

## Taking the energy transition forward in emerging and new frontier countries: complementary innovations in off-grid systems, multi-purpose energy hubs, battery repurposing and the enabling institutional reforms.

**Supervisors:** [Dr Charles Mbalyohere](#), [Professor Dev Kodwani](#) of Department of Strategy and Marketing, Faculty of Business and Law and [Professor Claudia Eckert](#) of Engineering and Innovation STEM faculty, The Open University Business School

### Project Description:

In the past decade, the effects of climate change have become increasingly apparent everywhere. The situation has been compounded by most harm happening in countries with limited or no access to electricity. Further, the many reforms implemented in the past two decades in these countries have been of limited success, measured on efficiencies across the value chain, universality of access to and affordability of electricity, service quality and price-cost gaps (e.g., Sen and Jamasb, 2012).

**One research focus** could therefore be a comparative review of these reforms in some of the affected countries/regions. The institutional situation has become significantly compounded by the rapid emergence of off-grid power technologies as viable alternatives to the traditional central grid systems. With time, these off-grids have come to represent the most promising route to significantly improving access to affordable electricity in these countries. Regulators and policy makers have therefore been under pressure to evenly support traditional central grid and emerging off-grid sub-sectors (e.g., Bhattacharyya and Palit, 2021). How diverse firms have asserted themselves amidst the uncertainty and how policy makers/regulators have woken up to try to develop fitting regulatory frameworks could be key considerations.

We expect aspects of institutional theory, strategic management and innovation to inform the study, among other theoretical angles. Interpretations that are sensitive to the dynamics of these new frontiers will play a particularly important role (e.g., Kodwani, 2010; Cuervo-Cazurra et al., 2016). This includes an understanding of not only formal institutions, but also informal ones that are particularly important in these contexts (e.g., Mbalyohere and Lawton, 2022). Further, it provides significant scope for the advancement of new explanations for the mixed outcome and for developing improved outcomes.

A study with this institutional focus could address the following indicative research questions:

- 1) To what extent have off-grid electricity systems emerged as viable alternatives to the traditional central grid systems in emerging and developing countries?
- 2) What are the complementarities between the two systems and how can they be strengthened?
- 3) How can emerging and developing countries improve their approach to electricity reforms in order to sustainably achieve stronger complementarities between the two systems?

An **alternative research focus** could be an investigation of a sector of the economy where climate change mitigation strategies could be consequentially deployed and where the energy transition could be significantly progressed – the transport sector. A strategic opportunity here arises from the ongoing global transition to electric vehicles. The study could develop strategies that can bridge between energy provision and electric mobility services and consolidate the energy transition by, among others:

- (A) **Participatively developing electric mobility-oriented energy hubs and the associated sustainable business models** with the hub-hosting communities. Action research could inform the realisation of this participation which would be expected to strengthen co-ownership and design robustness, hence sustainability of the innovation (e.g., Isaksson & Eckert, 2020). Further, the energy hub as a socio-technical system (Gigante & Falcone, 2022) requires new or reconfigured business models to meet the core needs of diverse stakeholders using integrated social, economic and environmental sustainability considerations (Reinhardt et al., 2019).
- (B) **Dynamically engaging the repurposing of large lithium-ion batteries** for integration in hybrid energy systems to improve stationary energy storage and eventual use for multiple purposes (e.g., Hu et al., 2022). Piloting battery repurposing (and recycling) systems is therefore strategically important both for energy-poor countries and for the global circular economy. In this alternative approach to the study, part (B) will in effect be a support consideration for the primary focus described in part (A) above by deploying the repurposed batteries in the hubs.

From a theoretical perspective of this alternative focus, we suggest a contribution to extant literatures on energy transitions, innovation, dynamic capabilities and product-service systems (e.g., Isaksson & Eckert, 2020; Mbalyohere et al., 2019). We think a mixed method approach, including action research methods, would be appropriate. However, there are alternative methodological approaches that can similarly attain good results. An indicative research question here could be: *To what extent can energy hubs and repurposed electric vehicle batteries innovatively contribute to transforming the renewable energy access landscape in emerging and developing countries?*

It is also possible to creatively merge the two study foci suggested above to generate something more holistic. But given the limited timeline and resources of a PhD research, it might be more realistic to choose a focus. The final constitution of two supervisors will depend on the study preference of the successful applicant.

### **About the Supervisors**

Charles Mbalyohere : is a senior lecturer in strategic management. He has core interests in the internationalisation of multinational enterprises, emerging institutions, non-market strategies and various aspects of the energy transition. He has explored pioneer institutional reforms in the energy sector in sub-Saharan Africa (SSA). He has also worked on solar PV technologies and energy resource centres as strategies for improved access to electricity in SSA. Most recently, electric mobility has attracted much of his attention, including efforts to develop concepts for repurposing and recycling of expired EV batteries; how such batteries can help developing countries to overcome their energy access challenges using improved energy storage systems is a critical consideration. The work here also feeds into debates on the circular economy and sustainable business models.

Dev Kodwani: Research Interests: Prof Devendra Kodwani's current research focuses on the evolution of regulatory institutions, corporate governance and ethics. He has been examining the reforms in the electricity, water and telecommunications industries in the UK, India and other emerging markets. His other interests include behavioural finance, management and accounting in utilities and derivatives.

Claudia Eckert: is *Professor of Design* at the Open University. She is interested both in understanding design in different design domains and different phases of the design process, and in developing techniques and computer tools for facilitating design activities. Her research is based on empirical studies in industry and brings theories and methods from different disciplines into design research. For example she applies insights from philosophy and sociology of science to design process modeling and from complexity theory to change prediction.

### References:

- Bhattacharyya, S. C., & Palit, D. (2021). A critical review of literature on the nexus between central grid and off-grid solutions for expanding access to electricity in Sub-Saharan Africa and South Asia. *Renewable and Sustainable Energy Reviews*, 141, 110792.
- Cuervo-Cazurra, A., Ganitsky, J., Luo, Y., and Mezias, J. (2016) Global strategy and emerging markets. *AIB Insights* 16(4), 3.
- Giganti, P., & Falcone, P. M. (2022). Strategic niche management for sustainability: a systematic literature review. *Sustainability*, 14(3), 1680.
- Hu, X., Deng, X., Wang, F., Deng, Z., Lin, X., Teodorescu, R., & Pecht, M. G. (2022). A review of second-life lithium-ion batteries for stationary energy storage applications. *Proceedings of the IEEE*, 110(6), 735-753.
- Isaksson, O., & Eckert, C. (2020). Product development 2040. Online. <https://www.designsociety.org/publication/43268/Product+Development+2040> (Accessed: 11.09.2023)
- Kodwani, Devendra (2010) Governance mechanisms for telecommunications and electricity industries in India: 19th Century to 21st Century. In: International Conference on Regulation and Competition Policy for Development: Practice and Challenges, 27-28 Jan 2010, University of Jordan, Amman Marquis, C., & Raynard, M. (2015). Institutional strategies in emerging markets. *Academy of Management Annals*, 9(1), 291-335.
- Mbalyohere, C., & Lawton, T. C. (2022). Engaging informal institutions through corporate political activity: Capabilities for subnational embeddedness in emerging economies. *International Business Review*, 31(2), 101927.
- Reinhardt, R., Christodoulou, I., Gassó-Domingo, S., & García, B. A. (2019). Towards sustainable business models for electric vehicle battery second use: A critical review. *Journal of environmental management*, 245, 432-446.
- Sen, A., & Jamasb, T. (2012). Diversity in unity: An empirical analysis of electricity deregulation in Indian states. *The Energy Journal*, 33(1).