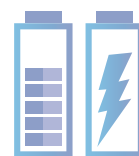
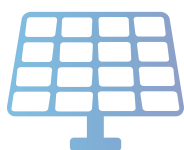


DENSYS

MASTER ERASMUS MUNDUS DECENTRALISED SMART ENERGY SYSTEMS



MASTER'S THESES 2020-2022



With the support of the
Erasmus+ Programme
of the European Union



Politecnica
di Torino



UNIVERSITAT POLITÈCNICA
DE CATALUNYA
BARCELONATECH

Internships and Master Thesis of the cohort 2020-2022:



Fabrice Lemoine,
Chair of DENSYS

To fight global warming, a transition towards a low carbon energy is required: renewable energy sources integration along with decarbonized energy carriers production, decarbonization of the final uses of the energy to achieve the ambitious objective of a carbon neutral world by 2050.

Decentralized smart energy systems play an increasing role in the perspective of renewable energy sources integration. This is the spirit of DENSYS. The overall goal of the DENSYS is to educate with multi-physics approaches (electrical, mechanical, chemical engineering) top skilled engineers, who will be able to design, size, optimize and operate decentralized smart energy systems while keeping a holistic vision to understand citizens' needs

DENSYS is a European Union funded program, coordinated by University of Lorraine (UL, France), jointly built with the Royal Institute of Technology (KTH in Stockholm Sweden), the Polytechnic Institute of Torino (PoliTo, Italy) and the Universitat Politècnica de Catalunya (UPC in Barcelona, Spain).

DENSYS implements the "T-shaped" education profile, the vertical bar of the T being the core competences in engineering (namely mechanical, electrical and chemical engineering) and the horizontal bar complementary competences that are required to have a holistic vision and to engage the dialog with different stakeholders.

DENSYS provides a solid training in engineering and also competences in economics and humanities. These last are of primary importance since the energy transition is mainly a human and societal concern. DENSYS is also an intercultural experience, which enables us to share local contexts which are so important to develop relevant and efficient energy solution.

DENSYS aims at training responsible engineers and researchers, but also ambassadors of new energy technologies and of the energy transition and citizens of a world that must urgently shift towards a climate neutral one.

As part of their training, DENSYS students complete a long-term internship and a master thesis. The diversity of internship subjects testifies both to the open-mindedness of the students, their intellectual agility and their ability to invest in advanced technologies of energy systems (renewables, heating and cooling), integration of renewables in networks, energy technology management, energy prospective or market analysis in the perspective of massive electrification, implementation of cross sectorial skills such as in the hydrogen sector or power to X, energy storage.

Among the 21 students (cohort 2020-2022), internships are carried out in the following sectors:

- Hydrogen: 5
- Energy forecast/market analysis: 5
- Integration of renewables, grid, power electronics: 5
- Renewables, clean heating and cooling: 3
- Energy storage: 3

They are shared between large international groups, SMEs or even in research laboratories, spread throughout the European Union. I let you discover our students and their master thesis topics.

Cohort 2020-2022:



**Johnchemberleen
Odira AJOAGU**



**Gbemileke Thompson
AKINYOKUN**



**Tea
ALIKAJ**



**Erasmo Elias
ALVARADO ALVARADO**



**Myriam Paola
APONTE GUZMAN**



**Andrea Catalina
BUITRAGO OTALORA**



**Adriana Carolina
CAMPOS RODRÍGUEZ**



**Nathaniel
ELI JUNIOR**



**Muhammad
Shehryar HAMID**



**M A Munaim
HOSSAIN**



**Mashiul
HUQ**



**Allen Masimba
JASI**



**Simran
MASOOD**



**Yashwant
MENTE**



**Indira Alejandra
OCHOA MEJÍA**



**Samuel Ayomipo
OGU-EGEGE**



**Carlos Miguel
PEREZ VILLANUEVA**



**Mohammad
ROOZBAHANI**



**Rida
SOHAIL**



**Muhammad
TAIMOOR**



**Olga
VOKUEVA**

Johnchemberleen Odira AJOAGU



Email :

Johnchemberleen.ajoagu@gmail.com

B.Eng. in Mechanical
Engineering at the University
of Nigeria, Nigeria

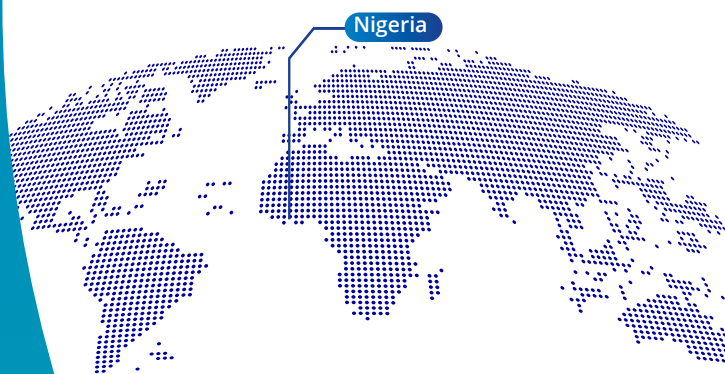
Mobility scheme



UNIVERSITÉ
DE LORRAINE



UNIVERSITAT POLITÈCNICA
DE CATALUNYA
BARCELONATECH



“

It
feels good
contributing to
something bigger
than myself
metaphorically
and literally.

”



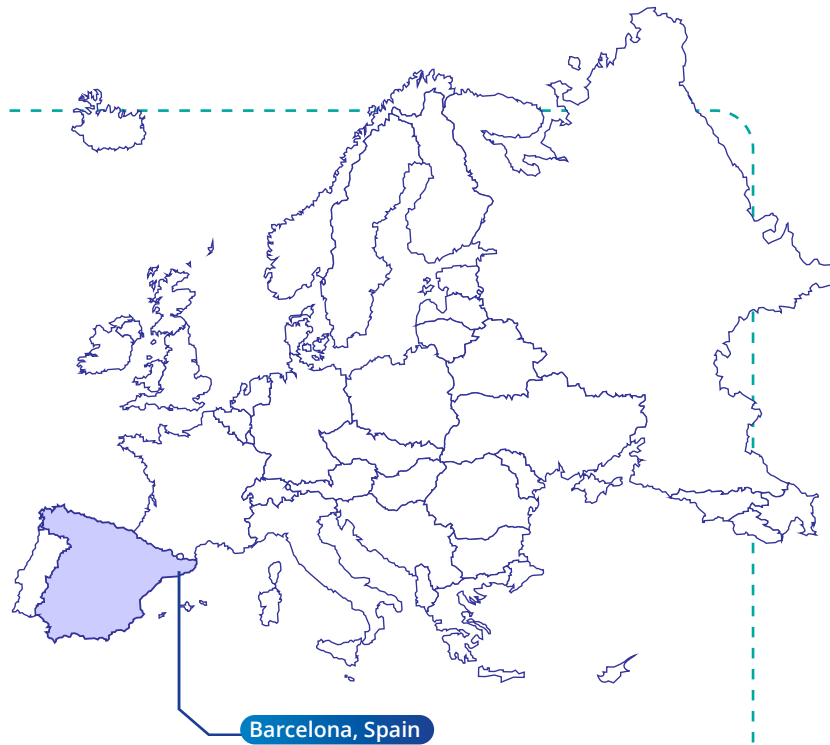
Company



GE Renewable Energy

GE Renewable Energy

GE Renewable Energy harnesses the earth's most abundant resources – the strength of the wind, the heat of the sun and the force of water; delivering green electrons to power the world's biggest economies and the most remote communities. 90% of the world's utility grids rely on her grid solutions and it manufactured 25% of the world's hydropower installations.



Master's thesis title

Thermal Modelling of Wind Turbine Generators



The development and deployment of an offshore wind turbine are particularly paramount in the context of a decentralised energy system. It is an economically feasible way to power Islands and drilling ships. However, the operation of wind turbine generators leads to heat generation due to electrical resistance and friction. Temperature control is essential because it determines the reliability, lifespan and net power produced by the turbine. During the course of this internship, I completed the development of a thermal software tool for the temperature prediction of the generator's parts. To further improve the computational time, a machine learning (ML) model relying on data from the thermal software was developed. This ML model coupled with a similar electromagnetic prediction model is used in the design of feasible operating points of future turbines. Furthermore, the tool helps

to estimate the lifespan of the generator considering the proposed operating conditions. In all, the tool informs the design decision from the thermal perspective which is geared towards the improvement of the turbine's annual electricity production (AEP) or its lifespan.

Through this internship, I have successfully stretched the limits of my ability to adapt and learn new skills by utilising my knowledge of energy systems, thermal engineering, and a rich background in computer programming to contribute to the further development of the Haliade-X wind turbine, which currently holds the record for the world most powerful offshore wind turbine.

Gbemileke Thompson AKINYOKUN



Email :

thompson.akinyokun@gmail.com

Bach. in Electronic and
Electrical Engineering at
Obafemi Awolowo University,
Nigeria

Mobility scheme



UNIVERSITÉ
DE LORRAINE



Lagos, Nigeria



The act of
LEARNING starts
by **DOING**, and by
continuously doing,
learning is gradually
accomplished...embrace
the process and have
FUN while at it...
Do, Learn, and
have Fun!





Company

CEVT

China Euro Vehicle Technology AB (CEVT)

CEVT is an innovation and development company at the forefront of mobility. Recognized for modular development, ground-breaking virtual engineering, software development and continuous innovation, the company delivers services to different automotive brands within the Geely group, including Volvo Cars, Geely Auto and Lynk & Co, alongside other clients worldwide.

Gothenburg, Sweden



Master's thesis title

Adaptive Modeling and State Estimation for Lithium-Ion Battery Management in Sustainable Energy Applications



The transition towards climate sustainability has seen electrification of both the energy and transport sectors take center stage in modern times. For this to work in several scenarios, battery energy storage (BESS), particularly Lithium-ion technologies have and will continue to play a pivotal role. A challenge that has emerged involves accurately estimating the state of charge (SOC) and other state of function of the battery in real time, especially with advancements in electric vehicle and smart grid applications where this information is needed to ensure safety, protection, and optimal usage and performance in the host application.

Against this background, this thesis is aimed towards developing a dynamic model and battery estimation algorithm for Li-ion cells in sustainable energy applications. To accomplish the goals, NMC Li-ion cells were set up in a temperature chamber and subjected to varied tests under different SOC-windows. The experimental data obtained was used to parameterize and calibrate an equivalent circuit model of the cell. This model was in turn used alongside an extended Kalman filter to accurately estimate the cell SOC and other state of function while also updating the parameters.

The results so far indicate that accuracy of the estimation will be a trade-off with model and algorithm complexity which may grossly increase computational time and cost, bringing about the need to critically assess the specific application before deployment. Moreover, life cycle assessment and multicriteria analysis are expected to offer insights on the sustainability of the cell technology and potential future applications, with ongoing experimental drive cycle tests expected to show a correlation between capacity loss and SOC at different windows.

Tea ALIKAJ

**Email :**

tea.aliko@gmail.com

Bach. in Environmental
Engineering, Polytechnic
University of Tirana,
ALBANIA

Mobility scheme

Albania

“ It has
been the most
inspiring and
purposeful experience
to be part of a collective
work to make energy
transition science
based, just,
democratic and
inclusive. ”



Company

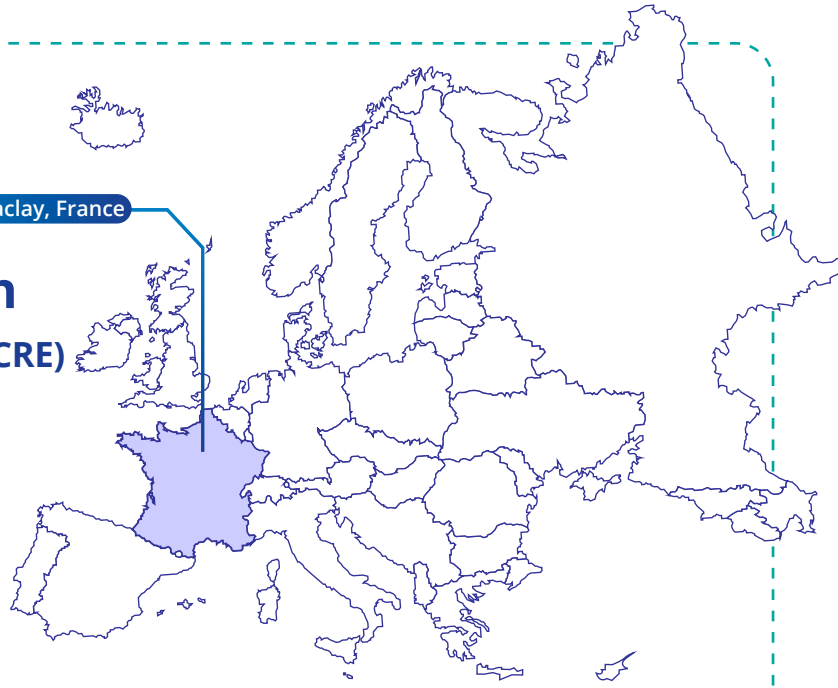


ANCRE

Paris-Saclay, France

National Energy Research Coordination Alliance (ANCRE)

The internship is placed under the aegis of the National Energy Research Coordination Alliance (ANCRE), bringing together 4 founding members - research organizations- (CEA, IFPEN, France Universités and CNRS) and 13 associate members. The alliance coordinates public research policies in the field of energy and acts in favour of public authorities by drafting prospective roadmaps on energy technologies, and by producing quantitative or qualitative prospective exercises, at national, European or even global level.



Master's thesis title

Technology and R&D in Net-Zero Scenarios by 2050



Given the ambitious climate targets and the limited time to achieve them, exploring different pathways to reach carbon neutrality is highly relevant and needed. The fundamental importance of this study is to give a global perspective on the development of technologies (mature and emerging) and highlight the main factors that make the technologies a feasible solution or not, considering scientific, economic, social, political and environmental context. This approach aims to achieve accuracy in the estimation and the proposed pathway for reaching the climate targets. Moreover, through this analysis is aimed to be delivered a summary of the bottlenecks that R&D faces and what is needed for further progress, as it can be a helpful foundation for future studies. In addition, knowing that most of scenarios are based on technologies that are still under development, this study also serves as an updated

version of the work previously done with net zero by 2050 scenarios.

Lastly, this study will serve as a base and data supplier for another complementary exercise, which aims to model the future French energy system in the perspective of the net zero target, based on a proper management of the technologies. This model will include the technologies of this study (both from supply and demand side) and their estimated contributions in carbon neutrality scenarios.

Erasmio Elias ALVARADO ALVARADO

**Email :**

erasmoalvarado94@outlook.com

Bach. in Electrical Eng. &
Mechanical Eng. at National
University of Honduras

Mobility scheme

UNIVERSITÉ
DE LORRAINE



Honduras



**The future
is unpredictable,
half of our efforts
go into forecasting
it and the other half
into explaining why
things didn't happen
as predicted. Make a
decision and don't
look back.**





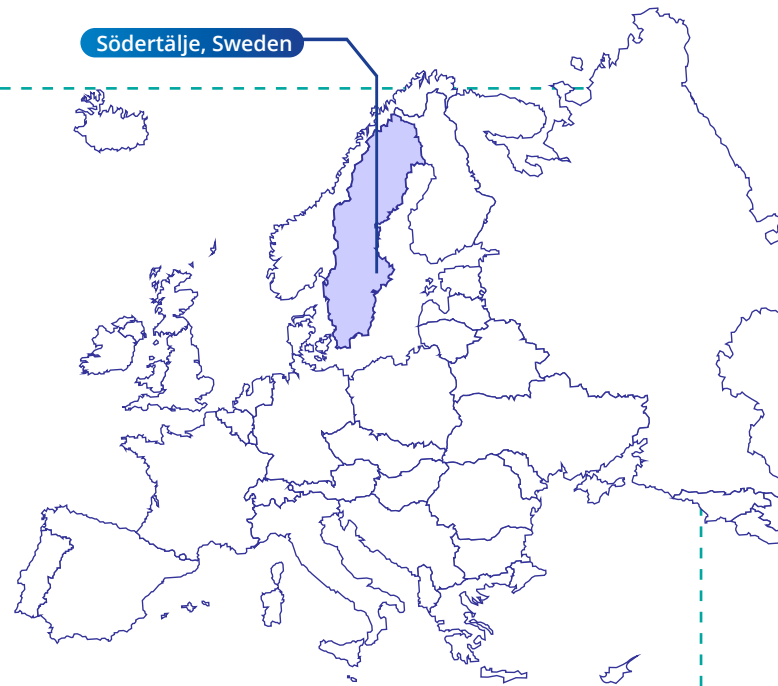
Company



SCANIA

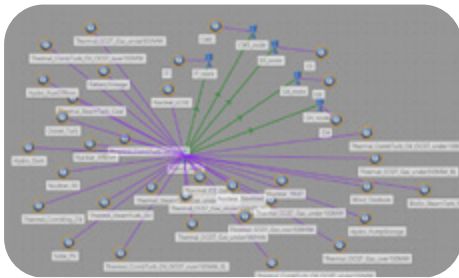
SCANIA CV AB

Scania is a world-leading provider of transport solutions, including trucks and buses for heavy transport applications combined with an extensive product-related service offering. Scania's purpose is to drive the shift towards a sustainable transport system, creating a world of mobility that is better for business, society and the environment.



Master's thesis title

Prognosis of electricity price in Germany & France until 2030



The transformation of the energy sector promoted by decarbonization principles has economic, environmental, and social impacts that deserve to be studied. The accurate prediction of electricity prices has long been a priority for the energy firms and investors in the energy sector, with companies depending on these predictions for risk analysis and investment decision making. The main objective of this Master Thesis project is to create accurate simulations using PLEXOS as a modeling tool to perform long-term forecasting of the electricity price in Germany and France for the year 2030.

With this thesis is expected:

- To develop a comprehensive analysis of the energy sector in Germany and France.
- To examine the energy and climate policies of European countries, and their influence in the Energy market.
- To model the Electrical power systems of Germany and France for the analysis of their electricity markets.
- To forecast the electricity price in the medium and long term for Germany and France, assessing the main factors that impact it.

Myriam Paola APONTE GUZMAN

**Email :**

mypaoaponte@gmail.com

Bach. In Environmental
and Mechanical
Engineering at Universidad
de los Andes, Colombia

Mobility scheme

UNIVERSITÉ
DE LORRAINE



Politecnico
di Torino

Bogotá, Colombia



“

**Every
building is a
unique “universe”
and I have been learning
the “magic” (which is
very complex in fact) of
tailoring solutions to
achieve greener and
more resilient
buildings.**

”

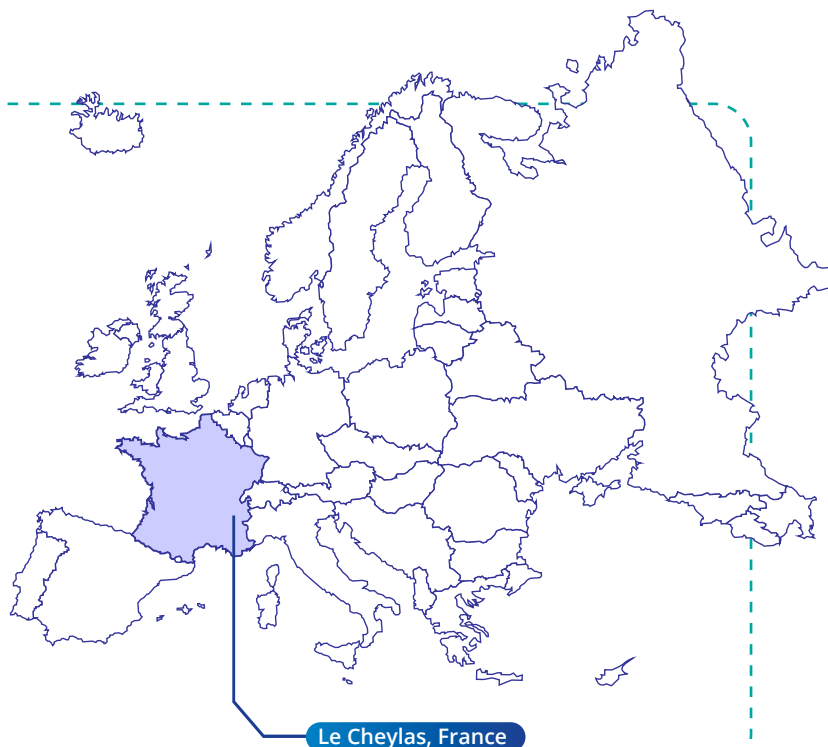


Company

Sylfen

Sylfen

Sylfen's solution, the Smart Energy Hub is a hybrid storage system, based on green hydrogen, that address the problem of intermittence of local renewable energies, mostly in the sectors of buildings, industries, and eco-districts. The innovative solution provides great flexibility for power production and storage thanks to the integration of batteries a reversible solid oxide cell and cogeneration.



Master's thesis title

Energy, environmental, and economic analysis of energy storage projects linked to large buildings using green hydrogen, for the identification of ideal use cases.



The company is looking to increase the penetration of their storage solution using a reversible solid oxide cell into targeted markets. Hence, the identification and documentation of ideal use cases are a very important step towards this objective. This process starts with an analysis to understand the European context regarding availability of the resource, electricity prices and carbon emissions.

Then, the project continues with the understanding of different characteristics and patterns regarding the electricity consumption that are specific to the building sector. Besides the comprehension of the load characteristics, relevant KPIs for the sector are used to provide a clear view of energy, economic, and environmental performance.

The next step is then to tailor the ideal configuration of the Smart Energy Hub for each specific case, with the aim of creating a documentation that

allows to show the maximum benefits this solution can offer. This material should provide Sylfen with clear information on the types of buildings that will benefit the most from the installation of a Smart Energy Hub and will also be useful for potential customers who would want to know about the energy, economic, and environmental benefits of the system.

Andrea Catalina BUITRAGO OTALORA

**Email :**

andreaabo27@gmail.com

Bach. in Electrical
Engineering and Electronic
Engineering at University of
Los Andes, Colombia

Mobility scheme

UNIVERSITÉ
DE LORRAINE



Bogotá, Colombia



“

**It has been
a challenging
experience full
of learnings, trying
to understand the
complexity of Electricity
markets and deal with
the uncertainty of
the future.**

”



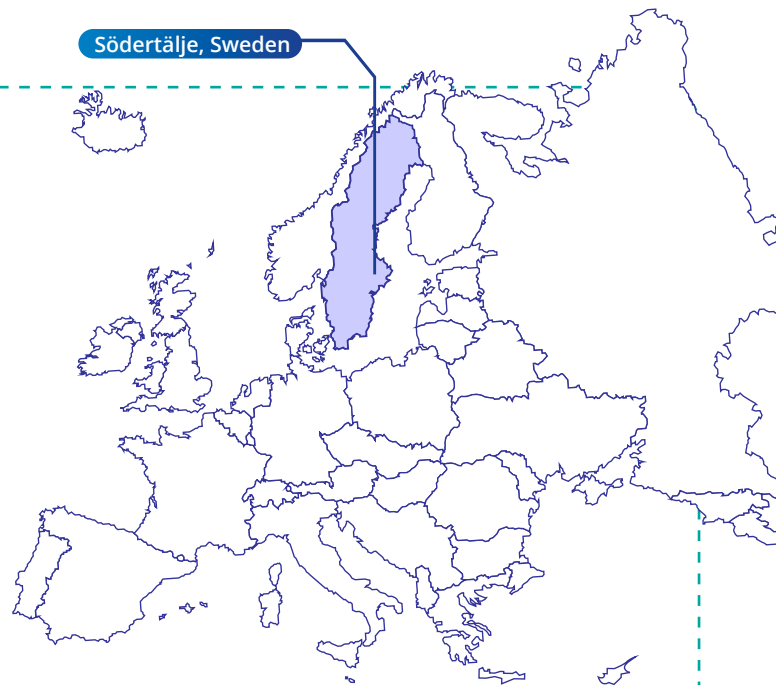
Company



SCANIA

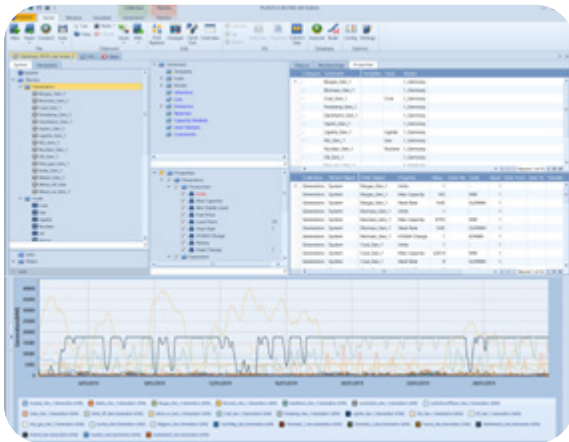
SCANIA CV AB

Scania is a world-leading provider of transport solutions, including trucks and buses for heavy transport applications combined with an extensive product-related service offering. Scania's purpose is to drive the shift towards a sustainable transport system, creating a world of mobility that is better for business, society and the environment.



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- To forecast the electricity price in the medium and long term for Germany and France, assessing the main factors that impact it.

Adriana Carolina CAMPOS RODRÍGUEZ

**Email :**

accamposr@unal.edu.co

Bach. in Electrical
Engineering at National
University of Colombia,
Colombia

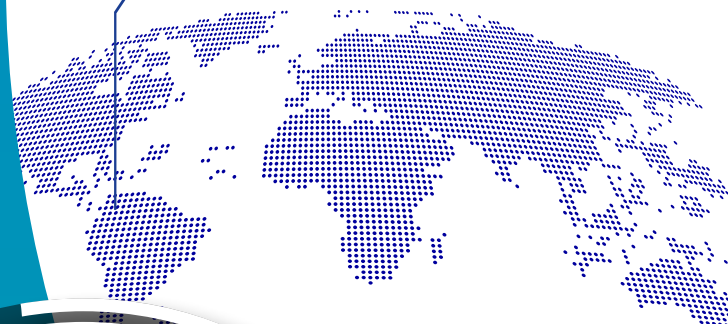
Mobility scheme

UNIVERSITÉ
DE LORRAINE



Politecnico
di Torino

Bogotá, Colombia



“ A relevant
research topic,
up to date with the
efforts to further
develop an MVDC grid,
in an international
environment with
a good mix of
academia and
industry. ”



Company



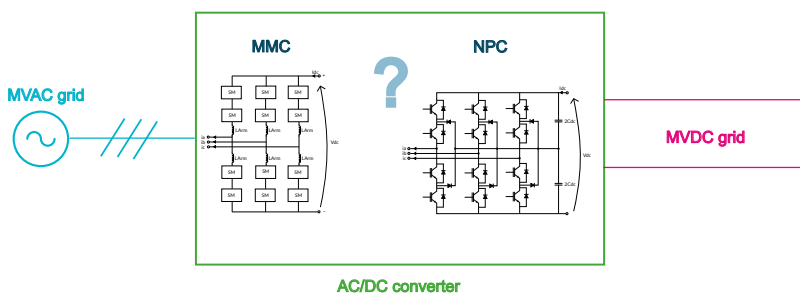
SuperGrid Institute

SuperGrid Institute is a research and innovation center for the future energy transmission system. Its purpose is to contribute to the energy transition and accelerate the development of the French industry, with a view to reaching European markets, by promoting the emergence of new technologies linked to the integration of renewable energies and the electrical networks of the future.



Master's thesis title

Comparison of AC-DC converters for MVDC applications



The goal is to do a comparison of two AC-DC converter topologies for medium voltage applications, in terms of sizing, losses and behavior under faults. One of the main objectives is to determine at which voltage level one topology is preferred over the other one, based on previously established Key Performance Indicators (KPIs).

In order to do this, it is necessary to assess both topologies over a given range of volt-

age and power levels, meaning there are numerous study cases for which the converter design has to be done and the KPIs obtained, not to mention that it has to be verified that the designs comply with the grid requirements.

In order to make this process easier, avoiding as much as possible to do time-consuming simulations, a tool that automates the calculation of all the design parameters and KPIs can be used. Such tool is partly developed for one of the topologies. One important realization of the internship is to further develop the existing tool, to add the new topology and other relevant KPIs.

The analysis of the system under faults, which is difficult to do analytically, will be done via simulation. In addition to these analyses, the technical difficulty to implement the proposed designs is evaluated.

Nathaniel ELI JUNIOR

**Email :**

nathandotjnr@gmail.com

MSc. in Decentralised Smart
Energy Systems (DENSYS) at
the Université de Lorraine,
France.

Mobility scheme

Port Harcourt, Nigeria



**Live, Learn,
Grow... and live
some more.**

PS: The Belgians and the French
have different ways
of saying "90"





Company

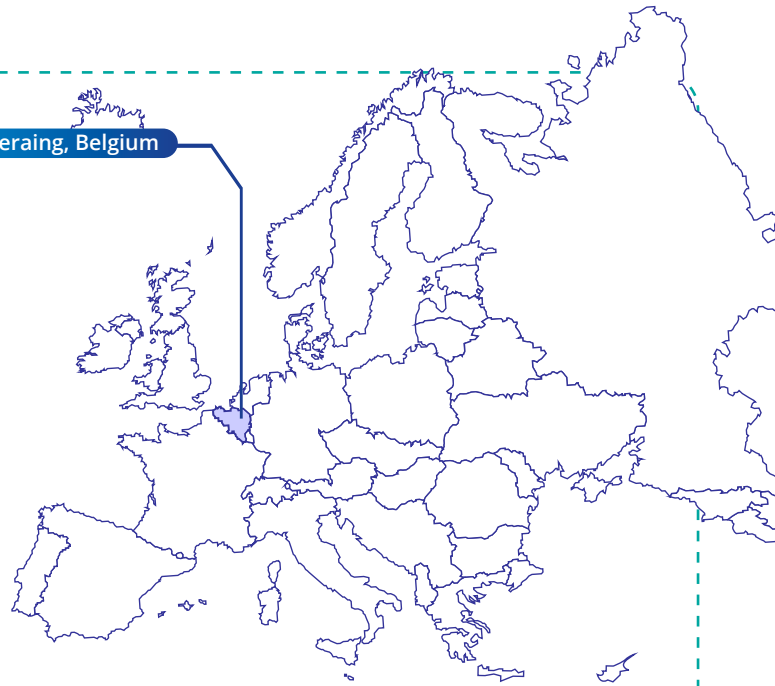


**John
Cockerill**

John Cockerill

John Cockerill is an engineering and service provider company, with activities in areas including defense, renewable energy, Industry, and Environment, executing maintenance services for on-shore and off-shore wind turbines in Belgium, France, Morocco and Brazil. John Cockerill is a world leader in the manufacturing and supply of high-capacity alkaline electrolyser.

Seraing, Belgium



Master's thesis title

Analysis and comparison of the on-shore vs off-shore scenarios for the conversion into green hydrogen of the renewable electricity generated by off-shore wind turbines.



The rise in climatic concerns have seen local and global key players work strategically towards abating this crisis. All the carbon neutral scenarios involve a significant increase in the offshore wind turbine power generation capacity and an even more rigorous deployment of hydrogen technologies to buffer intermittent sources and serve as a viable energy carrier. The amalgamation of these two solutions is seen as the silver bullet to combat the challenges posed by offshore wind energy and ultimately boost the green energy transition. This thesis proposes and analyses the topic: off-shore vs on-shore

hydrogen production using commercial scale offshore wind energy. The analysis addressed the technical, economic, environmental and safety aspects of these scenarios. Further multi-criteria analysis was done using the Analytical Hierarchy Process, where key stakeholders' opinions were weighted in for a more robust view. The results show that though the competitiveness of the on-shore hydrogen production scenario shined in terms of economics and environment, utilising existing facilities such as natural gas pipelines and platforms will see the off-shore hydrogen production scenario outperform the on-shore case economically. However, there seem to be some accompanying environmental concerns with the off-shore scenario.

Muhammad Shehryar HAMID



Email :

msh122221@gmail.com

BSc. in Mechanical
Engineering at New York
University in Abu Dhabi, UAE

Mobility scheme

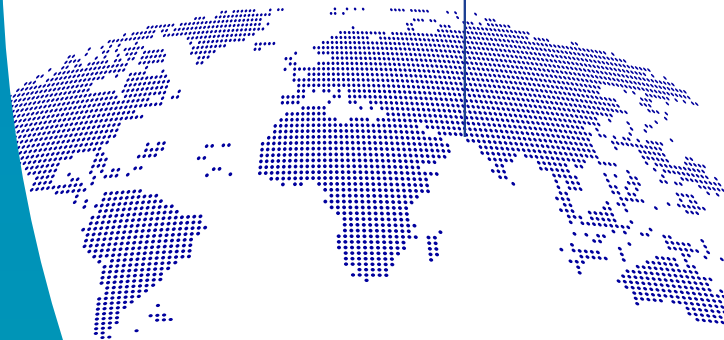


UNIVERSITÉ
DE LORRAINE



UNIVERSITAT POLITÈCNICA
DE CATALUNYA
BARCELONATECH

Lahore, Pakistan



“

**A Bright
Future:
Environmentally
-friendly Energy
Storage**

”



Company

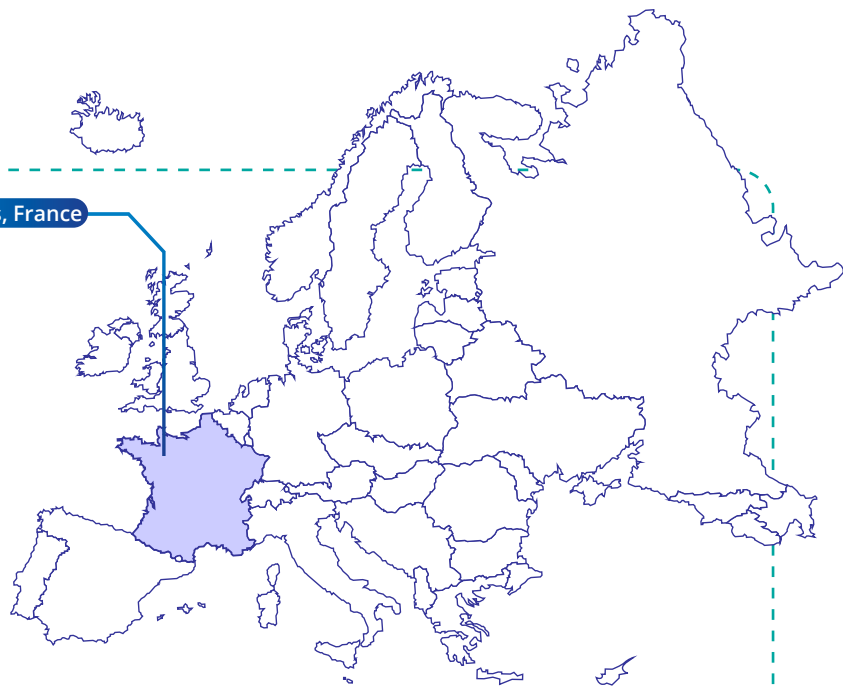


KEMIWATT
Your energy bank

KEMIWATT

KEMIWATT is a leading French startup developing an environmentally-friendly alternative for stationary energy storage. It was created in 2014 from the innovation developed in a French laboratory for 10 years. It is now in the pre-commercialization phase of its aqueous organic redox flow battery (AORFB) for medium to large scale applications.

Rennes, France



Master's thesis title

Development of Sizing Tools for KEMIWATT's Industrial Systems



The goal of this internship was to develop numerical sizing tools for the aqueous organic redox flow battery systems, as KEMIWATT enters its commercialization phase. The "Process Generator" tool was developed using Visual Basic .NET, and it optimizes the architecture of the battery for any use-case targeted by KEMIWATT. For this optimization, the tool considers several economic and technical constraints. The optimal battery configurations that are proposed are not only the cheapest options, but also most efficient in their utility of the hydraulic and electrical components of the battery. The tool can scan databases of equipment (tanks,

pumps, etc.) from different suppliers, and choose particular equipment models most suited to the project needs.

In addition, another aspect of this internship was to calculate the effective heating/cooling requirements for the battery systems, so that the processes can always be maintained at the most efficient temperature for the electrolytes. This requirement is calculated for two of the electrolyte tank configurations that KEMIWATT utilizes (rectangular and cylindrical). Based on this requirement, heat exchangers are designed, which use water to provide the necessary heating or cooling as is needed, to maintain optimal temperature.

M A Munaim HOSSAIN



Email :

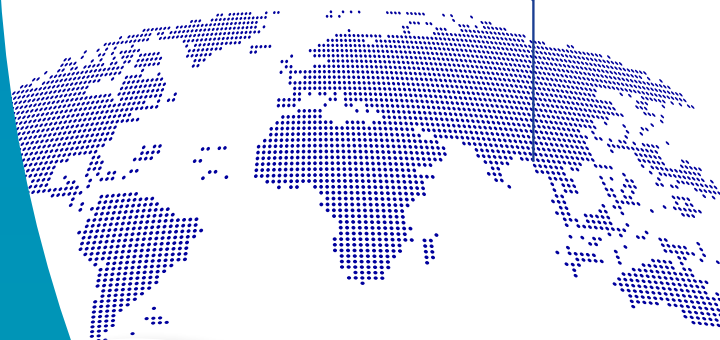
munaimhossain28@gmail.com

BSc in Electrical, Electronic
and Communication
Engineering MIST,
Bangladesh University of
Professionals

Mobility scheme



Dhaka, Bangladesh



“

**Batteries
have a dirty
secret- It has
shades of green
in it!**

”

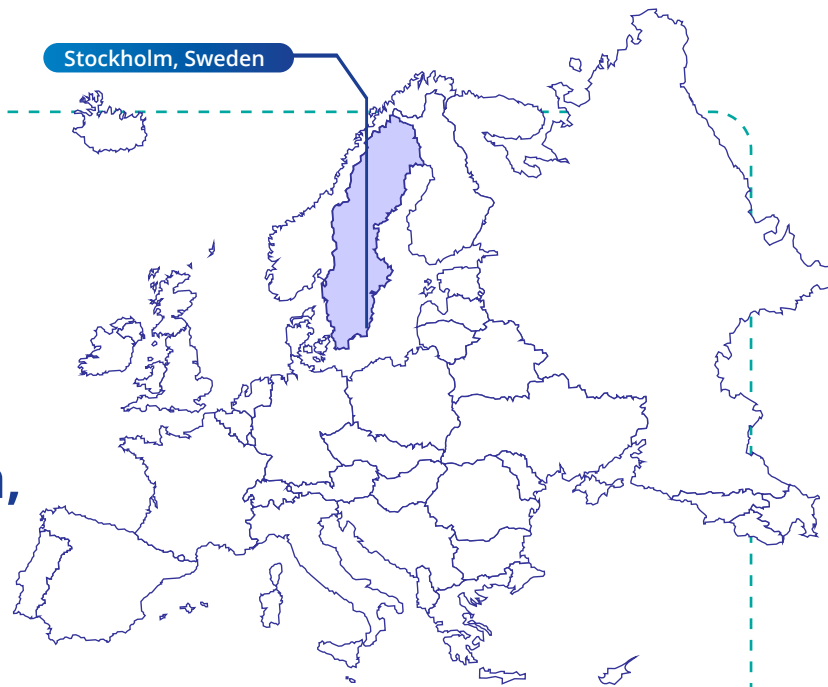


Company



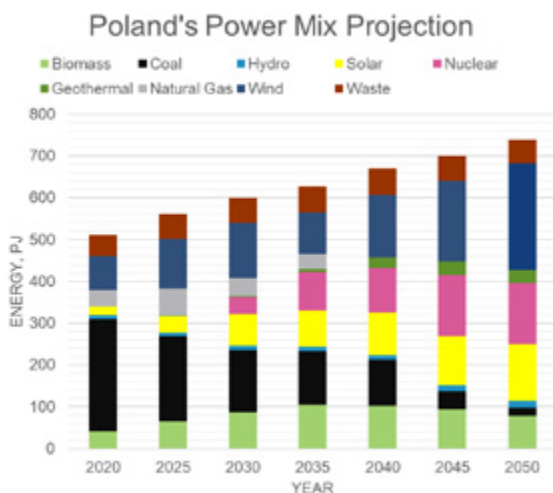
Heat and Power Division, Department of Energy Technology, KTH Royal Institute of Technology

The Heat and Power Division of KTH performs research encompassing the analysis and design of critical components and systems linked to renewable energy – solar, wind, and biomass – for providing sustainable electricity and other energy services to single households up to entire cities or regions. Much of their research takes place experimentally in world-class laboratory facilities with a vision of developing a resilient low-carbon future.



Master's thesis title

Environmental assessment of Stationary Energy Storage System (SESS) applications



Stationary Energy Storage Systems (SESS) are seeing an increased adoption in the last decade and till today. They assist in improving the resiliency and robustness of the energy system, flexibility of the energy grid and adoption of renewable energy sources (RES) by addressing their intermittency.

Various grid-scale energy storage systems have been installed in the recent years with different use cases in mind, to achieve better grid stability and economic purpose. In some of these cases, it has been shown that the practice can lead to an increase in overall net carbon emissions of the grid. As such this requires extensive study to find out the major deployment tactics of SESS sizing and modelling the battery usage as well as visualize the associated emission factors.

The thesis also aims to predict and project the energy mix of some significant EU countries with Sweden in its center. It is understood possible energy mix in the future will significantly impact the environmental assessment of the SESS as it will determine both the emission it can displace or itself disperse. A comparative analysis of the emission resulted due to the production and lifecycle of the storage system itself to the emission it can help saving gives a significant conclusion for the policymakers whether to include SESS in their long-term plan. Different results are expected based on different applications of the SESS. Results can also vary depending upon the single use or stacked service provided by the SESS.

Mashiul HUQ

**Email :**

mashiulhuq007@gmail.com

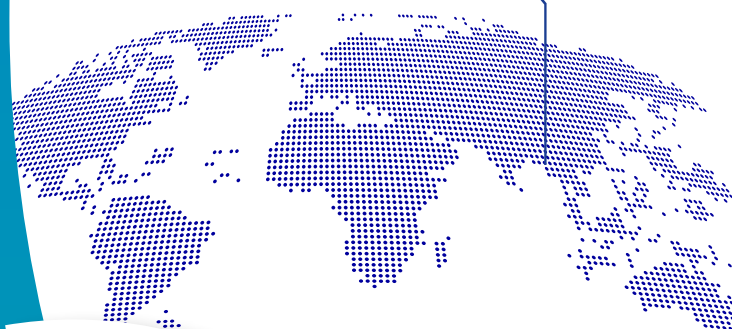
BSc. in Electrical and
Electronic Engineering at
AIUB, Bangladesh

Mobility scheme

UNIVERSITÉ
DE LORRAINE



Dhaka, Bangladesh



**A
fascinating and
thought-provoking
experience allowing
me to apply my acquired
interdisciplinary
background as well as
collaborate with very
diverse teams**





Company



Institut Jean Lamour (IJL)

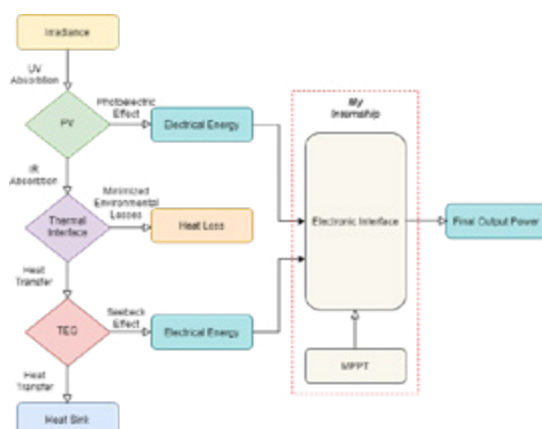
Institut Jean Lamour (IJL) is a fundamental and applied research laboratory specialized in materials, scientific processes, and engineering. The research institution houses over 500 researchers and is also in collaboration with the CNRS and Université de Lorraine. Some of their research activities include electronics, materials, nanomaterials, and plasmas in response to societal challenges such as energy, environment, the industry of the future, mobility, the preservation of resources and health.

Nancy, France



Master's thesis title

Design of a smart electronic interface for energy harvesting systems based on a PV-TE hybrid device



The objective of this internship is the design, modelization and simulation of a smart electronic interface, that performs the maximal power point tracking for the (Photovoltaic-Thermoelectric) PV-TE device, depending on the electrical connection of the PV and TE sources. One case will be explored which is a dual-source harvesting mode, with thermally coupled sources. The design of the specific and optimized electronic interface with DC/DC conversion will be studied and validated by simulation. This approach is essential to fully address the best choice of the electrical connection, depending on the system parameters and performs the maximal energy conversion efficiently at system level. One challenge involved is the

lack of existing in-depth literature regarding the electronic interface and control for PV-TE devices. Another big obstacle is to understand and analytically model the effects of the dedicated thermal interface, located between the PV and the thermoelectric generator (TEG), on the PV and TEG. The last big obstacle would be to find out which parameters have the most influence on the power output of the hybrid PV-TEG device. The prospective realization of the project would be a highly efficient and environmentally friendly power source that could be employed toward green IOT applications.

Allen Masimba JASI

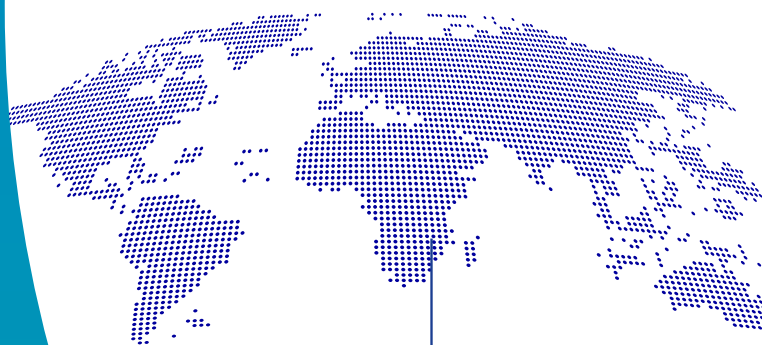
**Email :**

allenjassy@gmail.com

Bsc. in Electrical and
Electronics Engineering
at European University of
Lefke, Cyprus

Mobility scheme

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Mutare, Zimbabwe



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Institut Jean Lamour (IJL)

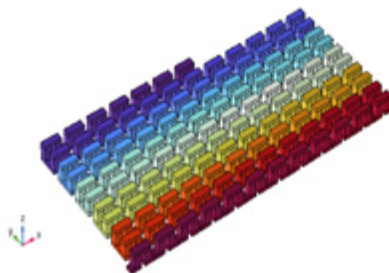
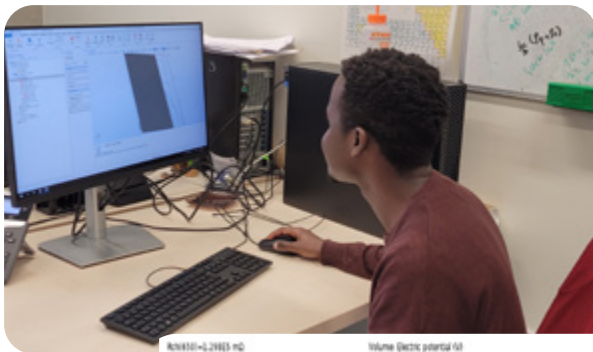
Institut Jean Lamour is a research institute formed by the joint partnership of CNRS and Université de Lorraine. It specializes in basic and applied research in the fields of science and engineering of materials and processes. The institute is committed to addressing complex societal needs, with the majority of their research work tackling global issues such as energy, health, environment, mobility, conservation and future energy.

Nancy, France

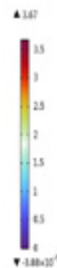


Master's thesis title

Design of a smart electronic interface for energy harvesting systems based on a PV-TE hybrid device



With the recent improvements in PV cell technologies, the efficiencies of classical single junction solar cells are slowly reaching the maximum theoretical efficiency of 33% , known as the Shockley Quessier efficiency limit. A novel and innovative approach to improve the solar cell performance is by integrating the solar cells with thermoelectric generators to form a hybrid energy device. The objective of this master thesis is to design an optimal architecture of the PV-TE hybrid energy device, mainly focusing on the electronic interface. Techniques on the combination of the thermoelectric generator physical models and the smart electronic interface are also studied. State of the art models of the PV-TE hybrid devices are far from optimal, due to the omission of the thermal interface between the PV cell and the TEG. In this thesis the effect of the photothermal interface between the two energy sources is investigated. In the study, physical models of the PV, TE and the photothermal are designed and integrated in Comsol Multiphysics. The performance of the overall hybrid energy system connected to an optimized electronic interface is evaluated. The expected result of the study is a more precise model of a PV-TE hybrid energy device with a higher efficiency in comparison to conventional hybrid devices.



designed and integrated in Comsol Multiphysics. The performance of the overall hybrid energy system connected to an optimized electronic interface is evaluated. The expected result of the study is a more precise model of a PV-TE hybrid energy device with a higher efficiency in comparison to conventional hybrid devices.

Simran MASOOD

**Email :**

simranmasood97@gmail.com

Bach. in Chemical
Engineering at Middle
East Technical University,
Northern Cyprus

Mobility scheme

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DE LORRAINE



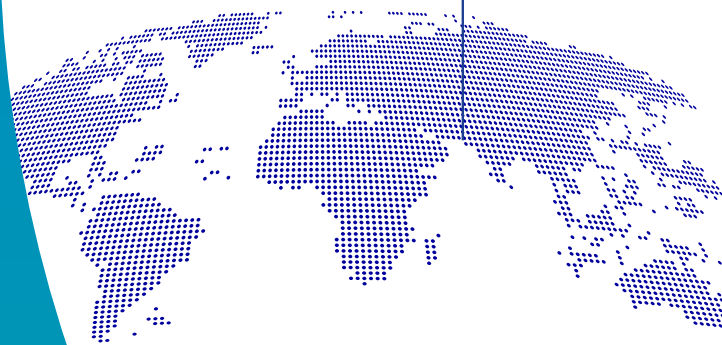
Politecnico
di Torino

Karachi, Pakistan

“

Ownership,
encouragement,
and
empowerment.

”





Company



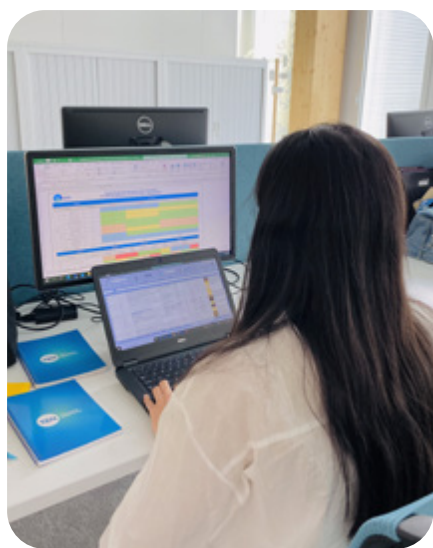
Technip Energies

Technip Energies is a world-leading engineering and technology player, having a proud 60-year history and key leadership in LNG. Their expertise includes a full range of design and project development services, from early engagement to delivery. Technip is leveraging its engineering expertise and technologies to develop new projects in hydrogen, sustainable chemistry, biofuels, CO₂ management/ decarbonization in addition to other solutions



Master's thesis title

Techno-economic Assessment of Power-to-X, Carbon dioxide (CO₂) Utilisation Routes



Power-to-X (PtX) is an umbrella term used to represent all the pathways for energy storage, conversion, and reconversion into various energy vectors. This study is divided into two main parts, the central aim of the first part is to perform literature research to consolidate the knowledge of PtX processes, particularly for carbon dioxide utilization through chemical conversion pathways. During the first phase of the project, a high-level assessment of multiple CO₂ valorization routes and molecules was performed based on the internal knowledge of Technip Energies (T.EN) and extensive literature research. As a result, seven primary molecules (Formic acid, Formaldehyde, Dimethyl ether, Methane, Methanol, Ethylene, and Propylene) were shortlisted and researched upon. Several key performance indicators (KPIs) were identified, and a thorough scoring and screening standard was formulated to assess the performance of each molecule to select the best scoring molecule in terms of economic, environmental, social and health and safety perspective.

The objective of the second phase of the project is to develop T.EN's own process scheme and simulation for synthesis of the selected molecule (based on findings of part 1). Detailed heat and material balances and process simulations on Aspen HYSYS would be performed. Lastly, a techno-economic evaluation of the proposed solution would be prepared for determination of the Levelized Cost of Production (LCOP) of the molecule and a life cycle assessment would be performed to fully evaluate the environmental implications of the process.

Yashwant MENTE

**Email :**

yash.mente@gmail.com

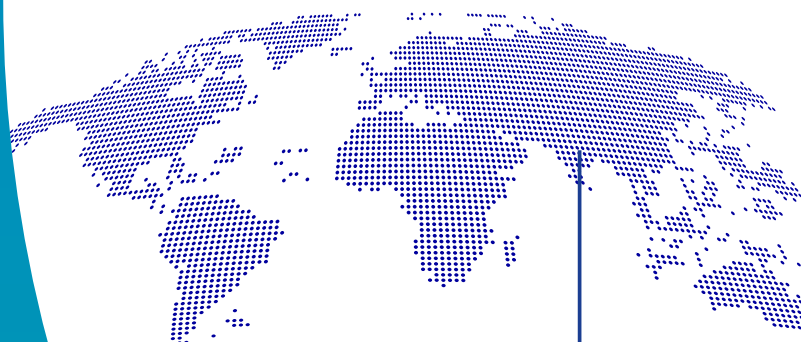
Bach. in Mechanical
Engineering from SPPU,
India

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BARCELONATECH



Mutare, India



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with heat
pumps!



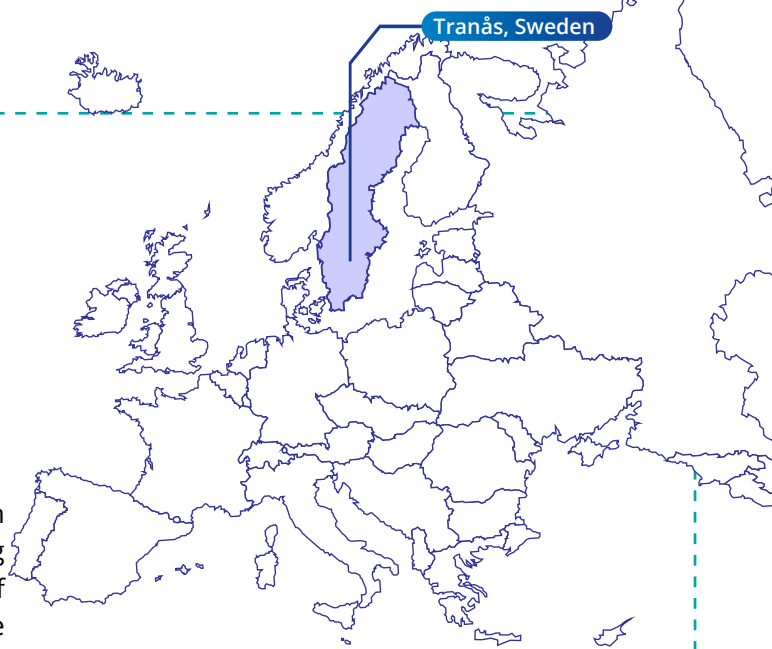


Company



Bosch Thermoteknik AB

Bosch Thermoteknik AB is a subsidiary of Robert Bosch GmbH. The company specialises in the manufacturing of heat pumps and it is the largest European supplier of heaters. Today, Bosch Thermoteknik produces in more than 20 plants in Europe, America and Asia with 14,200 employees globally and about 700 employees in Tranås, Sweden.

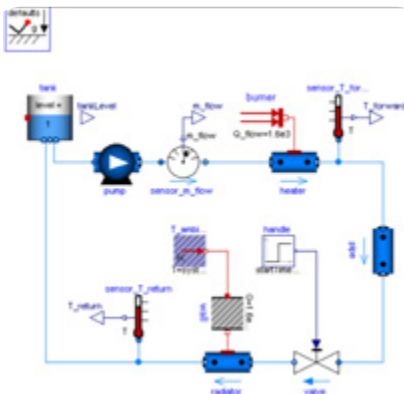


Master's thesis title

Dynamic Performance and optimization of Heat Pumps



Space heating and domestic hot water account for a big portion of the total energy consumption in the residential sector. Electrified heating using heat pumps is considered to be crucial by policy makers to avert the impacts of global climate change. However, development of heat pumps could be a cost and time intensive process. Dymola as a simulation software is a powerful tool that can help in bringing down the development cost and time of heat pumps. The main task for this master's thesis is to develop heat pump components and simulate the system behaviour of a L/W Heat Pump.



The objectives of this master's thesis are-

- 1 Modeling of heat pump components and validating their performance by comparing against the supplier data
- 2 Refrigerant-side and hydraulic-side system simulation and integrating them together
- 3 Behaviour of the system in space-heating and domestic-hot-water-heating mode
- 4 Developing a methodology for easy implementation of other heat pump components and simulations of other heat pump models.
- 5 Control strategies for the heat pump

Some of the challenges-

- 1 The documentation for Dymola/Modelica software is poor/nonexistent
- 2 Modelica is a modeling language. Adapting from programming language to a modeling language takes some time.
- 3 Calibrating the models to match the suppliers' results is a tricky task

Indira Alejandra OCHOA MEJÍA



Email :

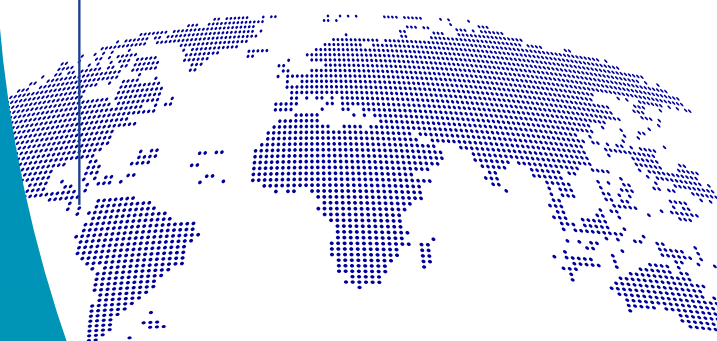
indiraochoa98@gmail.com

Bach. In Energy Engineering
at Universidad Tecnológica
Centroamericana (UNITEC),
Honduras

Mobility scheme



Villanueva, Honduras



**Nothing
negative
about
Hydrogen!**



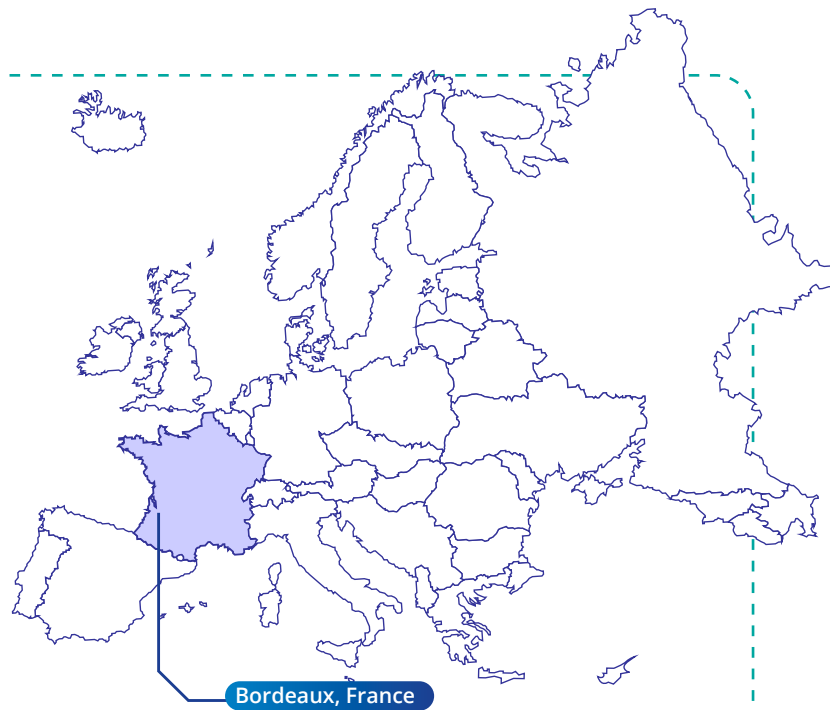


Company



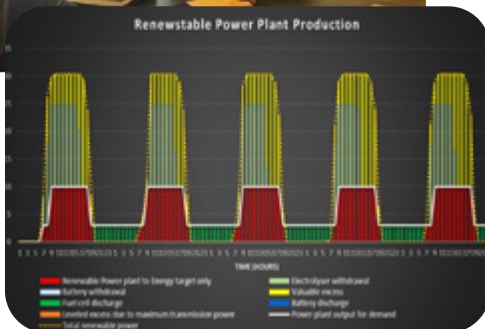
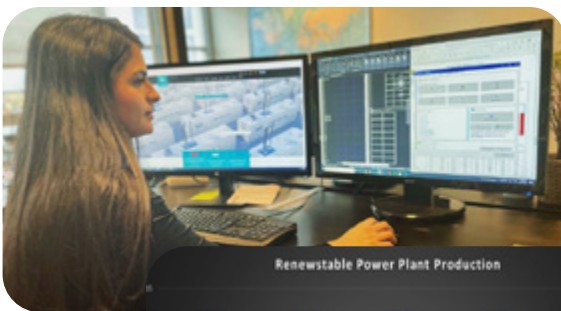
Hydrogène de France (HDF Energy)

HDF Energy is an Independent Power Producer (IPP) which develops and operates high capacity large-scale Hydrogen-to-Power infrastructure to provide firm or on-demand electricity from renewable energy sources (wind or solar), combined with high power multimewatt fuel cells and batteries. HDF Energy is also a manufacturer of MW scale fuel cell with a factory under construction in Bordeaux Metropole.



Master's thesis title

Performance Comparison of single axis tracker systems and fixed structures in Renewstable® Power Plants based on their location.



This study focuses on the analysis and comparison of Renewstable® Power Plants (Photovoltaic – Hydrogen-Batteries) with horizontal single-axis tracker and bifacial modules, fixed structure with an east-west orientation, and fixed structure with a south-or-north orientation, in eight countries. The study takes into account the effect of seasonality and specific location in the equator, south or north hemisphere. PVSyst was used to simulate the solar photovoltaic plants and their energy generation results were used in a techno-economic internal tool to analyze the PV production and hydrogen storage over the year and over lifetime of the plants by observing the energy target compliance (ETC), energy excess and economic behavior.

The final goal of this study is to be able to provide technical and economic information to HDF's business developers. Business developers will be able to identify what they should be looking for in specific zones in the world, the target production limitations, where to take into account seasonality and the number of sunlight hours in each country as well as how to adapt the ETC to specific conditions. Countries farther from the equator should be sized carefully taking into account seasonality to achieve better ETC values.

Samuel Ayomipo

OGU-EGEGE



Email :

samoguegege@gmail.com

Bach. in Chemical Engineering,
Anadolu University, Turkey.

Mobility scheme

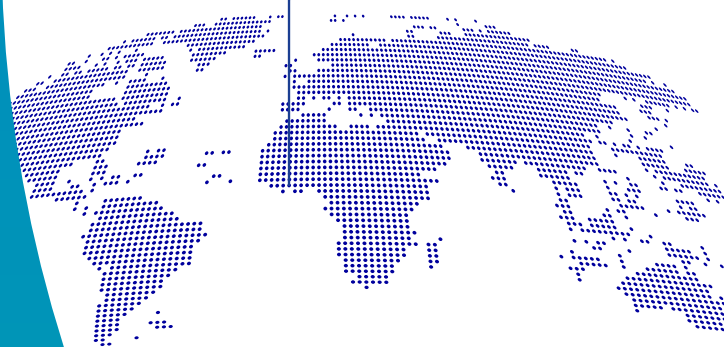


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give it
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POWERCELL

Powercell Sweden AB

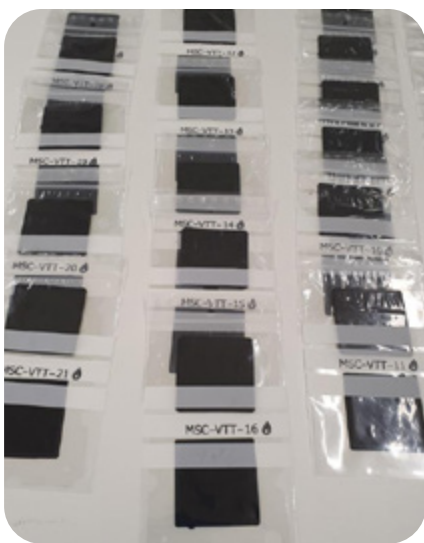
PowerCell Sweden AB (publ) develops and produces fuel cell stacks and systems for stationary and mobile applications with a world class power density. The fuel cells are powered by hydrogen, pure or reformed, and produce electricity and heat with no emissions other than water. As the stacks and systems are compact, modular and scalable, they are easily adjusted to any customer need.

Gothenburg, Sweden



Master's thesis title

Optimization of Membrane Electrode Assembly Fabrication Procedure and Parameters



Fuel cell technologies have a significant role to play in the decarbonization of our electricity grid and transportation systems. The Membrane Electrode Assembly (MEA), a key component of the fuel cell and where the electrochemical reactions occur must be optimized to improve the performance and durability of the fuel cell. Therefore, there is the need to optimize the MEA for optimal power density and durability.

In the scope of this thesis, the optimal process parameters for MEA fabrication are being studied.

In the initial phase, the aim was to ensure good pressure distribution and total transfer of the electrodes from the substrate to the membrane. This is primarily due to the high cost of Platinum and to ensure the MEA has the same catalyst loading as prescribed.

In the latter stages, more emphasis will be placed on optimizing the fabrication parameters for performance. The performance and durability of the fabricated MEAs are dependent on the pressing parameters as they influence the access to the three-phase boundary, i.e. mass transport, and the surface resistance of the MEAs. Tests will be run in a single cell setup to determine the performance of the fabricated MEAs in-situ.

Carlos Miguel PEREZ VILLANUEVA



Email :

perez.villanueva.carlos.m@gmail.com

Bach. in Nanotechnology at
National Autonomous
University of Mexico
(UNAM), Mexico

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di Torino

Toluca, Mexico



“
**Nowadays
data is
everything, it gives
a great power, and
with this power,
a great responsibility
to make wiser
decisions for the
future of our
planet**
”



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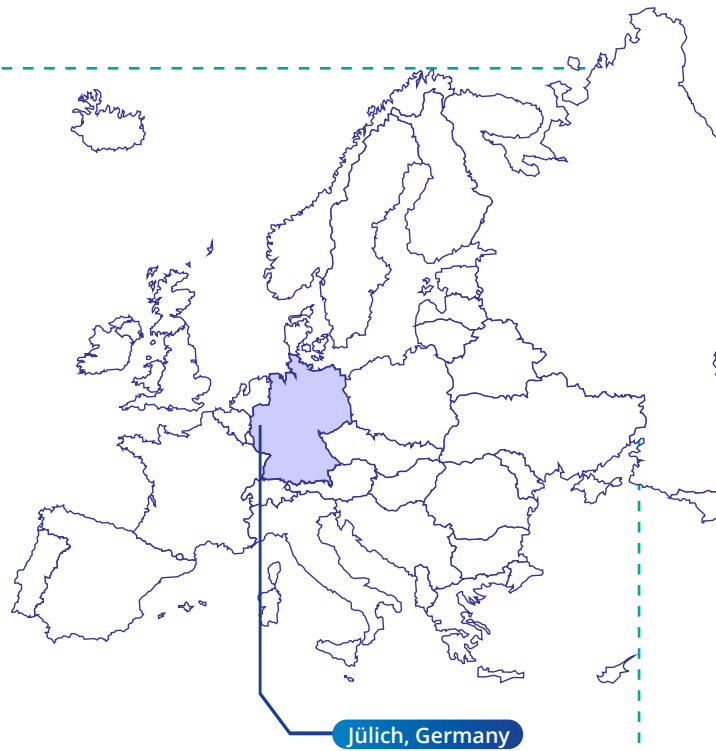


JÜLICH
Forschungszentrum

Forschungszentrum Jülich.

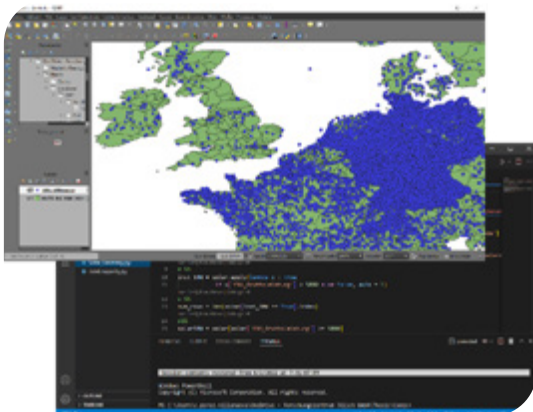
**Institute of Energy and Climate Research –
Techno-economic Systems Analysis (IEK-3).**

At the Institute of Energy and Climate Research – Techno-Economic Systems Analysis (IEK-3), we conduct research into how a sustainable energy system can be achieved and what it might look like. To this end, we develop a wide range of highly complex and detailed energy system models that we utilize to assess local-to-global energy systems in an integrated manner. Thereby, we aim to provide the best possible knowledge-based support for the implementation of the clean energy transition.



Master's thesis title

Analyzing the transition of electricity generation in the European energy system until 2030



In the framework of the transition of the European energy system towards the goal of becoming a carbon-neutral continent by mid-century, analyzing data to model scenarios is crucial in the development of policies for the energy transition.

In this context, this thesis aims to collect technical and geographical information on the power generation system in Europe, as well as the policies implemented in each country and at the European level considering the 2030 horizon. This information will be used to create a GIS database to feed the FINE (Framework for Integrated Energy System Assessment) model developed at Forschungszentrum Jülich and calculate the scenario of Europe's energy system in 2030 to identify possible gaps and infrastructure needs in the

current policies and targets.

The creation of such a database does not come without major challenges, the lack of a harmonized and unified source of official information makes it imperative to consult a wide variety of sources to obtain the information needed for the database. At the moment, the database has a 10% difference compared to the reported installed capacity of the analyzed countries.

Mohammad ROOZBAHANI



Email :

roozbahani.stu@gmail.com

B.Sc. in Mechanical &
Aerospace Engineering,
Sharif University, Iran

Mobility scheme



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DE LORRAINE



UNIVERSITAT POLITÈCNICA
DE CATALUNYA
BARCELONATECH



Hamedan, Iran

“

It is
always good
to cool it down,
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Electric Machine,
or the
PLANET

”



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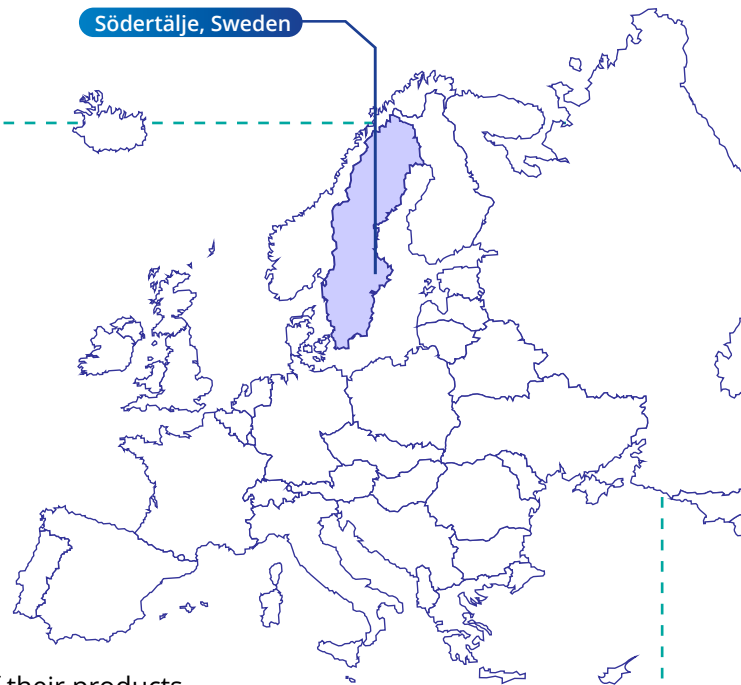


SCANIA

SCANIA CV AB

Scania CV AB is a major Swedish manufacturer headquartered in Södertälje, focusing on commercial vehicles—specifically heavy-duty trucks and buses. It also manufactures diesel engines for heavy-duty vehicles as well as marine and general industrial applications.

This company is in a fast transition toward electrification of their products.



Master's thesis title

Thermal Measurement and Thermal Modelling of Electrical Insulation in Electric Machines



Improved cooling in electric machines is of importance to achieve enhanced performance in electric machines and, in general, a necessary step in Scania's transition to electrification. The cooling of electric machines can be improved in several aspects, and one crucial part is to improve the thermal conductivity of insulating materials within stator slots. The majority of thermal conductivity resistance in the stator, which opposes heat extraction, is due to the electrical insulation materials used inside the slots. In this thesis project, several general purpose models (GPMs), made with different combinations of insulating materials have gone through thermal measurements in order to compare their thermal conductivity. Afterwards, the effect of thermal aging has been investigated on the thermal conductivity of insulating materials using accelerated aging methods. Furthermore, a 2D model has

been developed in COMSOL and MATLAB to evaluate the equivalent thermal conductivity of each insulation layer combination.

This project explains the steps and challenges of manufacturing GPMs in the lab environment and all the errors and difficulties experienced during the experimental thermal measurement. Finally, validation of simulations using experimental data and utilizing these models to measure the effective thermal conductivity of materials is explained.

Rida SOHAIL

**Email :**

ridashahid55@gmail.com

**Bachelors in Electrical
Engineering from NED
University of Engineering
and Technology , Pakistan**

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Karachi, Pakistan



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Laboratoire Énergies & Mécanique Théorique et Appliquée (LEMTA)

The Laboratories Énergies & Mécanique Théorique et Appliquée (LEMTA) has nearly 50 years of existence and experience in the field of mechanics and transfers. Energy has always been prioritized, but for the past ten years the strategy has been oriented towards the energy transition. The laboratory takes the advantage of its historical skills in the field of fluid mechanics, thermal engineering, electrochemical systems, and electrical engineering. It combines these areas of expertise to respond both to the major challenges set by research agencies on energy management and low-carbon energies, as well as to provide solutions to the research and development problems of its industrial partners, producer, or consumer of energy.



Master's thesis title

Consensus based approach for the primary and secondary control of microgrids.



The development of electrical transportation systems and the massive integration of renewable energy sources into the electrical grid contributes to the development of microgrids for both stationary and embedded applications. Thus, it is of utmost importance to formulate the energy/power management strategies of such microgrids.

In this project, an AC microgrid is considered comprising of different Distributed Generation sources (DGs), in Grid forming operating mode, connected in Mesh topology integrated/isolated with the Synchronous

Generator. The consensus approach based on Graph theory is used to ensure the system parameters' restoration after disturbance in the overall system.

The objectives are :

- ❶ To achieve accurate real and reactive power sharing among DGs which are powering the load. That is to develop primary control strategies.
- ❷ To ensure frequency and voltage restoration of the overall system to the nominal values so that it functions well within specified regulations. That is to develop secondary control strategies.
- ❸ P-HIL simulations to validate the developed control strategies.

The challenges in achieving these goals are:

- ❹ The communication delays between DGs which affects the stability of the system.
- ❺ Application of consensus algorithms to avoid this communication effect.
- ❻ Design of control parameters and their effect on the stability and dynamics of the system.

Muhammad TAIMOOR

**Email :**

taimoor151298@gmail.com

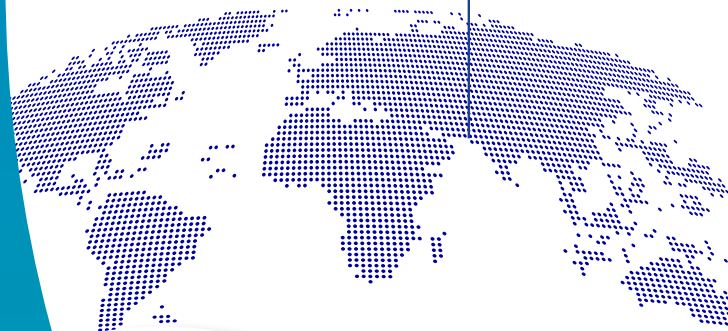
Bach. in Electrical
Engineering at National
University of Sciences and
Technology (NUST), Pakistan

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Lahore, Pakistan



**All
decisions in life
are optimization
problems, but sadly,
we can't find the
optimal solution to
most
of them**



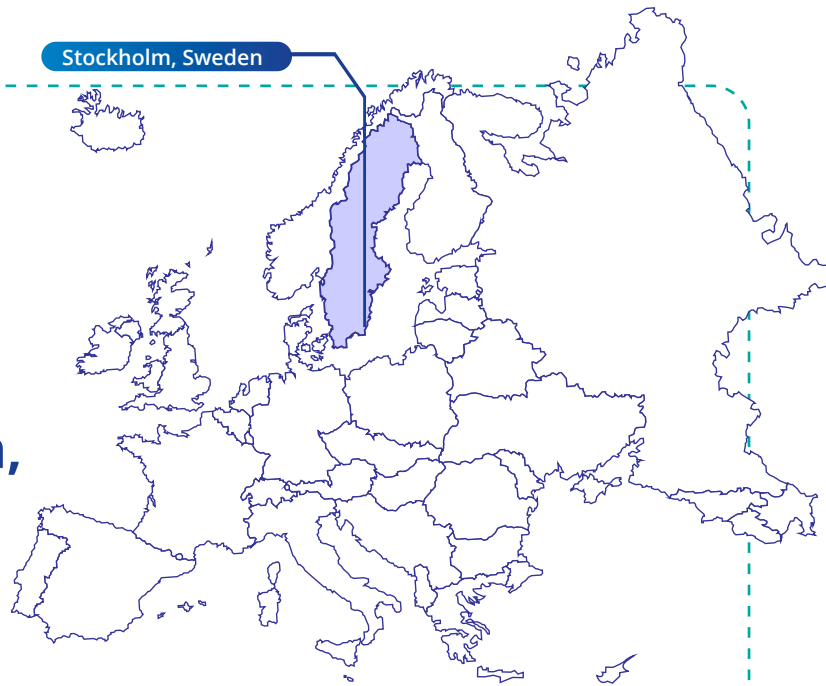


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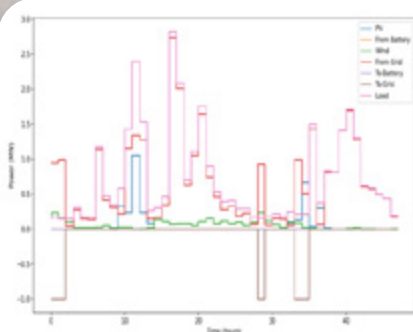
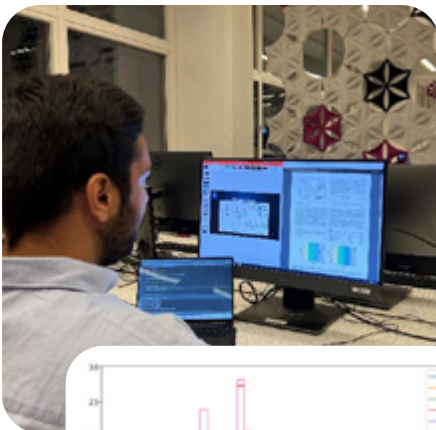
Heat and Power Division, Department of Energy Technology, KTH Royal Institute of Technology

The mission of Heat and Power Division at KTH is to contribute to the development of sustainable societies through research and teaching in heat and power technology. The research encompasses the analysis and design of critical components and systems linked to thermal and mechanical energy conversion. Strongly technical approaches are taken to harness renewable energy – solar, wind, and biomass – for providing sustainable electricity, heat, cooling, pure water, and other energy services to single households up to entire cities or regions .



Master's thesis title

Carnot Batteries – Advanced Dispatch Strategies to Maximize Renewable Penetration



With the increase in renewable penetration in the electric grid and their inherent intermittency, there is a growing demand for large-scale energy storage to balance supply and demand at all times. Carnot batteries provide such large-scale energy storage while being inexpensive and site-independent. This thesis work proposes optimal dispatch strategies for sensible packed bed thermal energy storage (TES) based Carnot batteries to maximize the use of intermittent renewable supply while reducing the operational expenditure of the overall system. The overall system consists of PV and wind generation, electric and heat grid connection, electric heater for charging the TES, steam generator, and steam cycle used for power generation.

The expected results include an hourly dispatch schedule for the renewable generation and TES charge/discharge cycles. A sensitivity analysis is carried out to understand the impact of key parameters such as electricity prices, load profiles and operational costs on the overall schedule. Finally, to understand dispatch trade-offs and present a comparison multiple objective functions are evaluated such as minimizing CO₂ emission and optimizing the capital cost.

Olga VOKUEVA

**Email :**

olga.vokueva@inbox.ru

Bach. in Nuclear engineering
at St.Petersburg Polytechnic
University, Russia

Mobility scheme

Saint Petersburg, Russia

**“ Active and
diverse work
in an international
environment where you
practice your academic
skills and benefit from
the expertise of the top
energy consultants.
You never get bored
here! ”**

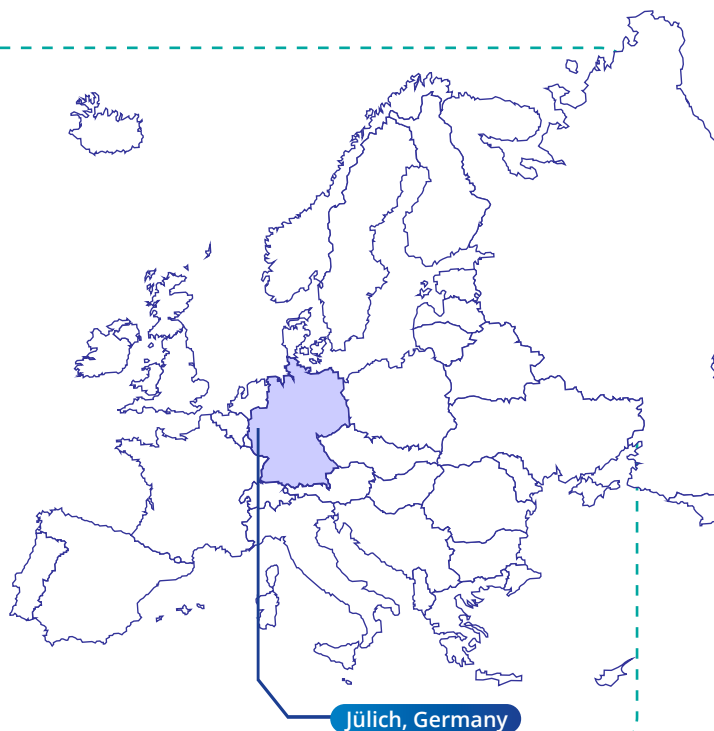


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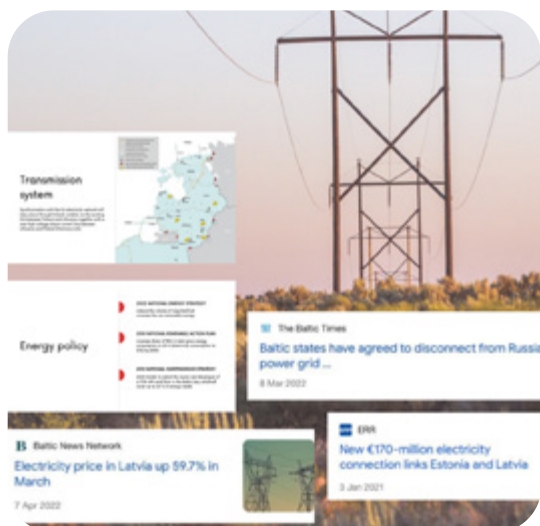
Elia Grid International

Elia Grid International is an international consulting company that offers consultancy services in market development, asset management, power system operations, market operations as well as owner's engineering and investment advisory support in the power grid sector. It is a full subsidiary of the Elia Group, which is organized around two transmission system operators, Elia in Belgium and 50Hertz in Germany.



Master's thesis title

Synchronization of the Baltic States (Lithuania, Latvia, Estonia) with the EU Continental Power Grid



For historical reasons, the power systems of the Baltic states have been developing as an integral part of the electricity systems of Russia and Belarus. In 2025, the Baltic States plan to synchronize their power grids with the grid of Continental Europe, becoming a full member of the European power grid and a player in the European electricity market. This project is identified as a key political priority for the EU. Its implementation is seen as ensuring safe, affordable and sustainable energy for the eastern Baltic Sea region and as an essential part of the common integrated European electricity market.

The main objective of this work is to analyze the status of the project, current challenges that TSOs and governments meet, along with the expected benefits of the synchronization. The report covers generation, transmission and distribution sectors of the power systems from technical and regulatory points of

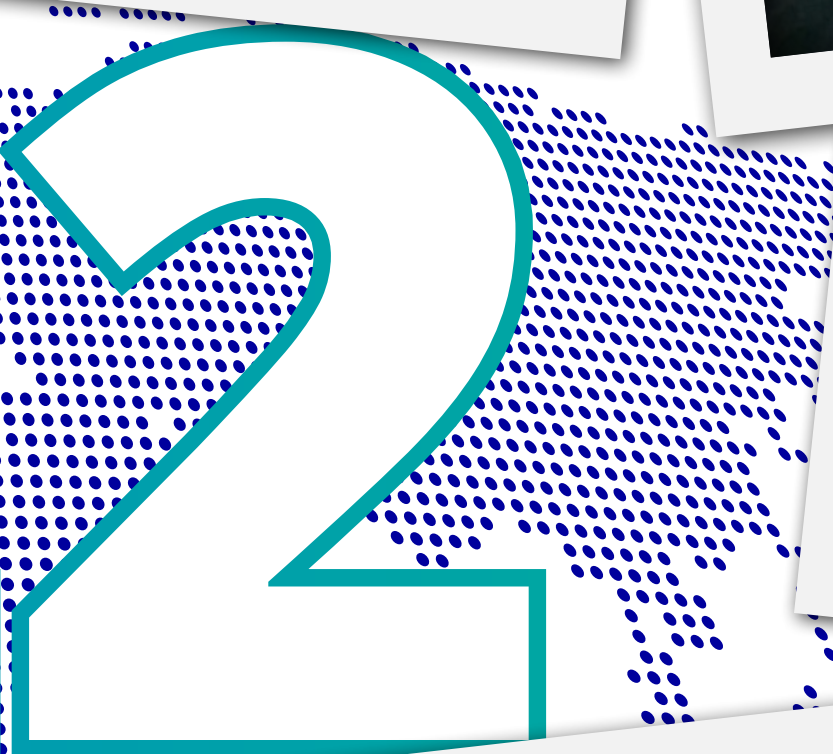
view with a specific focus on the transmission sector as the key element for the synchronization of the power systems of the Baltic States with the power system of Continental Europe.

This work will be beneficial for current EGI business development activities in the Baltic region. Being an up-to-date study of the current transition in the power system of the Baltic states, this research will serve as an academic contribution towards the field of power grids interconnection and synchronization in the Baltic region.



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densys-contact@univ-lorraine.fr



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