Master's Project Catalogue

September 2020

UNEP DTU Partnership

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# Introduction

UNEP DTU Partnership (UDP) is a leading international research and advisory institution on energy, climate and sustainable development. Its work focuses on assisting developing countries transition towards more low carbon development paths, and supports integration of climate-resilience in national development through in-depth research, policy analysis, and capacity building activities.

UDP employs 70 researchers of 26 different nationalities working around the world from offices in UN City, Copenhagen.

UDP is in a unique position, as one of the only universities worldwide to be so closely associated and housed within the UN system since the [Danish Ministry of Foreign Affairs](http://um.dk/en/), [UN Environment Programme](https://www.unenvironment.org/) and the [Technical University of Denmark (DTU)](https://www.dtu.dk/english) established the UNEP DTU Partnership in 1990.

As a UN Environment Collaborating Centre, UNEP DTU Partnership is actively engaged in implementing UN Environment’s Climate Change Strategy and Energy Programme.

As part of the Technical University of Denmark, within [DTU Management](https://www.man.dtu.dk/english), UDP is able to draw on a vast range of scientific expertise and to collaborate with world-leading scientific partners to conduct the research that serves as a foundation for its activities. In addition, UNEP DTU combines this with developing country expertise and network; we currently have projects running in a 100 countries.

More information on UDP is available at [www.unepdtu.org](http://www.unepdtu.org)

# Master's projects at UDP

UDP has a long tradition of working with students, from both DTU and other universities worldwide, on Master's research projects, normally as co-supervisor in collaboration with a main supervisor from the student's university department.

UDP can offer a stimulating environment to do your master's student thesis, working with experienced researchers who are engaged in tasks at the forefront of efforts to tackle climate change and sustainable development in developing countries, especially concerning renewable energy and other environmentally sound technologies.

UDP has developed a catalogue of project ideas and invites master's students, primarily from DTU, to consider working with us towards their master's thesis. The project ideas presented here show the breadth of subject areas that UDP works on, principally connected with climate change and developing countries, but spanning many academic disciplines. Above all, UDP offers an opportunity for students to work in close connection with real projects, addressing the challenge of climate change and sustainable development, particularly in developing countries.

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| Title | District Energy Systems in Cities (BMF) |
| UDP Section: | Business Models and Finance |
| Proposed UDP supervisor: | Supervisor group in District Energy System (DES) team, including Clara Camarasa Hernando, Romanas Savickas, Santiago Martinez Santaclara and Zhuolun Chen. |
| Problem background: | District energy systems in cities, which includes district heating and cooling, is a proven climate mitigation technology. The systems not only increase energy efficiency, but also integrate low-carbon and renewable energy. However, the current potential for district energy systems is not met, and non-market and market barriers still impede the full deployment. UNEP-DTU Partnership (UDP) is involved in a project with Danfoss Foundation to accelerate the deployment and investments in DES focussing on developing countries and emerging economics, in line with the UDP Business Models and Markets strategy area. The project, together with other related projects including GEF, KCEP etc., is closely coordinated and implemented with UNEP, and contributes to the UN SDGs, including SDG 13 on climate change, SDG 7 on energy, SDG 11 on cities. Under the condition of COVID-19, heating and cooling has been put in a more critical place, not only for human safety and comfort in space, but also for medical care, food storage and even in the supply chain. |
| Project assignment: | There are several potential topics for master's thesis in the context of these projects, and potentially contributing to real project implementation in the future. Possible research topics include:   * 4th/5th Generation of District Heating and Cooling * GIS-based district energy mapping and planning * Sustainable district heating and cooling technologies * Smart energy systems under Smart Cities * Natural solution-based energy systems, including geothermal, sea/river-sourced heat pump etc. * Climate adaptive design for buildings and communities * Long-term city-wide district energy planning, including integration of renewable energy and other low-carbon technologies * Technical, environmental and financial analysis, simulation and assessment of district energy systems in different countries or climatic conditions * Heating & cooling consumption simulation at building-cluster level and its reactions with the district energy network * Assessment methodologies for energy systems with multiple sources under different economic, climate and policy conditions * Analysis of policies and enabling frameworks, business models of district energy systems and their potential in developing countries and emerging economies * Methodology or theory of district/region sustainable development and green community design and operation |
| Prerequisites, theoretical background: | Background in engineering, including thermal/energy engineering, architectural engineering, energy engineering, mechanical engineering and civil engineering etc., with courses related to district energy, including but not limited to Sustainable Building, Solar Heating Systems, Sustainable Heating and Cooling of Buildings, Sustainable District Heating, Advanced Business Analytics, Renewable Energy, Energy Economics, Quantitative Sustainability Analysis, Low Carbon Technologies, Building Energy Efficiency etc. |
| Potential DTU Institute(s): | DTU Civil Engineering, Energy Engineering, Management Engineering, Mechanical Engineering, Environmental Engineer, Electrical Engineering, Wind Engineering |
| Additional information |  |
| Title | Climate-Change Adaptation Effects of Improved Community Forest Management in Cambodia (BMF/IAAA) |
| UDP Section: | Business Model and Finance and Impact Assessment & Adaptation Analysis |
| Proposed UDP supervisor: | Søren Lütken, Lindy Charlery, Henry Neufeldt, |
| Problem background: | Forests in Cambodia are degrading for many reasons, including bad management and illegal logging. Some of these degraded forests, owned by the government, have been allocated to local communities as Community Forests. Few communities see much value in these degraded forests and put little effort in upgrading them. At the same time, rains and floods are increasing, and villages are increasingly exposed. Well-managed community forests may mitigate a part of the damage offering the villages some protection from the floods, along with various livelihood opportunities as well as vital ecosystem services. |
| Project assignment: | UNEP DTU Partnership (UDP) is managing a project in Cambodia together with two local partners and Cambodia's Forest Administration targeting community forests for the production of sustainable charcoal. This requires replantation of some of the degraded community forests based on plantation models developed by UDP. In order to assess the adaptation value of these efforts (in addition to the business from operating a sustainable source of charcoal production), an analysis of soil properties of diversely planted patches of forest as well as the soils of the degraded community forests must be performed. This will be based on already existing forest as the plantation under the project is not yet ready.  The project contains   * on-site (in Cambodia) soil sample taking and general evaluation of the properties of the land on 4 sites * lab analysis - facilities to be identified in Cambodia (or in Denmark if sample export is allowed) * evaluation of the soil properties specifically with respect to absorption capacity for excessive precipitation * Estimates of other potential benefits derived from improved soil quality, including   + biodiversity   + productivity   + job creation   + economic benefits   The project is financed by the Nordic Climate Facility and will finance one or two travels to Cambodia to do the field research. |
| Prerequisites, theoretical background: | Background in forestry, biology, ecosystems |
| Potential DTU Institute(s): | ? |
| Additional information |  |

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| Title | Cost-benefit analysis of climate change adaptation measures/Disaster Risk Management (DRM) tool (IAAA) |
| UDP Section: | Impact Assessment & Adaptation Analysis |
| Proposed UDP supervisor: | Jingjing Gao, Lindy Charlery, Henry Neufeldt |
| Problem background: | Adaptation to climate change requires inputs from many aspects: institutionally, financially and technically. With the assistance of smart tech, more innovative and efficient adaptation measures and DRM tools for climate change become possible. However, we lack knowledge about the costs and benefits of implementing such tools in adapting to climate change? What measures are more efficient/effective in building resilience to particular climate impacts? What challenges and opportunities exist to facilitate resilience building by applying an innovative DRM tool? Answers to these questions will provide support to climate-change policy making, as well as maximising the innovation outcomes of building climate-change resilience.  The student has the opportunity to examine a real-life case in detail and to contribute to the investigation of the costs and benefits. The case study will be part of an on-going project led by UDP: Building Businesses' Climate Resilience in Sri Lanka (BBCR). BBCR aims to develop a DRM tool (a mobile APP) to help small and medium-sized enterprises (SMEs) in Sri Lanka to build business resilience to climate disasters (mainly focusing on flooding). |
| Project assignment: | The student is expected to:   * Explore cost-benefit analysis of climate adaptation measures in general * Carry out a case study associated with the BBCR project by   + Estimating the costs associated with a DRM tool (BBCR APP), e.g. data licenses and fees, infrastructure and operation, outreach and commercials etc.   + Estimating the potential benefits of applying the APP, e.g. economic, social and environmental benefit * Applying both qualitative and quantitative methods in data collecting and processing |
| Prerequisites, theoretical background: | The following qualifications are considered an advantage, but not a requirement   * Experience of cost-benefit analysis * Experience in (on-line) survey design and analysis * Knowledge of the local context |
| Potential DTU Institute(s): | DTU Management |
| Additional information | The BBCR Project (<https://unepdtu.org/project/innovative-decision-support-tools-for-building-business-resilience-to-climate-change-in-sri-lanka/>) is on-going and scheduled to end in spring 2021. The prototype Disaster Risk Management (DRM) tool, the BBCR APP has been piloted in Sri Lanka since August 2020. After piloting, the APP will be adjusted before launching in Sri Lanka. There are plans for commercialising the APP (in the public or private sector), incorporating more features and covering more climate impacts. A follow-up project (to develop adaptation measures for Sri Lanka through flood-modelling technology) has been proposed and is awaiting funding. It will be acceptable to slightly adjust the topic to fit the follow-up project, if the additional funding becomes available before the starting date of the thesis. |

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| Title | GIS-based UrbanSim Modelling for Energy Efficiency and Emission Reduction in Fast Developing Urban Areas (MADM) |
| UDP Section: | Mitigation Analysis and Data Management |
| Proposed UDP supervisor: | Talat Munshi, Subash Dhar |
| Problem background: | Eliminating energy waste is essential as it brings a variety of benefits like reducing greenhouse gas (GHG) emissions and addressing climate change. Urban areas currently consume a large portion of the global primary energy supply. With the rapid growth of urban areas, especially in developing countries, energy consumed by sectors like building and transport in urban areas is likely to increase further. Understanding urban energy consumption patterns may help to address the challenges to urban sustainability and energy security. A large portion of the energy consumed in urban areas is accounted for by the building and the transport sectors. Thus, energy-performance improvements in transport and buildings can contribute significantly to climate-change mitigation efforts.  Developing economies have a relatively lower level of urbanisation; for example, large parts of the African continent and Asian countries like India have urbanisation levels less than 40%. Increasing incomes coupled with population growth drives convergence and higher urbanisation levels, and will result in high demand for housing, vehicles, appliances, etc. resulting in an even higher demand for energy and consequently higher GHG emissions. Several technology options are being considered to help cities mitigate the adverse effects of ever-increasing energy demand, including demand management measures (measures that will either reduce or shift the demand for end-use, e.g., cooling, heating, lighting, travel, etc.)  Reliance on the technology improvements alone will not be sufficient to address climate challenges. Demand management measures will be necessary. Policies are required to change user behaviour to achieve demand reductions. For informed decision making, it is important to understand the complex process of urban development. Several methods can be used to model urban development complexities and predict future urban growth and development. One such model has been developed for the city of Rajkot. This model can be extended and developed using a GIS-based platform to predict future transport and housing demand, and hence future energy demand at high levels of disaggregation, paving the way for future interventions.  The proposed research will use data and concepts from the land-use simulation model developed for Rajkot, and aim to create a generic urban simulation model using GIS software. This will help to model scenarios of urban development and energy efficiency, and emission reduction strategies for buildings/transport sector. |
| Project assignment: | The project will entail:   * Review of energy efficiency measure in the transport and building sector * How has the city of Rajkot growth in the past? What will be the development in 2050? * Modelling the energy demand (transport/building) and GHG emissions for 2050 in the business as usual (BAU) scenario * Simulating the energy demand in 2050 for different demand-reduction scenarios in Building/Transport sector |
| Prerequisites, theoretical background: | Should have attended one more of the following courses   * Quantitative Modelling and Behaviour (42180) * Sustainable Urban Development Indicators and Sustainable Urban Development (42274) * Simulation of cities (42188) * Geographic Information Systems (30530) * Energy systems analysis and scenarios (42007)   Should be comfortable with quantitative data analysis, software and tools |
| Potential DTU Institute(s): | DTU Civil Engineering, DTU Management |
| Additional information/References: |  |

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| Title | Assessing GHG and Sustainable Development and Impacts of Electric Mobility in Public Transport (MADM) |
| UDP Section: | Mitigation Analysis and Data Management |
| Proposed UDP supervisor: | Subash Dhar & Talat Munshi |
| Problem background: | Transportation accounts for 24% of greenhouse gas (GHG) emissions from fuel combustion and is a significant contributor to the growing climate crisis. This has made sustainable transport an important goal for policymakers. 120 countries have included transport as a target mitigation sector in their strategies to fulfil their climate commitments and achieve the Sustainable Development Goals that were ratified in the Paris Agreement. In this context, electric vehicles (EVs) are seen around the world as a potential pathway for the transition towards sustainability in transportation systems. Modelling studies indicate that the large scale adoption of EVs can have multiple benefits. If combined with renewable power, EVs can reduce GHG emissions from the transport sector. EVs can reduce fuel demand from vehicles and enhance energy security for oil-importing countries. EVs have zero tailpipe emissions and can improve air quality and human health, especially in the urban areas of development countries. Our previous work shows that EVs are also seen as an opportunity to strengthen automobile industries and generate economic growth, with many countries announcing policies to incentivize local manufacturing of EV components.  Governments across the world have adopted a range of policy measures to stimulate the design, production, and uptake of EVs as a means towards achieving sustainable mobility. In response, manufacturers have made significant investments in supply chains and technological improvements. However, the adoption of EVs continues to remain low, with more than 90% of vehicles still operating on internal combustion engines.  The Solutions+ project funded by EU is researching the uptake of EVs for public transport by implementing several demonstration projects in Asia, Africa and Latin America. In Kigali, the demonstration actions include E-moto taxis and E bikes that will be integrated in the Bus Rapid transit System. The Bus Rapid transit also envisages electric buses. This MSc. thesis will do an ex-ante analysis of the sustainable development impacts of electric vehicles. |
| Project assignment: | The project will entail the following:   * Review of current and proposed EVs for public transport systems * Status of current public transport system operation in Kigali * Ex-ante assessment of public transport system with existing technologies in Kigali * Ex-ante assessment of public transport system with different shares of electric vehicle |
| Prerequisites, theoretical background: | Should have attended one more of the following courses   * Quantitative Modelling and Behaviour (42180) * Sustainable Urban Development Indicators and Sustainable Urban Development (42274) * Simulation of cities (42188) * Energy systems analysis and scenarios (42007)   Should be comfortable with quantitative data analysis, software and tools |
| Potential DTU Institute(s): | DTU Civil Engineering, DTU Management |
| Additional information/References: |  |

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| Title | The Role of Social Innovation and Cooperative in the Energy Transition (TTSI) |
| UDP Section: | Technology, Transitions and System Innovation |
| Proposed UDP supervisor: | Jay Sterling Gregg |
| Problem background: | Because energy services permeate so many facets of our economic and social life, the energy transition is a socio-technical transition, requiring both technical and social innovations to bring about systemic and institutional change. As increased investment in technological research and innovation and economies of scale have made renewable resources cost-competitive with fossil resources, the share of renewable energy has steadily increased on the grid. This has led to electricity generation being more distributed (i.e. spatially dispersed) and has opened new possibilities for ownership models. Moreover, increased demand flexibility, both through virtual storage and batteries, becomes more important to keep the grid balanced with an increasing share of intermittent energy resources. When combined with the social issues of energy poverty and energy justice, there has been an increased interest in what types of social innovation are emerging to respond to these developments. In particular, collective action initiatives (CAIs) (e.g., energy collectives, positive energy districts, wind power cooperatives, etc.) demonstrate how local communities and grassroots movements can potentially shape the energy transition and support sustainable development to a greater degree. |
| Project assignment: | This project focuses on the social innovation aspects of CAIs, how they align their interests and motivations, how they are mobilize people and resources, what barriers they face, and how they succeed or fail in acquiring power and influence. We also consider their emerging role and the potential positive and negative impacts they may have on the energy system. The project seeks to identify common themes, factors, and components for CAIs, and ultimately produce policy recommendations for how to support CAIs in terms of the larger goals of energy justice and sustainable development.  The project uses an inductive, case study approach, focusing primarily on CAIs within Europe. Examples from other regions of the world could also be useful as additional case studies. The student will study cases in depth and analyse their context, the parameters that led to success and failure and their impact. The specific master's project will be developed by the student and supervisor to focus on a particular aspect of CAIs, based on the student's interests, background, and future career aspirations. |
| Prerequisites, theoretical background: | The student should be familiar with or interested in:   * sustainability transitions theory, * energy poverty * energy justice * social movements |
| Potential DTU Institute(s): | DTU Management |
| Additional information | More info can be found here: <http://www.comets-project.eu/> |