*mKETs-PL working document*

# Country report United Kingdom

| | |
|---|---|
| Date: | 30th May 2013 (amended 10th July 2013) |
| Authors: | Finbarr Livesey, Eoin O'Sullivan |
| Number of pages: | 18 |
| Number of Annexes: | 0 |

The project partners of the mKETs-PL consortium are:

- Netherlands organisation for Applied Scientific Research TNO
- Fraunhofer-Gesellschaft
- Commissariat à l'énergie atomique et aux énergies alternatives (CEA)
- Cambridge University-Cambridge University Techical Services (CUTS)
- VTT
- Tecnalia
- Technology Partners Foundation
- Joanneum Research Austria
- D'Appolonia S.p.A
- Strauss & Partners
- Spark
- Noblestreet

# Content

# 1. Policy perspective

This section provides a brief overview of the UK policy context and content towards key enabling technologies (KETs) and multi-KETs (mKETs) situated in the frame of recent innovation and industrial strategy statements from the current government. The first section provides broad context, the second discusses mKETs specifically, and the final section provides an overview of the main policies in place in support of pilot lines.

## *1.1. UK policy context*

The policy context for the UK is dominated by recovery from the financial crisis of 2008, with a significant focus on 'rebalancing' the economy from services towards manufacturing. Because of this manufacturing has figured prominently in a number of key policy documents and initiatives. For example, the Growth Review process[1] instigated in 2011, which is intended to provide a framework for a return to economic growth for the UK, took advanced manufacturing as its first topic and area for consultation (BIS 2011). This builds on the slow re-emergence of manufacturing as an area for policy interest from 2002 onwards following what was then claimed to be the first governmental strategy for manufacturing in the UK (DTI 2002).

The approach currently favoured is the use of industrial strategies which are sectorally focused. They operate at a relatively high level focusing on "… access to finance, partnerships with sectors; support for emerging technologies; creating a pipeline of skilled workers; and finally, government procurement and the development of supply chains" (Cable 2012). Based on an analysis of their potential contribution to future growth and employment (BIS 2012) the following sectors were chosen

- Advanced manufacturing, including aerospace, automotive and life sciences.
- Knowledge intensive traded services, including professional and business services, the information economy and traded aspects of higher and further education.
- Enabling sectors, such as energy and construction.

The strategies for life sciences, aerospace and the oil and gas industry have been developed and released, and other strategies are expected over the coming year. There are very few discussions or even mentions of production technology within the strategies, as the approach is both sectoral and top-down in many ways. However, the recent aerospace strategy does have a clearer focus on the manufacturability of new aeroplanes and the elements of the strategy that are relevant to pilot production are discussed below.

Outside of official government documents and policy, there is ongoing concern in the UK that there is a lack of access to large scale test and what is referred to as experimental production facilities, specifically for SMEs. This was highlighted the recent report from the House of Commons Science and Technology Select Committee report on commercialisation of research, which was titled *Bridging the Valley of Death* (HOC 2013). The report includes the following recommendation:

"*We share the concerns of our witnesses that the UK small business sector lacks access to large scale test and experimental production facilities. We recommend the Government to find a way to ensure that those facilities that do exist can be more readily accessed by business, that gaps in requirements are identified and a fund established to subsidise those facilities that cannot afford to remain at the leading edge in a purely commercial environment.*"

Overall, this points to a policy environment where manufacturing and its related activities now receive a significant amount of attention at a senior level in government, but the detailed issues surrounding pilot or experimental production have not been adequately addressed. This may be due to the distance that the UK has

[1] See http://www.hm-treasury.gov.uk/ukecon_growth_index.htm for full details.

had to travel, coming from a position through the 1980s and the 1990s where manufacturing was in some senses ignored and considered low value. The macro narrative has changed, but the policy detail is still sometimes lacking. Some of these issues may be addressed by an ongoing Foresight project on the future of manufacturing which is due to report in the autumn of 2013.[2]

It is difficult to describe any of the UK policy landscape as being specifically targeted at either KETs or pilot production as much of UK policy has been developed on a sectoral basis. As an example on this lack of focus, in ENIAC only one bid came from the UK which was seen as very low. However, there are a number of programmes that touch on these issues and will have ongoing relevance for companies and organisations attempting to develop mKET pilot production. These include SMART awards and Innovation Platforms, which are discussed in more detail below.[3]

## Main stakeholders in the UK

There are many stakeholders that have an interest in the development of technologies that are included in the key enabling technologies list and in using these in production. The following section gives a brief overview of the main stakeholders in the public and the private sector, although it is not intended to be exhaustive.

- *Department for Business, Innovation and Skills (BIS)*
  The central government department with the greatest interest and the remit to cover new technologies and new industries is the Department for Business, Innovation and Skills (BIS). Its overall focus is on achieving economic growth, which means that it has a very broad set of policies to manage. The department has approximately 2,500 core staff, supported by 49 agencies and public bodies, and through the department and its supporting agencies spent just over £18 billion in the financial year 2012 – 2013.

- *Technology Strategy Board (TSB)*
  The Technology Strategy Board (TSB) was established in 2004 as an advisory board to assist with the government's technology strategy. In 2007 it was restructured as a non-departmental public body (NDPB) to act at arm's length from government, while receiving its funding from central government. Its current aim is to accelerate economic growth by supporting business-led innovation, focusing on the journey between concept and commercialisation. It refers to itself as the UK's innovation agency and this year will have a record budget of £440 million to invest (Groom 2013).

  Over the past five years its remit has expanded significantly, with many programmes being added to its activities. These include the following programmes which are directly relevant to the development of KETs and pilot production.

  - *Catapult centres*
    The Catapults (which were originally referred to as Technology and Innovation Centres) were proposed as part of the Hauser Review (DIUS 2010). Taken together, the Catapults represent an investment of approximately £1 billion over the next three to five years.

  - *Knowledge Transfer Networks (KTNs)*
    The transfer of knowledge between the different actors in the innovation space is seen as very important and so the TSB hosts 15 knowledge transfer networks (KTNs) which are national level networks in a specific technology or application field. Each network has a central website to act as a

[2] Current details for the project are available online at http://www.bis.gov.uk/foresight/our-work/projects/current-projects/future-of-manufacturing.
[3] A full review of the innovation policy landscape is available from ERA Watch at http://erawatch.jrc.ec.europa.eu/erawatch/export/sites/default/galleries/generic_files/file_0248.pdf.

hub for sharing of information and each is very open, as individuals or organisations with an interest in the area can join. Currently across the 15 networks there are 70,000 active members.

- *Research councils*
  The Engineering and Physical Sciences Research Council (EPSRC) through its manufacturing programme has a key role to play in the provision of new technologies and processes that are at an early stage of development (up to TRL and MRL 3 or 4). Funding from the EPSRC has been given to establish the Advanced Manufacturing Research Centres (AMRCs) and the Centres for Innovative Manufacturing (CIMs).

- *Trade associations*
  A number of trade associations exist across the manufacturing sectors (for example the Society of Motor Manufacturers and Traders (SMMT)). However, organisations such as the Engineering Employers Federation (EEF) and the Confederation of British Industry (CBI) are strongly engaged in policy and have taken positions on the role of government in developing and supporting advanced manufacturing.

- *Research and Technology Organisations (RTOs)*
  There are a number of intermediate organisations who are broadly in the category of research and technology organisations. A leading example is TWI (originally The Welding Institute) which is based near Cambridge UK. TWI has 700 staff and a turnover of £60 million, focused on developing solutions to problems in manufacturing, with a number of national and international firsts in manufacturing technology.[4]

  Within this group specific attention should be paid to a group of technology consultancy companies who provide development services across the manufacturing sector. These include Cambridge Consultants Ltd, The Automation Partnership and PA Consulting, companies which have developed both new products from concept to batch manufacturing, as well as developing and improving manufacturing processes for existing products. Companies such as these operate across the valley of death as described by the KET High Level Group and represent an existing approach to supporting companies in this space.

  The representative body for RTOs in the UK is AIRTO (Association of Independent Research and Technology Organisations) which has over 40 members, including many of the centres and organisations who make up the High Value Manufacturing Catapult as discussed below. According the a 2008 report from Oxford Economics, the intermediate research and technology sector employed over 22,000 people and carried out over £400 million of research in 2006 (Oxford Economics 2008).

The institutional structure of innovation policy in the UK is broadly captured by the latest ERAWatch report for the UK (Cunningham et al 2013) as shown in Figure 1. One element that this overview does not capture is the role of think tanks and third sector bodies in the innovation and industrial policy discussion. For example, the National Endowment for Science, Technology and the Arts (NESTA) has been very influential in driving new perspectives on innovation into government and in providing a venue for new discussions on such policies to be held.[5]

[4] TWI's innovation timeline has details of their developments in detail online at http://www.twi.co.uk/innovation-timeline/.
[5] See http://www.nesta.org.uk/ for further details of NESTA's work.

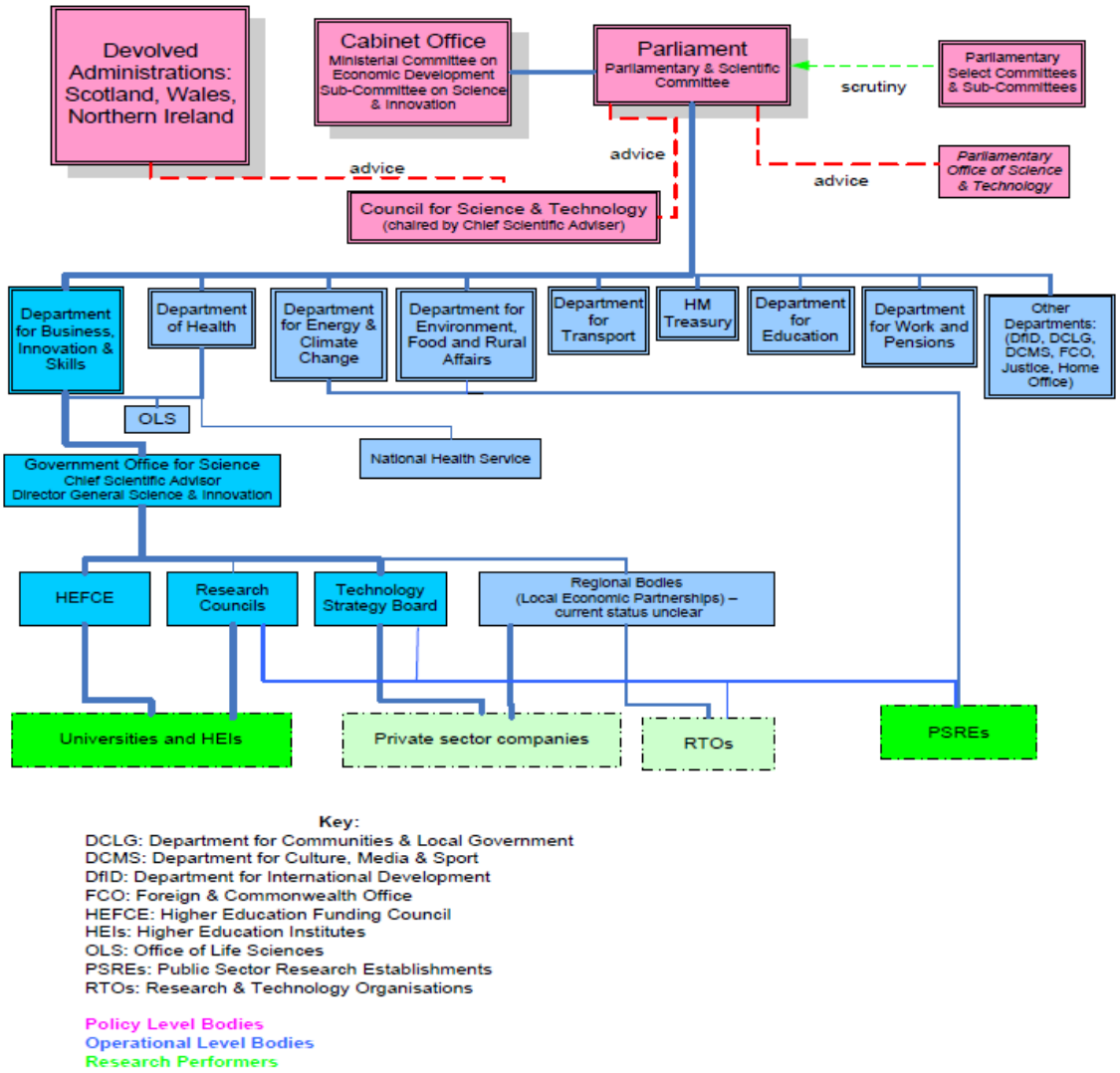


Figure 1 – the UK research and innovation system (reproduced from Cunningham et al 2013)

## 1.2. Organisation of mKETs policy in the UK

As discussed above, much of the UK's policy approach has either been through setting enabling conditions (i.e. working through horizontal policies such as R&D tax credits) rather than targeting specific technologies or even technology related areas. However, that appears to be shifting due to a series of reports developed b the Government Office for Science in their Foresight work and more recently though the promotion of what are referred to as the 'Eight Great Technologies'.

In 2010 the Foresight Group published a report looking at future technologies that could lead to sustained economic growth based on interviews and workshops with over 180 individuals from industry and academia from the UK and internationally (GO Science 2010). The report identifies 53 technologies, for example nanomaterials, smart grids, and biometrics, which were then grouped into 28 clusters, including ambient intelligence in the built environment and the cheap genome. The clusters were further grouped into seven cross-cutting areas, three of which were identified as being transformative as they had the potential to cut

across a very large number of sectors. The seven cross-cutting areas, with the three designated as transformative first, were -

- Manufacturing on demand
- Smart infrastructure
- The second internet revolution
- The energy transition
- New materials' contribution to a low carbon future
- Regenerative medicine
- Intellectual property

The report was updated and refreshed in 2012 to assess the initial list and to see if there were any changes that should be made. The report, based on interviews with 15 academics and 26 industry representatives, claims that the initial list is essentially sound but with some emphasis changed (GO Science 2012). The new themes identified are balance in the energy generation mix, service robotics, and the movement of additive manufacturing from mainly a research activity to being included in industrial strategies.

This stream of work appears to have culminated in a speech given by George Osborne at the Royal Society in November of 2012 in which he identified what have been referred to as the 'Eight Great Technologies' (Osborne 2012) -

- the Big Data Revolution and energy efficient computing
- Synthetic Biology
- Regenerative Medicine
- Agri-Science
- Energy Storage
- Advanced Materials
- Robotics and Autonomous Systems
- Satellites and commercial applications of Space.

This was followed by a speech and pamphlet launch at Policy Exchange given by David Willetts, Minister for Universities and Science, in which he provided further detail and updated the list (Willetts 2013). Little changed between the lists other than the order, which may indicate a prioritisation of some kind emerging within government, as synthetic biology and regenerative medicine moved down three slots. However, the Willetts announcement outlined £600 million investment in these areas, based on the Autumn Statement.

Overall it is interesting to see how 'technology' is used in a variety of ways and at a variety of levels across UK government policy, as this confuses the discussion slightly. Also a comparison between the EU's key enabling technologies and this list of eight technologies has some key overlaps but also some strong differences.

As noted above, there are a number of policies which while not specifically targeted at KETs or mKETs they can be used by companies and researchers working on these technologies. These include –

- **SMART awards** (previous entitled Grant for R&D)

  This funding is available to SMEs in order to help them develop new technologies, with three variants of award (proof of market, proof of concept, development of prototype). Interestingly it is available to companies individually, there is no condition of having a partnership or consortium. The proof of concept award can be used to investigate the technical feasibility of a new technology, product or process, with a maximum award of £100K covering 60% of project costs. The development of prototype award is to develop a new technology, product or process and can include building

demonstrators or carrying out clinical trials, with a maximum award of £250K and between 35% and 45% of project costs covered.

- **Innovation Platforms**

  The Technology Strategy Board (TSB) has five innovation platforms (low carbon vehicles, assisted living, low impact buildings, sustainable agriculture and food, and stratified medicine) which bring together government, business and academia around a societal challenge. Specifically, innovation platforms are intended to increase the coordination between the various actors involved in a technology or challenge area in order to align activities and lead to a step change in innovation outcomes.

Overall, while the UK policy landscape has many elements of strategy and support that address a number of the KETs, there is no clear and unified KET policy that spans either TRLs or MRLs, which may be a significant gap for the UK.

## *1.3. Main policies for Pilot lines in the UK*

As discussed above, the core policy which addresses the issue of pilot production as part of its remit is the Catapult programme. The Catapults (which were originally referred to as Technology and Innovation Centres) were proposed as part of the Hauser Review (DIUS 2010). Taken together, the Catapults represent an investment of approximately £1 billion over the next three to five years. There are seven Catapults either launched or in development –

- High value manufacturing - Driving manufacturing innovation to commercial reality.
- Cell therapy - Growing a UK cell therapy industry that delivers health and wealth.
- Offshore renewable energy - Applying innovative solutions for economic growth in offshore wind, wave and tidal generation.
- Satellite applications - Applying satellite solutions for economic growth.
- Connected digital economy - Accelerating growth through the Digital Economy.
- Future cities - Creating integrated systems delivering products and services that meet the future needs of the world's cities.
- Transport systems - Driving economic growth though the efficient and cost-effective movement of people and goods.

The **High Value Manufacturing Catapult** came into existence in October 2011, the first of the new Catapults to be formed following the Hauser Review. It is a partnership between seven organisations to provide capability across all forms of manufacturing to accelerate the commercialisation and development of new manufacturing technologies. The partners are -

- **Advanced Forming Research Centre**
  Collaboration between University of Strathclyde, the Scottish government and companies including Rolls Royce, Boeing and Barnes Aerospace which provides industrial scale forming machines based in a university environment.
- **Advanced Manufacturing Research Centre**
  Collaboration between the University of Sheffield and Boeing which focuses on advanced machining and materials research for aerospace and other high-value manufacturing sectors, employing 180 researchers and engineers.
- **Centre for Process Innovation**
  CPI works across a number of sectors (including pharmaceuticals, biotechnology and printable electronics) to develop, prove, prototype and scale up the next generation of products and processes.

It employs over 200 people and has worked with over 2,000 companies to date. It is the home to the UK's national centers for industrial biotechnology and printable electronics.

- **Manufacturing Technology Centre**
  The MTC is based on an original investment of £40 million for its buildings and production scale manufacturing equipment. The founder members are the universities of Birmingham, Loughborough and Nottingham, and TWI Limited, and its industrial members include Rolls Royce, Hewlett Packard and Gudel. The centre is intended to provide a high quality environment for the development and demonstration of new technologies on an industrial scale.
- **National Composites Centre**
  The National Composites Centre is based at the University of Bristol and was founded in 2009 with £25 million initial funding from national and European sources. Its focus is to assist companies to exploit composites through provision of a broad set of manufacturing capabilities. Key industrial members include Airbus, GKN, Rolls Royce, and Vestas.
- **Nuclear Advanced Manufacturing Research Centre**
  The Nuclear Advanced Manufacturing Research Centre is led by the universities of Sheffield and Manchester, with industrial partners including Rolls Royce, Areva, Westinghouse and Tata Steel. Its South Yorkshire facility has an open-plan 5,000 sq m workshop and acts as a 'research factory' for innovative processes in machining, welding and other areas of manufacturing.
- **Warwick Manufacturing Group**
  The Warwick Manufacturing Group was formed in 1980 and so has a long history prior to the formation of the Catapult. As part of the Catapult WMG is focusing on low carbon mobility, specifically looking at lightweight products, energy storage, and digital validation and verification. The group employs 450 people and has a number of industrial partners including Jaguar Landrover, Johnson Matthey, and Tata Steel.

According to recent reports the HVM Catapult has had interactions with over 1000 companies in its first year (The Manufacturer 2013).

The **Cell Therapy Catapult** was formed in 2012 and located at Guy's Hospital London. Its core focus is to help the industry grow by assisting companies to de-risk new cell therapy products by taking them into clinical trial and giving future investors' confidence in the products. As part of that process there is a focus on production, through providing small and large scale process development spaces and a Good Manufacturing Process (GMP) proving laboratory.

Beyond the Catapult programme there is no direct policy that addresses pilot production specifically. However, within the new industrial strategy for aerospace released in March 2013 there are a number of elements which may address pilot production issues. These include the founding of the Aerospace Technology Institute (ATI), which will have approximately £140 million in public funding each year over a seven year period, and the Manufacturing Accelerator Programme (MAP) which aims to spread best practice through the aerospace supply chain on the development of new production facilities and capabilities. How this will manifest itself in the future is unclear, but it is likely that the programme will be strongly aligned with the Catapults.

# 2. Business perspective

This section provides a summary of the opinions and perspectives that were discussed through our interviews with companies in the UK. Companies expressed the view that their issues transcended national boundaries, in that they did not particularly think of themselves in national terms, i.e. they are based in Europe and whether it was in the UK or elsewhere was due to historical factors. There is also a question on how to separate the needs of larger companies who are acting as primary drivers for new production processes, versus smaller companies who may be providing single pieces of equipment or a single element in a larger system. This is discussed further below in the comments on risk sharing.

Throughout all of the interviews the terminology of 'pilot production' was confused, as each sector and each individual had their own interpretation of what pilot meant in their context. This has made the interviews very difficult in this context as without agreement on the base terminology, combined with a lack of familiarity in many cases with the key enabling technologies as set out by the Commission, much of the start of these interviews involved understanding which terminology to use.

## *2.1. Implementation of multi-KETs pilot lines*

The UK companies included in the interviews for this report have, either in the past or currently, been involved in pilot or experimental production of some kind. However, each company has a different definition of what pilot production means for their context and none of the companies described their efforts as being focused on multiple technologies (mKETs). This framing of the development of new production technology is one which was not natural for the interviews and led in some cases to confusion and across the interviews made the process initially very difficult.

In developing pilot production there are clear distinctions made between developing a new process step, and the tools to carry out that individual production step, compared to developing a complete chain or sequence of production steps (i.e. linking together a number of production processes some of which may be well established, some of which may be novel). Beyond this distinction, companies also noted that while the production process can change, the materials used in a product may also change and this can be as difficult to manage, for example when an established production process attempts to work with a novel material.

The companies referred to individual element testing as the alpha phase, while the linking of a number of elements is the beta phase. This distinction allows larger companies to shift risk onto suppliers or smaller companies, who are asked to develop the individual elements away from the large company's production environment and then the large company can bring in tested production elements which it then links together. This also is a strategy for the maintenance of intellectual property and trade secret protection as many of the larger companies see the linking together of novel production steps as a core competence and one that allows them to protect their production knowledge.

Not surprisingly there are significant differences between sectors, as some sectors have a different interpretation of when pilot production exists in terms of TRLs. For example, industrial biotechnology companies see pilot production as spanning from TRL 4 forward to TRL 7, while the automotive sector has pilot production closer to TRLs 7 and 8 as it is seen as being very close to volume production. This is one reason why an intersection of TRL and MRL is required to bound a discussion on pilot production, given the number of different elements and how each can either be established or novel.

Sectoral differences extend beyond simply the stage of development as different industries have a stronger or weaker level of production synchronisation. The clearest example of this is in industrial biotechnology where processes are occurring in separated vessels with little direct linkage when compared to a continuous line such as in the automotive sector.

In terms of the implementation of pilot production the issue of skills was raised many times, as companies believe that there is a need for high levels of training for production workers to be able to work in complex pilot production environments. As production technologies continue to evolve, those working in pilot production will have to have very high levels of skills to manage the processes and adapt the processes as needed to ensure the success of the pilot production process. It is unclear whether current skills programmes are well suited to these kinds of needs for UK companies.

The final issue that was raised was one of cost and the structure of ownership. Reflecting the split between alpha and beta phases outlined above, many companies will want to have control of the beta phase and so shared facilities which will essentially be in the public domain will be unattractive. At the same time the cost of accessing and using public or shared public-private facilities may be prohibitive – one company indicated that for them existing public infrastructure was significantly more expensive to use than finding a small supplier willing to carry out bespoke development. This calls into question models of ownership and use specifically of the Catapults for the UK and how access will be priced and moderated both for SMEs and for larger companies. If shared facilities remain more costly they are likely to remain unused and not be able to achieve their funding profiles. At the same time, if companies can already access development capacity in smaller companies it raises the question as to whether there is a market failure at all in this space.

## Examples of existing pilot production

- The Centre for Process Innovation (CPI)[6] has recently completed the installation of a pilot production photolithography line to produce large area flexible organic thin transistor (OTFT) backplanes. This line has the ability to handle 8 inch, 12 inch and GEN 2 scale with 4 micron minimum feature size. The facility is run on an open basis, and CPI claims that this is a unique open facility in Europe.
- The SPECIFIC IKC[7] has opened in late 2012 a pilot line for the production of functional coated steel and glass for use in the building and renewable energy sectors. The IKC comprises a number of universities in partnership with multi-nationals such as Tata Steel, BASF, and NSG Pilkington.
- The recently funded Cambridge Graphene Centre (CGC)[8] is reported to be developing a pilot production facility as part of its expansion in 2013, with a target of employing 50 to 60 staff by the end of 2013. The initial funding of £1.2 million for the CGC has come from the Engineering and Physical Sciences Research Council (EPSRC) with a reported £12 million from industry to follow from partners including BAE Systems, Dyson, Du Pont, Nokia, and Plastic Logic.

It is interesting to note that aside from pilot production which is held within companies and not in public view, many of the pilot production facilities are hosted within university settings and are operated in an open fashion to both attract funding and partners.

[6] http://www.uk-cpi.com/
[7] http://www.specific.eu.com/
[8] http://www.graphene.cam.ac.uk/

## *2.2. Evaluation of KET policies/KET innovation eco-System*

The UK policy context was not seen as highly positive or negative at present for the industry representatives in our interviews. The companies have had varying levels of engagement with specific programmes but overall there was a sense that UK companies' expectations of government policy were relatively low, potentially as a hangover from many years of government being regarded as an impediment (reflected in the many calls for the removal of 'red tape').

While the shift towards manufacturing in policy, both in terms of attention and in terms of investment, has been positive much of the discussion was couched in terms of wait and see. Since many of the investments (such as the new Catapults) are so recent it is not clear yet whether the interventions are useful for companies of varying size and sector.

There was a sense that the issues around KETs will be very different for SMEs, although their true needs are not clear in this space. Especially for smaller companies any sense of policy was low, due to the simple fact of overstretch as managers and developers in smaller companies have to cover so many activities and do not have the time or the bandwidth to engage with policy generally. This may add to the continuing problem of engagement with smaller companies, both to understand their needs and to help them to access any planned support.

In discussing how new technologies come to market a number of complimentary issues were raised which were seen as important to include at the same time as providing investment for pilot production facilities. These included standard, test and validation capability and changes or extensions to regulation for a given sector. It was unclear at present how these issues are included in current policies and there was a concern that they may not be adequately covered in any new policies either at the UK or at the EU level.

Finally, the point raised above on whether there is a clear market failure, whether there is a need for government to intervene, was less clear in these interviews than stated for example in the high level expert group on key enabling technologies (European Commission 2011). While investment and support may be welcomed it is not immediately apparent that companies across sectors have a major issue in accessing and developing pilot production at present, as large companies are already running pilot plants and there is no visible demand from start-ups/smaller companies for support around KETs and new production technologies.

# 3. Conclusions

## 3.1. Summary of policy perspective

In reviewing the policy base for the UK it was striking that there is no clear and explicit programme or intervention that focuses on pilot or experimental production. The policies that are in place either are applicable to a very wide set of companies and circumstances and therefore encompass the pilot production phase (for example an innovation platform or SMART award) or they are working at the appropriate MRL level (between 4 and 6) but they do not have a clear focus on the scale up and development of the production process beyond a broad sense that this is needed in general (for example the Catapults).

At the same time research funding and other public support tends to reach up to TRL 6 in varying degrees, but only to MRL 4, which is why there may be a funding problem for companies and this may need to be addressed under the combined framework that is emerging from this project.

Catapults are the most connected element of the policy landscape for KETs, although it is unclear how much pilot production will be carried out within the Catapult spaces and how they will be accessed by companies from small companies up to large multinationals. Currently the primary KET which the UK is focused on will be industrial biotechnology as the other are KETs are seen as more niche for the current industrial base. This does not mean that there will not be continued investment or support for the other KETs and it should also be emphasised that the KET focus is likely to change over time for policy as the need for support is seen to either grow or to wane.

The policy landscape has gone through a significant shift post the financial crisis of 2008 and a new narrative on the importance of manufacturing has emerged, with rebalancing of the economy towards manufacturing being a key goal. At the same time a number of different lists of technologies and sectors have been drawn up as key for the UK, the most recent and potentially the most influential being the Eight Great Technologies put forward by George Osborne at the end of 2012. It remains to be seen how these statements will connect to the Horizon 2020 process and whether the UK will attempt to connect its efforts in this area to the emerging programme on KETs.

## 3.2. Summary of business perspective

The perspective of companies on KETs, mKETs and pilot production is both confused and complicated. There is no clear shared definition of pilot production and each sector has a nuanced understanding of what pilot production may be depending on the nature of the production, the maturity of the industry and how the industry is structured (between large and small companies). It is unlikely that one definition will be able to span these varying needs and understandings, which may complicate the development of a single programme for pilot production support.

How risk is shared between different actors as new technologies and in particular new production technologies are developed is key, with strong differences between the development of an individual production step and the integration and testing of a number of production processes into a single line. For many of the larger companies, the development of single production processes is pushed out into the supply chain and the integration of the production processes is held in house and seen as a protectable advantage.

Throughout the interviews the issue of skills was raised many times and appears to be a significant concern for UK companies. The issue of developing technicians and production specialists has been ongoing for the UK, but it is seen as a particular concern when considering novel production processes with new technologies. Any programme to develop mKET pilot lines should have a very explicit consideration of how the skills to support such facilities will be developed.

Finally, there is an open question from these interviews as to whether there is a true market failure for pilot production. Most large companies have investments in what they consider to be pilot or experimental production and there is no clear demand from small companies for support for this kind of activity. This may be because of the definitional issues identified earlier, but care should be taken in deciding on the scale and scope of support programmes.

## 3.3. Recommendations to support pilot lines

- In discussions with policymakers TRLs are commonly used but MRLs are less commonly used. Any framework which wishes to use an intersection of the two will need to ensure that policymakers have a common understanding and that discussions of where interventions are appropriate uses both TRLs and MRLs.
- The funding mechanism should be made as simple as possible to ensure industrial buy-in, as any complex formula or highly restrictive intellectual property arrangements will be a disincentive for companies to get involved.
- Coordination of funding streams (for example ERDF, Horizon 2020 and national investments) may be difficult for some countries and they should be supported in ensuring this can happen so that the funds invested can be leveraged as much as possible.
- There is a concern that there will be a lack of linkage between KET and non-KET technologies, that the programme and process will be exclusionary rather than include the various technologies in production and in products. As part of the programme design consideration should be given to mixed technology environments so that there are no unintentional exclusions.
- Pilot line or pilot production is still undefined and confusing for most companies with lots of possible definitional characteristics proposed, including industry lifecycle, supply chain existence, market certainty, technology lifecycle, capital investment requirements, product novelty, change in production volume. A clear definitional framework that can span sectors is required.
- There is a question as to whether pilot production applies only over a certain scale/volume of production, i.e. for low volume products does the concept make sense? The programme should on a sector by sector basis define the scale at which production is regarded as being pilot production.
- There is a question whether pilot line support would address modularised elements (test for example) and if not what complementary programmes exist or would be brought forward to make sure the halo of need is addressed.
- Finally, the programme needs to ensure that there are clear spillovers and it is open for debate at what level of development this can occur (i.e. TRL/MRL mix) and at what physical scale. In order to have broad impact across the EU it is recommended that there are many small investments rather than a small number of very large investments which potentially would tie the technologies and skills developed into a small number of companies and countries.

# 4. References

## *4.1. Literature*

BIS (2011). Growth Review Framework for Advanced Manufacturing, Department for Business, Innovation and Skills.

BIS (2012). Industrial Strategy: UK sector analysis, Department for Business, Innovation and Skills.

Cable, V. (2012). Using Industrial Strategy to help the UK economy and business compete and grow, speech delivered at Imperial College London, 11th September 2012.

Cunningham, P. et al (2013) ERAWATCH Country Reports 2011: United Kingdom, JRC Scientific and Policy Reports.

DTI (2002). The Government's Manufacturing Strategy, Department for Trade and Industry.

European Commission (2011). High Level Expert Group on Key Enabling Technologies: Final Report.

GO Science (2010). Technology and Innovation Futures: UK growth opportunities for the 2020s, Government Office for Science.

Groom, B. (2013). "UK innovation agency to oversee record £440m funding" *Financial Times* 14th May 2013.

HOC (2013). Bridging the Valley of Death: Improving the commercialisation of research, Eighth Report of Session 2012 – 2013, House of Commons Science and Technology Committee.

Osborne, G.(2012). Speech to the Royal Society, Royal Society.

Oxford Economics (2008). Study of the impact of the Intermediate Research and Technology Sector on the UK economy.

Willetts, D. (2013). Eight Great Technologies, speech and pamphlet delivered at Policy Exchange, January 2013.

## *4.2. Interviews*

| Name | Organisation |
|---|---|
| Richard Archer | The Automation Partnership<br>Cell Therapy Catapult |
| Dr Sam Beale | Previously Head of Technology Strategy at Rolls-Royce<br>Visiting Professor, University of Cambridge |
| Belinda Clarke | Lead Technologist for synthetic biology<br>Technology Strategy Board |
| Simon Edmonds | Director, Catapults<br>Technology Strategy Board |
| Keith Hodgkinson | Deputy Director, Innovation<br>Department for Business, Innovation & Skills (BIS) |
| Tony Holden | Chief Engineer<br>IRISYS |
| Prof Paul Shore | Head of the Cranfield University Precision Engineering Institute<br>Director and Principal Investigator of the EPSRC Ultra Precision and Structured Surfaces Integrated Knowledge Centre and the EPSRC Centre for Innovative Manufacture in Ultra Precision |
| Roger Whatmore | Previously Director of the Tyndall Centre (Ireland)<br>Research management and material science consultant<br>Ex-industry (Plessey, GEC Marconi, UK) |
| Lee Voudsen | EU Innovation Policy, International Knowledge and Innovation Unit<br>Department for Business, Innovation & Skills (BIS) |
| Will Barton | Head of Technology<br>Technology Strategy Board |
| Richard Dashwood | Academic Director<br>Warwick Manufacturing Group |

# *Contact information*

## *mKETs-PL consortium*

**Overall project management**
Ruud Baartmans, Maurits Butter
P.O.Box 49
NL-2600 AA Delft
The Netherlands
☎: +31 888668517
✉: ruud.baartmans@tno.nl

**Other partners**
Fraunhofer-Gesellschaft, Axel Thielmann
CEA, Laurant Herault
CU/Cambridge enterprise, Finbarr Liveley
VTT, Torsti Loikkanen
Tecnalia, Mirari Zaldua
TPF, Tomasz Kosmider
JR Austria, Christian Hartmann
D'Appolonia S.p.A, Stefano Carosio
Strauss & Partners, Roland Strauss
Spark, Marc de Vries
Noblestreet, Arnoud Goudsmit