Life Cycle Assessment of Cloudburst Management Plans in Adaptation to Climate Change in Copenhagen, Denmark

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The City of Copenhagen has developed Cloudburst Management Plans to flood-proof the city with regards to an expected increase in extreme rain events due to climate change (The City of Copenhagen, 2012). The plans are largely based on green infrastructure, as opposed to traditional solutions based on underground pipes and retention basins.

While cost and flood risk assessments are inherent parts of storm water management (SWM), the environmental impacts are often not analyzed. In this study, these impacts were quantified using Life Cycle Assessment (LCA), and compared for two different SWM scenarios for the sub-catchment Nørrebro (2.6km²):

- "Green" scenario: Green infrastructure is utilized to retain, infiltrate and discharge runoff above the surface as proposed in the Cloudburst Management Plan;
- "Grey" scenario: Runoff is handled in underground pipes and retention basins, and is cleaned at a wastewater treatment plant before discharge.

The Life Cycle Assessment shows that the environmental impacts of a green infrastructure based (“green”) system are lower than for a subsurface (“grey”) alternative in the Nørrebro catchment.

Material production is the main contributing life cycle stage. This highlights the possibility to significantly influence the environmental impacts of systems in the design phase.

Conclusions:

- The Life Cycle Assessment shows that the environmental impacts of a green infrastructure based (“green”) system are lower than for a subsurface (“grey”) alternative in the Nørrebro catchment.
- Material production is the main contributing life cycle stage. This highlights the possibility to significantly influence the environmental impacts of systems in the design phase.
- The sensitivity analysis shows that single parameters significantly influence the results, but the impacts for the “grey” system remain higher for all tested scenarios.
- The choice of flood safety targets influences the environmental impacts, which can be assessed by allocating the impacts to the different safety levels.
- Management of extreme events (domain C) causes higher impacts in the “green”, than in the “grey” system. Small rain events (domain A) cause minor impacts in both systems.