

MASTER THESIS 2016 - 2017

ME3

European Joint Master in Management
& Engineering of Environment
and Energy

Thesis Defense Schedule :

10th and 11th July, 2017

13th September, 2017



Graduate Engineering School
FRANCE



IMT Atlantique

Bretagne-Pays de la Loire

École Mines-Télécom

9h



Cristina DOMINGUEZ - Guatemala
Tecnalia Research and Innovation (Derio, Spain)
Energy Modelling and Assessment of Energy Transition Strategies of Nantes.

Tecnalia is the largest technological corporation for applied research in Spain, which focuses on seven business divisions. Within the Energy and Environment division, the Energy Efficiency unit aims to support the authorities in their actions towards a low-carbon economy, conceptualizing energy efficient Smart Cities and urban planning. Following that objective, this thesis consists on the assessment of the first pilot city (Nantes, France) of the EU Commission-funded project: MySMARTLife, which belongs to the scheme Horizon 2020, and aims to achieve the energy transition of European cities by applying strategies of sustainable urban planning. These strategies will occur as well in pilot cities of Germany and Finland; then they will be replicated in other follower cities. For the analysis of Nantes, it is made a city-scale simulation of the current energy demand-supply scenario; subsequently it is forecasted for next 10-20 years. At a district level (Île de Nantes), evaluations of interventions such as renewable energies in buildings and energy efficiency measures are calculated. These evaluations consist on technical, financial, and environmental studies, as well as socio-economic impact analyses at a local level applying the input/output model. This proposed methodology will be used as starting-point for the assessment of the next cities.

10h15



Nikita SHETTY - India
Fraunhofer IAO (Stuttgart, Germany)
Development of tool to accelerate replication of smart city solutions across Europe.

The Fraunhofer Institute for Industrial Engineering (IAO) is an applied research institution heading the European initiative called "Morgenstadt". It aims to accelerate the sustainable development of cities by facilitating cooperation between cities and industry on future technologies. Though numerous Smart City pilot projects have been realized across Europe over the last decade to kick-start a mass market for smart city developments, the rate of replication of these projects has been limited. Meaning that lessons learned, determining factors and other relevant information have not been passed to the relevant actors in scale-up cities. Hence, as part of the EU HORIZON 2020 Project Triangulum, Fraunhofer IAO aims to develop a tool which would help cities replicate existing Smart City Solutions. A Smart City Solution is an integrated set of technologies aiming to provide more benefits to stakeholders than the sum of its parts. This Master Thesis involves understanding the challenges associated with replicating a project and analyzing ways to foster replication. This information would further be used to develop a tool that helps cities find relevant, existing Smart City Solutions and provides the necessary information and process for successfully replicating them.

11h30



Johanna PEREZ - Venezuela
Perspectives Climate Change S.L. (Alicante, Spain)
**Assessment of Climate Change Mitigation Actions
in 20 Mediterranean cities.**



Perspectives Climate Change offers leading expertise in consultancy on mitigation and adaptation projects for private and public sectors worldwide. The actions towards climate change mitigation are diverse, including measures such as transition to renewable energies and adoption of energy efficient technologies, and its application to transport, residential, commercial, industrial and agricultural sectors. Recently, an increasing number of cities authorities have been merging these actions under Low-Carbon City Programs (LCCP). In this study, LCCPs of 20 Mediterranean cities are assessed applying World Bank's Mitigation Action Assessment Protocol (MAAP). The World Bank's Networked Carbon Markets (NCM) initiative has developed the MAAP to assess mitigation actions (MA) according to a common metric, enabling to:

- Support the design and implementation of different MAs
 - Enhance comparability of MAs
 - Increase investor confidence in the viability of the MAs and support risk assessment
 - Provide inputs for decisions related to carbon markets and mitigation outcomes' trading
- The data is collected from publicly available LCCPs and interviews to cities' representatives. The project outcome is a quantitative analysis of the design, management, finance and development benefits of each city program.

14h



Aashis JOSHI - Nepal
ArcelorMittal (Maizières-lès-Metz, France)
**Feasibility study of valorizing waste heat from steel reheating
furnaces.**



ArcelorMittal is the world's largest integrated steel and mining company with 260,000 employees worldwide. Steelmaking is an energy-intensive process, and ArcelorMittal aims to optimize its processes to be more energy efficient. The internship project is the evaluation of the technical and economic feasibility of valorising waste heat from reheating furnaces in steel production plants where the heat cannot be reused internally. Working with data from three European plants, my task is to find the best technical and economic solution for using waste heat--whether to generate electricity or use for district heating, etc.--depending on the local energy context. I will also explore opportunities to fund the project through investment from energy service companies (ESCOs) or through incentives for energy efficiency and waste heat recovery. The end goal is to develop a business plan to propose to ESCOs along with an aided-decision tool for ArcelorMittal plants.

15h15



Marco DURAN - Costa Rica
2° Investing Initiative (Paris, France)
**Developing a framework to design decarbonisation scenarios to
assess energy transition risks in financial analysis.**



The 2° Investing Initiative (2°ii) is a leading global think-tank working to align the financial sector with Climate-related metrics and policies in financial markets. 2°ii is based in Paris, and it has offices in New York, Berlin and London. Their work focuses in the alignment of the financial sector with 2°C climate goals, developing the metrics and tools to measure the climate performance of financial institutions and mobilize regulatory and policy incentives to shift capital to energy transition financing. The master thesis is carried under the Energy Transition Risk (ETR) project, aimed at improving the attractiveness of sustainable energy investment. The master thesis is focused in developing a framework for building decarbonisation scenarios that can be integrated in the assessment of a company's exposure to financial risks associated with the energy transition towards low-carbon economy. The work includes collaboration for developing the ET Risk scenarios for targeted sectors defined by the project, mapping and extrapolation of current policy and market trends, data processing of available scenarios (e.g. IEA-ETP) and based in financial models from the project's partners, along with contributions in the drafting for the publication of results and in the development of consultation tools to facilitate the utilisation of the scenarios for investors.

9h



Alfonso Julio DE LA CRUZ TORRES - Peru

Division of Energy System Analysis dESA - KTH (Stockholm, Sweden)
Assessment of the Santa Eulalia River sub-basin on the long-term electricity system planning of Peru.



KTH Royal Institute of Technology is a leading university in Sweden and dESA, its Division of Energy System Analysis, which is committed to analyze, assess and chart out the economic, social and environmental performance of energy and related resource systems, mainly in developing countries. One of these countries is a recent role model of economic development in the Latin-American region: Peru. Its energy demand is increasing, specifically electricity that grew up 8% over the past years and 54% is generated in hydropower plants at national level. For Lima, the capital, Santa Eulalia River sub-basin is strategic both for water use and electricity production activities. The objective of this thesis is to identify potential pressure points in the water-energy interactions at two scale-levels: National level and Santa Eulalia river sub-basin level. The methodology is based on the development of an electricity system model using the Open Source energy Modelling System (OSeMOSYS), soft-linked with the Open Source Spatial Electrification Tool (ONSSET) to complement the electrification access analysis, both strategically framework-linked to Climate, Land, Energy and Water (CLEWs). Results are expected to provide interesting insights that could ultimately contribute to a better understanding of water -energy interactions and policy design.

10h15



Omar HUARCAYA - Peru

Elia Grid International GmbH (Berlin, Germany)
Development of Demand Side Response Business Model in the German Market.



Elia Grid International (EGI) is a daughter company of the Elia Group, one of the leading-edge TSO groups in Europe. EGI aims to provide consultancy and engineering services based on its proven expertise and hands-on experience of their homebased TSO's, Elia the TSO in Belgium, and 50Hertz the TSO in northern and eastern Germany. EGI's core business is to deliver innovative energy solutions to a variety of international clients that includes central government departments, ministry of energy, regulators and system operators as well as private investors seeking to move towards low carbon energy transition. The scope of EGI's advisory service goes from grid development, power market design, regulatory framework adaptation, renewable integration and assets management. The master thesis aims to develop a business model based on Demand Side Response as an additional market mechanism for system optimization and management. This work stress to explain revenue streams and feasibility assessment applied to the German market. The innovative solution provides an economic prospect as well as technical benefits which support handling the increasing rate of renewable penetration into the power system.

11h30



Michael ANEES - Egypt

SOWITEC Development GmbH (Sonnenbühl, Germany)
Technoeconomic study of large scale battery storage systems.



SOWITEC group, established in 1993, is an internationally active developer for wind and solar power projects with a strong focus on Latin and South America with about 1.5 GW of installed capacity currently in operation or under construction. SOWITEC is considering a variety of promising energy storage strategies, in both application and scale. However, the direction to which main storage technology solutions will eventually evolve is yet unclear. The project involves carrying out a techno-economic study on projects being developed in Latin America. The study should determine if battery storage is feasible for certain applications. The applications considered are arbitrage (load shifting), peak shaving, power smoothing, and injection-point-upgrade deferral. Next to the techno-economic studies on energy storage, the project includes carrying out support work for the department of development. This includes reviewing wind and solar met mast measurements (wind speed, wind direction, temperature, humidity, pressure, and solar irradiation), and reporting sensor anomalies. Later this data is used for wind and solar energy assessment.

14h



Cecilia FURTADO BERGMAN - *Brazil*

Carbonium (Paris, France)

Climate change: a major challenge for developing countries - the role of international funds.

Carbonium is an independent company specialized in strategic consulting in sustainable development and climate finance. Its fields of expertise cover mitigation (renewable energies, energy efficiency, greenhouse gas reductions) and adaptation (natural resource management, rural development, etc.) in developing and emerging countries. Even with the 2 degree max global warming target decided under the Paris Agreement, the world is about to face climate change environmental consequences, faster than before. These consequences include more extreme weather conditions, with more frequent floods and droughts, which will lead to loss of biodiversity, coastal damage, and loss of agricultural land, among many others. Climate change has a disproportionately stronger impact on the lives and livelihoods of those societies which depend on the natural environment for their day-to-day needs. To address the pressing mitigation and adaptation needs of developing countries, international financial resources are provided by developed countries, such as the Green Climate Fund (GCF). The agreement is to mobilize USD 100 billion per year by 2020, to fund projects aiming to reduce GHG emissions, decarbonize emerging and developing economies, adapt to the impacts of climate change and reduce poverty, increasing population resilience and empowerment. This project aims to discuss the role and importance of climate funds in the development of developing countries. To analyze and discuss some project cases and how they contributed to the countries to help them deliver meaningful climate action.

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9h



Siddharth KRISHNA SWAMY - *India*

Energy Research Center of Netherlands

ECN (Petten, The Netherlands)

Short-term decision making support tool for Operation and Maintenance (O&M) of Offshore Wind Farm (OWF).

ECN, The Netherlands' largest energy research institute, develops new technology and conducts pioneering research, creating solutions to facilitate the transition to sustainable energy management. In order to achieve targets set by the EU to increase its share of renewable energy to 20% by 2020, The Netherlands sees offshore wind as one of its most promising areas of investment. However, offshore wind parks tend to be more expensive than their onshore counterparts, in part due to the complexity of operations & maintenance (O&M). O&M costs contribute up to 30% of an offshore wind farm's life cycle cost. To facilitate operators of an offshore wind farm optimize their short-term O&M strategies by reducing their maintenance cost and increasing output, ECN is developing a software tool called "ECN Despatch". The objectives of the master thesis focus on further developing this tool, for planning daily maintenance activities on offshore wind farms. Certain areas of work identified include developing a demonstration front-end interface for the tool, creating a more sophisticated and robust back-end logic for determining the optimum maintenance schedules, and performing case studies to determine the effectiveness of the tool in terms of financial and energy savings with the use of real wind farm data.

10h15



Andrés SOUZA SOSA - Mexico

MicroEnergy International (Berlin, Germany)

Design and analysis of innovative business models for the sustainable dissemination of Improved Cook-Stoves in Colombia.



MicroEnergy International is a consulting company based in Berlin, Germany, which is dedicated to mobilising and supporting financial, technical and scientific actors to provide households and micro-entrepreneurs at the Base-of-the-Pyramid with reliable, affordable and sustainable energy solutions. It has more than 15 years of experience on more than 30 countries in Latin America, Africa and Asia. Following its mission of improving access to renewable energy and energy efficiency technologies for the 2.6 billion people that still rely on fossil biomass for cooking worldwide, the goal of this thesis is to propose and discuss innovative business models that can successfully and sustainably support Colombia's transition from the current assistance-based approach for the dissemination of improved cook-stoves to a market-based approach. Moreover, it aims to identify potential challenges and opportunities, as well as to draft recommendations for the actors involved through the whole value chain, paying special focus on entrepreneurs and SMEs, and the formation of strategic alliances within the concerning actors in the sector.

11h30



Kazim Raza SYED - India

Volvo Group Trucks Technology (Gothenburg, Sweden)

Experimental Characterization of Li-Ion Battery cells for Thermal Management in Heavy Duty Hybrid Applications.



The Volvo Group is one of the world's leading manufacturers of trucks, buses, construction equipment and marine and industrial engines. The Volvo Group also provides complete solutions for financing and service. Within Volvo, the division of Group Trucks Technology carries out research and product development of complete vehicles, powertrain, components and service offering. The temperature at which Li-ion battery cells operate can have a significant effect on their performance and life. The overall performance, the dynamic response and the efficiency are all dependent on the battery cell operating temperature. This work focuses on the development of experimental methods to measure thermal output & properties of the battery cells. Suitable testing equipment will be built to enable accurate measurement of cell specific heat capacity, thermal conductivity in three dimensions, and heat generation during charge/discharge profiles. The experimental data will be extracted for several types of Li-ion cell technologies.

14h



José Fernando DIAZ NARVAEZ - Honduras

Akuo Energy (Paris, France)

Hydropower and Solar Photovoltaic Power Plants Development.



Akuo Energy is a French Independent Power Producer, with presence in Europe, North and South America, the Caribbean, Asia, Africa and Australia. The company is dedicated to the development, construction and operation of renewable energy projects within a wide range of technologies, such as Hydropower, Solar PV, Biomass, and Ocean Thermal. In the current global effort of transitioning from energy derived from fossil fuels to renewable energy technologies, the policies, legal framework, environmental standards and the energy market differ from country to country. Under this context, this master thesis will present a comparison between the different stages required to deploy hydropower and solar photovoltaic power plants. A broad view will be shown, including the main technical steps to follow as well as the most important legal, environmental, social, administrative and financial milestones that must be accomplished in order to build and operate power plants with the different renewable energy technologies. For this matter, the region of South America, specifically Colombia and Peru, will be used to illustrate the different stages.



Luis Fernando ALAY LEMUS - Guatemala

International Renewable Energy Agency (IRENA) (Abu Dhabi, United Arab Emirates)

Investment Statistics: Public Funding of Renewable Energy.

The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future, and serves as the principal platform for international cooperation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. In recent years, the deployment of renewable energy (RE) projects around world has increased significantly. These RE projects are an essential component of the climate mitigation strategy implemented by many countries. The financing of RE projects in some cases depends on financial support by various global, regional or bilateral financing institutions. Under IRENA's investment statistics the role of public funding for renewables are analyzed based on the different variables involved, such as RE technology, amount to be financed, financing instrument, financial institutions involved, geographical location etc. The project includes the following:

- Primary data collection on renewable energy financing through desktop research
- Secondary data collection for specific research questions and case studies
- Drafting concise summaries of key findings of the analysis and recommendations to policy makers



Daniyar BATYROV - Kazakhstan

Indar Energy (Paris, France)

Study of the impact of the use of electricity on the prices of fossil materials.

Indar Energy is company which provides services and expertise in energy fields. The Company is involved in consulting and brokering on energy deregulated markets: power, natural gas, coal, cogeneration, energy saving certificates, renewable energies, CO2 emissions. Customers of Indar Energy are companies that require support on new volatile and non-mature markets to control their energy portfolios through data monitoring and analysis. The main aim of the Master Thesis is to find correlation between the prices of secondary and primary energy sources, make a study on how electricity produced from non-conventional sources can influence energy market prices. Besides the thesis, intern in the Company is involved in development of daily, monthly market analysis reports, provision of support on advisory and consulting projects.





Maresa BUSSA - Germany

Song Saa Foundation (Phnom Penh, Cambodia)

Developing a Demonstration Garden to Nurture Climate Change Resilience in the Koh Rong Archipelago.

The Song Saa Foundation is committed to supporting «the health and wellbeing of the environment and local communities through programmes that promote environmental and social sustainability» (www.songsaa.com). The Koh Rong Archipelago (KRA) is located in south-west Cambodia, with it's estimated 3000 inhabitants relying on natural resources for their livelihood. Because of limited economic opportunities the archipelago communities are particularly vulnerable to the impacts of climate change. The project aims to create a demonstration site where villagers can observe vegetable and crop growing strategies that enhance resilience in the face of climate change. The main parts of the project are:

- evaluation of potential impacts of climate change on the KRA
- exploration of climate change resilient vegetable and crop growing strategies
- investigation of mitigation strategies such as soil improvement and water conservation
- the development of educational materials
- the design of a demonstration climate change garden, with accompanying plans and budget
- construction of associated communication materials
- community evaluation and feedback into the ongoing development of the garden

With my tutor and the Foundation's community coordinator I am collaborating on the accomplishment of this project.



Isaac CAMPERO DEL ANGEL - Mexico

Clarity (Madrid, Spain)

Development of intuitive Environmental, Social and Governance metrics for financial digital investments tools..

The Thesis project at Clarity addresses the current challenge of providing understandable and intuitive metrics for individuals interested in Sustainable Investing. The focus of the project relies on screening the current methodologies from Environmental Social and Governance, Corporate Social and Responsibility and other additional important existing global metrics such as United Nations seventeen sustainable Development Goals among others. A selection of the specific indicators and Key Performance Indicators will be proposed and standardized in a way that a common framework can be used to evaluate multiple companies and provide a final output/result with intuitive Sustainable ratings based on:

- Environmental qualities such as resource usage, GHG emissions, carbon emissions, energy efficiency, energy waste, product footprint.
- Social qualities such as human capital, employment quality, health and safety, diversity, employee satisfaction, chemical and product safety, access to health care, etc.
- Governance qualities such as financial and operations transparency, Product Financial safety, Compensation policies.



Jean Joseph DORISMOND - Haiti

ALBIOMA SOLAIRE ANTILLES (La Trinité, Martinique)

Life cycle assessment of two rooftop-mounted 250 kWp PV Systems in Martinique.



Albioma Solaire Antilles is a subsidiary of the group Albioma which is an independent power producer company that develops and operates projects in three promising activities in the French energy industry and internationally: Coal/bagasse Cogeneration power plant, biomethanisation and solar energy. Being aware of the climate change, the company aims to produce cleaner energy and to have a responsible and sustainable approach in its development perspectives. As for solar energy, in 2016, the company had a total installed capacity of 75 MWp. 80% of this capacity is in the French Overseas Territories with high solar irradiation. Accordingly, the aim of this master thesis is to:

- Quantify the non-renewable primary energy use and GHG emissions from electricity generation of two rooftop-mounted 250kWp PV systems designed by Albioma Solaire Antilles and located in Martinique. The first PV system was built in 2010 and the second one is a proposed system for a bid called by the French Energy Regulatory Commission in September 2016.
- Assess the improvement in terms of reduction of GHG emissions and non-renewable primary energy consumption between the two systems.
- Find the optimum PV power system with a lower environmental impact for 1kWh of electricity produced.

The results of this study will allow the company's project developers to design cleaner PV energy System.



José Ignacio FUENZALIDA - Chile

R.O.L.E. Foundation (Bali, Indonesia)

R.O.L.E. leading the challenge of zero waste to the Balinese sea by implementing sustainable systems.



R.O.L.E Foundation is a non-profit organization which mission is to minimize environmental damage, specially preventing solid waste reaching the ocean by educating local communities on sustainable energies and waste management systems. To do this R.O.L.E. is constructing an Environmental Education, Research and Demonstration Center in a local council. A recent World Economic Forum publication states that by 2050, in a business-as-usual scenario, the weight ratio of plastic solid waste (PSW) to marine life will be greater than one. One of the countries polluting the most in the world is Indonesia, and particularly, Bali, a hinduist island where tourism represents around 80% of its economy. If no actions are taken, people will lose their jobs, suffer from health issues and cause irreversible damage to the environment. This internship aims, while applying the principles of circular economy, to develop and create a small-scale sustainable energy and waste management model for the Center. The main tasks are the design and implementation of three systems: off-grid energy solutions (solar panels, biogas, among others); grey and black water waste treatment and the upscaling treatment for solid waste. The outcome will be a model able to be replicate in other councils of the island.



Yu-Han HORNG - Taiwan

Institute for Climate Protection, Energy and Mobility - IKEM (Berlin, Germany)

Business model for addressing the landlord tenants dilemma for the thermal services in residential buildings.



IKEM is an institute that examines the legal and political frameworks in the fields of climate protection, energy and mobility from an interdisciplinary, integrative and international perspective. This study is part of the large-scale initiative “Kopernikus”, which was launched by the German Federal Ministry of Education and Research with the aim of developing innovative technological and economical solutions for the transformation of the energy system. In a high house renting rate city, such as Berlin, one of the major barriers for improving energy efficiency agenda is the investor-user dilemma. As landlords often do not live in the same flat with the tenants and usually have no problem finding new ones, there are limited interests for the landlords to maintain or upgrade their household facilities. However, tenants, on the other hand, would like to cut down on their bills with new technologies such as solar thermal collector, or smart thermostats, etc. Through examine the investor-user dilemma, stating crucial actors, and investigating best practices, this thesis project intends to shed a light on possible business model that could be applied to this dilemma and mold it for the thermal services in the residential buildings.



Rodrigo VARGAS LOMELI - Mexico

Veolia Environnement Research and Innovation - VERI - (Limay, France)

Potential Evaluation for Industrial Symbiosis.



Veolia assists cities and industries to manage, optimize and make the most of their resources. The company develops innovative technologies, provides alternative solutions and designs efficient ways to deal with water, energy and materials – with a focus on waste valorization –. Closed-loop thinking is at the heart of its business and industrial symbiosis is one of the solutions that Veolia propose to its clients to promote the transition toward a circular economy. Industrial symbiosis is an association between two or more industrial facilities or companies in which the wastes or by-products of one become the raw materials for another. The research and innovation department of Veolia (VERI) is focused on creating a decision-making tool that helps technical units evaluate the potential of different possible symbiosis within a defined perimeter. The first study case is identified: an industrial park that hosts chemical, textile and wood industries, and where Veolia provides utilities for its industrial clients. The tool should also assists business units in finding industrial synergy opportunities that add value (e.g. economic, technical and environmental). To make this possible, a database should be created and the evaluation process should be detailed; therefore, the aim of this project is twofold:

- Identify the needs (inputs and outputs), materials, energy and water for three industrial sectors: i.e. pharmaceutical, paper and dairy.
- Define key performance indicators (KPIs) to account the impact on each stakeholder engaged in the symbiosis and the park as a whole



Gaurav VISVANATHAN - India
Zoetic Energy (Washington, USA)

Developing a product mobilization program for hydrokinetic energy solution.



Zoetic Energy is a US-based project developer committed to being the world's leader in utility-scale hydrokinetic energy production. Their focus is to capture the enormous amount of energy present in the outflow of existing dams. Leveraging existing infrastructure like dams and deploying the modular turbines avoids additional environmental harm and societal displacement. Zoetic's hydrokinetic solution consists of an array of individual, submerged turbines that are rapidly deployable. The hydrokinetic turbines are economically compelling with competitive CAPEX and minimal OPEX. This solution, is the only renewable energy solution that can provide additive baseload power. The work of the internship encapsulates the following:

- Establishing a product mobilization program that involves rapid deployment models, measurable processes and training procedures.
- Participating in the project management of their power-purchase agreements by building out an end-to-end project deployment plan and schedule.
- Develop a competitive research matrix and provide regular industry updates to the leadership team.
- Provide research on energy portfolios of countries, hydro dam opportunities, economies of the project in which determines the prioritization of project deployments.

