CARBON TRUST

Low Carbon Technology Innovation and Diffusion Centres

Accelerating low carbon growth in a developing world

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Preface

The twin challenges of global climate change and energy insecurity can only be solved with rapid development and diffusion of low carbon technologies, both for energy supply and energy efficiency. Moreover, this rapid development and diffusion is needed globally. This need is recognised in statements by governments, business, and in international agreements and declarations such as those adopted by the G8 and in the Bali Action Plan. The challenge is how this can be achieved.

There are many dimensions to this challenge. Many proposed solutions address either the R&D end of the problem, or focus on issues of technology supply, funding, intellectual property and enabling environments, as with the work of the UN Expert Group on Technology Transfer. But less attention has been given to the overall process of low carbon technology innovation and diffusion, and how the emerging experience of some national efforts in this area might be extended internationally. That is the focus of this study.

The Carbon Trust, established in 2001 to help the UK move to a low carbon economy, has grown to become one of the world's largest such operations, and is unusual in combining programmes for innovation and for deployment of low carbon technologies. The Carbon Trust experience has emphasised the value of combining these activities and indeed the difficulty of drawing a line between them: for example, its technology acceleration programmes foster innovation 'in the field' to reduce the real and perceived risks around new technologies, building commercial capacity, reducing costs and increasing confidence for both users and the private sector.

Earlier this year, the Carbon Trust held discussions with the World Bank concerning different approaches to designing a network of low carbon technology centres, drawing on the Carbon Trust's technology development expertise, and lessons from the Consultative Group on International Agricultural Research (CGIAR) network in developing countries. Based upon the Carbon Trust's experience and drawing on interviews with thirty developing country and sector experts, we set out to explore whether and how the global transition to a low carbon economy could be accelerated by a network of centres designed to stimulate low carbon technology innovation and diffusion, with an emphasis upon their possible contribution in developing countries. This report summarises our recommendations and expands on these in a number of areas, including benefits of support for early-stage R&D and integrated approaches in commercial technology development and diffusion.

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Executive summary

This report sets out the case for establishing a network of Low Carbon Technology Innovation and Diffusion Centres internationally, and focuses upon some of the issues and options in the design and activities of the Centres.

There are a wide range of technologies at various stages of development that could contribute to energy and environmental goals. However, they are not being developed at the rate required due to a combination of technological, skills, financial, commercial and regulatory barriers. In addition, public and private sector funded low carbon R&D is low relative to the scale of the challenge and is concentrated in the G8. Faced with the scale and urgency of the energy-environment crises, one of the greatest challenges for the world is to accelerate the commercialisation and international transfer of better low carbon technologies. Developing countries in particular have the potential to leapfrog existing technologies and move directly onto a low carbon, sustainable economy pathway.

Current proposals for 'Climate Investment Funds' totalling several $/€bn remain modest compared to the scale of the challenge and ongoing mainstream energy sector investments. They are set against a backdrop of recognised inadequacy in low carbon energy R&D expenditure and a long-standing intergovernmental debate about international technology transfer. However, in neither of these areas have efforts to date adequately engaged the private sector, which has the potential to bring far greater resources to bear upon the challenges, combined with different and complementary expertise.

Thus a huge gap remains that requires a different approach from large-scale public funding of demonstration projects on particular 'big-ticket' technologies in the developing world. The need is for publicly funded organisations that can work on the ground in individual countries across a wide range of technologies appropriate to the needs of those countries, and engage national as well as multinational companies to overcome the local barriers to the development and deployment of these technologies.

A network of these Low Carbon Technology Innovation and Diffusion Centres located in selected developing countries could enhance local and regional engagement with global technological developments, and catalyse domestic capacity to develop, adapt and diffuse beneficial innovations. Experience indicates that effective innovation needs to encompass the 'software' of commercial, institutional and financial structures, as well as the 'hardware' of the technology itself, and both need to learn from experience in the field. The Centres would nurture these capabilities through targeted interventions including field trials, business incubation, capacity building and seed capital (see Table 1 for full list of potential activities). These Centres would reduce technology costs through innovation and help to leverage private resources and thus bridge the clean energy financing gap that currently exists.

To achieve this, the Centres would need to be set up as Public-Private Partnerships that could work collaboratively with local academic organisations, businesses and governments to ensure the most cost-effective projects are supported, catalysing the large commercial investment required to achieve a transition to a low carbon economy. These national Centres would be independent, but could be supported by an umbrella organisation which ensures lessons are shared between Centres and with other countries with similar characteristics.

Based on the Carbon Trust's experience over the past seven years, we estimate that each Centre would require an investment of $40m to $100m per year. At an overall level this would require a total investment of $1bn to $2.5bn over five years to establish five national Centres, as a first phase of activity. Given the long lead times involved in energy research, development and deployment projects, a five year funding budget is the minimum necessary to establish the network and achieve measurable progress. Future funding for additional Centres and subsequent time periods should be considered in light of the success of the first phase.

Such public sector support could leverage 5-10 times as much as private sector investment. It could enable up to 50 projects per year to be supported in each Centre, many of which could lead to self-sustaining low carbon technologies and businesses, given appropriate

policy environments, with considerable carbon and economic benefits. Locating the first set of such Centres in archetypical developing countries, to develop capacities appropriate to fundamentally different kinds of operating environments, could accelerate the wider international impact. Establishing such a programme thus holds the potential to make a major contribution to the combined goals of low carbon technology, energy security and development.

Table 1: *Types of interventions required to address specific local barriers to technology innovation and diffusion*

Activity	Gap/need addressed	Benefits
Applied research and development Grant funding, open and/or directed at prioritised technologies	Inadequate support for relevant applied research for technologies where private funding is minimal due to classic innovation barriers[1]	New ideas from local scientific knowledge base applied and developed to point of potential commercial relevance
Technology accelerators Designing and funding projects to evaluate technology performance e.g., field trials	Uncertainty and scepticism about in-situ costs and performance, and lack of end user awareness	Reduction in technology risks and/or costs by independent collection and dissemination of performance data and lessons learnt
Business incubator services Strategic and business development advice to start-ups	Lack of seed funding and business skills within research / technology start-ups – the 'cultural gap' between research and private sectors	Investment and partnering opportunities created by building a robust business case, strengthening management capacity and engaging the market
Enterprise creation Creation of new low carbon businesses by bringing together key skills and resources	Market structures, inertia and lack of carbon value impede development of low carbon start-ups or new corporate products and services	Creation of new high growth businesses to both meet and stimulate market demand Development of local commercial and technical capabilities
Early stage funding for low carbon ventures Co-investments, loans or risk guarantees to help viable businesses attract private sector funding	Lack of financing (typically first or second round) for early stage, low carbon businesses due to classic innovation barriers combined with perceived low carbon market / policy risks[1]	Enhanced access to capital for emerging businesses that demonstrate commercial potential Increased private sector investment in the sector through demonstrating potential investor returns
Deployment of existing energy efficiency technologies Advice and resources (e.g. interest-free loans) to support organisations to reduce emissions	Lack of awareness, information and market structures limit uptake of cost-competitive energy efficiency or low carbon technologies	Improved use of energy resources through enabling organisations to implement energy efficient measures and save costs Catalyse further investment from organisations receiving support
Skills / capacity building Designing and running training programmes	Lack of capacity to install, maintain, finance and further develop emerging low carbon technologies	Growth in business capacity and employee capabilities to enable more rapid uptake of existing and new low carbon technologies
National policy and market insights Analysis and recommendations to inform national policy and businesses	Lack of independent, objective analysis that can draw directly on practical experience to inform the local government and the market	Enhancing the policy and market landscape to support the development of the low carbon economy

[1]Governments have long recognised the case for public support of research and development, because new ideas often create public benefits which are not possible (or desirable) for private companies to capture exclusively. In addition, analysts have identified numerous other barriers to adequate levels of innovation, including the long time horizons and the lack of fit between 'disruptive' technologies and existing institutions and infrastructure. For a recent survey of research on this topic see T. Foxon et al. (eds), 'Innovation for a low carbon economy', Edward Elgar, 2008

1. Introduction

Reducing dependence on fossil fuels and avoiding man-made climate change, by moving to a low-carbon global economy, is a goal shared by many countries.

Achieving the goal of moving to a low carbon global economy whilst supporting economic development requires urgent action to accelerate and significantly increase the level of investment in the development and deployment of both energy efficient and low-carbon supply technologies.

This of course is a huge challenge with many dimensions. Scientists and engineers tend to focus on research and development. The fossil fuel industry emphasises the need for a major demonstration programme for carbon capture and storage technologies. Developing countries emphasise the need for technology transfer, financial support and the removal of perceived barriers around intellectual property. And policy analysts tend to argue the central importance of getting the policy environment right, in terms of stable regulatory frameworks and carbon pricing to incentivise private investment.

These perspectives all form part of the story, but are incomplete. The chain from technology idea to wide adoption is long, slow, risky and complex. Technologies that are already widely used in some countries can still be regarded as novel and challenging in others. Technology studies have consistently emphasised that innovation and deployment are often closely entwined, as experience and economies of scale feed back into production processes and new ideas are merged to improve existing technologies. Studies also emphasise that institutions can play a crucial role in all these processes.

Recent developments, particularly around the various proposals for publicly backed Climate Investment Funds, have established willingness in principle by industrialised country governments to spend billions on the challenge of low carbon technology development and deployment.

Though the need for low carbon innovation and diffusion is widely accepted, less clear is any common view of how in practice public expenditure can most effectively be used to accelerate the processes of low carbon technology innovation, and its international diffusion.

Over the last decade or so, experience has accumulated with various publicly-funded institutions established to accelerate low carbon innovation and/or diffusion in industrialised countries. A recent report from the UNEP Sustainable Energy Finance Initiative[2] reviews four major such developments, in the UK, Ireland, the Netherlands and Finland; and there are several others, including various funds established in US states. There is much to learn from all of these. The UNEP SEFI report notes Carbon Trust as a particularly interesting example because of its scale and the way it combines activities of technology development with commercialisation and diffusion activities.

The Carbon Trust is the UK's principal institution that combines these activities in a concerted effort to work with business and the public sector to accelerate the UK's transition to a low carbon economy. It was established as an independent company in 2001 by the UK Government to accelerate the move to a low carbon economy by working with organisations to reduce carbon emissions and develop commercial low carbon technologies.

Drawing on our practical experience and the experience of other similar models, this report first summarises the rationale for such interventions, then sets out the case for considering a network of Low Carbon Technology Innovation and Diffusion Centres internationally, and then focuses upon some of the issues and options in the design and activities for such Centres. We suggest a methodology for selecting projects and key activities that the Centres could seek to undertake. We also highlight key factors required for such a network to be successful in the long run.

[2]The UNEP-SEFI Public Finance Alliance, January 2008.

2. Rationale for public intervention

Many of the sectors most relevant to carbon emissions – like energy utilities and buildings – are characterised by very low rates of technological innovation and diffusion. Understanding the reasons is key to effective public involvement that can overcome the numerous barriers to development and deployment of low carbon technologies.

Tackling climate change will require a wide diversity of technology responses across many activities and sectors. Some of the highest-profile technologies intrinsically require very large-scale funding on discrete projects. However, it is a myth that the only technologies that matter are the big, centralised technologies like carbon capture and storage or nuclear power.

On the contrary, global sustainable energy scenarios by the IPCC and the International Energy Agency find the biggest potential lies in more energy efficient technologies across a huge range of products and processes. There is also an enormous diversity of supply technologies, at many different scales of development, as well as technologies for improved conversion, distribution and control in power grids and heat supplies. A common feature, moreover, is that most of these technologies reduce greenhouse gas emissions and also improve energy security and/or local environments by reducing dependence on fossil fuels.

The world is vastly under-investing in innovation in low carbon technologies. R&D intensity (expenditure per unit turnover) in the energy sector – and in some of the key end-use sectors like buildings – is between a tenth and a hundredth of that in sectors like information technology or pharmaceuticals. This is also associated with the very slow diffusion of better technologies – even when, as with many energy-efficient technologies, they appear to be highly cost-effective. Incentives for low carbon innovation are further weakened by real and perceived uncertainties about whether governments will effectively regulate emissions in ways that gives value to low carbon solutions.

Experience and independent assessments have demonstrated repeatedly that energy markets on their own will not deliver the scale or pace of either innovation or take-up required. Indeed, academic studies use the term “technology valley of death” to describe the gap between the results of publicly funded research and the lack of deployment of new technologies.

Most of the world’s energy systems are based on technologies that are many decades old. This is for several reasons. We do not here reiterate the wide-ranging analyses of barriers to low carbon innovation and the adoption of leading-edge technologies; these obstacles are comprehensively covered in academic literature and government assessments – reviews of this topic include the IPCCs Fourth Assessment Report[3].

From a commercial perspective, a key difference is between sectors dominated by consumer-oriented, product-based competition, compared to competition purely on price. A company that develops a new mobile phone or home entertainment system can potentially extract an enormous profit as long as its product is more appealing to consumers; the same is true for pharmaceutical companies that develop a new drug. An innovation for a different way of producing electricity, however, is not selling a different product with mass market appeal; it can only extract a marginal economic benefit if it can produce more cheaply than existing technologies. The benefits of the innovation to purchasers are, similarly, quite modest. Not surprisingly, energy companies, and users, prefer to stick with the known and familiar in markets where there is no product-driven competition.

[3]Intergovernmental Panel on Climate Change, Climate Change 2007: Mitigation, Report of Working Group III of the IPCC, Cambridge University Press (particularly Chapters 2, 11 and 13).

Since the commercial benefits of such innovations are marginal and slow to be realised, the appetite for taking risks is lower, even if there are no explicit barriers to entry. This of course is even more the case when we are seeking innovations in part for public goals, such as reducing CO_2 emissions or reducing energy dependence – goals for which there is no economic value to companies unless strong regulation or consumer preference makes it so. To drive innovation and accelerate take-up, public interventions either need to significantly increase the rewards – which is very expensive and often politically difficult – or greatly reduce the costs and risks of innovation. Low Carbon Technology Innovation and Diffusion Centres focus mostly on the latter, and the experience of the Carbon Trust, amongst others, has demonstrated the difference that appropriate support can make.

A global perspective

The world faces a huge challenge to move towards a low-carbon global economy. We will need to deploy existing energy efficiency and low-carbon technologies, and develop new low-carbon technologies and infrastructure on a hitherto unprecedented scale.

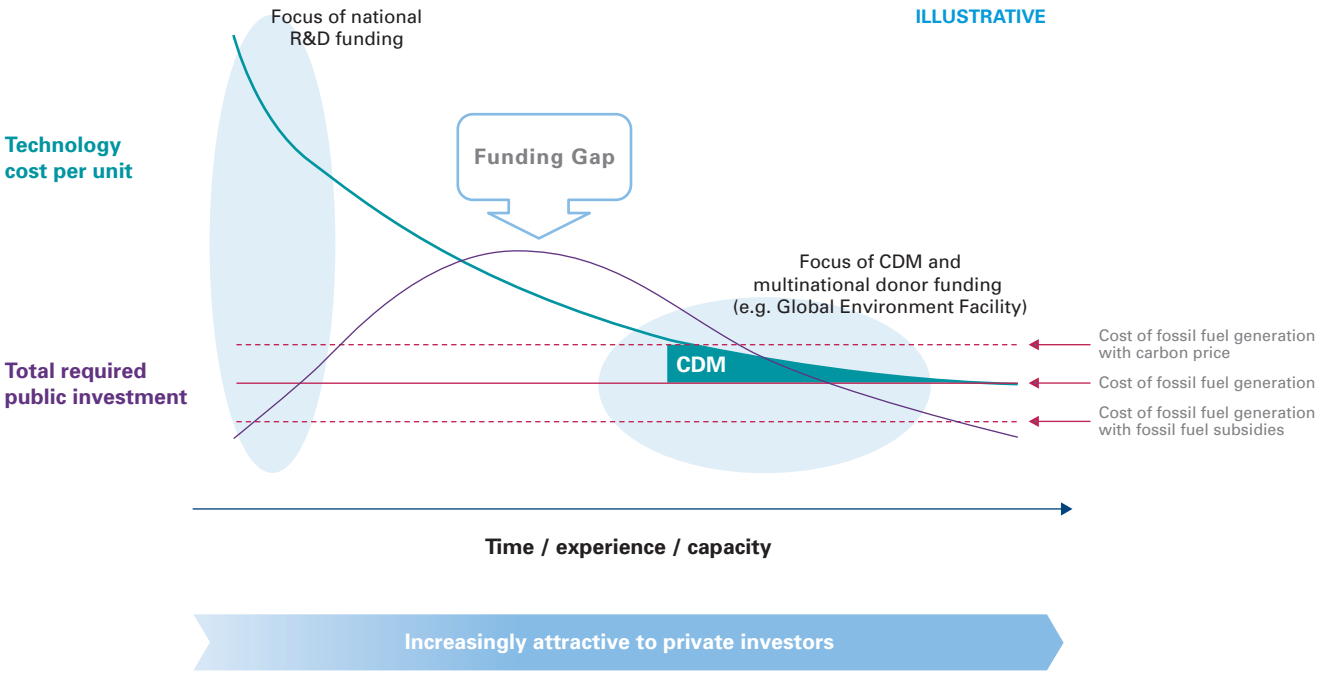
The most effective way to address this challenge is to develop a policy and market framework which stimulates and scales up low-carbon investment.

One element of this endeavour would be a mix of public and private funding that would be used to drive down the cost of emerging low carbon technologies, reduce the commercial risk, and begin to leverage much greater private sector funding to bring forward low carbon technologies.

Whilst every country will have different needs and circumstances, we believe that the value of public support for accelerating both innovation and diffusion of low carbon technologies is a theme common to all countries. Climate change is a common threat, and low carbon scenarios require action everywhere. Consequently, there is an overwhelming case for international financial and technical support for a network of Low Carbon Technology Innovation and Diffusion Centres in developing countries.

The transition to a low-carbon world will not be achieved unless developing countries are helped and encouraged to develop their own low-carbon economies. Low Carbon Technology Innovation and Diffusion Centres would accelerate the development and deployment of low carbon technologies in, and for,

Figure 1: *Role of public funding to accelerate development and deployment of low-carbon technologies*



developing countries; give them the evidence base to design effective domestic technology diffusion policies; help them secure economic value from clean energy technology investment; and give them confidence that they can commit to measurable and verifiable action on carbon emission reduction.

Figure 1 illustrates how current multilateral support for the developing world is concentrated on supporting the later stages of technology development and is small relative to the scale of the challenge. The Clean Development Mechanism (CDM) helps to provide incremental finance for low carbon investments. This is useful, but it does not address specific barriers to diffusion; nor does it reduce the risk of investing in more risky, innovative solutions, at initially higher costs. The vast majority of CDM projects have been in 'low-hanging fruit' projects for reducing industrial emissions of non-CO_2 gases, or well-established technologies like hydro power. Again, this is useful, but clearly insufficient in relation to the far deeper changes required to move towards low carbon economies. The ability of the CDM to support innovation is furthermore undermined by perceived uncertainties about its future and the likely carbon price.

Thus a big challenge is to use public sector funding to drive down the cost of leading-edge technologies so they can be competitive against conventional fossil fuels. Public sector funding needs to reduce the risks of investing in such technologies and demonstrate their commercial viability so that the private sector can invest at scale.

3. Objectives

A network of Low Carbon Technology Innovation and Diffusion Centres in developing countries could help accelerate low carbon development and deployment and greatly reduce the size of the financing gap through innovation and business development at the national level.

Developing countries face a huge challenge to deploy new low carbon technologies and infrastructure. The International Energy Agency estimates that developing countries will need an investment of $165bn per annum over the next thirty years to provide electricity to the 1.6bn people currently without access[4]. The World Bank estimates that an additional $30bn per annum will be required for this to be provided through clean energy development[5]. Currently less than a quarter of the $32bn global investments in renewable energy occurs in the developing world[6].

A network of Low Carbon Technology Innovation and Diffusion Centres could greatly reduce the size of the financing gap through innovation at the national level to address key barriers to low carbon technology development and deployment including:

- High or uncertain costs of new technologies;
- Limited or uncertain suitability of technologies for local conditions;
- Limited business capacity or skill base to identify useful technologies, adapt them for local use, and provide installation and maintenance services;
- Uncertain market demand;
- Limited access to capital due to a conservative banking sector and very thin, and highly sector-specific venture capital and private equity sectors; and
- Unfavourable regulatory and political climate (including competing priorities, vested interests, market distortions and subsidies in favour of fossil fuels).

In many developing countries these barriers are frequently compounded by the lack of a central organisation acting as the focal point bringing together the academic, business and government communities to address the low carbon innovation challenge in a co-ordinated manner. Where focal points do exist, they generally lack the scale and experience needed in order to have a significant impact.

Low Carbon Technology Innovation and Diffusion Centres could help accelerate low carbon development and deployment by enabling multi-lateral donor funds to be cost-effectively deployed at the national level, using public money to reduce the risks facing private sector investment. Targeted interventions can reduce the future cost of deploying low carbon technologies, providing the conditions for increased private sector investment. For every unit of public sector investment, the Centres could leverage in up to ten times this amount in private sector investment either by creating breakthroughs in the cost and market readiness/acceptance of technologies so that they can be adopted at scale without further support, or by defining the additional public policies (local or international) to help stimulate their adoption. The total cost of these Centres should be relatively low when compared with other larger infrastructure projects.

The Centres could address both local and international barriers and help create a favourable national policy and regulatory framework for low carbon, avoiding lock-in to high carbon development pathways. The network could also enable lessons learnt to be codified and promulgated across developing countries to accelerate the process.

Whilst no analogy will be perfect, one example of a similar approach from other fields is the Consultative Group on International Agricultural Research (CGIAR). This network, consisting of fifteen centres, played a valuable role in deployment of agriculture science and technologies in developing countries. The International Energy Agency (IEA)/OECD Report on CGIAR[7] concluded that international collaboration on technology R&D was valuable, and highlighted the potential importance of having a network of national centres with a coordinating structure at the international level. However, the IEA warned that it is important to ensure that the solution be 'tailor made' to the specific local circumstances and characteristics of the energy-environment problem.

We now turn to take a closer consideration of what we believe are the kinds of activities that these Low Carbon Technology Innovation and Diffusion Centres could undertake, depending on local energy needs and institutional and financing constraints.

[4]WBCSD 'Investing in a Low-Carbon Energy Future in the Developing World'; REN21 'Global Status Report 2006 Update' and IEA World Energy Outlook 2007

[5]World Bank 'An Investment Framework for clean energy and development' 2006

[6]NEF/SEFI 'Global Trends in Sustainable Energy Investment 2007'

[7]International Energy Agency/OECD Environment Directorate, International Energy Technology Collaboration and Climate Change Mitigation, Case Study 2

4. Recommended approach

A network of Low Carbon Technology Innovation and Diffusion Centres should be structured to suit local needs. Projects should be selected based on the greatest potential to support the combined goals of local economic development and carbon reduction.

The proposed network could initially consist of five national Low Carbon Technology Innovation and Diffusion Centres in archetypical locations, structured to suit local conditions[8], supported by a secretariat that maintains a global perspective, monitors progress for the Centres and ensures knowledge transfer (see Appendix B for potential components of a governance structure).

A range of activities, shaped by the characteristics of the host country and appropriate to different stages of the technology and market cost curve, could be utilised by the Centres. These could include, but are not limited to the following activities (see Section 5 for more details):

- Applied research and development: providing grant funding, open and/or directed at prioritised technologies, to support relevant applied research;
- Technology accelerators: designing and funding projects to evaluate technology performance e.g., field trials, in order to reduce technology risks and/or costs by independent collection and dissemination of performance data;
- Business incubator services: providing strategic and business development advice to start-ups to increase their capacity to attract private sector finance;
- Enterprise creation: creation of new, high-growth low carbon businesses by bringing together key skills and resources;
- Early stage funding for low carbon ventures: co-investments, loans or risk guarantees to viable low-carbon businesses, helping them attract further funding and demonstrating potential investor returns in the sector;
- Deployment of existing energy efficiency technologies: providing advice and resources (e.g. interest free loans/partial grants) to support organisations to implement energy efficiency and low carbon projects;
- Skills / capacity building: designing and running training programmes to grow business capacity and employee capabilities to enable more rapid uptake of existing and new low carbon technologies; and
- National policy and market insight: independent and objective analysis based on practical experience to inform national policy and businesses and support the development of the low carbon economy.

These activities provide a continuum of support from the early stages of technology demonstration to full market deployment. By combining all these mechanisms in one centre of expertise the Centres can create more value than stand-alone approaches: business intelligence from investors and the market would inform early stage technology support and project selection. Conversely, a deep understanding of early stage technologies can be fed back to the market – enabling early sight of new opportunities and catalysing private sector investment.

Suitably set-up, such Low Carbon Technology Innovation and Diffusion Centres could be well placed to work in ways that traditional government approaches cannot, by drawing in expertise and resources from not only government, but also business, the energy sector and investors. As independent organisations they would be impartial, seeking the most appropriate solutions and would be more resistant to lobbying from vested interests. Their business-oriented approach would ensure that all activities would be focused on increasing the commercial potential of clean energy technologies, leveraging private sector investment alongside public funding.

[8]This may be a single office or network of offices within the country. For example, the Carbon Trust has offices in London, Wales, Scotland and Northern Ireland.

The Centres could provide further benefits by collecting data from technology projects, businesses and the market, analysing the information and feeding key insights back to policy makers and to business. By identifying successes (e.g. niche markets, early adopters, particular technology installations, new business models) and the barriers that remain (e.g. regulatory hurdles, perverse subsidies, technology and market barriers), the Centres can help governments and business to work together to improve the market environment for clean energy.

Project selection

Given the uncertainty in technology development, it would be important for the Centres to adopt a portfolio approach i.e. not to limit their work to potential "winner" technologies, but rather to ensure that their strategy covers the acceleration of multiple technologies. Within this portfolio approach, however, it would still be necessary to prioritise between different potential projects. The knowledge the Low Carbon Technology Innovation and Diffusion Centres gain through exclusive focus on the low carbon sector and through understanding the local resource, economic and regulatory backdrop would enable development of credible national technology prioritisation frameworks.

The following three stage approach could be used to identify projects with the greatest carbon and local economic development potential, which the Low Carbon Technology Innovation and Diffusion Centres would be well placed to address (*Figure 2*).

The first step would be a high level classification of technology areas with a high potential for national efforts to make a difference: *Figure 3* summarises the example of the Carbon Trust's own technology prioritisation where 45 low carbon technologies and 7 enabling technologies were evaluated. Those in the upper right hand box (UK Priority) are a priority for local development and deployment while those in the upper left hand box (Global Priority) are a priority for deployment.

The second step would then focus upon understanding, for each priority technology area, the barriers and current structure of innovation and deployment systems in the country.

The third step, informed by specific project proposals, would then focus upon key opportunities and their alignment with capabilities and resources of the centre. This prioritisation approach, continually updated in light of ongoing projects, would lead to an increasingly cost-effective suite of activities.

Figure 2: *Project prioritisation*

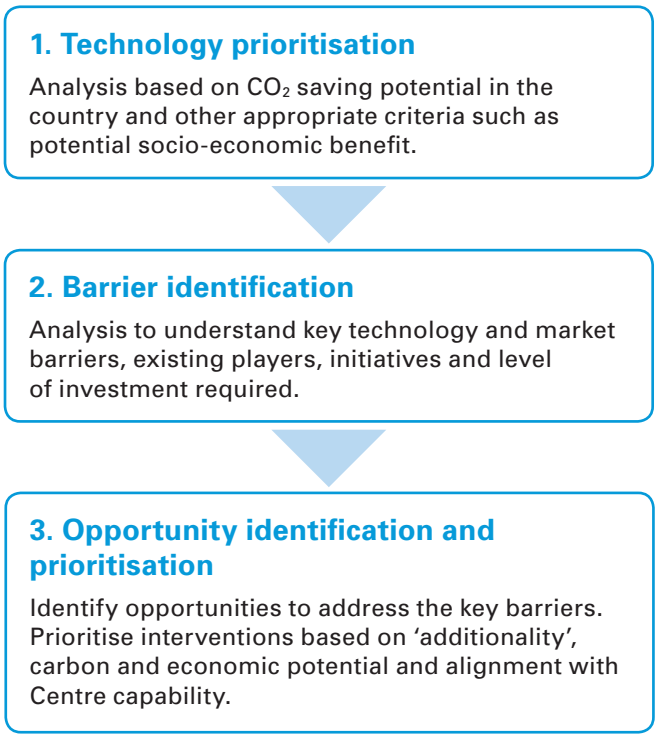
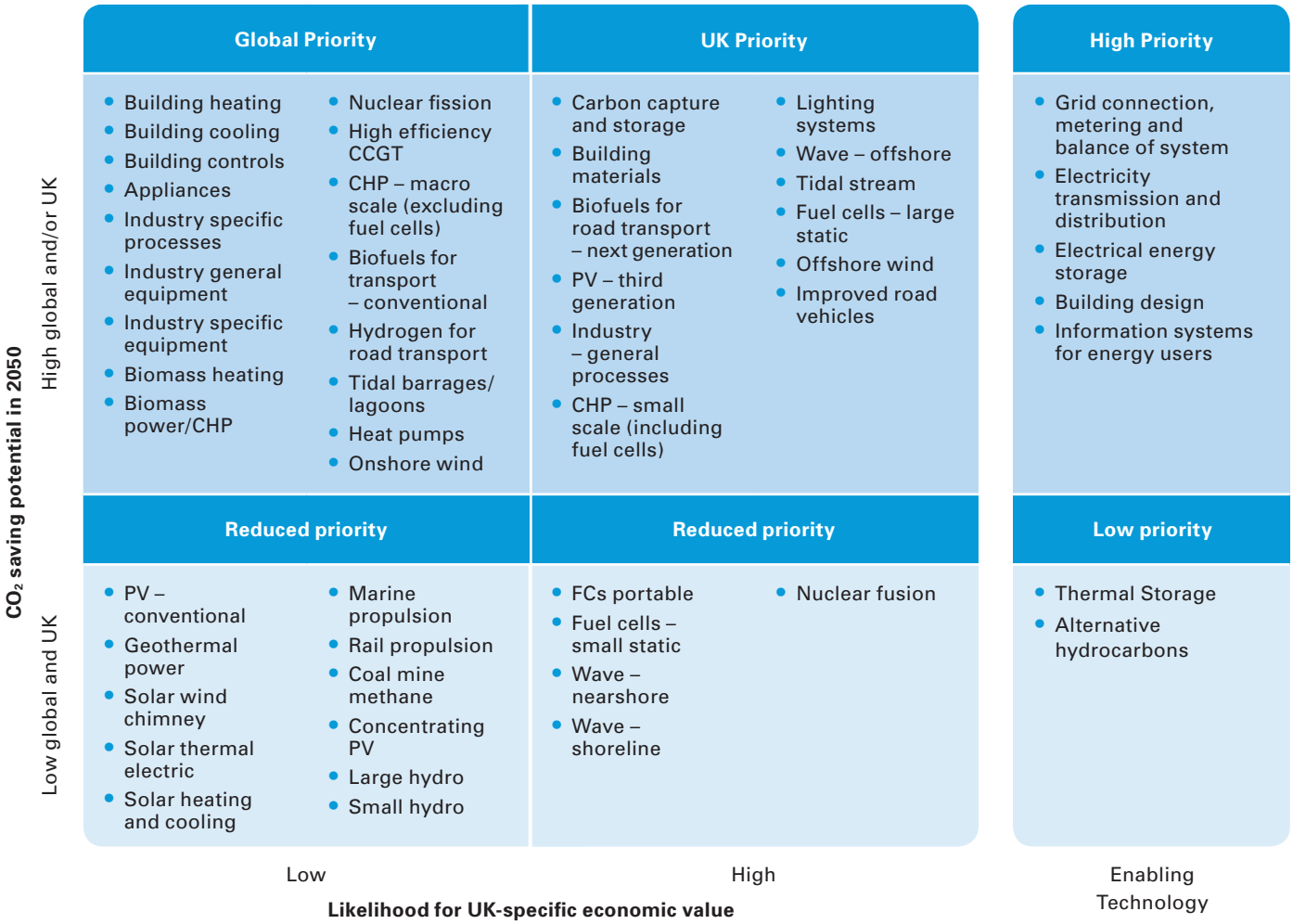


Figure 3: *Example – Carbon Trust's UK technology prioritisation matrix*

ILLUSTRATIVE



Host country selection

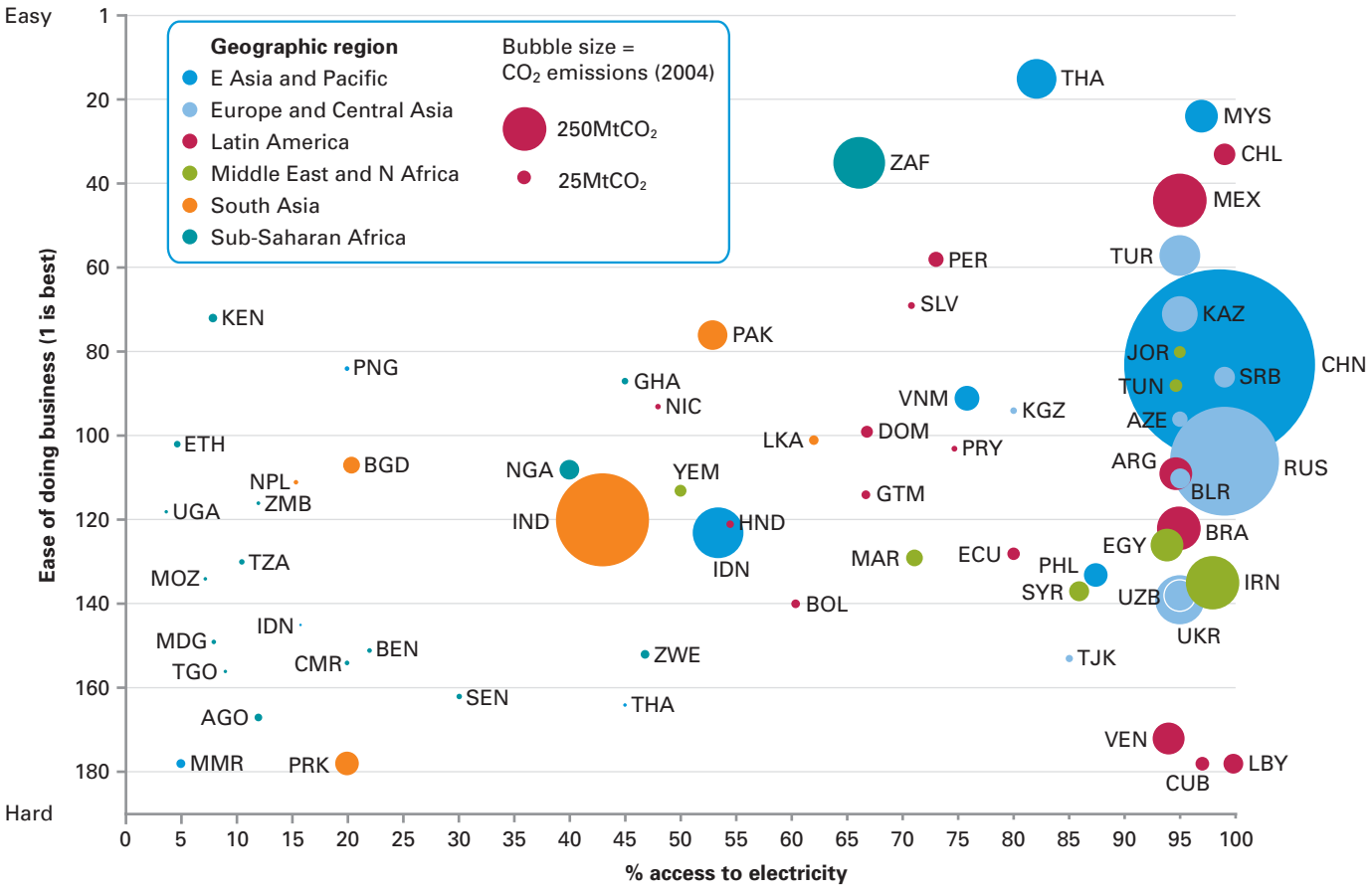
The impact of the Low Carbon Technology Innovation and Diffusion Centres could be maximised by ensuring appropriate host country selection. Host countries should be committed to the low carbon agenda and as far as possible be willing to support the Centres financially. A competitive host country selection process could help ensure this. In addition, it would be essential for the network of Low Carbon Technology Innovation and Diffusion Centres to cover the broad range of technical and environmental challenges. The nature of these challenges would depend on a variety of factors, including:

- Access to energy/electricity;
- Extent of urbanisation/industrialisation;
- Infrastructure development;
- Natural resource base; and
- Ease of doing business.

Figure 4 illustrates some of the differences in key characteristics by country, which would determine their priorities. These characteristics include: 1) access to electricity, 2) ease of doing business and 3) carbon emissions profile. For example, some countries may focus on the decarbonisation of the existing energy infrastructure and catalysing the established industrial and business sectors to take action (e.g. Eastern China) while others may concentrate efforts on ensuring the development of appropriate new clean energy systems to provide access to low carbon energy sources (e.g. sub saharan Africa).

The range of activities proposed for the Centres could address both challenges – and by working collaboratively across the network, the Centres could ensure effective knowledge transfer between developing countries with similar characteristics, local opportunities or barriers, to maximise the impact of the initiative as a whole.

Figure 4: *The nature of the challenge will vary by country: an illustration of two axes of variation for 73 countries*



Sources: World Bank 'Doing business' ranking 2007; IEA CO2 emissions data 2004; Electrification statistics – WRI Earthtrends (from IEA World Energy Outlook: Energy and Poverty 2002) – where this was not available (in around 20% of countries, mainly ex-USSR or Sub-Saharan Africa), an estimate was made based on per capita electricity consumption/% urbanisation/similar country comparison.

5. Activities

Activities should provide a continuum of support from the early stages of technology demonstration to full market deployment. Activities should be tailored to suit local needs, drawing lessons from across the network.

Based on our initial analysis, we know that different countries will gain different environmental and economic benefits from the Centres. For example, some countries will already have well-established R&D programmes and will want to focus on near commercial technology development. Each country will also have a different resource and industry base on which to build, e.g. biomass energy could be a priority area in Brazil. Centres should be designed to include the mix of activities most appropriate to the identified needs of each developing country. See Appendix C for a case study on the activities of the Carbon Trust in the UK. We expect the activities that could be deployed in the Low Carbon Technology Innovation and Diffusion Centres should include some or all of the following:

Applied research and development

- **Need addressed:** Inadequate support for relevant applied research for technologies where private funding is minimal due to classic innovation barriers.
- **Benefits:** New ideas from local scientific knowledge base applied and developed to the point of potential commercial relevance and investment readiness. Creation of new Intellectual Property.
- **The activity:** Provide financial support, usually via non-repayable grants, for research and development projects that offer the potential to take new scientific principles 'out of the lab' and towards low carbon technology products or services. To ensure that only those ideas with a realistic chance of commercialisation are supported, the funding should not cover 100% of project costs, requiring the participants to demonstrate their commitment through a cost contribution (which could be 'in kind' via time and materials). Depending on the strength and particular expertise of the country's research base, the Centre can either make an 'open' call to encourage innovation from any sector, or 'directed' calls that specify areas of local technical strength or market opportunity. This activity may be most appropriate to emerging economies with established research communities (e.g. India, China, South America).
- **Selection of projects:** Where 'directed' calls are judged appropriate, areas of focus could be determined based on national research capabilities, natural resources and a detailed technology prioritisation. Specific projects ('directed' or 'open') should be selected on their merits based on factors such as size of carbon-saving opportunity, degree of innovation, viability of the business case and the strength of the project team.
- **Management and delivery partners:** Project proposals could be reviewed by a panel comprising Centre project managers and technical experts (who may come from the local academic community), and this group would make recommendations to the Centre governance centre, who could authorise the investment. This separation of reviewers and approvers would be important to sustain a focus on the overall strategic objectives of the Centre. The Centre project managers could then be responsible for ensuring that the research project delivered to the expected outcomes required and managing the overall contractual relationships.

Technology accelerators

- **Need addressed:** Uncertainty and scepticism about in-situ costs and performance of new technologies, and lack of end user awareness.
- **Benefits:** Reduction in technology risks and/or costs by independent collection and dissemination of performance data and lessons learnt.
- **The activity:** Designing and funding projects to evaluate technology performance e.g., field trials. Projects typically would involve collection of real operational data in the local environment, engineering support, economic, supply chain and performance data analysis and results dissemination to relevant parties such as government, technology developers, installation companies, service providers and end user companies. The activities undertaken would depend on the barriers being addressed. For example, where there is a lack of evidence of the benefits and performance of a technology in local conditions, a

statistically robust number of trials in representative local sites would be required. If, on the other hand, the key aim is to demonstrate and achieve cost reductions, detailed technical and engineering support may be required. Results could be disseminated via reports, publications and /or articles combined with hosting and/or speaking at relevant workshops, conferences and seminars as well as one-to-one key stakeholder engagement.

- **Selection of projects:** Potential projects could be identified through regular review of low carbon technologies, based on an agreed prioritisation framework, and an initial analysis of barriers to identify opportunities suitable for a field trial project. A scoping study could be used to understand the specific barriers to progress, review national and international activities in the sector and design the appropriate intervention. This could then be verified by a designated committee with the authority to approve the project.
- **Management and delivery partners:** Each project could be run by a Centre project manager, responsible for setting the overall strategic direction, managing the contractual relationships and the relationships with key stakeholders and ensuring delivery against plan. Delivery could be outsourced to one or more technical contractors who could provide the functional, technical and industry-specific expertise to shape and deliver the project. Participants in the project would typically including technology developers, installation companies, service providers and end user companies. Key Performance Indicators should to be agreed at the outset of the project (e.g. demonstrable cost reduction from field trials, level of outreach of insights). Project participants should be expected to contribute financially or via time and materials, leveraging Centre funding.

Potential example: bagasse in Mexico

In Mexico, waste bagasse from the sugar industry could provide a significant renewable resource from which low carbon heat and power to the grid could be generated at low cost. At present, Mexican sugar mills use cogeneration for in-house needs, but none do so very efficiently and all but one import electricity and fuel oil. Field trials in this area could help de-risk the technology via an exemplar that improves the economics of the sugar industry as well as reducing CO_2. The project could leverage technology and skills from countries such as Brazil and India and could help to prove the economic case for biomass power/CHP generation from sugar industry bagasse. The project could involve the sugar producer if there is sufficient interest, or alternatively an independent power producer could set up alongside the mill, taking the waste bagasse and then selling the heat and power to the sugar mill and to the grid. Information regarding cost and carbon savings, in addition to know-how, would then be disseminated widely to the sugar industry, power producers and government to stimulate replication across other sugar mills.

Business incubator services

- **Need addressed:** Lack of seed funding and business skills within research / technology start-ups – the 'cultural gap' between research and private sectors.
- **Benefits:** Investment and partnering opportunities created by helping start-ups build a robust business case, strengthening the management capacity and engaging the market; leading to increased entrepreneurial capacity and success in attracting private sector finance for start-ups.
- **The activity:** This service could provide strategic and business development advice to start-up companies, helping management teams achieve further commercial investment and supporting development of key commercial partnerships. If appropriate, the service could also extend to providing physical office space for the start-ups or other professional services such as accounting, legal and HR support.
- **Selection of projects:** The Centre should set out a list of criteria required to qualify for incubator support (e.g. carbon saving, financial potential, other socio-economic benefits). Companies could then apply to the Centre via the submission of a proposal for support, outlining the extent to which they meet the required criteria. A Centre panel could decide whether to support each proposal, based on the criteria specified. The relevance of incubator activities would vary by country and the success of the activity would depend on the availability of good potential incubatees.
- **Management and delivery partners:** A Centre manager could be responsible for the selection of projects, agreeing high-level project plans, monitoring progress and collecting information and intelligence useful in shaping future incubator activities as well as other Centre activities. The delivery of support itself could be contracted out to one or more incubator companies. Initial research shows that there are active incubator companies in many developing world countries, although their capabilities may not be fully aligned with the types of activities required and the scale of existing support may be insufficient. In these cases, some capacity building activity in the incubator community may be required initially.

Enterprise creation

- **Need addressed:** Market structures, inertia and lack of carbon value impede development of low carbon start-ups or new corporate products and services.
- **Benefits:** Creation of new high growth businesses to facilitate the growth of local markets. Development of local commercial and technical capabilities. Demonstration to the private sector of the opportunities for new businesses in the sector.
- **The activity:** The Centre should identify market opportunities based on its sector knowledge. The Centre could then develop a commercial proposition and bring together the skill set, assets, technologies and financing required to build the new business. For example, in the UK the Carbon Trust saw untapped potential for renewable energy projects on public sector land and formed a company to work with public sector bodies to plan, develop, construct and operate wind and other renewable energy projects.
- **Selection of projects:** The Centre should identify market opportunities for low carbon businesses and assess these opportunities against a set of criteria which could include carbon impact, lack of other companies operating at scale in the area and ability of the Centre to unlock the market. This pipeline of prioritised projects could be further refined by detailed market analysis.
- **Management and delivery partners:** The Centre should establish a management team to deliver on the business plan and partner with other organisations, e.g. technology providers, as required. The Centre could seek co-investment with expected leverage of 10:1 private versus public investment. The Centre may seek these equity partners from the outset or may seek follow-on investment from the private sector once a viable business model has been proven. Any financial returns from dividends or exits could be re-invested into the Centre's activities.

Early stage funding for low carbon ventures

- **Need addressed:** Lack of financing (typically first or second round) for early stage, low carbon businesses due to classic innovation barriers combined with perceived market / policy risks.
- **Benefits:** Growth in the low carbon sector by providing enhanced access to capital for emerging low carbon businesses that demonstrate commercial potential. This activity would further catalyse the low carbon sector by demonstrating potential investor returns leading to increased private sector investment.
- **The activity:** The Centre could use its sector knowledge to identify investment opportunities in early stage companies and attract private sector investments. Depending on perceived risks of a specific deal, co-investments, loans, risk guarantees etc. could be used to improve attractiveness of investment to private sector. Support could be provided for companies developing new technology and for businesses seeking to import and deploy low carbon technologies from overseas, facilitating technology and knowledge transfer.
- **Selection of projects:** Portfolio companies could be selected by a Centre investment team based on their potential to deliver a significant return on investment, subject to meeting set criteria (e.g. potential to lower carbon dioxide emissions, positive local socio-economic benefits, robust business model, etc). A comprehensive set of procedures to cover each step in the assessment of investment proposals and authorisation of expenditure should be put in place. The funding of early stage ventures, although applicable to most developing world countries would, in a similar way to the incubator activities, be restricted by the availability of incoming quality proposals. The types of businesses funded in different countries may also vary (e.g. high-tech projects would be more likely in emerging economies such as China or India, whereas less developed countries may see portfolios more focussed on adaptation of existing technologies and import and distribution of technologies from overseas).
- **Management and delivery partners:** A Centre investments team could manage the Centre's funds, leveraging other private sector co-investors (either local or international).

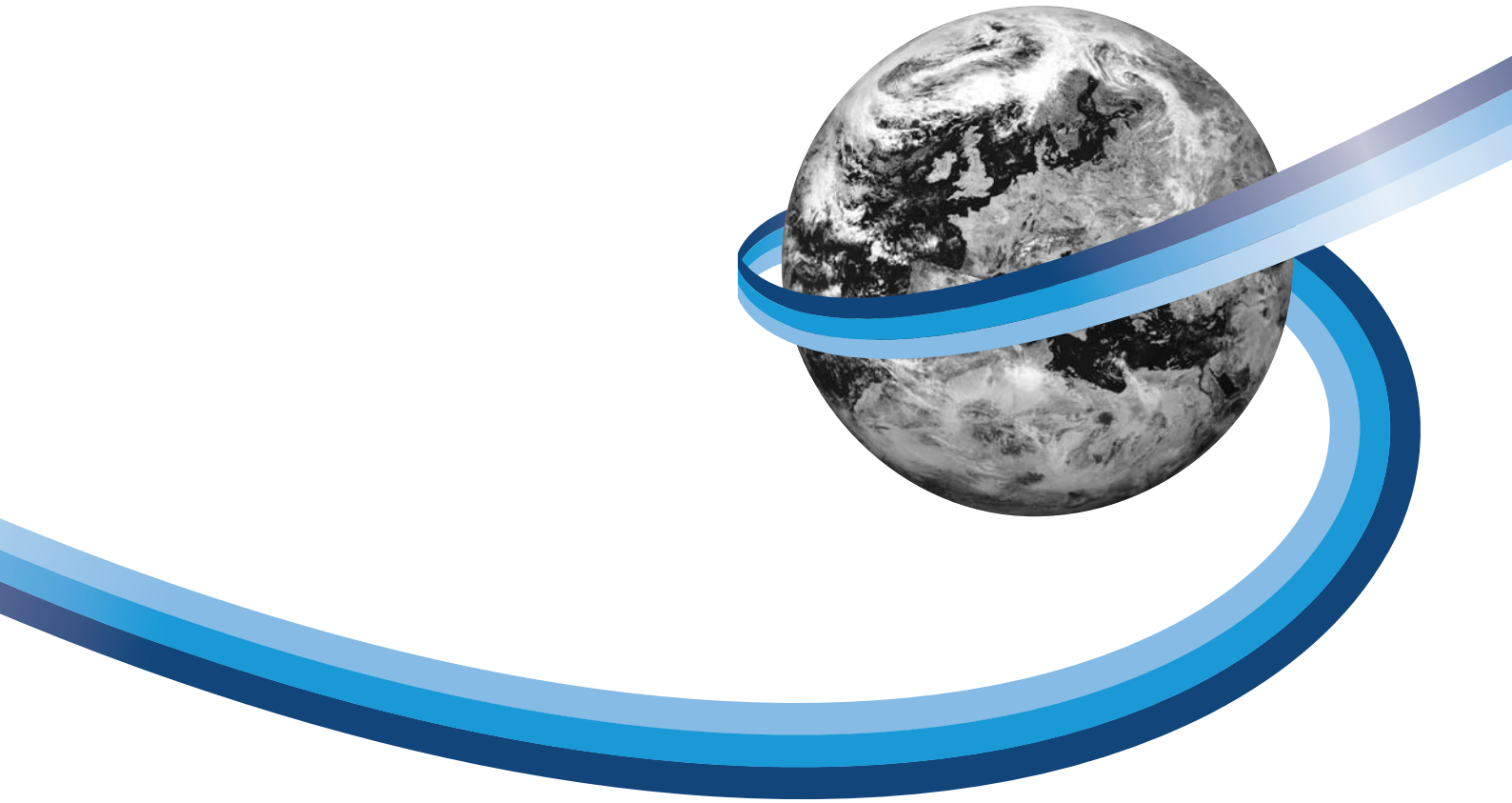
Deployment of existing energy efficiency technologies

- **Need addressed:** Lack of awareness, information, and market structures limit uptake of cost-competitive energy efficiency or low carbon technologies.
- **Benefits:** Improve use of energy resources and enable organisations to implement carbon saving projects. Catalysing investment by organisations receiving support, frequently five or more times the value of the support provided.

- **The activity:** The Centre should provide information on the costs and benefits of low carbon technology (helpline, web, publications etc.). The Centre could offer practical onsite advice to identify and implement projects. The Centre could also offer financial support through interest-free loans or partial grants for capital intensive projects (potentially with a focus on specific sectors – e.g. public sector or small organisations).
- **Selection of projects:** The support would be tailored to the needs of the applicant – scaled according to energy use or carbon footprint.
- **Management and delivery partners:** A team within the Centre could develop the material, service modules and financing program. Delivery of these services could be outsourced to technical consultants if required with an internal sales team managing the relationships with organisations.

Skills / capacity building

- **Need addressed:** Lack of capacity to install, maintain, finance and further develop low carbon technologies.
- **Benefits:** Growth in business capacity and employee capabilities to enable more rapid uptake of existing and new low carbon technologies.
- **The activity:** Designing and running of training and/or other skills building programmes targeted at tackling specific skills shortages in the country. These programmes would depend on the audience, skill type and where the best source of knowledge lies, but would likely include the co-ordination of exchange programmes between local and international companies and co-ordination and funding for apprenticeship programmes as well as running of workshops and other training events.
- **Selection of projects:** Potential projects could be identified through a regular review of low carbon technologies, based on an agreed prioritisation framework, and an initial barriers analysis to identify potential candidate technologies whose development or deployment is limited by skills or capacity shortages. A scoping study could then be required to understand the case for intervention, to identify potential training or delivery partners, recruit participants and design the programme. Projects could be verified by a designated committee with approval authority.



- **Management and delivery partners:** The project could be managed and monitored by a Centre project manager, and delivered using a variety of partners, depending on the type of project. For example, an exchange or apprenticeship programme could require partnering with local and/or international businesses and potentially with education sector partners or organisations running similar programmes. Workshops and training events could require contracting with expert consultants or specialists in the field as well as training experts or delivery bodies. Leverage of private funds could be achieved via sponsorship deals with the business community.

National policy and market insights

- **Need addressed:** Lack of independent, objective analysis that can draw directly on practical experience to inform the local government and the market.
- **Benefits:** Identification of opportunities to enhance the policy, regulatory and market landscape to support the development of the low carbon economy.
- **The activity:** Undertaking objective analysis, often supported by findings from other Centre activities (such as field trials) and by analysis of best practice globally, aimed at informing existing and upcoming national policy to address barriers to clean energy. Key findings and recommendations could be communicated to relevant government and business audiences through reports and publications, supported by dissemination via conferences, seminars and one-to-one meetings with key stakeholders.
- **Selection of projects:** Potential projects would be identified via the regular technology barriers analysis, findings from other activities, such as field trials, and knowledge of upcoming policy decisions or reviews. Projects would then be prioritised by the team on the basis of potential carbon and economic benefits (using a set of pre-defined criteria), taking into account regulatory timelines.
- **Management and delivery partners:** Projects would be led by a Centre project manager, with the support of expert partners such as technical consultants or national or international policy think-tanks.

6. Funding

To achieve material progress against the goals of the Low Carbon Technology Innovation and Diffusion Centres, we estimate that each Centre would require an investment of approximately $40m to $100m per year.

Estimates of funding needs are inherently uncertain. However, our experience is that a certain level of activity is required to make a material difference – we estimate a requirement of $40 to $100m per annum per Centre.

Annex A lists the activities we have identified together with indicative costs based on the Carbon Trust's experience of supporting projects across the UK. Exact costs depend on local circumstances, the number of projects being supported and the level of ambition in the country. This clearly implies a broad range, but for an inter-related set of activities, spanning the innovation chain, we have outlined a reasonable set of activities that a Centre may choose to undertake.

At this scale, the Centres are unlikely to be engaged in large-scale demonstration projects, e.g. CCS and clean energy infrastructure projects, like those currently planned under the proposals for World Bank's Climate Investment Funds. However, a proportion of such international funding could be targeted at financing Low Carbon Technology Innovation and Diffusion Centres in a number of developing countries.

This would enable countries to lower the cost and demonstrate the commercial potential of a range of low carbon technologies at a local level, enabling both national and international private sectors to increase their confidence in investing in these technologies over the long-term.

The size of the Centres needs to be sufficient to support a range of low carbon technology projects and early-stage companies. However, this needs to be set in the context of the ability for the local market to supply the required number of projects, e.g. larger, more industrialised countries are likely to have many projects to fund. However, countries where access to energy is of primary concern may wish to concentrate their efforts on funding deployment of one or two key clean energy technologies.

We would suggest that the Low Carbon Technology Innovation and Diffusion Centres approach is first piloted by four to six countries or regions, before significantly scaling up internationally. This would enable all parties to learn from the experiences of the initial network of piloting countries. At an overall level this would require a total investment of $1bn to $2.5bn over five years to establish five national Centres, as a first phase of activity.

Given the long lead times involved in energy research, development and deployment projects a five year funding budget is the minimum necessary to establish the network and achieve measurable progress. Future funding for additional Centres and subsequent time periods would be considered in light of the success of the first phase.

The Low Carbon Technology Innovation and Diffusion Centres would seek additional funding from other public sources and would be expected to achieve additional funding from national governments in middle income countries. Funding from local governments and leveraging of private sector funding would be expected to increase over time.

The Centres would allocate funds based on prioritisation of the range of projects available to them. Profits made from commercial projects would be retained and reinvested in the national Centre in question.

7. Factors for success

Success will depend on three main factors: appropriate governance that provides effective engagement and oversight whilst protecting the independence of Centres; funding at a scale and durability to enable Centres to invest for the long term; and an implementation strategy tailored to local needs.

Developing countries have a crucial part to play in the transition to a low carbon economy; given their growing energy demands and their capacity and capability to deploy low carbon technologies at scale. The industrialised world can help developing countries to accelerate the development and diffusion of low carbon technologies, by helping to establish a network of locally run Low Carbon Technology Innovation and Diffusion Centres.

For a relatively small sum, the developed countries can seed this growth over the next five years at approx $40m to $100m per Centre per annum. These Centres would enable developing countries to harness their low carbon resources and capabilities to lower the overall cost of low carbon technologies. By designing and implementing public policy instruments to manage regulatory risk and help drive markets, the private sector would be encouraged to invest at scale.

Ultimately, the challenge would be for Low Carbon Technology Innovation and Diffusion Centres to accelerate deployment of low carbon technologies at both a national and international level. If the Centres are successful, the developing world would be deploying lower cost low carbon technologies more quickly than would otherwise have occurred, thereby reducing the combined costs of mitigating climate change.

Locally developed technologies and market opportunities will also create export opportunities for developing countries – either to other developing or developed countries. The Centres would also provide a means of growing low carbon enterprise – where early-stage and incubator companies can test their technology in local markets, grow quicker and at lower cost with the support of the low carbon technology network.

Three factors are crucial to the success of such a network:

1. Governance: The Centres should have a partnership approach between developed countries and developing countries, which should include agreed goals and success criteria. There must be appropriate local ownership and independence of each Centre, with establishment of local governance and local control of project prioritisation.

2. Funding: Public funding must be on a scale and committed time horizon sufficient to allow planning and implementation of complex projects, including sufficient public funding to undertake pre-commercial activities. An effective collaborative relationship with government and the private sector would be needed to leverage additional funding, without compromising the ability of the Centre to provide an independent viewpoint on the policies needed to contribute to agreed goals.

3. Implementation: Clear criteria for project prioritisation, based on both environmental and economic potential, are needed. The Centres should span a full spectrum of activity from R&D to deployment, tailored to local needs, with the Centre acting as a focal point for low-carbon activity and knowledge sharing. Eventually, as the Centres become embedded and prove their worth, they could transition towards greater private sector and/or funding from host governments. What matters, however, is to get started with this concrete step to accelerate the process of low carbon technology development and deployment.

Appendix A – Indicative costs of activities

Areas of activity as described in Section 6, indicative costs based on Carbon Trust experience.

Activity type	Estimated required funding per project	Type of support/ funding mechanism	Typical length of project	Estimated number of projects initiated per Centre per year	Indicative required funding per year	Leverage
Applied research and development	$0.1-1m	Grant (co-funding)	2-5 years	10-20	$1-10m	• Direct industry co-funding ($ and in kind)
Technology accelerators	$2-10m	Grant (co-funding)	2-5 years	1-5	$5-40m	• Direct industry co-funding ($ and in kind) • Catalysed market, leading to significant commercial investment
Business incubator services	$50-100k	Grant, advisory services and/or investment	6-12 months	5-25	$0.5-2.5m	• Subsequent fundraising by supported companies as a result of incubation services (10:1 leverage potential)
Enterprise creation	$3-10m	Investment	3-7 years	1-2	$3-10m	• Direct industry co-investment
Early stage funding for low carbon ventures	$500k-3m (for first round funding only)	Investment or loan	3-7 years	2-10	$2-30m	• Co-investment by private sector funds (10:1 leverage potential) • Further catalysed market for low carbon investment through demonstrated success
Deployment of existing energy efficiency measures	$10-100k	Advisory services and/ or loans	12-24 months, repeatable	100-1,000pa	$1-50m	• Initially free, but eventually shared cost with business • Stimulate investment by organisation receiving support
Skills/ capacity building	$50k-1m	Grant and/or advisory services/ training	6-24 months	2-5	$1-5m	• Leverage of partner company resources • Catalysed markets by freeing supply chain capacity constraints
National policy and market insights	$100-500k	In-house and commissioned strategy work	3-12 months	2-5	$1-2.5m	• Catalysed markets by enabling development of regulatory regimes which incentivise and de-risk low carbon private sector investment

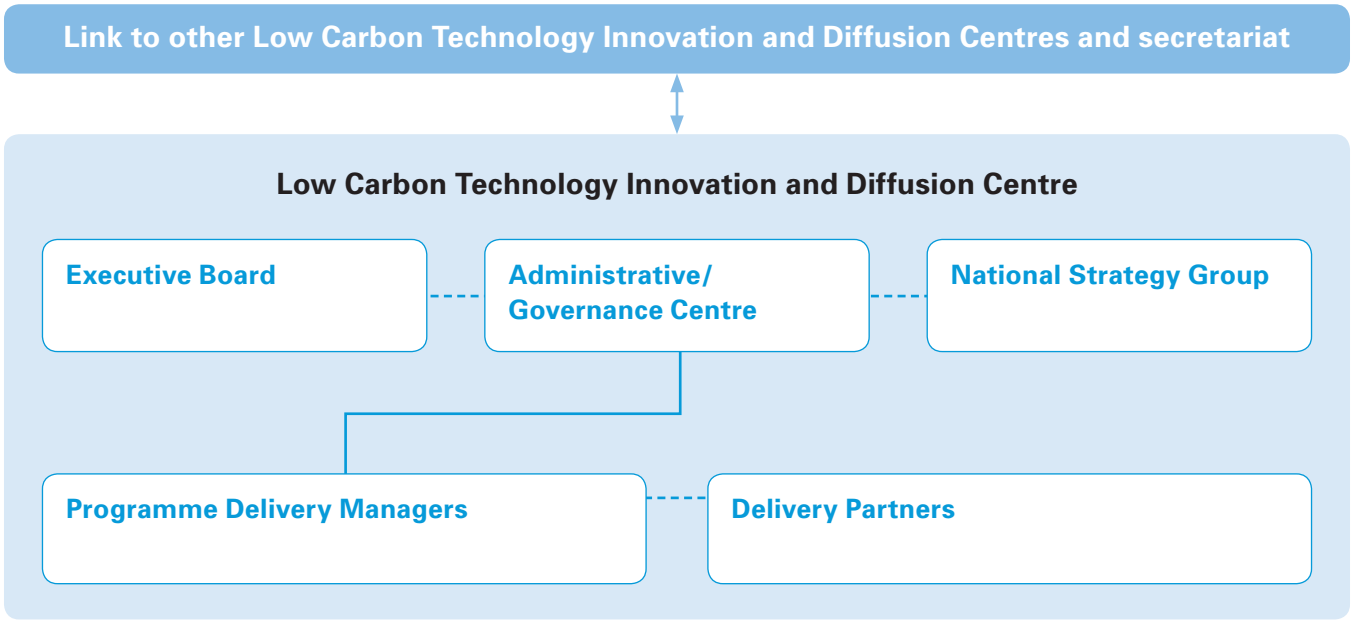
Appendix B – Components of governance structure

The Low Carbon Technology Innovation and Diffusion Centres should be structured to suit local conditions, and would be supported by a secretariat that maintains a global perspective, agrees overall plans and monitors progress for the Centres and other initiatives and ensures knowledge transfer across these. Each of the national Centres could comprise: an administrative centre, a national strategy group and a series of in-house teams and/or third party delivery partners. The diagram below illustrates this:

- An executive board which could be responsible for defining the strategy, plans and budgets for the delivery of low carbon innovation activities in the Centre, developing an organisation capable of delivering the plans, managing the delivery of the plans and monitoring and reporting on progress. The executive board could consist of equal representation from the central institution, national government and independent members such as from local business or academic communities.
- An administrative centre to facilitate the delivery of the various programmes would act as a local centre of excellence for low carbon innovation, engaging with public and private stakeholders as well as representing the Centre to the secretariat.
- A national strategy group to be responsible for analysing and explaining the issues and opportunities around low carbon innovation locally and for providing input into the development of the Centre strategy and delivery plans, supported where necessary by the strategic and scientific advisory group in the secretariat.
- In-house local delivery managers responsible for the delivery of the activities, supported where necessary by external delivery agents.

In order for the Centres to be able to maximise their impact, we feel it is essential that they be independent, mission driven organisations. Existing organisations can be leveraged through partnerships and collaborations.

The Centres could draw up proposals on an annual basis for approval, and objectives and targets could be agreed between the secretariat and the Low Carbon Technology Innovation and Diffusion Centre. Objectives and targets may include a leverage target (i.e. raising of additional private and/or public sector funds), project delivery targets (number of projects started/completed across the various areas of activities), and outcome targets which could include IP generation, numbers of companies attracting further funding and carbon savings. The component ideas suggested here are based on a review of a number of potential operating structures for the Centres (e.g. Consultative Group on International Agricultural Research (CGIAR)) and would need to be further defined by participating countries.



Appendix C – Case study: Carbon Trust

The Carbon Trust's experience in low carbon innovation in the UK supports the hypothesis that appropriately designed and established national centres are able to accelerate the development and deployment of low carbon technologies. The Carbon Trust uses a range of targeted interventions, including:

- Technology acceleration projects in wave and tidal-stream power, micro-CHP, advanced metering, low carbon buildings, biomass and offshore wind, which address specific shared technical and market barriers faced by industry participants. For example, the Marine Energy Challenge, focused on wave and tidal-stream power, was completed in 2006 and achieved a significant technology cost reduction, developing a route to cost-competitiveness for wave and tidal-stream energy devices.
- Business incubation services providing targeted advice on IP protection, IP licensing, fundraising and business planning to low carbon start ups. Since 2004, 57 companies have participated and 25 have gone on to raise a total of £65m in private sector finance.
- Enterprise development where the Carbon Trust has built six new businesses, including Partnerships for Renewables which secured over £100m of private sector funding from £10m public sector investment, accelerating the deployment of wind farms on UK public sector land.
- Early stage venture capital support for low carbon companies (which face a funding gap in the UK[9]). The Carbon Trust's venture capital activities achieve a private sector leverage ratio of 10:1.
- Deployment of existing energy efficiency technologies through advice and resources to help businesses and the public sector identify and cut carbon emissions, working with over 50% of the FTSE 100 companies, conducting over 3,500 site surveys annually and providing over £18m in interest-free loans annually.
- Policy and market insights where, by demonstrating the viability and business case of low carbon technology opportunities, we have also informed the UK policy landscape, e.g. the mandated roll-out of advanced meters following a field trial showing the cost effectiveness of the approach.

The Carbon Trust's success relies on its independence and a detailed understanding of the UK technology and business landscape and of the specific cost and market barriers applicable to the UK. Since launch in 2001, we have helped our customers to save some 12Mt$C0_2$ and our support of low carbon technology has leveraged over £2 of private sector capital for every £1 we have put in and around £10 for every £1 committed to our venture capital investments.

Many of the approaches used by Carbon Trust in identifying barriers to technology innovation, working collaboratively with industry and leveraging private sector capital are transferable to the developing world context.

[9]HMT (2005) identifies an equity gap for investments below £2m in the UK and provides the rationale for the Enterprise Capital Fund mechanism.

www.carbontrust.co.uk

The Carbon Trust was set up by the United Kingdom Government in 2001 as an independent company.

Our mission is to accelerate the move to a low carbon economy by working with organisations to reduce carbon emissions and develop commercial low carbon technologies.

We do this through five complementary business areas:

Insights – explains the opportunities surrounding climate change
Solutions – delivers carbon reduction solutions
Innovations – develops low carbon technologies
Enterprises – creates low carbon businesses
Investments – finances clean energy businesses.

www.carbontrust.co.uk

ACT ON CO_2 is the Government's initiative to help individuals understand and reduce their carbon footprint. Visit http://actonco2.direct.gov.uk for more information.

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