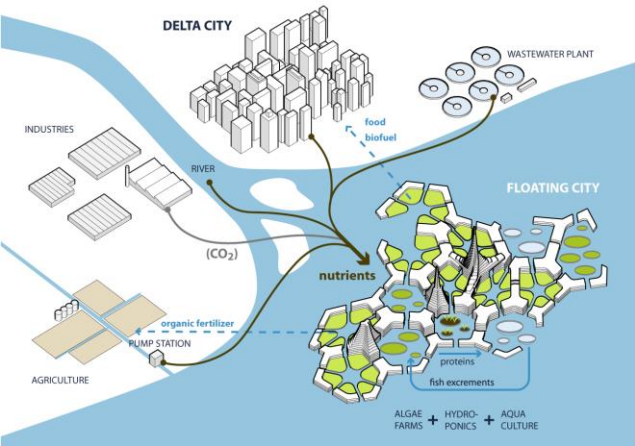


# BLUEREVOLUTION

Potential of floating urbanization and food production for coastal/delta cities



Rutger de Graaf  
Bart Roeffen  
Barbara del Bo Zanon  
Karina Czapiewska  
Hannah Haertwich

Deltas in Times of  
Climate Change II

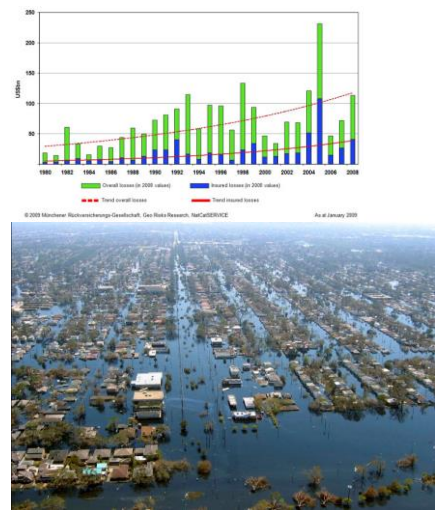
26 09 2014

## Urban challenges of the 21st century

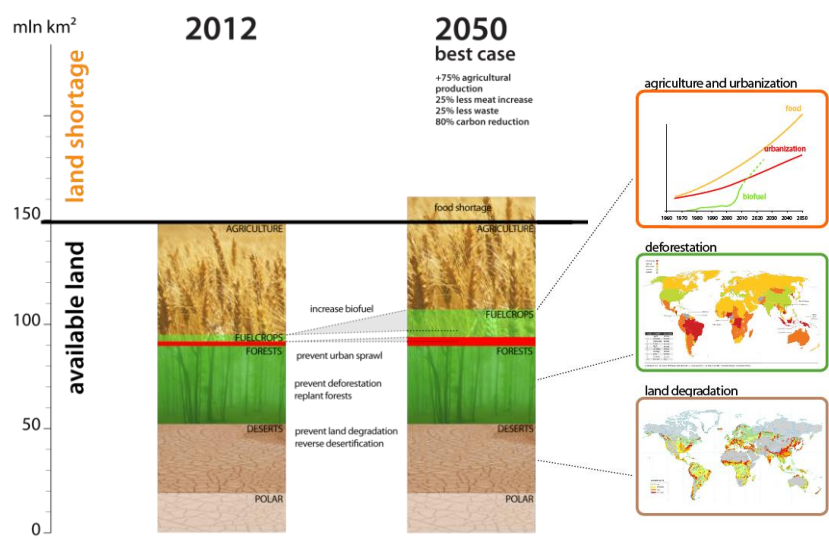
### Urbanization



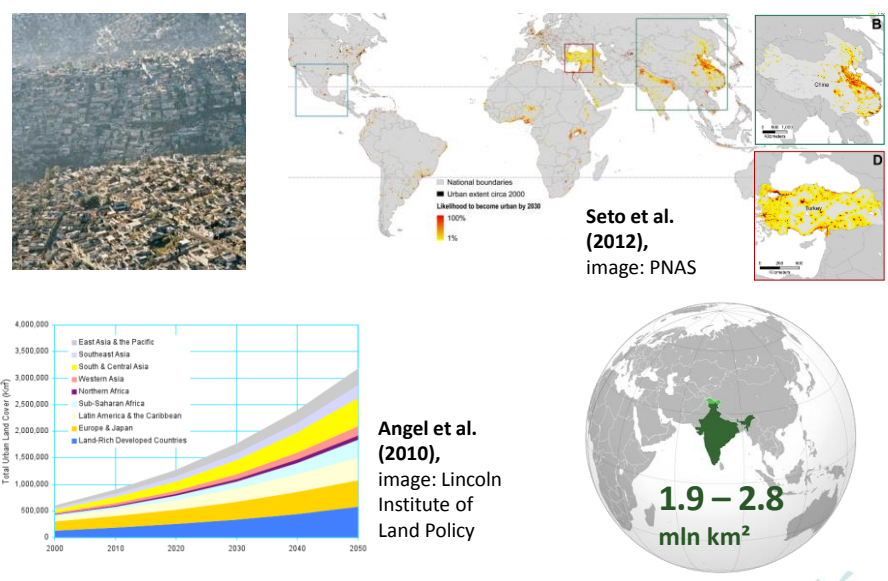
### Flood risk / Climate change



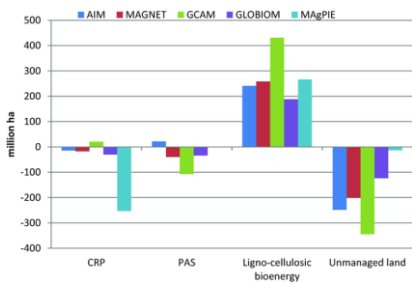
# Global risk of land scarcity



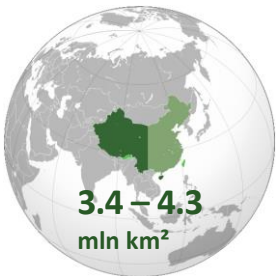
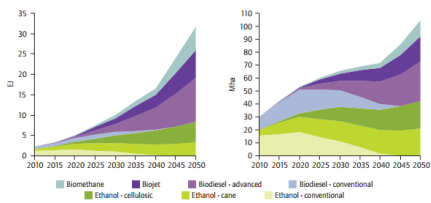
# Urban expansion



# Additional land for biomass/biofuel



Lotze-Campen et al. (2013),  
image:  
Agricultural  
Economics



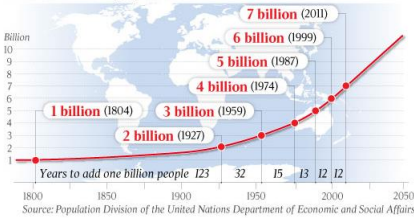
BLUEREVOLUTION

deltasync  
WATER-RELATED URBAN DEVELOPMENT

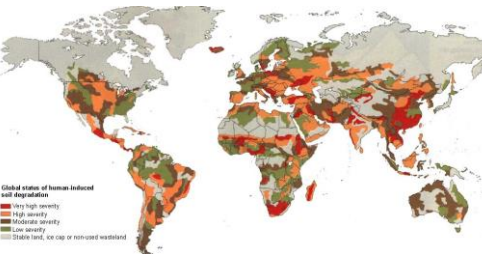
# Additional land for food production

## Population growth

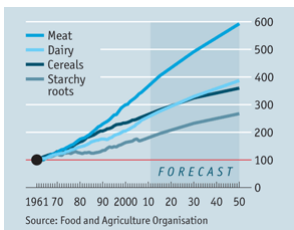
Years when world population reached increments of 1 billion



## Soil degradation



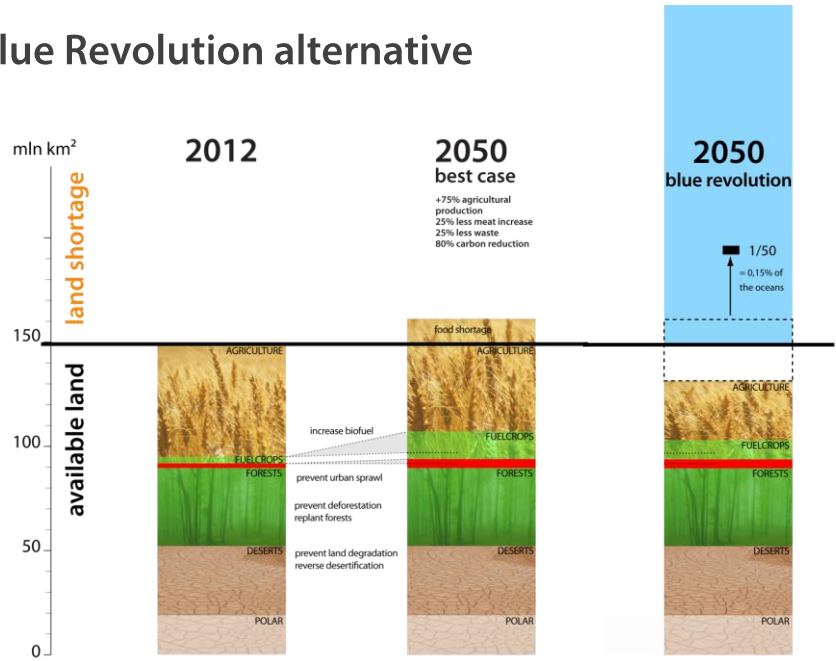
## Nutrition



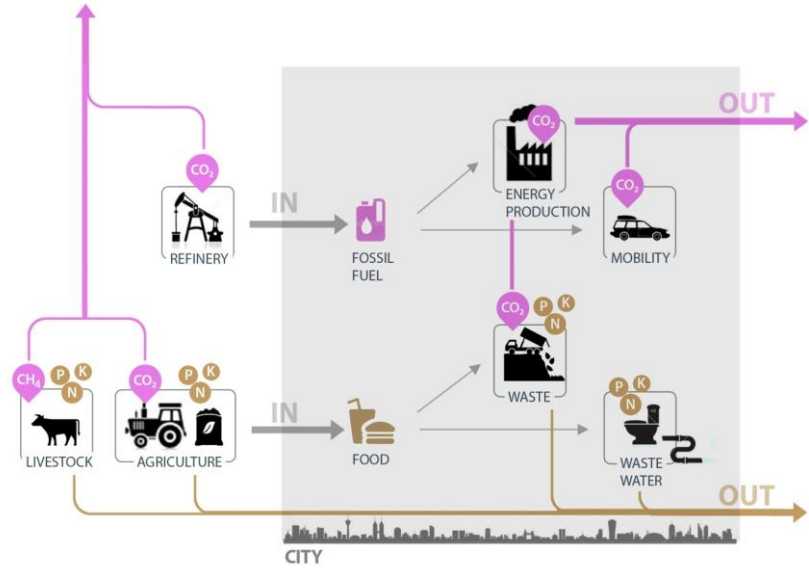
BLUEREVOLUTION

deltasync  
WATER-RELATED URBAN DEVELOPMENT

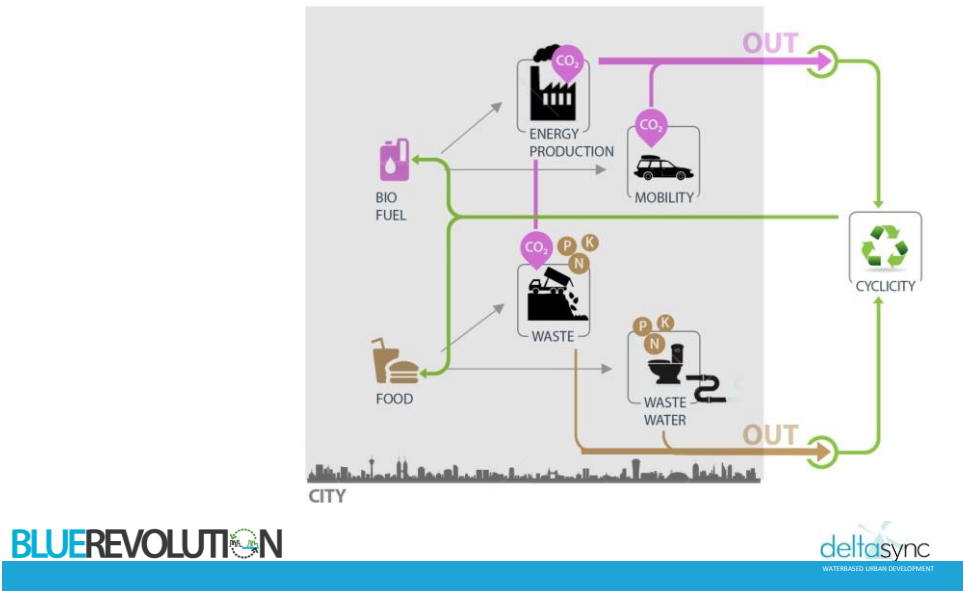
# Blue Revolution alternative



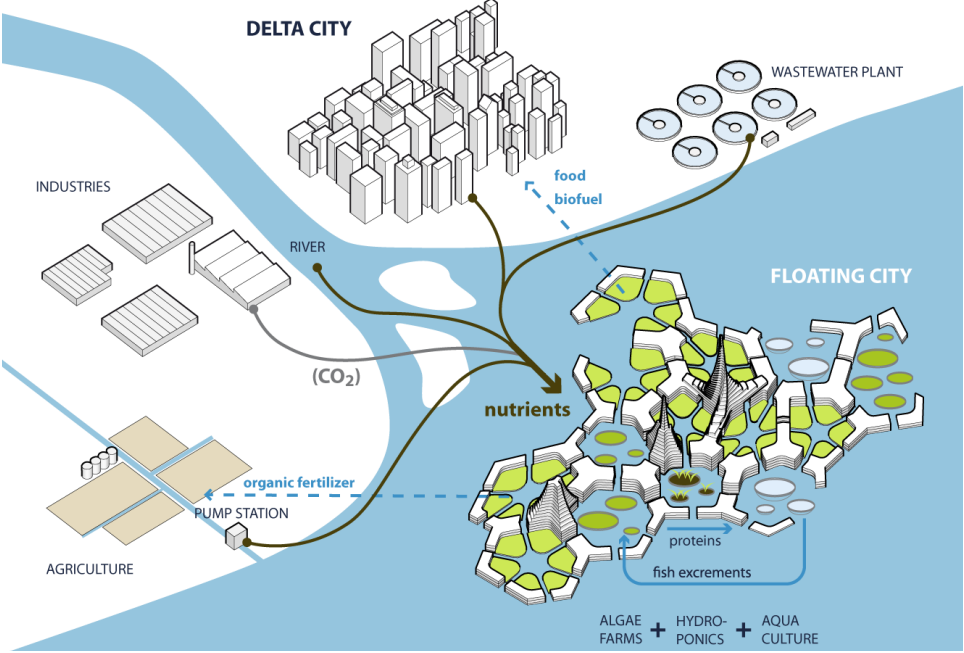
## Urban Metabolism | CONVENTIONAL



Urban Metabolism | CYCLICAL



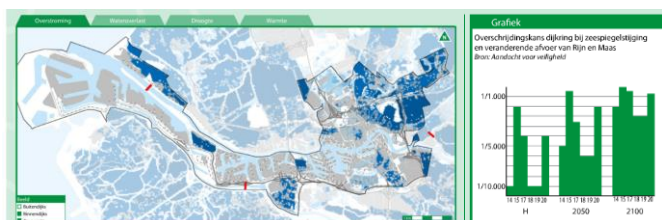
BlueRevolution concept



## Case Study| Rotterdam



## Rotterdam challenges | CLIMATE CHANGE



## FLOOD RISK



**WATER SQUARE** source: fastcoexist.com



**GREEN ROOFS** source: Erasmus MC

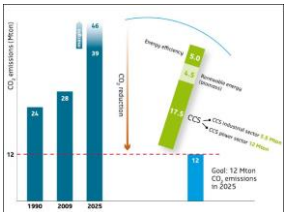


## FLOATING EXPANSION

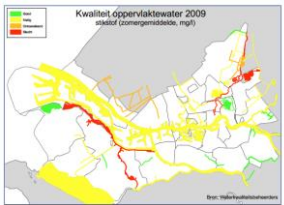
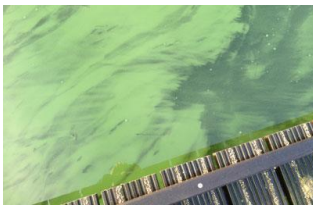




Rotterdam challenges | EMISSIONS



**CO<sub>2</sub>**  
EMISSIONS



**NUTRIENT**  
EMISSIONS



  
WATER-RELATED URBAN DEVELOPMENT

Rotterdam challenges | SUMMARIZED

**TOO MUCH**  
**WATER**

**TOO MANY**  
**NUTRIENTS**

**TOO MUCH**  
**CO<sub>2</sub>**



  
WATER-RELATED URBAN DEVELOPMENT

# Rotterdam challenges | SUMMARIZED

TOO MUCH  
WATER

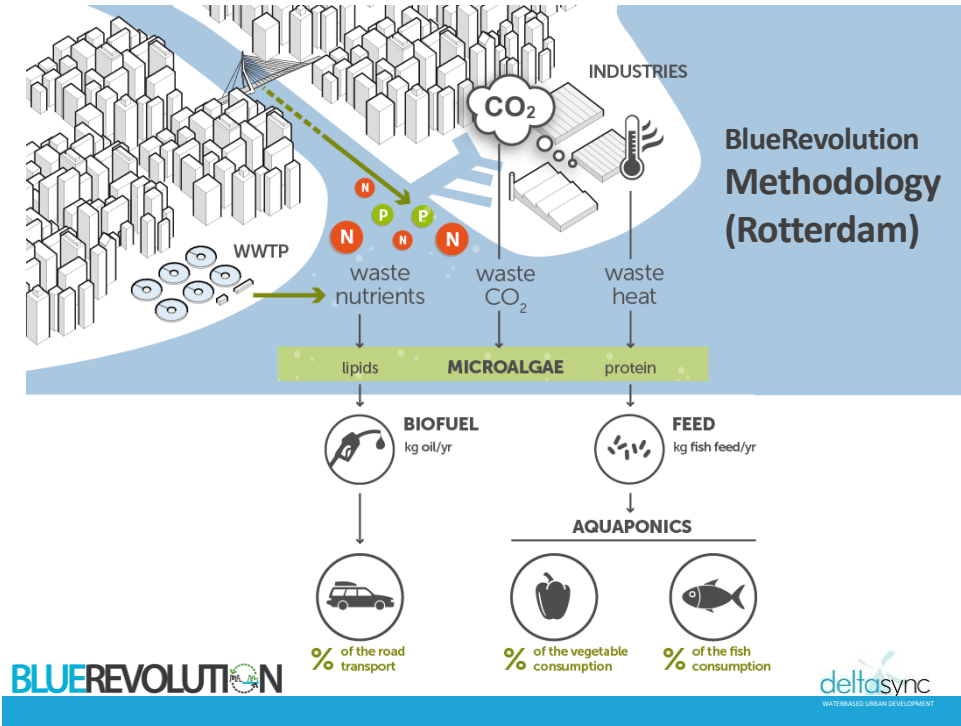
TOO MANY  
NUTRIENTS

TOO MUCH  
CO<sub>2</sub>

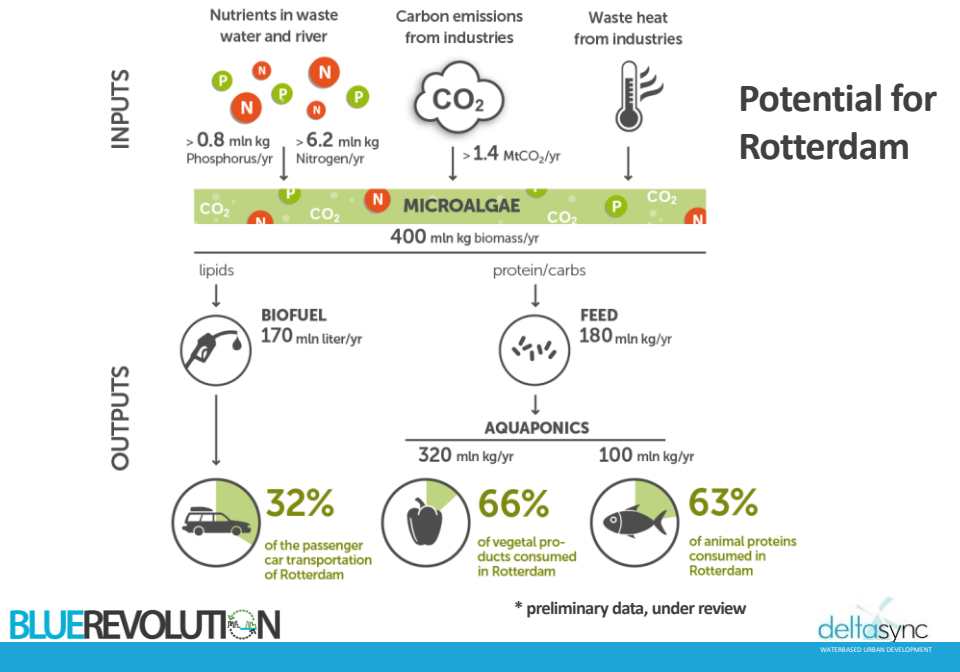
BASICALLY THE  
REQUIREMENTS  
OF A PLANT

BLUEREVOLUTION

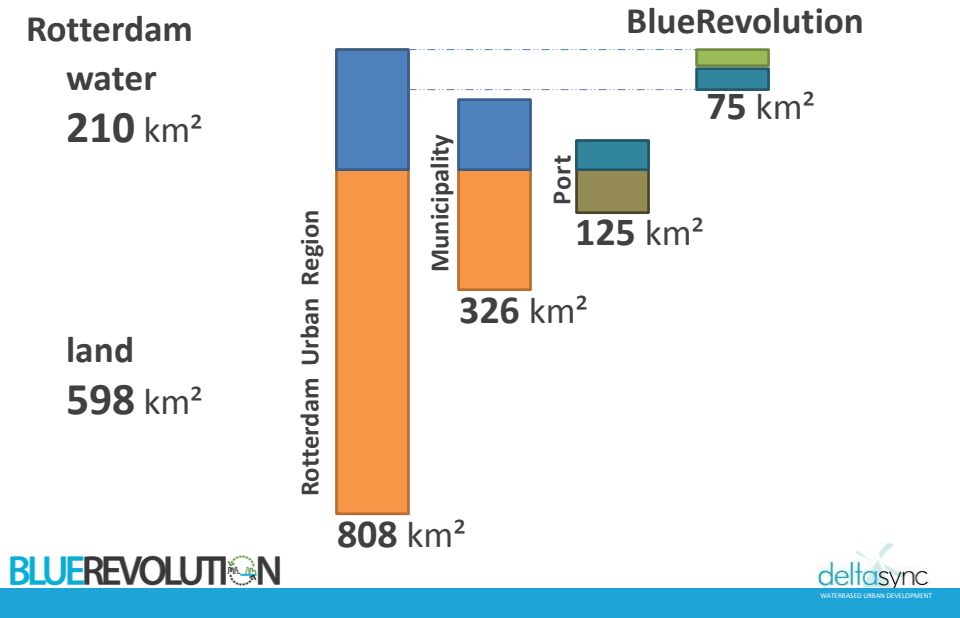
delta sync  
WATER-RELATED URBAN DEVELOPMENT



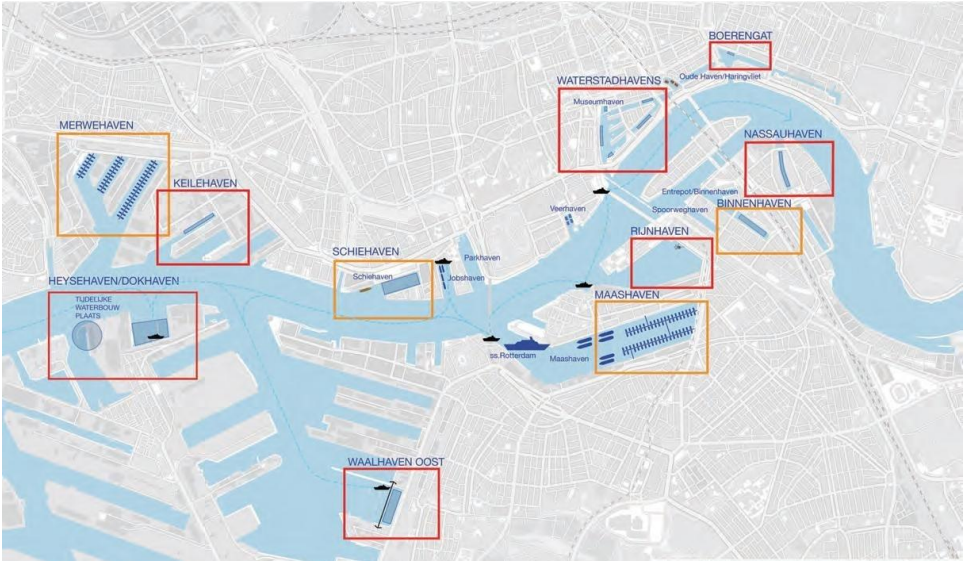




## Space requirements



Implementation | SMALL SCALE PILOTS



**BLUEREVOLUTION**

**deltasync**  
WATER-RELATED URBAN DEVELOPMENT

Implementation | SMALL SCALE PILOTS



**BLUEREVOLUTION**

**deltasync**  
WATER-RELATED URBAN DEVELOPMENT

## Implementation | SMALL SCALE PILOTS



### Algae Facade

source: [www.fastcoexist.com](http://www.fastcoexist.com) / ARUP

**BLUEREVOLUTION**

**deltasync**  
WATER-LED URBAN DEVELOPMENT

## Implementation | SCALING UP



**BLUEREVOLUTION**

**deltasync**  
WATER-LED URBAN DEVELOPMENT



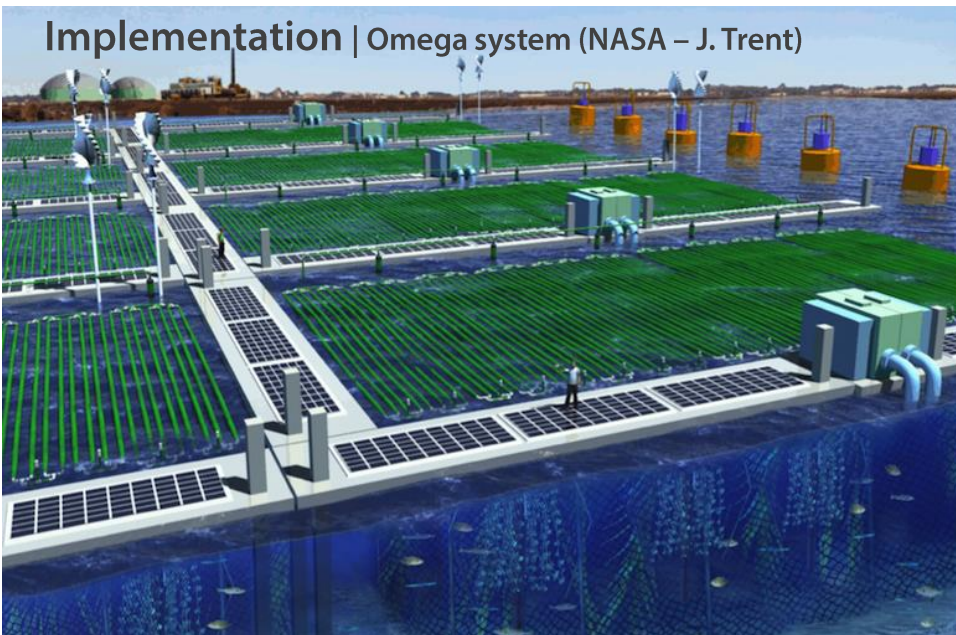
## Implementation | SCALING UP



**BLUEREVOLUTION**

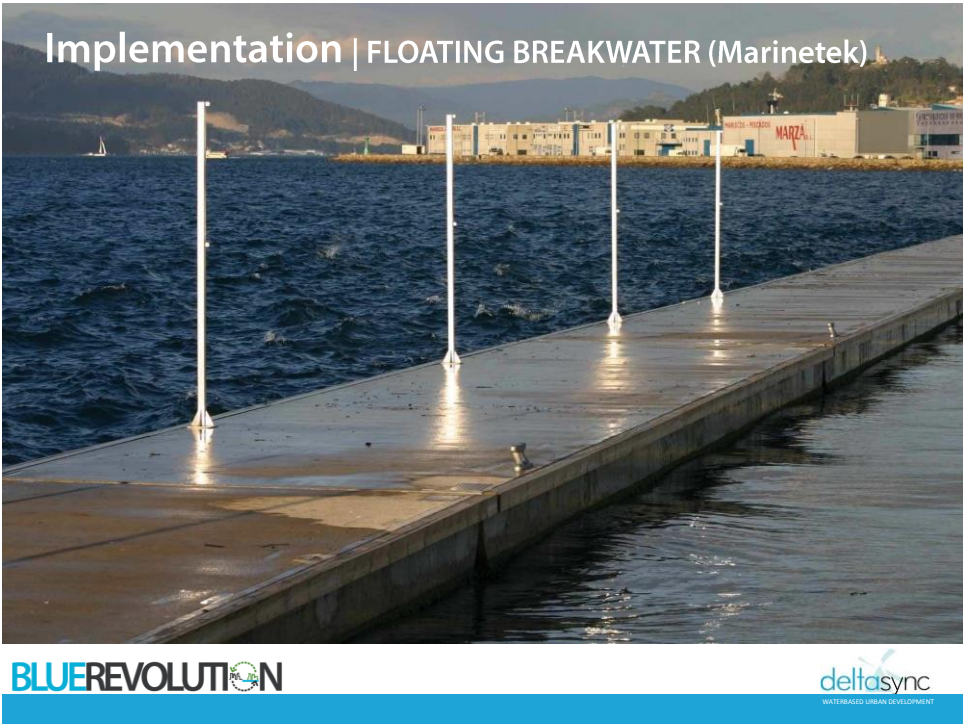
**deltasync**  
WATER-BASED URBAN DEVELOPMENT

## Implementation | Omega system (NASA – J. Trent)



**BLUEREVOLUTION**

**deltasync**  
WATER-BASED URBAN DEVELOPMENT



Blue Revolution benefits

Improving  
Resilience



32%  
of the passenger  
car transportation  
of Rotterdam



66%  
of vegetal pro-  
ducts consumed  
in Rotterdam



63%  
of animal proteins  
consumed in  
Rotterdam

Mitigation  
of Emissions



7.5%  
reduction  
(rotterdam+port)



60%  
reused

Reducing  
Fish Depletion

replace 40%  
of wild caught  
fish  
(Dutch annual  
quota)



## ...more benefits

- Creates extra space without land
- Creates safe, green and climate-proof expansion
- Provides economical benefits and jobs

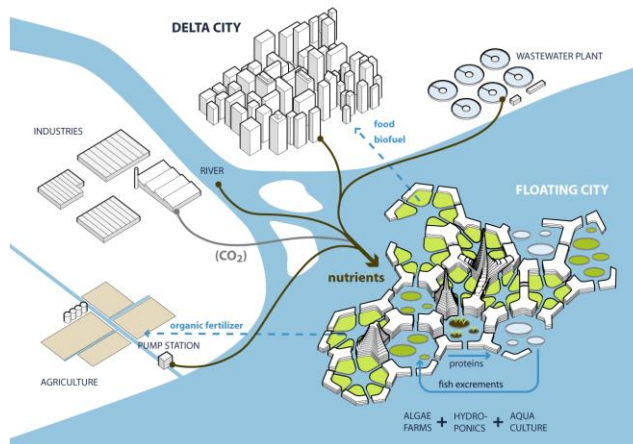
## Applicability and limitations

- Results are the maximum potential, based on all available nutrients
- Further research should point out how much can be captured
- Limitations of reusing waste water that is possibly contaminated
- Commercial feasibility



# BLUEREVOLUTION

Potential of floating urbanization and food production for coastal/delta cities



More info:

[www.Blue21.org](http://www.Blue21.org)

[www.deltasync.nl](http://www.deltasync.nl)