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Potential for Application of UK Energy-Related Technologies to Developing Countries

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EXECUTIVE SUMMARY

With the backdrop of global population increase, rapid demographic changes, expanding urbanisation in developing countries along with climate change, a massive global challenge is to provide clean, green, secure, affordable energy for everyone and to deploy this energy within holistic transitions to low carbon economies. This means simultaneously:

- reducing emissions
- re-thinking energy use regimes
- improving security of supply, and
- reducing cost of energy

The UK is already a major contributor of research and innovation into low carbon transitions within the countries of the developing world, particularly through the leadership of the Department for International Development (DfID). This work has not previously been coordinated with the work of the Business, Energy and Innovation Department to maximise the deployment of the actors within the UK economy and knowledge base to support HMG aims in the developing world.

As a result, this report outlines the areas where there are significant opportunities for the UK to enhance its presence within these markets, to help deliver UK growth ambitions and also to make a major contribution to meeting international development targets and climate commitments.

By harnessing the UK knowledge base and commercial capabilities there is a significant opportunity to:

- position the UK as a first mover in emerging markets
- create commercial opportunities for energy sector entrepreneurs
- catalyse wider economic value chains for the benefit of local communities in the Global South
- help meet international development targets and climate commitments

However, there are a number of challenges involved in looking to introduce UK technologies into a Global South context. The socio-political context presents a complex mix of political, financial and technical issues that vary from region to region and country to country, whilst environmental and climatic factors can create more extreme and challenging conditions under which a technology must operate.

Another challenge is to understand the social and cultural context in which energy use takes place, so avoiding the temptation to ascribe 'western centric' motivations, drivers and explanations whilst failing to understand local social dynamics, norms, behaviours, needs and structures.

For companies looking to operate in the Global South, understanding local markets and forging effective knowledge and business partnerships can also prove complex and time-consuming. They also can encounter challenges around local consumer trust and confidence

in new technologies and products due to undeveloped or poor quality infrastructures and weak market institutions.

Further to this, most energy technologies facilitate the distribution, storage or generation of energy which is then utilised within another system. All technologies operate within energy systems made up of a combination of technologies, resources and social systems/cultures. As such, any technology has to suit the particular circumstances of generation resources, storage and load-shedding capabilities and energy uses, as well as the social environment.

We focus the report onto a number of areas where there are particular opportunities for UK business and industry (Energy Systems, Bioenergy, Solar, Thermal Energy, Energy Storage and Appliances).

This means that, for the UK to achieve the most impact when seeking to step up its involvement within this sector, it needs to adopt an holistic approach to understanding the specific challenges involved within low carbon energy transitions, the interplay and mix of technologies and methods to resolve those challenges and the local social, political and economic contexts within which those technologies must be situated. The types of steps involved in developing such an approach might include:

- Drawing on academic knowledge and experience to identify particular markets and develop a deep understanding of need and context – this could relate to a particular scenario in a given country where there is a particular mix of energy resources in place.
- Road-mapping with in-country partners to plot different pathways to low carbon economic growth and solutions. This would help identify where wider contextual factors need to be addressed such as around standards or in-country capacity.
- Running a competitive programmes for business opportunity leads offering financial and other support to develop **service-based business opportunities** – the focus would be on finding/stimulating the creation of teams with the ability to build service delivery propositions that reflect an accurate understanding of a need. This should include mechanisms for providing access to academic partners, charities or other bodies active in the country (eg through offering innovation vouchers). Could look for this along the lines of Distributed Energy Service Company models. Finding suitable in-country partners and champions within the communities being targeted is critical.
- Encouraging/facilitating engagement with investors early on so that these can keep an awareness of progress and potentially get involved/contribute as they choose.
- As part of this approach, on-going support could be used to provide access to a range of tools/mechanisms for sourcing technologies and skills to fill gaps identified. Thus, Innovate UK/KTN, for example, could help set up projects as potential customers for SBRI challenges, open innovation platforms, etc. Funds could be provided to support R&D, design work, piloting, for technology companies that have been selected as offering the best prospects. These open innovation platforms would be run to draw as widely as possible on UK technology expertise, not just energy tech. Where in-country skills are lacking, the project would be enabled to reach out to the UK Vocational Education sector to seek partners for skills training in-country.

However, there is also a need to consider the wider challenges and issues that were identified through this report, that will require a long-term, sustained and collaborative approach between UK partners.

To take this forward, a partnership of key organisations should be convened to build a multi-faceted programme that could take UK support beyond piecemeal funding of individual companies to cover the following broader cooperation themes:

- Leveraging UK expertise in fundamental research,
- Facilitating complementary partnerships between UK companies
- Facilitating international partnerships
- Leveraging UK expertise around systems thinking
- Aligning innovations with targeted, user-informed, business models
- Catalysing value chains and local entrepreneurship
- Capacity building around institutions and governance
- Helping UK Companies to operate in the Global South
- Better availability of research, information and intel
- More actively positioning the UK in emerging markets

Summary of each of the technology areas

Technology Area	Market observations	Opportunities and challenges	UK strengths	Interventions
Energy Systems	Developing countries tend to have inadequate or dysfunctional grids and so distributed, micro-grids and smart grids offer the best prospects. Solutions need to be tailored to a very diverse range of situations with different potential energy sources and uses.	Lack of good data and predictability over energy requirements demands innovative approaches to financing and payment – business model innovation. Tailoring of solutions.	The UK is at the forefront of smart grid thinking and energy system innovation, with a lot of Government funding going into these. Range of companies with potential including consultancies.	Take a systems approach to seeking and implementing solutions. Use an approach to develop an energy service analysis and need specification to draw in technology requirements. Need to incentivize adaptation of systems approaches for Western context being adapted for developing world. We propose a process model to drive innovation and inform Government funding support.
Bioenergy	The preponderance of agriculture in developing country economies results in opportunities to harness biomass for energy generation. This is an area that has a long history. There are a growing number of options and models but also competing uses for these agricultural bi-products.	Challenges include variability and seasonal nature of many sources of biomass, and the wider implications of different types of bioenergy generation in relation to GHG emission, air pollution, etc. Different energy extraction methods and technologies have very	The UK has worldleading research capability in this area but most of the funding has focused on the Western market so this capacity is not being exploited as well as it could be for developing countries. Bioenergy is a well-developed and varied sector in the UK, with a	We need to find a way to incentivize the UK research base to engage on the immediate practical challenges of bioenergy generation and less on cutting edge technologies that are some distance from real impact. Innovation Vouchers could be one way to do that.

Technology Area	Market observations	Opportunities and challenges	UK strengths	Interventions
		different profiles. There can be a large capital investment requirement but this is only viable when feedstock supply is predictable. Ultimately, solutions will be dependent on the ability to combine this with other energy sources.	large variety of end-uses, technologies and fuel inputs, providing a significant economic and energy benefits. The UK landscape is dominated by SME's and the research base is large but fragmented although the Bioenergy Superhub is seeking to address this.	
Solar	Off-grid solar energy generation at different scales and for different applications has huge potential given the climate and extensive sunlight in the developing world. It is a mature sector in many ways and a number of countries have targeted support and investment support at this to grow its contribution.	The cost of solar energy generation has reduced significantly but access to finance is still a major barrier. There are aspects of the environment of developing countries that adversely affects solar PV generation and this creates opportunities for technological innovation. There is scope for business model innovation.	The UK is not a major producer of solar panels and systems but has a large and growing number of highly innovative and specialist companies that are targeting the innovation challenges. A significant amount of Government funding has already gone into this area. The Solar energy Superhub is providing a valuable focus for innovation and can assist in testing new technologies before they enter markets.	Interventions could focus on helping UK specialist companies to partner with existing solar producing companies in the developing world so that their particular solutions can be incorporated. Wider opportunities to support through standard setting, quality control and training.

Technology Area	Market observations	Opportunities and challenges	UK strengths	Interventions
Cooling and energy for and from this	This is a complex area but delivering cooling solutions could have wide-ranging benefits to the developing world including on health, nutrition and economic productivity, as well as reducing energy consumption and GHG emissions associated with inefficient technologies such as Air-conditioning. The issues vary considerably by context.	Opportunities to look holistically at all the factors that can support maintaining lower temperatures from design, behavioural change and technology	The UK has considerable relevant research expertise and commercial strength in relation to this area but deploying this to address the needs of the developing world would be relatively new and represent a shift. Much can be done, however, if we harness the diverse strengths we have, in combination.	This needs a substantial investment and focus, that supports road-mapping, scenario development and Action Research approaches to experimentation with new approaches to learn what works best in different contexts.
Energy storage	Effective energy storage is centrally critical to meeting the challenges of energy delivery in the developing world because of the fluctuating and non-aligned supply and demand profiles and the distributed and off-grid circumstances meaning that balancing between sources and storage of excess energy are going to be needed	There are a wide range opportunities and challenges and there is a need to look beyond just battery storage to innovative approaches that fit the environment and resources including phase change materials.	The UK Government has focused substantial investment on energy storage but much of this is aimed at automotive and other Western country applications. The underlying expertise in both the research and commercial sectors could be harnessed to address the particular and different needs of developing worlds to good effect.	There is a need to support some business opportunity analysis to set out the case for commercial engagement in addressing the energy storage requirements of the developing world and shift the focus of attention in that direction. Research needs to focus on this area that could drive innovation and commercial interest.
Appliances	There is a substantial market for appliances that are viable in	There are particular challenges associated with	The UK is not a major producer of appliances but	This is an area where there is considerable scope for the

Technology Area	Market observations	Opportunities and challenges	UK strengths	Interventions
	developing world contexts with different demand profiles and where supply can be more erratic. This has been extensively studied with a wide range of appliance types being identified as potentially making a big difference to economic growth and health.	appliances as they need to be used directly by consumers and design considerations and user behavior are both particularly important. This creates a more fragmented market with appliances needing to be adapted for diverse cultural, language, educational level contexts. Particular sectors of interest include refrigeration and solar pumps.	can bring substantial innovation, design and quality control strengths to the development of solutions.	UK to play a part within multilateral programmes and play to its strengths. Partnerships with countries like China that are major appliance manufacturers could be very fruitful.