NHS and we believe that a mission-oriented approach to innovation in these spaces could in the long-term remedy these issues.

A recent report from the Small Business Research initiative in Healthcare (SBRI-H) demonstrated that as of July 2017, SBRI-H has funded 176 projects and awarded contracts to the value of £73M. Of these, 8 projects have been successful and account for 85% of current SBRI-H sales to the NHS. This investment has led to estimated cost savings to the NHS and government of up to £30.1M already, with further savings of up to £19.1M every year. Furthermore, it has led to the creation of jobs worth an estimated £14.4M and "crowded in" another £122M of private investment.[25] This demonstrates the potential for an investment in R&D to result in cost savings for the state and significant economic growth.

Within the AI grand challenge, the current mission is to "Use data, Artificial Intelligence and innovation to transform the prevention, early diagnosis and treatment of chronic diseases by 2030". There is a strong correlation between how early a disease can be diagnosed and the likelihood of survival and the reduced cost to the NHS and the taxpayer. Recent research between University College London and Google DeepMind has demonstrated incredible developments in early diagnosis of eye disease using low cost testing and a machine-learning algorithm.

Within the 'Ageing Society' grand challenge the current mission is to "Ensure that people can enjoy at least 5 extra healthy, independent years of life by 2035". Dealing with the increased costs required to support an ageing population is often cited as one of the main causes of increased demand upon the NHS and clearly increasing the years that an elderly person can live independently and healthily reduces this burden on the NHS and on the taxpayer.

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[24] Mohnen, Pierre & Lokshin, Boris, 2009. "What does it take for an R&D tax incentive policy to be effective?,"MERIT Working Papers 014, United Nations University - Maastricht Economic and Social Research Institute on Innovation and Technology (MERIT). https://ideas.repec.org/p/unm/unumer/2009014.html

[25] "A review of the benefits of the Small Business Research Initiative in Healthcare" 2018, available from: https://sbrihealthcare.co.uk/wp-content/uploads/2018/09/81492-Review-of-the-Benefits-of-SBRI-Healthcare_Brochures_SPREADS_v1.pdf

We are currently preparing to launch a new ground-breaking report on R&D in the medical and pharmaceutical sector titled "*The People's Prescription: reimagining health innovation to deliver public value"* which will be available from 15th October here: https://www.ucl.ac.uk/bartlett/public-purpose/publications

7. Conclusion

To conclude, the UCL Institute for Innovation and Public Purpose, with its MOIIS Commission, share the government's vision for a strong economy that delivers prosperity for all through inclusive and sustainable growth, through a comprehensive Industrial Strategy.

We believe that through adopting a mission-oriented approach to innovation, and market-shaping rather than market-fixing policies, the public sector can create an environment in which R&D can develop solutions to the UKs grand challenges. A mission-oriented approach can engage citizens and government around an innovation-driven economy. By putting innovation at the centre of our thinking of economic growth and aligning the industrial strategy to the more systemic ways in which government interacts in co-shaping markets, the multiplier effect will be larger.

In this document we have set out some recommendations of how to adopt and implement a mission-oriented framework across government. This work continues at IIPP and we would welcome the opportunity to have an ongoing dialogue with HMT on this ground-breaking approach to policymaking.