**Abstract:**

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**Intro:**

* 1. **Motivation for the project**
  + Introduction to Gouna and the canals in between, and show why the city is a great candidate for EV and EMV.(abundance of solar energy)
  + Estimation of Carbon emissions only due to boats in Gouna
  + The increasing market share of EV, and the emerging EMV (Electric Marine vehicle).
  + An assessment of the value of integrating renewable sources of energy with EMV.

**1.2 Scope:**

* + Intro to our base case study with Sultan bay
  + The steps from installing electrical engine and batteries then specifying a load-profile in KWh for the boat, then defining Reference Case for our study, and its corresponding boundary conditions.
  + Definition and selection of remaining Case studies, which depends on exploiting one boundary conditions at a time. Example can be different system components architecture, or replacing a system component by a totally different one, or even changing the load profile.
  + Simulation of selected Study cases and evaluating results.

**1.3 Research questions and Goals**

* + Is boat retrofitting possible? For which applications (load profile) and is it financially beneficial?? Answers can be simply answered by comparing both Reference and Base case.
  + A comparison between Simulated case studies, Reference case.
  + Kg CO2 per year saved and other qualitative assessment.
  + For ElGouna, is integrating renewable energy with EMV worth it? and for which applications?

**Literature review:**

* 1. Marine terminology, boat resistance
  2. how to calculate boat resistance and power prediction
  3. Insights about propellers
  4. Electric drives vs conventional drives in ship
  5. Electric motor types for EV, brushless (BLDC) vs induction
  6. Batteries(Li-ion vs lead acid)
  7. MPPT and Solar modules

**Methodology:**

* 1. Data collection and measurement with Base Case.
  2. Data collection and measurement with electrical engine and Lead acid batteries.(Reference Case)
  3. Defining our Boundary conditions, based upon Reference case.
  4. Defining Simulated Cases
  5. Simulation (Dymola modalica)
  6. Trial Case
  7. Data collection

**Results key points:**

* Preferred Case for battery life-time
* Preferred Case economically
* Preferred Case for least Grid power required.
* Preferred Case for least Grid power required.
* Retrofitting
* CO2 saved
* ~~Discussion~~

**First Evaluation:**

* 1. Annual Energy input for ICE and Electric Engine.
  2. Economic Evaluation.
  3. Qualitative evaluation
  4. Discussion
  5. Evaluating each case.
  6. Economic Evaluation for each case.
  7. Qualitative evaluation for each case.
  8. Compare Trial Case data with its simulated case.

**Conclusion**

* 1. Electric Engine and its possible utilization in Gouna (Retrofitting).
  2. Solarization of input power benefits and Preferred general setup.
  3. uncertainty & difficulties, things to put in mind
  4. Sustainable Tourism

**Suggestion for Further research:**

* 1. Impact of using lithium-ion batteries on system, and new payback period
  2. Study of boat hull shape(form factor) and defining the best form with the least resistance and best utilization of available power

