



DEPARTMENT OF ENERGY TECHNOLOGY  
AALBORG UNIVERSITY

## PhD Public Defence

**Title:** Integration of Microgrid Technologies in Future Seaports

**Location:** Pontoppidanstræde 111, auditorium

**Time:** Friday 2 August at 13.00

**PhD defendant:** Nor Baizura Bintiahamad

**Supervisor:** Professor Josep Guerrero

**Moderator:** Associate Professor Sanjay Chaudhary

**Opponents:** Associate Professor Samuel Simon Araya, Dept. of Energy Technology, Aalborg University (Chairman)  
Professor María Rodríguez Gámez, Universidad Técnica de Manabí, Ecuador  
Professor Mohd Rizon Bin Mohamed Juhari, Aswara University, Malaysia

**All are welcome. The defence will be in English.**



## Abstract:

The port can be classified as a small city that has a variety of facilities and is a shelter from the wind and the waves. Additionally, it acts as a key to a central business network that connects the various countries and region. From year to year, the demand for sea-borne shipments increased relative to land and air. More than 90% of the global-scale trade is by the sea transport due to the most cost-effective way of transportation over long distances and containerization has played a vital role in world maritime transport as well as improvements in the security sector and delivery time. The concern based on this situation is the environmental pollution will be increased if do not have any initiative will be taken to reduce the emission, especially from the combust engine (automotive sector) which is transportation. The main transportation in the seaport area is cranes and ships, which is the minimum average time ship (container) anchored around 21 hours and the maximum average time anchored around 52 hours (bulk carrier). While the ships are anchored, the engine still running to the facilities function in the ships, and it means the combustion of fuel is occur. Therefore the awareness of the jeopardy of contamination and the emission for the human and environment especially in seaports area, many parties take seriously about this case like the European Commission is also partnering and suggest ideas such as "innovations for energy efficiency and emission control in waterborne" to address the problem of environmental pollution.

In this study, the crane engines and energy storage systems will be emphasized, including the ship ports interface (cold ironing). Although developed countries are now using electric cranes which are connected directly to the grid but still have obstacles. Cranes are used for heavy-duty loads such as for loading and unloading container boxes and transferring to another transport for delivery to destination. In this process, when the crane lifts the container, it acts as a motor and requires high power from the grid. While when lowering the container, the crane will act as a generator, where a mechanical energy converts into electricity and for an existing system, this energy will be released at heat resistance to avoid damage to the converter. Therefore, one initiative is taken by integrating the system with energy storage. The appropriate energy storage needs to be identified for this system, which will be connected to the DC-link. This is because the process of lifting and dropping containers will frequently occur throughout the day for a crane at the port. Thus, the flywheel energy storage is selected because flywheel energy storage systems (FESS) can be overloaded with that also no risk of explosion.