

Design:
The design refers to the historical context of the site as a shipyard. At that time the area was part of the canal system of Copenhagen. To let people experience the site, a path way gives space for strolling. On the west end of the area steps invite visitors to sit down and to watch the scenery of the moving cranes. The combination of high cranes as landmarks in the city and wide open views offer different spatial experiences. Not only the historical context, but also the actual position next to a treatment plant is helpful, because waste water streams can be used to produce biogas, which is later converted into electricity.

For the calculation of the **energy output** of the facility, the growing rate of the algae and the assumed produced amount of biogas is key for the business assessment. We assume the used type of algae to be able to produce biogas with 8.100 m3 CH4 per ha each year, which is a rather conservative

value leaving a upside potential of at least factor 10 to researchers. With a total production area of 4 ha, the total output is approximately 32.100 m3 CH4 per year. The biogas will be directly used to fuel the combined heat and power units integrated in the lower part of the cranes. Additionally, small gas storage allows for a flexible energy generation. The combined heat and power plant operates with an overall efficiency of 90%, taking into consideration heat an electricity generation (65% heat, 25% electricity). To sum up, the annual electricity production will lie in the range of 81 MWh and additionally around 210 MWh of heat will be generated.

The following **materials** are mainly used in the design:
steel for basic crane construction: 100t
concrete for bridges/ pathways: 7000 sqm
with a width of 10-30 cm, additionally concrete for grounding
organic rope for algae growth basins: 7000 m

For the **environmental impact statement** the following protected goods should be taken into consideration:

human: the proposal enhances many people to enter the area, explore it and make them rethink about environmental problems. Furthermore it is a recreational area for the city's inhabitants in the centre of Copenhagen.

animals and plants: the maritime ecosystem network will be improved by algae as a source of nutrition and habitat for many fishes, mussels and insects. The fertiliser, which is a waste product in the bioenergy production will be given back to the sea life, which completes the ecological cycle.

soil: the contaminated soil will be removed and replaced by natural sea water, which was the former state of the area. Sealing of the surface is reduced as much as possible, which improves the climate in the city and water circulation.

water: algae are able to clean the polluted water, improve the water quality and absorb waste water, for example from the nearby treatment plant. With an improvement of the water quality, people are able to use the canal for swimming, canoeing or other sport activities. Moreover the maritime ecosystem will be kept intact, when waste water penetration is reduced.

climate and air: due to the photosynthesis of the algae, CO2 will be reduced and the city will gain fresh air. By reducing the global warming, the quality of life for the inhabitants in the city will be enhanced.

landscape and culture: the former use of the area as a harbour will be taken into consideration and the industrial landscape will be given a new interpretation.

All in all by securing the protected goods, the city will gain fresh air and a good water quality, which has positive effects on the environment and improves the conditions of recreational areas for the city inhabitants.

Today algae are an important resource to efficiently produce biomass or biofuels. Currently researchers investigate the use of algae as biofuels. The first planes start to fly with algae biofuel and the facades of buildings are covered with microalgae to gain energy. Nevertheless, the technology of producing bioenergy from algae is new. Hence, research needs to be intensified to further increase efficiency. The production of energy by algae brings many positive effects for the environment and is in no concurrence with food production or settlements. With this positive circumstances, the production of algae to produce energy will become more and more important in the future.

