the Floating City into an ocean of opportunities
The independent organisation Urgenda is brought into existence to stimulate making the Netherlands more sustainable. This is done in several ways: by connecting current sustainable initiatives, by accelerating that which is stagnant and scaling up that which has already proven to be sustainable at smaller scale. And finally by initiating icon projects: sustainable projects that are to be in the spotlight and have international relevance and allure. The Floating City is a perfect example of such a sustainability icon: it offers an innovative solution for sea level rise, can be built with climate neutral technology, is more flexible and cost effective than its land-based counterpart, combining residential, commercial and recreational functions and can become social cement for the community of inhabitants.

This brochure serves as a visiting card for the icon-concept of the floating city. We of the Urgenda hope that reading this brochure will be as inspiring and exciting to you, as we already are about this much talked-about concept. We would like to thank the municipality of Rotterdam, Rotterdam Climate Proof (RCP) in specific, for their readiness to facilitate this brochure, and pioneering firm DeltaSync for the production of this brochure. May the Dutch floating city be realised within 10 years!

Jan Rotmans
Urgenda
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The sustainability platform Urgenda is taking the initiative to commission the first floating city in the world. Floating urban development offers a solution to problems of lack of space in low-lying delta areas and has a positive impact on the growing vulnerability of these areas resulting from urbanisation and climate change. The aim of this prospectus is to encourage interest among developers and investors to take part in this project.

Technology and knowledge for floating cities
Current technology for floating construction focuses on free-floating buildings not on districts or towns. To develop floating cities new technology is needed so that each facility can be executed afloat instead of being ‘borrowed’ from the mainland. In addition, a great deal of social and community knowledge is needed about human behaviour and movements on and around water.

For a long time unclear regulations meant that floating projects never materialised or only with a delay. But through learning by doing the pilot project can contribute to testing and evolving new rules and regulations in practice. Technically, socially and policy-wise the pilot project will offer exclusive knowledge to the consortium partners.

Application in a growth market
The new knowledge and experience gained by the consortium partners involved can be put to optimum future use since floating construction is a growth market with a number of specific advantages. Floating construction offers an ideal opportunity of separating the production site of a building from the place where it is to be located. Floating buildings are movable, so that they can be constructed on an industrial scale under controlled conditions. This offers unprecedented openings for innovation in the building industry, reduces inconvenience from building activities and offers chances of successfully introducing new sustainable concepts, like cradle to cradle, in the building world. In comparison to conventional urban development massive quantities of sand need no longer be brought on site to prepare land for building, flooding problems are pre-empted and major cost items arising from ongoing soil settlement are avoided.

Why a Floating City?
Floating construction by comparison with conventional urban development offers a number of advantages that support the growing market for this form of building.
- makes multiple use of space possible: combines urban development and water storage;
- resolves flooding problems;
- allows for flexible town planning;
- has international allure;
- requires no input of sand to prepare land for building, thus saving time and money;
- incurs no cost items from repairs arising from soil settlement.
The Floating City pilot project offers solutions for universal problems in low-lying deltas throughout the world producing new valuable exportable knowledge in a domain in which the Netherlands, water land, has traditionally excelled. The Floating City creates new space in densely populated areas and offers new opportunities for sustainable urban development.

Urbanisation trends
Populations are becoming increasingly concentrated in urban areas and these are situated more and more in delta zones. In 2007 for the first time there were just as many people living in towns and cities as in rural areas. In 2003, 23% of the world population was living less than 100 kilometres from the coast and in 2030 the percentage will have risen to 50%. This migration to the coastal areas and rivers means that around 200,000 people daily are relocating to towns and cities. This urbanising trend results in greater vulnerability to climate change and natural disasters as populations and economic assets becoming increasingly more concentrated. Lack of space in cities leads in turn to rising property prices and mobility problems.

Sustainable solution
The Floating City offers a solution for the above problems in low-lying deltas. Floating urban development allows town planning and water storage to be combined to achieve multiple use of space. Moreover a floating building moves along with the water level, an adaptive capacity that fits well with the great uncertainty in forecasting the impacts of climate change. This has a positive impact on lessening the vulnerability of urbanisation in low-lying delta areas. Lastly the flexibility of floating construction means that a floating city can easily adapt to changing circumstances and social wishes. The city can be restructured or expanded without having to demolish particular buildings.

This prospectus will first look at the current state of the art of floating construction in terms of technology, policy and regulations, followed by some concepts for potential functions in the floating city and will close with an assessment of the market potential and strategy realisation.

The Floating City that Urgenda is realising in the Netherlands is providing a solution to worldwide problems. The knowledge accumulated in this project can be applied internationally.
Current technology for floating construction is geared to free-floating buildings, not to districts or cities. To build floating cities new technology is needed so that each of the functions can be executed independently afloat, including parking space, infrastructure, urban green amenities, energy supplies and waste processing. New insights are also needed into people’s behaviour and perceptions on and around water. The technical and social knowledge accumulated is systematically recorded and is for the exclusive use of consortium members.

Concrete caissons
Most of the floating homes or arks are built on a floating concrete caisson. The oldest ark built using this method was delivered in 1922. More than 75 years later the ark is still afloat. Concrete caissons have gained in quality over the years as material properties and execution techniques have improved. The caissons are relatively inexpensive, stable and they can be used as a floor of the building. Sinking through leaks is virtually impossible. A leak in the home itself or water used to extinguish a fire does pose a hazard though. An element the size of a house can be produced in a number of factories and transported by water through the Netherlands. Innovations can make these caissons even more suitable for modern floating homes. The basic structures can be linked together so that in addition to free floating homes linked homes can be manufactured. Structures of considerable size can be produced thanks to the knowledge and skills acquired in making sink tunnel caissons for traffic tunnels under waterways. A huge floating concrete element has been built for a floating prison. The underlying structure for this detention platform measures 100 by 22 metres. Substantial houses or apartments can be built on constructions of this kind.

EPS concrete structures
In Canada floating homes are built on floating constructions comprising a core of EPS blocks provided with a concrete shell on the lateral and upper sides. This system has been used in Canada and the US to build many floating structures. A Dutch construction company introduced the system in the Netherlands a number of years ago. The first floating homes using this method have meanwhile been built. The disadvantages are the relatively high centre of gravity and the high material costs. The system though is unsinkable.

The construction method can also be used to build large-scale floating platforms. Another Dutch construction company has recently developed a method of making EPS and concrete platforms actually in the water. EPS sheets are first glued together to create a large floating surface on which a grid of EPS blocks is placed between which a grid of concrete bars is poured. The platform is then provided with a concrete floor. The building phase needs special attention with a view to uneven loads from fresh concrete.
For years regulations on building on water posed problems. Nowadays more and more new floating homes are treated in the same way as homes on land. Clear regulations are thought to be in the pipeline. The pilot projects of the Floating City can help this process along.

Rules and regulations in the past
Unclear rules and regulations meant for a long time that floating projects failed to materialise or only very slowly. In the past the legal status of floating objects was guaranteed by legislation covering mobile homes and houseboats. This legislation was rescinded and the rules on the siting and building of a mobile home were incorporated into the Housing Act. Apart from a section in the Housing Allocation Act on moorings nothing remains on floating homes in national legislation. Central government took the view that adequate rules should be drawn up locally with the result that no unambiguous and transparent regulations were ever drafted. Case law offers no unequivocal outcome either. Differing judgements have been passed in similar cases on whether a floating object is a building construction, movable property or real estate and subject to a building permit.

Towards equality before the law
Current floating projects are sold as real estate. The SEV Steering Committee for Experiments in Public Housing having researched living on water, recommends that floating homes, amphibious homes and homes on land should be regarded as complete equals as a matter of principle. The fact that the home may have to be moved at some point for maintenance does not detract from the fact that it is immovable property. The floating home remains legally inextricably tied to the water ‘plot’. The formulations of the Building Decree do nothing to change this point of departure. Therefore a floating home is a construction work and subject to a demolition and building permit.

Current developments suggest that it won’t be long before unequivocal legislation comes into force. The first Floating City pilot project, through learning by doing, can help to test and evolve new rules and regulations in practice.

Floating as a sustainable solution:
Floating urban development has great potential in terms of sustainability for a number of reasons:
- physically sustainable
  energy savings, multiple use of space, sustainable materials, climate proof
- economically sustainable
  affordable, safe, reliable, international market and alluring features
- socially sustainable
  pleasant living environment, water as a binding factor for communities
- culturally sustainable
  in the sense of cultural historic associations
Urban Design

Urban development on water faces many new challenges. The moveability of floating buildings makes for a dynamic development of the urban fabric. Moreover, a city on water creates numerous infrastructure options of combining road and water transport. Floating town planning can consequently concern itself more with growth strategies than with strictly demarcated spatial planning.

Flexibility

Floating construction offers an ideal opportunity of separating the production site of a building from the place where it is to be located. Floating buildings are movable, so that they can be constructed on an industrial scale under controlled conditions. This offers unprecedented openings for innovation in the building industry, reduces inconvenience from building activities and offers chances of successfully introducing new concepts like cradle to cradle in the building world.
Longer economic life
The economic value of the building and the location can be separated. Both can be sold separately and be given a new use. This prevents premature demolition, keeps the economic value of the buildings intact and makes it easier to respond flexibly to the openings on the real estate market.

Flexible town planning
Another major potential asset is moveability and flexibility during construction, use and the end-of-life phase. The urban planning structure of a floating district can be easily adapted to the ongoing changing requirements of the community. The floating district easily adapts to changing circumstances, such as the rise in sea level, while the modular structure of the floating system makes it straightforward to expand.

Sustainable manufacture
Floating construction enables the use of factory-made floating elements that are assembled in situ. The result is high quality at a lower price. Moreover the incentive to innovate is greater since the investment costs for research and development are spread over a greater number of products and need not be recouped from a single project. Sustainable development in the construction process becomes more realistic if the production and demolition phase take place in a controlled environment.

Less nuisance
The nuisance that is commonly caused these days by construction projects is largely avoided. Examples of nuisance that will no longer occur are the creation of construction pits, excavation work and noise during the construction. Even the demolition work can be done out of town.

Urban design concept
Different town planning typologies are conceivable varying from a compact core to more dispersed configuration. Investigating the two extremes reveals how density affects infrastructure and spatiality. A compact city needs fewer infrastructures but the sense of space and contact with the water are more limited. This is the opposite for a dispersed model where spaciousness comes at the cost of more infrastructures. The dynamic nature of the Floating City makes it possible to begin with a dispersed plan and to develop this further into one or more centres. The best possible use of the available water surface is thus continually achieved.

A list of the advantages:

Production phase
- factory made products
- dismantleable construction
- no nuisance from construction work

Use phase
- moveability
- building and location separated
- flexible town planning

End-of-Life fase
- re-use of building
- easier re-use of building materials (controlled demolition)
- no nuisance from demolition work
The presence of water often offers added value as the Amsterdam canal concerts and beach pop concerts bear witness. This particular event (Dance for Climate Change) wants to contribute to a more sustainable society by using the proceeds of the festival to support sustainable initiatives. The floating event can visit diverse water cities at home and abroad.

Floating parking is a solution in densely populated areas, where there is usually little space for such amenities. Being movable, such a facility can be deployed temporarily in the case of major events or urban redevelopment plans. The roof can be used for parking or as additional public or commercial space.

The Floating City provides added value in more than one way. Besides being an excellent place for people to live and work the floating city offers residents and visitors alike opportunities to relax; there is space for leisure activities. The initiative of the municipality of Rotterdam to organise floating events is a good example. The local authority believes that this must be possible in the very near future.

The presence of water often offers added value as the Amsterdam canal concerts and beach pop concerts bear witness. This particular event (Dance for Climate Change) wants to contribute to a more sustainable society by using the proceeds of the festival to support sustainable initiatives. The floating event can visit diverse water cities at home and abroad.
Multiple use of space

Many urban centres suffer from a lack of space. Attractive spots close to the water’s edge are regularly filled up by parked cars. By creating new space to park below water level, river and canal banks can be restored to the domain of public space.

Temporary parking facilities

This floating function can serve as temporary or additional parking space. Big events or urban redevelopment projects regularly give rise to a shortage of parking spaces. A floating parking facility may offer temporary relief and at a later time can be moved to another area.

Waterfront homes

Demand for waterfront homes is high. The Floating City literally offers oceans of space in the zones outside the dikes. Housing shortages and space for emergency recovery measures are resolved in one go. The Floating City will experiment for the first time with connected floating homes and living spaces.
Floating real estate, a growth market!

Floating construction has been booming recently. In 1992 the construction of 80 homes started. In the next few years another 700 are planned and according to the SEV, the Steering Committee for Experiments in Public Housing, the figure will rise to 2750 in the near future.

Floating construction is particularly attractive in central locations with high land prices. Floating building sites vary in price from €150 to €350 per square metre making this new form of construction extremely competitive with regular land grants in prime sites. Participation in the Floating City pilot project offers consortium partners a lead in this rapidly expanding market.

Added value of floating construction
Studies have shown that waterfront dwellings are rated more highly than those on dry land. Real estate agents’ rule of thumb is that waterfront homes fetch 10% more than an equivalent dwelling that is not close to water. The presence of lots of water is one of the reasons that Dutch cities are so attractive. Because a water site from a technical environmental point of view has to have enough depth and a buildable water surface area of a maximum of 40%, this is an opportunity to develop a city that is unique for the Netherlands and even the world. The first floating city where it is pleasant to live and priority is given to superior natural assets.

The business case below shows that the presence of water makes for good returns on floating homes.
### Case study | Floating City project

**Planned area total:** 53 ha  
**Commercial:** 7.5 ha  
**Leisure:** 2.5 ha  
**Residential:** 15 ha  

With an average of 35 homes / hectare

Model distribution of 525 homes

- 105 Urban villas (including first-time buyers’ homes)  
- 210 Semi-detached homes  
- 170 Detached villas (or self build plots)  
- 40 Living/working combinations

**Urban villas**

<table>
<thead>
<tr>
<th>Number</th>
<th>Market value</th>
<th>Building costs</th>
<th>Resid. land value</th>
<th>Land/market value</th>
</tr>
</thead>
<tbody>
<tr>
<td>105</td>
<td>15,747,690</td>
<td>10,469,301</td>
<td>5,278,389</td>
<td>34%</td>
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<tr>
<td></td>
<td>GFA/LFS 1.25</td>
<td>Building costs/m² 953</td>
<td>Additional costs 35%</td>
<td></td>
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<tr>
<td></td>
<td>LFS 62</td>
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**Semi-detached**

<table>
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<th>Resid. land value</th>
<th>Land/market value</th>
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<tbody>
<tr>
<td>210</td>
<td>88,200,000</td>
<td>55,814,063</td>
<td>32,385,938</td>
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<tr>
<td></td>
<td>GFA/LFS 1.25</td>
<td>Building costs/m² 900</td>
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<tr>
<td></td>
<td>LFS 175</td>
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**Detached villas / self build plots**

<table>
<thead>
<tr>
<th>Number</th>
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<th>Building costs</th>
<th>Resid. land value</th>
<th>Land/market value</th>
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</thead>
<tbody>
<tr>
<td>170</td>
<td>108,800,000</td>
<td>74,358,000</td>
<td>34,442,938</td>
<td>32%</td>
</tr>
<tr>
<td></td>
<td>GFA/LFS 1.35</td>
<td>Building costs/m² 1,200</td>
<td>Additional costs 35%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LFS 200</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

**Living and Working combinations**

<table>
<thead>
<tr>
<th>Number</th>
<th>Market value</th>
<th>Building costs</th>
<th>Resid. land value</th>
<th>Land/market value</th>
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<tr>
<td>40</td>
<td>20,000,000</td>
<td>15,833,880</td>
<td>4,166,120</td>
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<tr>
<td></td>
<td>GFA/LFS 1.35</td>
<td>Building costs/m² 21,086</td>
<td>Additional costs 35%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LFS 200</td>
<td></td>
<td></td>
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</table>
The Floating City will be realised in different phases. In phase one a toolbox will be developed for building a floating city. The toolbox comprises the following elements: technical solutions in the fields of energy, sustainability, use of materials and infrastructure; financial and economic key data of the potential functions and research results regarding the social circumstances. Next the first functions to be realised will be chosen. Other urban functions will be added in stages.

Process innovation

Creating a floating city can be split into a number of activities. A time line of these is given below. Together these activities will result in the first sustainable floating city in the world. It will be developed in accordance with the latest insight into Public Private Partnership (PPP) processes. The essential innovation in this process is that first the functions will be put out to tender followed by the capital resources, infrastructure, real estate and materials. The business cases of the operations can be sold as asset titles to investors, minor and major: financial innovation.

The innovative PPP process will be subdivided into a number of phases. The toolbox will be developed at the preparation phase. At the same time a consensus will be reached on the project to be developed. At a subsequent stage the functions will be selected. Once a contour has emerged and the functions are known, the developers will be chosen. The tendering round will be concluded with a covenant or agreement. Afterwards at the contract phase the builders will be chosen, the functions will be built in the construction phase and commercial exploitation will commence after completion.

Realisation of prototype

The flexibility of floating urban development allows a prototype to be created in the first phase of the PPP process. This will be transported to the location of the floating city at a later stage. The prototype serves several ends: development of high-tech and sustainable solutions, calculation of the key data for each function, recommendations on the materials to be used etc. By doing this floating construction will be presented to the world as a sound high-tech option. The knowledge gained in building the prototype is part of the toolbox.

<table>
<thead>
<tr>
<th>Activity schedule for the development of the Floating City</th>
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<tbody>
<tr>
<td>2008</td>
</tr>
<tr>
<td>ppp preparation phase</td>
</tr>
<tr>
<td>development phase</td>
</tr>
<tr>
<td>realisation phase Floating City starts</td>
</tr>
<tr>
<td>start exploitation Floating City</td>
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</table>

An investment of about €500,000 is needed for the preparatory phase. An investment of about €25 million is needed for the building of the prototype.

Process innovation model

<table>
<thead>
<tr>
<th>Process innovation model</th>
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<tbody>
<tr>
<td>consensus</td>
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<tr>
<td>process structure</td>
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</table>
You too can participate in this unique project!

The municipality of Rotterdam is aware of the need for a pro-active response to climate change. The Rotterdam Climate Proof program (RCP) focuses on making secure Rotterdam water-wise. Hence the RCP is doing its best to encourage extra opportunities for creating an attractive water city to live and work in and spend one’s leisure time. Together with leading partners the idea is to have Rotterdam expand into the foremost innovative city in the world when it comes to knowledge about water. The Floating city is an inspiring example that is actively supported by the RCP and is being implemented in the Port of Rotterdam harbours.

A floating city that demonstrates to the world that the Netherlands is still a leader when it comes to innovative water solutions. A city that will be an international icon of sustainability and innovation. Altogether more than 200 million euro in real estate is being developed. In specific terms the vision for the area is a mix of low density housing and recreation in an environment with a lot of green space and water. The well-endowed water location and the planned quality of the low-maintenance dwellings in the alluring Floating City will ensure that values will rise.

By participating now in this prestigious project you will shortly be given a prominent place in this development and the valorisation of knowledge and experience.

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3062 PA Rotterdam

Participation round for prototype now open
You can now participate in the prototype at the WereldExpo Shanghai 2010.

A business case is being developed with an estimated investment sum of about € 25 million. This development will also follow the PPP process. Developers of exhibition and conference centres are invited to submit proposals.

If you have any questions please get in touch through the contact details given above.
The Floating City is an Urgenda iconic project for creating a sustainable floating city. As a sustainability platform Urgenda wants to commission the first floating city in the world in the conviction that floating urban development offers a solution to space shortages in low-lying delta areas and impacts positively on their growing vulnerability resulting from urbanisation. The aim of this prospectus is to interest parties in participating and investing in the project.

Colofon

At the initiative of Urgenda, the climate agenda:

Urgenda is an independent organisation that wants to ensure that the Netherlands becomes sustainable faster through an ambitious agenda and a great sense of urgency. The whole involves a strategic plan with a number of steps and a list of concrete short-term and long-term actions. In addition, a number of iconic and regional projects are being carried out directed or guided by Urgenda.

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Stichting Sirum
TU Delft Onderzoeksgroep Floating Cities
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Design by DeltaSync
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