Netherlands

Reinventing multifunctionality

Innovation through integration

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Foreword

An embankment that serves as a flood defence, a road, a tidal energy plant and a water passage to restore estuarine dynamics, all at the same time. These four goals are integrated, and together share the means of the embankment. This book gives dozens of comparable examples of multifunctionality from the Netherlands. This book also tries to explain the reinvention of multifunctionality that is going on in these examples; they're more than just a couple of functions on the same spot, they reinforce one another.

What explains the growth of the number of authorities, companies, NGO's and communities thereof that work together on integrated projects like for instance a nature reserve that stores water, purifies water, and also serves for recreation? Often the explanation is that a project started because of a compelling reason, like water storage to adapt to climate change, whereas another solution was found for a completely different problem, recreation to enhance the livability of the environment.

Looking for more explanation the Netherlands Enterprise Agency wants to reach out to partners all over the world. What do you think, do we have an angle here to better work on problems like climate change, energy transition, and urbanization? There is an increasing demand for solutions that secure food supply, biodiversity, sustainable energy use and safe water. A way to manage these challenges is multifunctionality: integrating goals, and sharing means.

At a time when space and natural resources have never been so scarce, the economy proves its volatility time and again, and health issues can suddenly surprise the whole world, individuals, authorities and businesses are faced with new challenges. Professionals and users who are involved in area development, production chains and social services are looking for new earning models and cooperation. This publication demonstrates how we can work with what is already there: people's qualities, areas, products and services. Through multifunctionality we can reinforce the developmental power that already exists.

To tackle challenges in safeguarding sustainable development in the Netherlands the cooperation between the government, private sector, and knowledge institutes has been pivotal. To provide for integrated solutions however this cooperation evolves to a new way of working. The process of establishing multifunctionality does by itself create communities of authorities, companies, NGO's and knowledge institutes. Only within a community it's possible to integrate goals and share means.

More and more people are opening the treasure chest and discovering that a new combination of functions is achievable. We are convinced, however, that there are still many more possibilities. To put it even more strongly, the failure to integrate will mean missed opportunities. It is important to escape from compartmentalised structures, because we cannot feel the loss of an opportunity from within our own compartment.

We as the Netherlands Enterprise Agency encourage entrepreneurs in sustainable, agrarian, innovative and international business. We can also learn from practices abroad. In this publication, we show that many ways have already been found, and we want to inspire and challenge people to seek new ways, by actually starting to practise multifunctionality.

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Case description

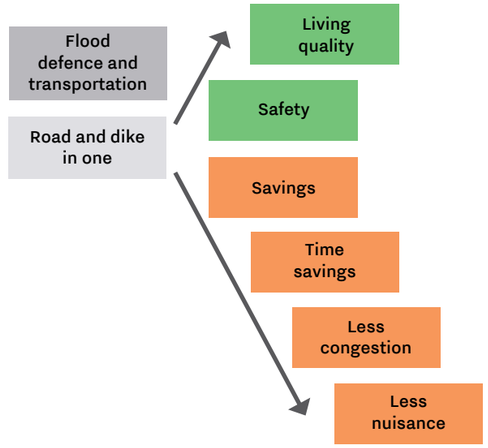
A road and dike in one in Gouda

In 2012, the city of Gouda retrieved a new ring road. In the initial design, the ring road had been located parallel to the Hollandsche IJssel River, besides a dike. This dike protects Gouda and its surroundings against floods. In that same year, the Water Board of Schieland and the Krimpenerwaard, concluded that this dike did no longer meet their safety standards. Instead of developing a separate dike and road, South Holland Province and the Water Board decided to collaborate to make an integrated plan.

Initially, the Province developed a plan for a new ring road, while the Water Board developed a completely separated plan for dike improvement. After a while, a policy official from the Water Board wondered how to explain the development of a new embankment without a flood defence function in front of a dike that needs to be improved. The Province and the Water Board then decided to investigate the possibility of building the road as a primary flood defence.

The embankment of a road is usually made of sand, while flood defences are made of clay. By using clay for the embankment of the road, the two functions can be combined. In order to do so, the service road (road for emergency services solely) next to the dike has been transformed into the actual flood defence structure with the ring road on top.

While an integrated design turned out to be a quick win, it created new questions concerning responsibility in the operations phase. The Province and Water Board determined that the whole structure had to be designed as a dike with the road as an addition on top. Therefore, the Water Board bears the main responsibility during the operations phase, while the Province was the major investor during construction.



The Water Board handed responsibility for design and construction fully to the Province. An exact calculation of costs and benefits has never been made as the advantages for both parties have been more than clear from the beginning. The fundamental belief that the combination of road and dike is the right thing to do was enough to collaborate.

Looking back, it can be concluded that around €4.2 million is saved, which equates 84%! Besides considerable savings, the integrated development generates several benefits too. First of all, the integrated design resulted in a shorter building period: the ring road has been opened eight months earlier than planned. The old dike, which encompasses several dwellings, has lost his infrastructural function. Therefore, this area has been transformed into a purely residential area. The new ring road results in less congestion and improves safety as it divides local traffic from traffic that just passes the area. Besides that, less space is used. The main benefit for the surrounding area, however, lies in the decision not to carry out the original, unavoidable dike reinforcement. The homes on the old dike would have suffered a lot of inconvenience from this in the form of noise nuisance and reduced accessibility.

Involved parties
South Holland Province, Rijkswaterstaat, Water Board of Schieland and the Krimpenerward, Gouda Municipality, Van Hattum en Blankevoort, Hollandia, Boskalis, KWS Infra

Table of contents

Cases

Cover cases

- Natural climate buffers (p. 72-73)
- Zero energy buildings (p. 11)
- Building dikes with sediment (p. 66-67)
- Self-supporting river systems (p. 27)

List of frequently used terms

Rijkswaterstaat	National governmental body responsible for the design, construction, management and maintenance of the main infrastructural facilities in the Netherlands. Examples are roads, dikes and storm surge barriers.
Province	Regional governmental body.
Water board	Regional governmental body responsible for managing water barriers, waterways, water levels, water quality and sewage treatment in their region.

Chapter 1

Reinventing Multifunctionality

1.1 Introduction

Safety has aways legitimated the use of hard structures such as dikes and other water works in order to ensure water safety in the Netherlands. As a consequence of this, the river delta and coastal area have been transformed substantialy in the last centuries, thereby disturbing nature. Last years, this is gradually changing, under the influence of sustainable development and climate change. In water works engineering, a paradigm change is taking place: more and more projects are embracing the dynamics of nature and water, and relinquishing the strict control of the system. Multifunctionality fits seamlessly into this paradigm shift and starts to play an increasingly important role. The example of the Brouwersdam storm surge barrier, dike-in-dune in Katwijk (case p. 14), dune in front of a dike Hondsbossche Zeewering (case p. 72-73) and many others prove this.

To illustrate, the Brouwersdam project will have four effects: it is a flood defence and road, and it will be a power plant, and nature will be better protected. To combine these four effects, it's essential to align the three goals of flood defence, energy production, and nature restoration. In order to do so, the dyke manager, nature manager and energy company have to collaborate. They have to decide under what circumstances the tidal power plant has to close, which happens during extreme weather conditions when the Brouwersdam needs to function as flood defence. They also discuss the inlet and outlet of fresh and salt water and the impact on nature. Finally, they discuss how the yields of renewable energy can be optimised. By doing so, a community of stakeholders is generated.

The three goals of the Brouwersdam are interrelated. The community, therefore, balances the focus on the three goals in order to realise a total optimun instead of maximisation of one of the three goals. This balancing of goals in order to realise a total optimum is the essence of integrated multifunctionality. All three goals condition the other two, or else there will be no integration. That's the essence of multifunctionality, and that's what this book is about. Multifunctionality is more than just having a set of functions in one place, like a shopping mall or a high rise. It's about the mutual reinforcement of goals; 'Reinventing Multifunctionality'is finding out what that really is. With the help of dozens of examples this book is the attempt to do just that.

Case description

Tidal power plant Brouwersdam

The Brouwersdam is one of the Dutch Delta Works that protects the lower parts of the Netherlands against the sea. It was completed in 1971 and functions as a storm barrier and road. The Brouwersdam transformed the lake that lies behind it, the Grevelingen, from an open coastal inlet into the largest stagnant salt-water lake of Western Europe. The lack of tidal differences leads to limited current within the lake, which results in low percentages of oxygen in the lower layers of water. The lowest layers of the Grevelingen are nowadays described as a 'black zone' where all flora and fauna died and only sulphur bacteria survive.

To increase the water quality and biodiversity in the Grevelingen again, Rijkswaterstaat came up with the idea to create a water passage (culvert) through the embankment of the Brouwersdam that restores an estuarine dynamic in the water system. This culvert will consist of twelve pipes of 8x8m that will create a tidal difference of 40cm within the Grevelingen. Developing this culvert requires substantial investments that cannot be bore by Rijkswaterstaat itself. To overcome this, they came up with the idea to implement a tidal power plant within the culvert. This power plant should be financed and exploited by a financial party, resulting in a public-private partnership. Combining the investments, development and maintenance for the culvert and tidal power plant results in an interesting business case for both Rijkswaterstaat and the private party.

The tidal power plant will have a capacity of 20-50 MW and a yield of 67-85 GWh a year: enough energy for the whole island of Goeree-Overflakkee with 50.000 inhabitants. This results in a carbon reduction of 45.000 tons a year. In addition to aforementioned effects, the region will be enriched by the development of valuable tidal nature and creation of bird habitats, and offers new commercial possibilities for recreation, and an expansion of the fish and shellfish sector, that all contribute to economic development of the region.

Last years, Rijkswaterstaat has been occupied finding a suitable private party to setup the public-private partnership with. During this process, they realised that a tidal power plant within the culvert is indispensable due to climate change. The seal level will rise till a level that water does not automatically flow back into the North Sea during low tide. The pumps required for the tidal power plant can then be used to pump water back. This new insight only strengthened the need for public-private collaboration.

The social cost benefit analysis pointed out benefits of approximately 350-430 million euros. National and regional government authorities have committed themselves to fund the water quality measures, but there is no balanced budget yet. Private exploitation is expected only to be profitable under certain conditions, for instance the allocation of national sustainable energy subsidy. In 2020, the project entered the second plan definition phase, which means different design alternatives are considered. The coming two years, Rijkswaterstaat will do everything they can to develop a working business case and attract a private party.

Involved parties
Rijkswaterstaat, Zeeland Province, South-Holland Province, Goeree-Overflakkee Municipality and Schouwen-Duiveland Municipality.

Websites
Deltawerken.com/brouwers-dam, technischweekblad.nl, getijgrevelingen.nl

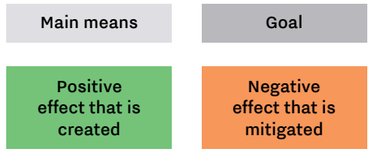
1.2 Reader's guide

Throughout this publication you will find descriptions of a large number of cases. These cases are displayed in between orange lines. All show the integration of two or more, sometimes up to ten goals. The left-hand pages deal with the theoretical background of multifunctionality. The case descriptions deal with the following topics:

- Circularity
- Clean and reliable energy
- Clean and healthy environment
- Well-being and living quality
- Spatial quality
- Biodiversity and nature development
- Transport and mobility
- Efficient use of land and subsoil
- Water safety
- Climate adaptation
- Big data
- Temporarity and flexibility

The thread running through the theoretical section is as follows. Chapter 2 looks at multifunctionality in more depth and defines what multifunctionality is in the sense of integrating goals and sharing means. Chapter 3 provides the background to the phenomenon 'multifunctionality' on the basis of the relationship between economy, multifunctionality and sustainability. Chapter 4 deals with a special subject: how to make transport and mobility part of multifunctionality. Chapter 5 is the attempt to bring everything together in an idea of area development, and how all kinds of goals can integrate within one area. Practical pointers are covered in Chapter 6, where we look at the question of how to achieve multifunctionality, and also what obstacles can be in the way of making sound combinations. We conclude with Chapter 7, which contains agenda points for further discussion and again briefly summarises how you can set about multifunctionality yourself.

Throughout this publication, you can find figures that display the positive and negative effects generated or mitigated by the cases. The figure below shows the meaning of the colours in these figures.



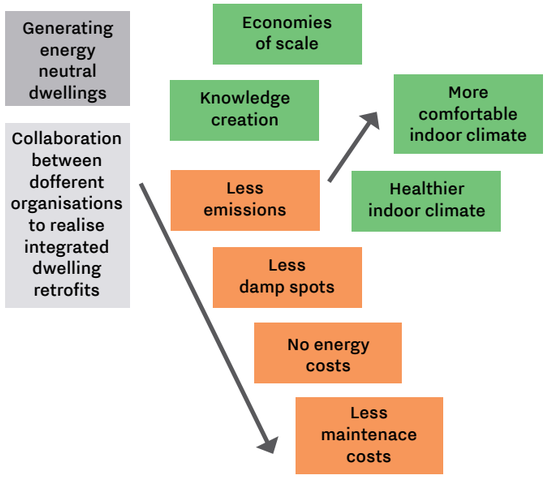
Case description

Zero energy buildings

The awareness of the impact of human kind on the earth is growing. Individuals are trying to limit their footprint on the earth by reducing waste, becoming vegetarian or limiting their number of flights. However, a substantial part of the footprint of individuals is generated by the energy use of their houses. This energy use does not only generate a lot of emissions, it also costs a lot. Several Dutch companies came up with integrated solutions to make dwellings energy neutral and eliminate the always-increasing energy bill.

One of these initiatives is Future Factory. FutureFactory is a consortium of construction agencies, technical suppliers, knowledge institutions, housing corporations and NGOs. FutureFactory develops an organisation that develops and produces sustainable dwelling refurbishments. Their aim is to realise 25.000 retrofits a year: 12,5% of the total required amount of retrofits in the Netherlands.

A Future Factoryt retrofit combines new technologies such as prefabricated facades, insultated rooftops wit solar panels, smart heating, and ventilation and cooling installations. After such a retrofit, a dwelling is net zero energy, meaning it generates the total amount of energy required for its heating and cooling, hot water and electrical appliances. This results in dwellings with a healthy indoor climate and no energy bill.



Some parties involved in Future Factory, are also part of another initiative: Energiesprong [Eng: energy jump]. This initiatieve offers retrofits as well. An Energiesprong retrofit is financed by future energy savings plus the budget for planned maintenance and repairs. Dutch banks created special financial arrangements to for an Energiesprong retrofit, which means the retrofit does not result in extra costs for residents.

Energiesprong works with independent market development teams. These teams intervene in the market by creating mass demand for high performance, desirable and affordable retrofits. This is all to drive an industry that creates better, cheaper and more desirable retrofit solutions overall. This to ensure everyone can live in a home that not only fits our time, but is also ready for the future!

What both initiatives have in common, is their drive to generate energy neutral dwellings for the lowest price. This makes it possible for low-income households to make their dwellings more sustainable. Besides that, it shows that the energy transition does not have to be expensive when private parties and banks join forces. All it requires is innovation, collaboration and a different way of financing.

Involved parties
Energiesprong, FutureFactory, RC Panels

Websites
Energiesprong.org, future-factory.nl

Chapter 2

Integrating goals, sharing means

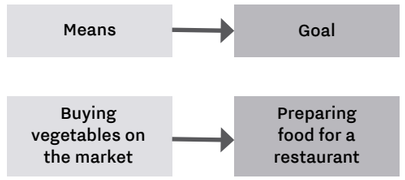
2.1 Integration

In Bakkum, a small village near the North Sea, clients of a psychiatric care facility are growing organic vegetables together with agriculture students. They have been commissioned to do this by a restaurant that boasts a Michelin star. Previously, clients grew vegetables on their own piece of land, as did the students, and the restaurant simply bought its vegetables at the market. Currently, they are sharing a plot of land, where the agriculture students' lecturers can make sure the restaurant receives the high-quality produce it needs.

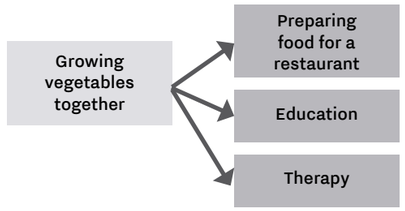
By setting this quality requirement, the quality of the students' education improves, as does the quality of the clients' therapy. This represents the essence of integration. Economic profit results from reducing costs while, at the same time, increasing results. Reducing the costs is achieved by sharing means: in this case a piece of land and the cheap workforce of clients and students. The results are increased due to mutual reinforcement between the various goals. Stand-alone goals lack this interplay and must be pursued in another way, with different quality and costs.

In standard situations, clients from a psychiatric care facility simply give the vegetables and flowers they have grown to visiting family and friends. The incentive provided by working for a restaurant is absent, while working for a 'real' customer has proven to be beneficial for clients with certain conditions like autism and serious stress-related burnouts. Almost the same applies to students. Education is the goal of their agricultural school and a range of means are used to achieve this goal, including cultivating the soil - getting their hands dirty, as it were. If this objective is not linked to other goals, the students have no reason to make more of cultivating the soil. The incentive provided by working for a customer has proven to be very effective in the learning process.

The perspective of the restaurant is similar to the perspectives of the psychiatric care facility and agricultural school. The restaurant will simply buy its produce at the market when the goal of preparing good food is not linked to the goals of therapy and education. Their vegetables won't have the same quality as the organic ones that have been grown with care by the students and clients. And they won't have the same remarkable background story, a story that the restaurant's customers appreciate. The motivation to deliver this kind of quality is particularly important to a restaurant with a Michelin star. When we set a goal for ourselves without considering other goals, we miss out on opportunities for utilising the means that others have to offer: means which may be useful in reaching one's own objectives. Setting individual goals is the way that most people and organisations tend to pursue their goals and implement their respective means. This can be represented with a simple diagram as follows:



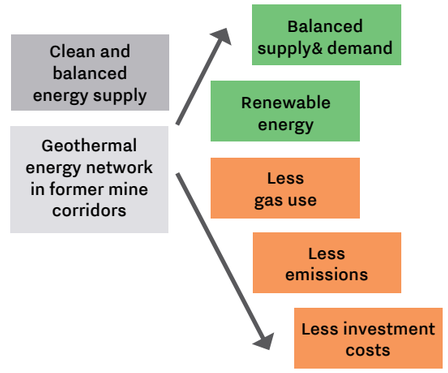
This book aims to demonstrate that increasing numbers of people and organisations are no longer simply identifying individual goals, but that they are putting their means to coordinated use to serve two or more objectives. This works as follows:



Case description

Mine water as starting point for sustainability

In 2003, Heerlen Municipality started using the sustainable energy available under its feet: heat from geothermal wells. The former mine corridors contain hot water and can therefore form the basis of an innovative energy network. This low-temperature source provides heating and cooling to homes, offices, shops and industrial companies. It also uses residual heat from the surrounding area and, when there is less demand, ensures that residual energy is stored in existing underground corridors or power plants with buffer vessels.



The initial geothermal energy network uses already existing mine corridors, which results in limited investments. In the last years, the network is expanded with prefabricated barrels at locations without mine corridors. This resulted in a large energy network in and around Heerlen. Buildings with extensive heat, such as the APG data center, can release their heat to the geothermal energy network too. Heat that would have been discharged in open air is used now to heat the 32.000 m² of office space of APG, and to warm around 70.000 m² of other buildings.

The success of mine water technology is an example for other cities that are looking for natural, gas-free alternatives. In principle, it is possible to build thermal energy networks in other cities. For example by connecting existing thermal energy storage (TES) systems, intermediate dwellings and other heat sources in the city, such as (cooled) supermarkets, data centers or office buildings. Such a local thermal circular energy network leads to significant savings for everyone involved.

The mine water technology has been extended to the neighbouring Brunssum Municipality. In addition to new-build homes, it concerns the renovation of existing social housing complexes and private properties. The thermal energy network of Brunssum is not connected to the network of Heerlen. Instead, several TES installations are combined and connected to a water-bearing layer at a depth of 100 meters. At the end of 2019, the first power plant and the required thermal pipeline network have been installed. The TES installations function as heat buffers. In the near future, these buffers will use geothermal heat. Till that moment, heat pumps are used. Mine water technology is gaining more and more international renown for its innovative 'demand-supply' system. A system by which energy requirements can be accommodated on the basis of factors such as weather forecasts and customer demand. Along with other resources, such as solar energy, wind energy, biomass energy, buffering, and a perfect control system, it is able to generate an optimum yield. The hybrid pipe network transports the relatively warm and relatively cold water to the right place: where the customer needs it. Thanks to the continuous development of the system, mine water energy is now an essential part of Heerlen's 2040 renewable energy master plan.

Involved parties
Heerlen Municipality, Mijnwater BV, APG and many others

More information
Mijnwater.com

Proper coordination of the goals is crucial here. To illustrate, the restaurant cannot work around the school holidays, but nor can the school expect the restaurant to close during holdiays. The care clients can compensate for the students' absence; this requires coordination with the care facility. An inevitability of the entire model is that students and care clients come and go. The lecturers at the agricultural school, the owners of the restaurant and the counsellors at the care facility are therefore responsible for ensuring continuity. This also illustrates how the coordination of such divergent goals as food preparation, providing education and administering therapy requires special attention and effort.

A completely different case provides an equally apt illustration: the incineration of waste that also serves to generate a supply of heat. This requires a different form of incineration than usual, one that is not only suited to the goal of waste processing but also to that of supplying heat. This demonstrates once again the distinctive focus of this book; it shows an alternative to the usual way of doing things in which means are put to use to achieve only a single goal. Coordination like in this incineration example is not the norm everywhere, but it is the norm among the examples in this book.

Case description

A multifunctional dike-in-dune

The whole coast line of the Netherlands functions as flood defence that protects the hinterland during extreme weather circumstances. Katwijk is a weak link in this structure since this village is more or less situated on the flood defence structure. The increased frequency of storms and higher sel levels that will appear required action to improve this structure. Instead of building a monofunctional dune, the new flood defence structure is combined with a parking and nature park, which results in higher value and lower costs.

Main goal of the new flood defence structure is protecting Katwijk against flooding. To fulfil this goal, 192 parking lots along the coastal strip had to be removed. Finding another suitable location for these parking lots turned out to be rather hard. Therefore, the function of flood defence is combined with a multi-layered, underground parking garage through developing a concrete structure with a sandy dune on top. Next to this multifunctionality are some other benefits. The dune connects two nature parks with each other, which increases the living area of several species. Besides that, it increases spatial quality by removing parking lots from public space, and preserving the view line from the village towards the sea.

The initiator and owner of the integrated flood defence structure, the Rijnland Water Board, has strict regulations concerning their constructions. This regulation is solely focused on protecting the Netherlands from water and therefore does not allow any function combinations. To enable the design of the dike-in-dune, the water board changed their regulations. The integrated design resulted in several benefits: it turned out to be €24 million cheaper than a separate flood defence structure and parking amenities. These lower costs originate from lower investments, lower management costs and an increase in economic development around the dike-in-dune, for example higher real estate values and higher revenues from restaurants and cafes. On top of that, by combining the construction process, the surrounding area only suffered the inconvenience once. The Katwijk dike-in-dune is finished in 2015 and in full use right now.

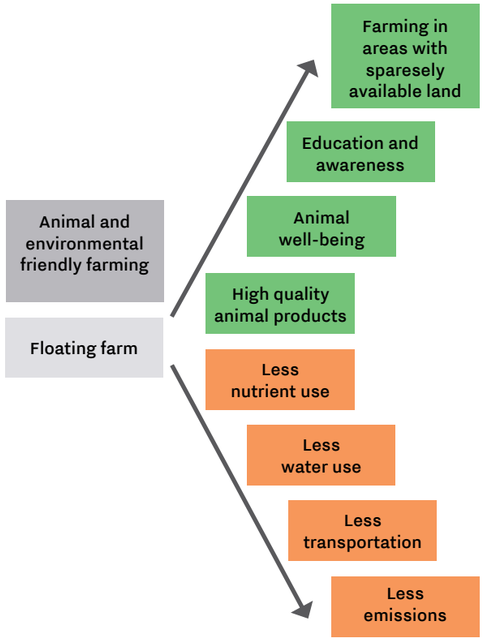
Involved parties
Katwijk Municipality, Water Board Rijnland, South Holland Province, OKRA Landscape Architects

Case description

Floating farm in the port of Rotterdam

The floating farm is a multi-layered cow farm situated in the harbour of Rotterdam that aims to minimise the impact of farming on the environment and strengthen the food chain. To do so, it produces fresh dairy and meat in an animal-friendly and sustainably way. The production is circular: cycles of nutrients, energy and water are closed as much as possible.

The floating farm holds cows that provide high-quality milk, and are used for their meat too. The floating farm produces and sells milk, yoghurt, cream butter and buttermilk. The farm is circular, which implicates that the farm is self-sufficient in terms of water supply, water treatment, energy generation, waste processing and feed for the cattle. This is realised through connecting the processes at the farm to processes in the city. To illustrate, the cattle is fed with organic and strictly controlled residual-streams of industrial processes from, for example, beer breweries and potato factories. The cows process these waste streams into high-quality protein that we, as human beings, can consume again. The urine and manure of the cows is collected by a robot and processed into compost with a high percentage of nitrogen and phosphates, which is used to fertilise the soil of city parks in Rotterdam.



The farm is located on the water and connected to several water ways, which makes this solution interesting for cities with sparsely available land for urban farming. It also minimises the need for transportation as the consumer and suppliers are located close to the farm.

The farm also has an educational function. In order to provide educational information about food and raise awareness concerning circularity in our food chain, the farm is accessible to public. The part of the farm where the cattle is held and milked is transparent, so all installations are visible. In this way, people can see how cattle live, how food for the cattle is produced and how the fresh dairy products are produced. Fresh milk can even be tapped directly on the spot from a dairy wall. Fresher milk is not possible!

The floating farm shows an animal-friendly and circular way of farming in which small-scale stock farming is combined with innovative milk processing, information technology and automation. The floating farm combines different goals, as can be seen in the figure, which results in a business case that is interesting for farmers, suppliers, visitors and many others.

More information
Floatingfarm.nl

Why do we implement a means to reach a goal, and why should we put a means to use in serving two or more combined goals? Is the latter preferable? In the example of a noise barrier carrying solar panels, this barrier is a means to achieve the goal of noise reduction as well as the goal of generating renewable energy (case p. 29-31). What is crucial here is that the goals are formulated taking their interlocking nature into account, and that is a new concept. The decision to link waste incineration to heat supply means using an entirely different method of incinerating refuse. For one thing, heat conduits are damaged when they are allowed to heat up and cool down too quickly, placing some restrictions on their use. It is no different than the case of the noise barriers, in which a solar panel must be constructed in a way it actually fits on or into the barrier, while blocking noise as well as a regular barrier.

Something new in society is happening here compared to the past and to many instances in the present: goals are being coordinated to allow a single means to contribute to achieving multiple goals. In this book, we refer to this as reinventing multifunctionality. **Where does this concept come from and why are people doing this more often today than they have in the past?**

2.2 Finiteness of resilience and natural resources

Many interventions in the physical environment have been made — and continue to be made — as if the environment has infinite resilience. One example is the emission of substances which are not cleaned up, or in any case not adequately disposed of, by natural processes; think of nitrogen. Another example would be wildlife areas that have become too fragmented to be self-sustaining. A nigh-infinite number of permits have been issued to date, granting individuals permission to use the environment to their own advantage, without concern for the fact that the quality thereof might suffer as a result. Where disadvantages to development have been recognised and the use has therefore been prohibited, an exemption can often be granted – potentially on condition of compensation. For instance the emission of nitrogen is still granted in many cases.

The environment suffers as a result of this, yet there is an assumption that the global environment is so resilient that an extra localised setback should pose no problem. Meanwhile, it has become clear that this ability to bounce back has its limitations. The air quality, for instance, is currently under threat; harmful substances find their way to even the most remote corners of our planet. The pressure on natural resources and space has become more visible last years. To illustrate, the Dutch Government limits maximum car speed to 100 km/h to stay within the limits of nitrogen emissions set by European law. The same pressures apply to resources: space has been scarce in our country for years.

There is a growing awareness that both the resilience of the physical environment and its natural resources are finite. Yet despite this knowledge, most human action is still organised as if resilience and natural resources were infinite. Even when faced with shortages, we do not perceive these as absolute or non-negotiable. Our assumption is that the shortages are temporary, either because we have the idea we are living on an infinite planet or because we are confident that technology will come up with a solution. This way of thinking is hard-wired into the profile of virtually every company and most often applies to government bodies as well. The consequence of this assumption of inexhaustibility is that people and businesses act as if there can always be more, and faster. Now that the finiteness of resilience and resources is beginning to become tangible, there is an increase in phenomena such as sharing, intensive utilisation and circular economy. None of these ideas is new, but each of them had been previously overshadowed by the idea of inexhaustibility.

Case description

Fairphone, a journey towards a circular phone

Most people regard their mobile phone as a disposable product; they buy a new one after two or three years without really thinking about the impact of this. However, mobile phones are filled with around 30 different minerals and metals. Mining these minerals is connected with child labour, civil wars, collapsing mine shafts, felled rainforest and toxic substances that leak into nature.

Fairphone is a social enterprise that develops and sells smartphones in order to uncover its production systems, addressing problems in its sector and stimulate discussions about what is fair. The initiative was founded in 2010 and has sold around 170.000 phones so far. In August 2019, their third generation smart phone has been released. In their way to produce a 'fair' phone, Fairphone focuses on the miner, the manufacturer and the planet.

The miner
All minerals and metals are abstracted from mines. Most miners work as day labourer for unofficial, small mines, which results in uncertainty and working for low wages under poignant circumstances. Besides that, several mines are linked to rebel groups, contributing to political and economic instability. Even for Fairphone that aims to use responsibly mined materials, it is not completely possible to avoid the use of materials that are mined under questionable situations. Therefore, they are focusing on fair mining of the eight major minerals, such as gold and cobalt.

The manufacturer
Working long hours for low wages under bad health and safety conditions is standard in the manufacturing industry. To change this, Fairphone is establishing transparent relationships with manufacturers who are willing to invest in employee well-being.

The planet
Fairphone tries to limit the impact of mobile phones on the planet in several ways. The phones are modular, which makes it possible to replace one part of the phone in case of malfunction instead of replacing the whole phone. Besides that, 3D-printed accessories are available which eliminates the need for long-distance shipping and producing excess stock. Fairphone also tries to use recycled materials from e-waste. They partnered up with a company that abstracts materials from e-waste in countries without a formal electronics recycling sector, and encourage their clients to donate their old phone by sending it to Fairphone, who will abstract the useful materials for their new phones.

Why an ethical phone?
There are literally thousands of social and ecological standards that can be improved in the production of smartphones. They cannot be overcome all at once. With the Fairphone a range of interventions is defined to gradually address some of them. It is a tool to open up the supply chain and build a movement towards fairer electronics. Consumers deserve to know the whole story, including where they spent their money on.

Fairphone publishes a Cost Breakdown to give a detailed overview of where their customers' money goes, and publishes a list of suppliers to reveal where all components come from. The Fairphone is therefore a storytelling device that provides a useful metaphor for complex, interconnected supply chains. This symbolic product changes the relationship that people have with their products and contributes to an economy based on different values.

Involved parties
Fairphone, iFixit, Closing the Loop, Teqcycle

Websites
Fairphone.com, deingenieur.nl

Intensive utilisation concerns the use of existing products, such as buildings or cars, and provides ideas on how to make better use of them. A school building can also be used in the evenings for choir practice, meals, meetings or even performances. In a similar way, a car might see many more hours of use each day if we were to make it a shared car. Integrating goals and sharing means is a special form of intensive utilisation of products. Think of the integration of a school and a library into one building. The pupils have more books at their disposal, which the school does not have to provide, and the library gains ready access to an important group of clients. The library and school share building costs, which is important in an era of cuts in public costs.

Now that people are becoming more aware that both environmental resilience and natural resources are finite, intensive utilisation (including integrating goals and sharing means) is gaining in importance. A phenomenon such as integrating goals and sharing means can only be truly understood in circumstances involving finiteness. We would therefore argue in favour of a reversal in the current thinking based on inexhaustibility. That is to say, society can better operate from the assumption that both resilience and natural resources are finite.

Case description

Lightyear One: the first solar powered passenger car

Lightyear One is the first long-range solar-powered car. With its futuristic and user-centred design, the car is likely to steal the hearts of innovation and sustainability adepts. It combines four in-wheel electric motors with around 5m2 of integrated solar cells that recharge the car with sunlight. The design process was focused on overcoming the three largest fears that hold people back from purchasing an electric car: not having enough range to reach the destination, not finding a suitable charger, or finding an available charger in general. The Lightyear One overcomes all of these problems.

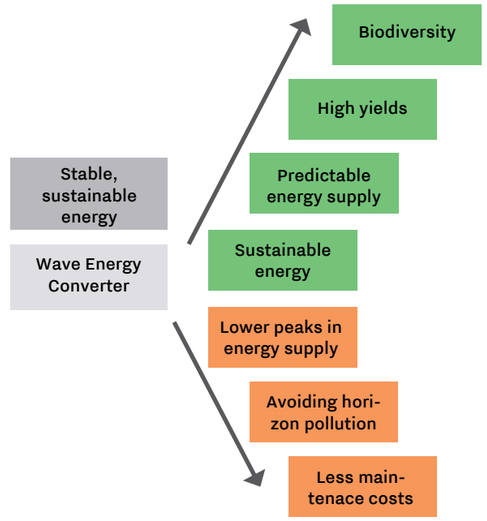
The first problem is tackled by the large range of the car. Specifically, it can go up to 725km between charges. This is enabled by an ultra-efficient platform that lowers energy consumption per km compared to other electric cars. Even during extremely cold weather, the range remains above 400km. The second problem is addressed by designing a power outlet & cable that can be plugged into a fast-charger or a standard power socket. Car owners can charge their cars anywhere, even locations without special EV-charging stations. The third problem is solved by the solar cells on the roof of the car. These cells generate enough energy to drive around 50km to 70km a day and continuously recharge the car, as long as daylight is present. This range covers the average daily commuting distance in the Netherlands, so most drivers would not need extra electricity for their daily commutes.

Lightyear One has been developed by alumni of Eindhoven University of Technology. The founders of Lightyear One were part of the Solar Team, who developed and built a solar car that competed in a 3000km race across Australia. This inspired them to apply their knowledge to a passenger car that contributes to clean mobility by reducing electricity usage as well as reducing emissions of CO2 and nitrogen while making driving comfortable. When produced on a larger scale, Lightyear One will become closer to its mission of realising one million solar kilometres driven before the year 2035.

Case description

Reliable energy from the sea

The Slow Mill is a strong example of one means that serves several goals. It is a wave energy converter that converts the power of waves into energy. The Slow Mill consists of a floater with blades connected to an anchor on a seabed. The floater is pushed up and down by the waves, while the blades move back and forth. As a result, wave movements in every direction are utilised for power generation.



Most wave energy technologies only utilise power from one direction, resulting in low yields and difficulties with extracting power from short and irregular waves, like those of the North Sea. The Slow Mill overcomes this problem with its unique blade system and thus generates higher yields, which makes it a technology with an attractive business case. It provides year-round opportunities to extract energy, also during storms or when there is almost no wind. Therefore, it is a predictable sustainable energy source without heavy peaks. The Slow Mill has a positive effect on biodiversity in the North Sea as well. In the last decades, oyster banks, flora and fauna that need hard soil, have been decimated due to industrial fishing. The anchor of the Slow Mill is made of concrete and adds 600 sqm of hard soil. Sea life can grow on this hard soil. In this way, the Slow Mill contributes to the growth of the flora and fauna in the North Sea. Besides these major effects, there are some other effects as well. First, the Slow Mill does not create horizon pollution, which makes the implementation process less susceptible to protests. Secondly, the Slow Mill is a modular concept and every part can be replaced on location. This results in a long life span at moderate maintenance cost.

In 2019, a Slow Mill anchor has been placed close to the Dutch island of Texel. The anchor was accompanied by several measuring instruments that measure current, temperature and salt levels in order to discover the effects on the biodiversity around the Slow Mill. Experts expect that a park of Slow Mills will transform into a reef. This minimises the loss of sediment around Texel, possibly leading to major savings for sand supplementation. Alongside, fish species might adopt the Slow Mill park as breeding area. The development of the Slow Mill park is still in its testing phase, but results of the analysis will be published during the course of this year.

Involved parties
Slow Mill,Rotec, Ingenieursbureau Rotterdam, Deltares, NIOZ, Innoship

Websites
Slowmill.nl

The transition towards integrating goals and sharing means is a radical one. The individual and sector-specific development of goals and utilisation of means are deeply rooted habits in our country and all over the world. In the past, individual means on a specialised basis have been continually optimised, with the only restriction that others should not suffer as a result. As a consequence, many goals and means have become strictly separated. When people start to combine these aspects, new competencies are called for. Change is necessary to help people realise that they can achieve mutual advantage by working together, even ultimately increasing mutual freedom. This movement could be considered a paradigm shift. Excellent examples of this shift can be observed in instances where people work with nature.

At a young age, children in primary school are taught about the usefulness of leaves that fall to the ground and remain there, ultimately helping to create a fertile humus layer in the soil. Organic material gets into the soil, with benefits including an improved structure and more efficient storage of water, nutrients and CO_2. The biodiversity in the soil increases as a result. This helps to increase food production and resistance to stressors including climate change. It promotes disease-fighting capacity and the binding of contaminants, as well as the soil's self-cleansing ability. Such capabilities are referred to as ecosystem services – in this case those of the topsoil.

Case description

Between plants and paintings

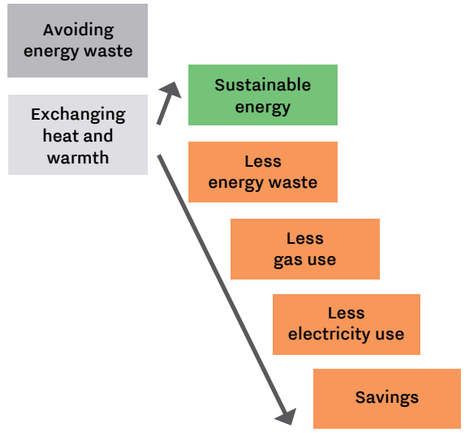
The Plantage Area in Amsterdam houses two special institutions: the Hermitage and Hortus Botanicus. The Hermitage is the second location of the well-known Hermitage Meuseum in Sint Petersburg, Russia. It is situated in a monumental building from 1691 and shows pieces from the Meuseum in Sint Petersburg. The Hortus Botanicus Amsterdam, established in 1638, is one of the oldest Botanic gardens in the world. The Amsterdam Hortus has a wide collection of tropical and local plants and trees and maintains several monumental buildings. As an art institution, the Hermitage requires more cooling than heating to safely maintain its artwork. The opposite situation occurs at the Hortus Botanicus, where more heat is needed for its large collection of tropical plants and trees. A pipeline connects the heating and cooling systems of the Hermitage and Hortus Botanicus, which results in a sustainable and economically attractive solution.

Art work requires a specific and stable temperature and humidity, which results in more cooling than heating in the Hermitage. As a result, the chillers and heat pumps of the Hermitage produce a surplus of heat. This heat surplus needs to be eliminated in order to restore the heat/cold balance in the thermal underground system of the Meuseum. Lowering the residual heat into the air by, for instance, a dry cooler would have been the easiest solution. However, it is not very sustainable. Instead, the Hermitage took the effort to look for a useful purpose for their residual heat. The closest neighbours turned out to be unsuitable, but by looking a bit further, the Hermitage came across the botanical garden of Amsterdam. The Hortus needs a large amount of energy to heat its monumental tropical and subtropical greenhouses. Using the surplus heat of the Hermitage would not only be an economic benefit, but also a great progress in sustainable energy supply.

The exchange of heat and cold between the two institutions required the construction of a double pipeline of 425 meters crossing streets, bridges and even metro lines. This resulted in a precisely guided drilling project leading the pipes underground and even under the existing metro line. The deepest point of the transportation pipe is 26 meters! In addition, a 400kW electric heat pump has been installed in the new boiler room of the Hortus Botanicus in order to be able to make the surplus heat from the Hermitage useful for the greenhouses. A cascade of eight high-efficient gas boilers with a total of 850kW has been installed for periods of peak demands. This ensures continuous heating of the Hortus Botanicus, even when the heat supply from the Hermitage is not sufficient.

Prior to the project, the Hortus used over 190,000 m3 of gas annually, on average. With the use of surplus heat from the Hermitage, the gas consumption has dropped with 65% in 2017 and 2018. This saved the Hortus around € 45,000 in energy costs a year. During the winter months, the savings may be up to € 9,000 a month. The Hermitage, in turn, receives cold from the Hortus. Thus, cold water is used for cooling, which reduces the electricity consumption for air conditioning.

In the end, the investment costs for this project exceeded budget expectation, mainly due to the fact that this was the first time such a project has been implemented. Costs for similar projects in the future are therefore expected to be 30% lower. Continuous monitoring and adjustment of the technical system is crucial to optimise its performance. The energy and financial performance of 2019 is therefore expected to exceed the first two years of operation by approximately 20%.



Involved parties
Hermitage Amsterdam, Hortus Botanicus Amsterdam, Amsterdam Municipality

Websites
https://english.rvo.nl/initiatives/energy-innovation-projects/between-art-and-greenhouse

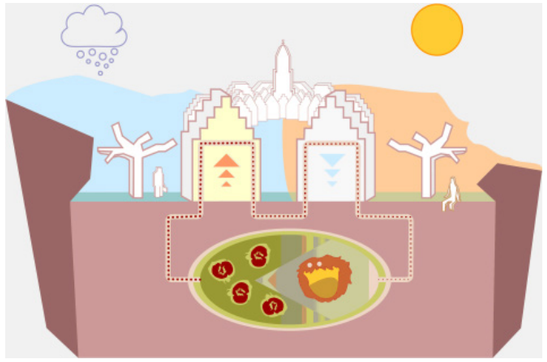
Ecosystem services are functions served by the physical environment for the benefit of society. This includes functions like groundwater purification and providing biomass for food and energy. These services are capable of reinforcing one another. This entails the virtually continuous integration of means as the intensification of one function inevitably affects the other. An increase in the amount of organic material, for example, leads to more biomass to be harvested and to an improved ability to retain CO_2. This is how ecosystem services work: they integrate with one another almost as a matter of course, as one service reinforces the other in a very natural way. Combining functions is therefore an integral part of the ecosystem-service concept. The example of the Bio Washing Machine (case p. 23) demonstrates how the soil itself can cope with contamination. By linking an existing ability of the soil with the solution to a problem, a business case is created. In contrast to the previous method, which typically led to soil exhaustion, the resilience of the soil will now be increased.

Ecosystem Service	Nature and scale of services
Water regulation	• The costs saved on drainage /sewerage in the city are estimated at € 5,000 per hectare of non-metallic ground per year. • With rainwater drainage via surface infiltration, approx. 50% of the metallic surface is needed to allow water to infiltrate. • Via infiltration facilities known as wadi, approx. 15% of the metallic surface is needed to allow water to infiltrate.
Regulating temperature and humidity	• Non-metallic ground and greenery around buildings lead to energy savings of up to 50% on air conditioning. • The surrounding land is 3-8 degrees cooler than the city; large parks cool the urban area up to a radius of 1-2 kilometres. • Cooling by a few degrees via small, green elements (0.1 ha) at regularly-spaced intervals requires approx. 1.5% of the urban surface area. • 10% increase in greenery on non-metallic ground results in a decrease in temperature of a few degrees in urban areas.
Greenery in the city	• Green surroundings/landscaping increase the value of a house by 5 to 15%. • Greenery contributes to the health and well-being of the people living in the neighbourhood. • Greenery on the ground is cheaper to manage than surfaced ground (€ 0.02 – 0.45 for green versus € 3.60 for paved public space).

Case description

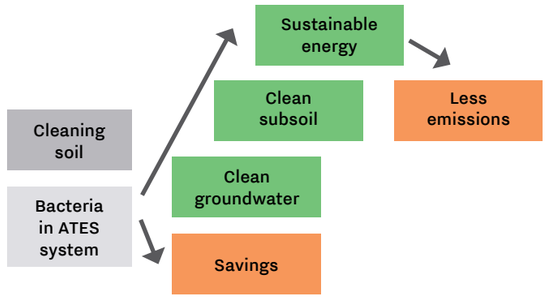
The Bio Washing Machine

The subsoil around Utrecht Central Station is heavily contaminated with chlorinated pollutants due to historical activities (painting, dry washers and metal industry). As a result, more than 180 million m³ of groundwater is polluted. Cleaning up this contamination is very time-consuming and expensive. The municipality of Utrecht therefore decided to remediate the deeper groundwater by a combination of ATES (Aquifer Thermal Heat Storage) and biological natural attenuation. This perfect opportunity for synergy between redevelopment, groundwater remediation, and energy storage (reduction of CO2) has resulted in an integrated, area-oriented approach, called the Bio Washing Machine.



The subsoil is naturally cleaned by bacteria that degrade pollution into CO^2, water and salts. The bio washing machine accelerates this process by installing ATES-systems. Such systems actively mix polluted groundwater, which stimulates bacteria to react with polluted subsoil. Thanks to the ATES systems, contaminated groundwater can be cleaned at least ten times as quickly as with other technologies.

ATES systems are installed to provide heat and cold to buildings. General ATES systems work as follows. The system pumps up groundwater and extracts heat from it in winter, and emits heat into it during summer. For that it uses a heat exchanger that is also used to extract cold from it in summer, and emit cold into it in winter. As a result, groundwater is constantly pumped from one side of the aquifer to the other. Normally, ATES systems are only applied in areas with clean groundwater to avoid spreading of the contamination. In the case of the bio washing machine, the ATES systems are deployed in contaminated areas to increase the amount of polluted groundwater that comes into contact with the bacteria. The ATES systems can therefore be seen as the engine of the washing machine. Every new ATES system that starts to supply buildings in the area of sustainable heat and cold makes the washing machine run faster.



Without the invention of the Bio Washing Machine, it would have been possible to pump up all contaminated groundwater and treat it, but this would have taken around twenty or thirty years and is very expensive. The new system works faster and is more affordable. To illustrate, soil remediation in the Utrecht Station Area would have costed around €100 million, opposed to €11 million for the current bio washing machine.

There are thousands of locations in the Netherlands where soil pollution is associated with risks, most of them located in cities. Cities are the most attractive locations for ATES systems too, as the high density makes this system economically attractive. The techniques behind the bio washing machine are therefore interesting for several locations in the Netherlands.

Involved parties
Utrecht Municipality, Stichtse Rijnlanden Water Board, Utrecht Province, Ministry of Housing, Spatial Planning and Environment, NS, ProRail BV

More information
Bioclearearth.nl, naturvation.eu
Zhuobiao Ni (2015). Bioremediation of Chlorinated Ethenes in Aquifer Thermal Energy Storage. Wageningen: Wageningen University [PhD defence].

2.3 Working with nature as an example of combining goals and sharing means

Working together with nature is a more sustainable option than working against nature. Good examples of this principle is the Hondbossche Zeeweringen (case p. 72-73). Instead of posing a threat to the community, the water becomes an instrument that promotes its safety. The Ecoshape Foundation encourages such solutions and, within the context of the innovation programme 'Building with Nature', investigates whtether there is evidence of a paradigm shift, from strictly controlling the water system to embracing its natural dynamics. A paradigm shift takes place when an old way of thinking and acting is replaced with a new one that is adjusted to the altered circumstances. The new way of acting not only solves the problems, it also eliminates the old method's disadvantages. As previously demonstrated in the introduction to this book with the Brouwersdam (case p. 8-9), such a shift appears to be in evidence in water works engineering. There the former, highly controlled methodology may well have resolved safety issues, while at the same time creating new problems like the destruction of ecosystems.

Another example of the paradigm shift is the move in cities from protecting only against rainfall to also using this free and clean water for plants and cooling (case p. 50-51, p. 69-71, p. 76). Green roofs are particularly well suited to growing plants and retaining water. Plants are beneficial for the liveability of the city; it's also beneficial to prevent water from disappearing into the sewers immediately. Retaining it on green roofs and in other green parts of the city helps to prevent heat islands from forming, and to keep the city cooler in general. Utilising rainfall is making good use of the ecosystem. The Building with Nature initiative is based on this principle, as are projects involving climate buffers.

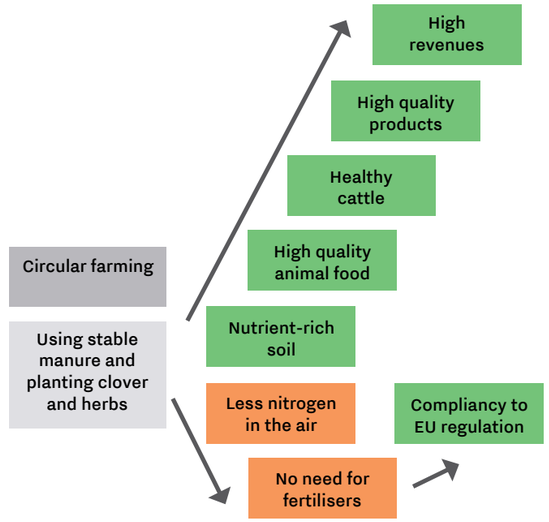
2.4 Conclusion

Integrating goals and sharing means fits with the concepts 'ecosystem services', 'climate buffers' and 'Building with Nature'. All three concepts are based on the principle of finiteness. The examples in this book show that a change is taking place in many other, extremely diverse, social fields towards production and projects based on this principle. We note that the same paradigm shift is taking place in a large number of sectors, making use of new methods and concepts, and that this provides plenty of opportunities. Even more changes are possible when people accept the fact that they are acting under finite conditions. Then, they take the depletation of raw materials into account and realise the economy's limitations. People start to look for other modes of production. A positive note is that an economy based on finiteness is not itself finite. In fact, there is a great deal of 'economy' to be created based on the idea of resilience and finite nature resources.

Case description

Circular farming at De Groote Voort

'De Groote Voort' is a centuries-old cow farm managed by the Van de Voort Family. At the farm, that encompasses 50 hectares and holds 95 Jersey cows, organic milk, cheese and meat is produced. This is done in a circular way: large numbers of functions related to soil, grass, manure and water are mutually reinforcing and form a closed cycle.



The current farm of the Van de Voort Family is built in 1925. Initially, the family enlarged their scale and focused on increasing efficiency, just like most cow farms. However, they refused to use artificial fertilisers and a milking robot. Instead, they optimised their process in such a way that they minimised the need for external materials. This results in an interesting situation with several benefits.

The soil is the basis of De Groote Voort: fermented stable manure is used to make the soil healthy and fertile, which results in abundant grass. Alongside grass, a lot of clover and a diverse mix of herbs is planted at the meadows. Clover binds nitrogen from the air to it in a natural way, so no artificial fertilisers are needed. The herbs assure that the cows retrieve a rich variety of nutrients and minerals. All materials used at De Groote Voort are natural (not synthetic). Due to this, the cows do not need any antibiotics and mortality among the young calves is lower. Altogether, this results in healthy cattle who produce high-quality organic milk, cheese, meat and manure.

The process of De Groote Voort contains a continuous circuit of food, manure, water and health in which almost no external materials are needed. This all takes place on the same land and by one user, the farmers family. This results in a healthy business case as there are no costs for fertilisers, minerals, antibiotics, manure and water, and making high revenues due to the high quality of his products. These high revenues enable the family to finance the spacious cowshed, organic food and particular machines. Besides benefits for the family itself, De Groote Voort realises benefits for others too. They reduce public costs for water purification, water storage and pollination.

The family continues optimising their process. In 2018, they opened the 'Natuurpakhuis' where the cheese is stored and cooled with a CO2-cooling system instead of a chemical one.

Websites
Remeker.nl, agrarischeondernemer.nl

Chapter 3

Multifunctionality as economic motor

3.1 Introduction

Climate buffers will cost millions of euros, but they will help prevent many more millions of euros of flooding damage, and positively affect the quality of life and health of people in surrounding towns and cities. Considering this, it is clear that the costs of climate buffers will be fully compensated by their benefits. Calculations have shown that climate buffers are often more economically attractive than present land and water management strategies. In addition to finiteness of resilience and resources as explanation of the rise of multifunctionality in the previous chapter, there is an economic explanation. Climate buffers illustrate this. Climate buffers are exemplary for other multifunctional solutions in which goals are integrated and means are shared. The all-over consequences for the economy inspire to look at the macro-economics of multifunctionality.

The example of climate buffers also shows that profit is more than just money. Other benefits are a better physical environment and a better quality of life for people. Multifunctionality gives a fair chance to create a sustainable business case that is good for people, planet and profit. This chapter proves that. Besides that, looking at the business case draws attention to the micro-economics of multifunctionality. Finally it will describe a last economic feature of multifunctionality: it is a part of the sharing economy since sharing means is at the very basis of multifunctionality.

3.2 A macro-economic explanation of the rise of multifunctionality

The first examples of integrated goals in recent times are already more than thirty years old and are related to the integration of care and housing. Those involving integrated centres for children (community schools) date back more than twenty-five years. At the same time, there are also some highly physical examples of integration, such as the dual use of flood defences. Although the examples are extremely diverse, there is a consistent thread in the ascent of multifunctionality. Wherever the old method of production becomes too expensive, integration crops up. For this reason, the many combinations with care and education come as no surprise as these social sectors have been subject to cuts for decades now. Agriculture is under increasing pressure too and that explains the emergence of integration in this sector (cases p. 15, p. 25, p. 35, p. 62-63).

The fact that some sectors, such as water management, have traditionally had their own costing system seems to provide a good explanation for why the number of examples of integration involving such themes as water safety and quality is of a more recent date. The Hondsbossche Zeewering (case p. 72-73) shows this. Every social function is eligible for integration and almost no single combination is inconceivable. The only restriction is related to whether an integration is profitable or not. The gradual profitability of one integration after another creates the impression that the rise of multifunctionality is an economic development. And so it is, but not exclusively.

An integration must be profitable. Otherwise it is not worth it to realise it. Profitable here, however, also means socially profitable. Another important reason why integration is becoming more and more profitable, both financially and socially, is related to the desire to make society more sustainable. This endeavour towards sustainability is very much related to economic reasons: the costs of compensating for non-sustainable action are increasing further.

Case description

Self-supporting river systems

Since a few years, every new maintenance contract for Dutch rivers contains an Innovation Team that aims to come up with innovations regarding sustainable river management, and collects innovations of third parties. The innovations include topics like sediment management, biomass, energy from water, plastic and robotics.

Self Supporting River Systems (SSRS) is an innovation program that strives to use the natural dynamics of the river system in order to make river management more affordable, reliable and sustainable. The program aims to achieve this by embracing concepts like ecosystem services, natural capital, nature based solutions and building/maintaining with nature. One remarkable element of the SSR program is the creation of the so-called Innovation Space with an Innovation Team in 2015.

The first contract that encompasses an Innovation Team is the maintenace contract for the IJssel River and Twente Canals. The Innovation Team consists of the 'Golden Triangle': contractor (BAM/van den Herik), government (Rijkswaterstaat) and knowledge institute (Deltares). It is an open consortium, meaning that any interested party can approach the team with their idea or innovation. During the first stages of this project, most innovations have been initiated by the three organisations from the Golden Triangle. In later stages, innovations from other parties have been embraced as well. The criteria to adopt innovations have been the following:
Having the potential to :

- increase sustainability,
- reduce maintenance costs,
- develop a business chain on the long term,
- generate benefits (especially for the innovation owner, which results in intrinsic motivation and the will to act as ambassador and to invest resources).

The Innovation Team helps innovation towards its next phase by supplying knowledge, generating funds, co-developing the innovation, designing the pilot, implementation, permitting processes, monitoring, evaluation and communication. Currently, the innovation team is testing different innovations like flexible groynes, vegetation management with herded sheep and new monitoring techniques with an Aquatic Drone.

Flexible groynes
Groynes influence the current of rivers. At the IJssel, Rijkswaterstaat investigates whether groynes made of X-stream blocks, can result in more sustainable river maintenance. The flexibel groynes require less material, are easy to repair and provides a habitat for different organisms. Only one material is used, which makes it easier to make changes than with traditional, multi-layered groynes. In November 2019, three flexible groynes have been built in the IJssel. The effects on sediment and ecology will be monitored for at least a year. The Aquatic Drone will be used for parts of the monitoring.

Innovation take-off
Ownership and a societal cost benefit analysis diversified for different stakeholders are indispensable for innovations to really take off. Scale is often an issue as well: the IJssel River in itself cannot generate sufficient benefits for all innovations, but when taking into account other rivers, in the Netherlands and abroad, more opportunities arise.

The Innovation Space has proven itself valuable for this project. Therefore, it is now part of the standard maintenace contract at Rijkswaterstaat for all major Dutch roads and rivers. This gives Rijkswaterstaat the opportunity to address challenges in maintenance on various levels and locations and will allow cross-pollination of innovation between the various contracts.

Involed parties
Rijkswaterstaat, BAM/ Van den Herik, Deltares, many others

More information
www.ssrs.info

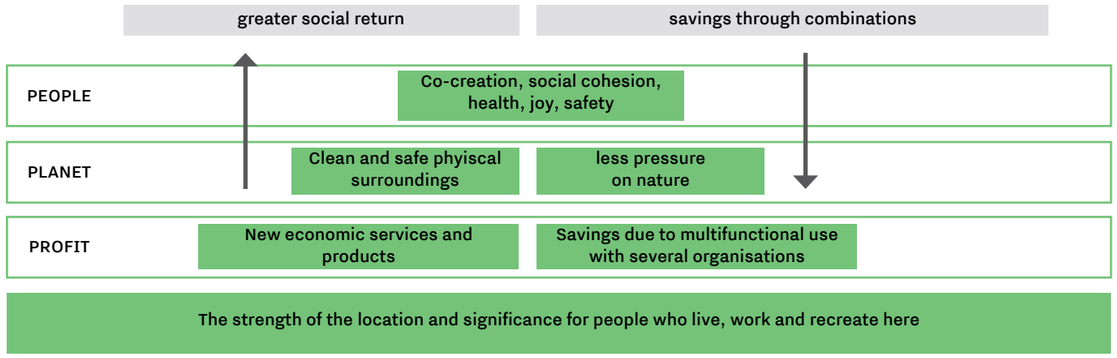
3.3 Mixed earning model

Most examples of integrating goals and sharing means are more or less natural combinations. The aspects fit ‘logically’ together. They reinforce one another in a natural way: costs are saved by using the same physical space. Solar panels can be installed on a noise barrier alongside a road and greenery can be planted on the other side, which in turn can collect fine dust. The slope can serve as a depot for excess dredged material. The greenery on the side of a neighbourhood can, for example, serve as a public garden. Moreover, the barrier means it is possible to use land nearer to the road for living or working, among other things. In the city of Ede, a cinema has been set up in this way, and along the A2 Highway in Utrecht there are commercial premises in the form of an elongated noise barrier.

Integrating goals and sharing means is geared towards the sustainable advantages of a place and the opportunities to reinforce them. It makes the hard and soft values of a place visible. On the one hand, this gives rise to a greater social return and, on the other, produces savings. By using one place for several purposes at the same time, a lot of money can be saved. The coherence between the functions and the earning model by meansis illustrated by the diagram below:

The starting point is always the strength of the area. With that as starting point, you can earn on different fronts. Purely economically, new products and services arise, which can be marketed. By integrating, savings are also made. Together, these form the profit side of integration. When it comes to ecology, it can be a question of services for the benefit of the physical environment, for example greenery or water. The savings are often situated on the planet side. Negative environmental consequences are avoided, which mean that there is no need for expensive clean-up or compensation measures, now or in the future. People are at the top of the model. The services and facilities are geared towards them and they determine the value, the importance they attach to them, their usefulness and the choices to be made.

A well-functioning integration of goals always calls for cooperation and development. The users of an area play a key role. Physical combinations are often initiated and realized by public and private parties, and increasingly by users or residents themselves. The people-effects of multifunctionality are expressed by an increase in social cohesion, more pleasant living situations, improved health and increased happiness. Therefore, multifunctionality always results in a mixed earning model.By saving on set-up costs as a result of combining functions, you simultaneously avoid nuisance and clean-up costs for the protection of nature and the environment, and social cohesion increases. Often, this acts as a flywheel since it creates a breeding ground for even smarter services. As a result, the area becomes an even more attractive place to live, work and reside.



Case description

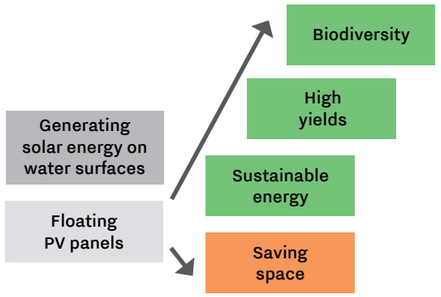
New solutions for solar energy I

PV panels are among the most common ways to generate sustainable energy. The panels convert solar energy in electricity, literally bringing production home. One of the biggest advantages of PV panels is that they turn users into producers, which increases self-sufficiency and reduces the pressure on the electricity net. In the last years, the number of roofs, facades and even windows that are covered with PV panels has increased rapidly. To meet the ever growing demand for PV panels, the Dutch came up with solutions to apply PV panels to water, nature, agriculture and infrastructure. Some of the most innovative solutions are described here.

Water

Worldwide, there are many unused waters and rivers near urbanised areas. Sunfloat aims to efficiently use available water for producing energy, by placing floating bifacial solar panels on water surface. The reflection of the sun, cooling effect of the water and position with no shade, results in up to 50% higher yields than traditional PV panels mounted on a roof. Nevertheless, the investment costs are comparable to traditional PV panels, making them financially attractive.

The design of the floating PV panels is strong and stable: the placement on water makes it unnecessary to rotate along with the sun’s progression. Alongside, the PV panels are designed with the aim of limiting the impact on their surroundings and the environment to an absolute minimum. The frames in which the panels are mounted allow for open space between the panels to avoid covering the entire surface of the water.



Infrastructure

In the near future, several Dutch highways will be surrounded by noise barriers containing PV panels. One of them is a solar park along the A58 highway near to Etten-Leur. This solar park will be opened in the summer of 2020 and will generate enough energy for over 1000 households. In 2018, construction firm Heijmans developed noise barriers featuring integrated bifacial solar modules along a 400m stretch of the A50 near Uden. Rijkswaterstaat uses this project to investigate the feasibility of installing further solar noise barriers. And with positive results: the PV panels generate enough energy for around 60 households, around 20% more than expected.

Rooftops

Woonstad Rotterdam, the biggest social housing association of Rotterdam, aims to make their housing stock more sustainable. In order to realise this ambition, they challenged organisations to come up with innovative energy solutions that replace the current gas use. HRsolar is one of the winners of this competition. This company developed the Green Energy Rooftop Storage (GERS): an installation of PVT panels (panels that convert solar energy in both electricity and heat), solar collectors, heat pumps and buffer vessels on a green roof. The installation can be installed on multi-layered apartments without an elevator. This is a typical social rental dwelling typology that can be found in large numbers all over the Netherlands. Dwellings with a GERS installations on their roof do not use any gas anymore, which results in less emissions and no energy costs for the inhabitants. What distinguishes GERS from other initiatives, is their focus on the end-user. The installation is accompanied by clear instructions and tools, such as an electric cooking plate and pans, to make switching from gas to sustainable energy sources as convenient and comfortable as possible.

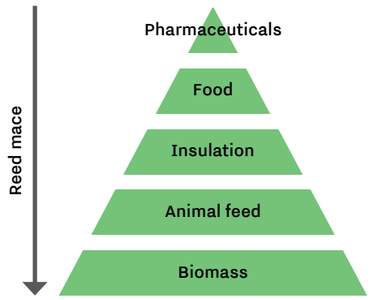
3.4 Business case

When integrating goals, costs decrease. Land, infrastructure, buildings or equipent are shared or used for multiple goals. For example, for a building that contains housing, care and a school, the costs for design, construction, finance, management and operation are shared. Another example: Noord-Holland Province has saved 34% by using dredged material for the construction of road embankments instead of storing it in a special depot. The soil department takes care of recycling the dredged material and the roads department uses it for road building. Dredged material can also be used to raise a noise barrier which results in saving of 37.5% (see table).

Locating a road on a dyke saves costs. In Gouda, the reverse is the case and costs are saved by building a road that also serves as a dyke: a saving of 84% (see p. 5). The road also results in extra benefits, such as increased accesibility to the area. Beside cost savings multifunctionality is also about creating new qualities, which can lead to profits. To illustrate, to reduce the turbity of the water in the Kromme Rijn river, and thereby make it more suitable for nature, a silt catcher was designed. The costs are at least € 8 million for an area of 6 hectares that can no longer serve any other function. Instead, the decision was made to build 2.5 kilometres of nature-friendly banking, in addition to the existing 7.5 km. These banks already serve as an alternative to silt catching and, at the same time, have functions for nature, the landscape and bank reinforcement. The cost of the extra 2.5 kilometres is estimated at € 850,000. This multifunctional solution results in a saving of millions, but also yields extra returns for nature, the landscape and bank reinforcement.

The Noord-Holland Landscape Foundation has developed a business case for ‘wet’ farming in the Westelijk Veenweidegebied (western peat meadow area). There, the average annual proceeds for a dairy farmer are € 965/ha . This can rise to € 1450/ha if combined with water management that leads to more water storage and more nature, and to less subsidence. An alternative to dairy farming is reed mace cultivation with financial returns of € 1630/ha, due to a high yield of raw materials for numerous uses, including food and medicines; the biobased economy . Extra returns go hand-in-hand with cost savings here: subsidence leads to heavy costs and is associated with the escape of greenhouse gases. Furthermore, wet farming combines well with water level management and can certainly save considerable energy costs for pumping stations in the western part of the Netherlands. This produces a strong business case.

The search for competitive crops is an important issue when it comes to making farming on wet land economically viable. Growing crops that can be used as animal feed, such as reed mace, peat and azolla, seems to be an attractive option. It is even more interesting to look for crops that serve several purposes and can be used in different layers of the product pyramid. For example, a certain substance from reed mace can be used in the pharmaceutical industry and the residual product can serve as insulation material, animal feed and biomass (see figure).



	Standard raising with sand	Variant: raising with dredged material	Saving	Percentage
Road - groundwork	€432,642	€286,517	€146,125	34%
Noise barrier - groundwork	€1,295,474	€794,474	€501,000	37.5%

Case description

New solutions for solar energy II

Nature and agriculture

Solarpark de Kwekerij is one of the first of many solar parks in the Netherlands that combines PV panels with biodiversity, landscape and other values like recreation and biological agriculture. De Kwekerij is large and multifunctional. With 7000 PV panels, de Kwekerij generates renewable energy for more than 500 households in Hengelo. The park encompasses innovative applications of solar energy, such as ponds with floating solar panels and the option to recharge electric cars with the generated solar energy. Besides generating energy, the solar park offers opportunities for recreation with water, nest boxes, a small sheep herd and insect hotels.

At the moment, several scientists are conducting research on the synergy between solar parks and nature and agriculture. Solar park Shell Moerdijk, with 76,000 PV panels, has been studied by the Natural Biodiversity Center. The scientists concluded that this solar park is a suitable habitat for both plants and animals. This makes well-equipped solar parks a safe haven for biodiversity in addition to a source of sustainable energy. The Solar Research Programme of Wageningen University aims to provide a scientific basis for sustainable solar parks that are profitable for the economy, nature and society. They collaborate with the federation of Dutch NGOs for nature and environment to enable the sustainable development of solar parks. In order to so, they take aspects such as landscape and spatial quality, governance, biodiversity, soil quality and the integration of food production into consideration.

Not only scientists are supporting large-scale integration of solar energy into the landscape. The National Consortium Solar in Landscape and Agriculture is a multidisciplinary initiative of project developers, financial service providers, designers, consultants, knowledge and government institutions. Their main challenges are maintaining and strengthening the social acceptance of large-scale solar farms by means of visual integration into the landscape, increasing knowledge about the impact of a solar farm on the soil and nature value (biodiversity) and enabling the functional integration to realise synergy, resulting in added value over monofunctional use.

Involved parties

Sunfloat, Rijkswaterstaat, Heijmans, TNO, Woonstad Rotterdam, HRSolar, Solarpark de Kwekerij, Natural Biodiversity Center Naturalis, Wageningen University, TNO

Websites

Sunfloat.com, pv-magazine.com, deingenieur.nl, hrsolar.nl, solarfields.nl; naturalis.nl, wur.nl, tno.nl

The figures look promising, financially speaking, particularly as milk prices are under pressure at the moment and as the current subsidies, among other things to protect meadow birds, are superfluous with wet farming. Dairy farming yields about €1,000/ha for farmers. If a farmer starts to grow crops partially on wet land, the other land can be used for organic production, which can yield €1,500/ha . If a farmer cultivates peat moss, this can even yield as much as €2,500/ha .

Wet farming would be even more interesting financially if carbon emissions were capitalised. Draining leads to the oxidisation of peat, resulting in carbon emissions (and subsidence). Wet farming, by contrast, reduces carbon emissions. Nature can even capture carbon in wet conditions. A financial incentive for farmers to limit carbon emissions, for example by funding carbon reduction with carbon credits, would make wet farming even more attractive. Conversely, the introduction of charges for carbon emissions would currently mean bankruptcy for many farmers so a transition period is needed. In this period they can learn to integrate goals, and share means. This sharing, is that part of the sharing economy?

Case description

Combining new forests and tiny houses

The Netherlands is one of the most densely populated countries in the world. There is relatively little space and rural areas have to deal with competing claims from agriculture, nature and housing. As in many other countries major steps are necessary in the area of climate policy in the forthcoming years. New forest can make an important contribution to this. Forest and wood contribute to climate goals, recreation, water retention and biodiversity. Forests are the lungs of the world and are a form of above-ground CO_2 storage.

In the next 10 years, the housing stock in the Netherlands will also be expanded considerably, with particular attention to starter homes, homes for the elderly, generation-proof living and sustainability. There is increasing attention for tiny houses and other forms of small-scale housing. Developments around tiny houses are interesting from a sustainable perspective as the ecological footprint of these houses is very low, and as they offer new possibilities for suitable housing in rural areas. Tiny houses fit into a broader trend of circular construction, nature inspired design and eco lodges. Combining different functions offers interesting perspectives.

An example is a combination of forestry and agriculture through agroforestry or food forests, or in combination with small-scale housing and recreation. Tiny houses provide a sound business-case for the realisation of new forests. Meanwhile, a series of initiatives have been started across the country focused on the realisation of (food) forests in combination with tiny houses. A provisional estimate is that by removing obstructive regulations, 20,000 hectares of new forest can be created in combination with 60,000 tiny houses. This can meet a large need, for housing and for the creation of new forests.

In 2018, the Dutch institute of Social Innovation launched a national test lab for tiny housing in forests. At the moment, the test lab focuses on adjusting policies and zoning plans in order to enable tiny housing. Pilots in Overijssel Province and Wageningen Municipality showed the positive reaction of inhabitants and willingnes of governmental bodies.

Involved parties
Dutch institute of Social Innovation, Tiny House Nederland

Websites
imi.nu, natuurverdubbelaars.nl

Case description

Subsurface city

The Dutch subsurface is packed with pipes and cables. Spaghetti might even be a suitable word to describe the current situation under the surface. Our urban lifestyle demands an extensive pipeline network for gas, water and electricity, but also tunnels, parking garages and waste containers. The energy transition, the 5G-network and the required expansion of sewage capacity to deal with heavy rain falls due to climate change all require the addition of more pipes and cables. At the same time, more trees are needed to retain water during such heavy rain falls, which decreases the space available for pipes and cables. 'Common ground' is the name of a project of the Dutch Centre for Underground Buildings that aims to make order out of the chaotic spaghetti subsurface.

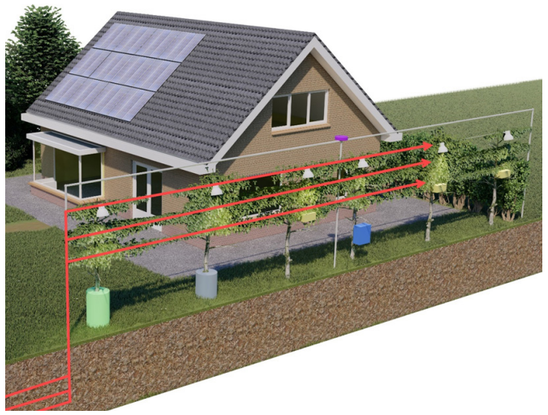
The first step towards a solution is acknowledging the subsurface as a common resource. It is required to get all involved parties at the table to collaborate and align. Next step is looking for ways to solve each other's problems. To illustrate, roofs can be turned into green areas that contain water. This reduces the pressure on the sewage system. Large scale application of green roofs can therefore result in the opportunity to decrease the capacity of the sewage system. The same principle applies for creating and storing energy at location. Such smart, local solutions result in fewer and smaller pipes and cables.

Vertical stacking
Another way to create space is to position pipes and cables on top of each other instead of next to each other. This can save up to 80% space. Besides that, excavation damage will decrease as the networks are covered from above and underneath. This results in considerable savings. Thanks to the freed up space, more trees can also be planted in the public space. This vertical system can even be taken a step further. This next step consists of an underground main infrastructure situated at the depth of the pile points of the foundations of buildings. This results in a deep network of horizontal pipes with vertical shafts. This infrastructure could be used for transporting heat and cold between underground storage and above-ground users as well, while simultaneously cooling the other pipes and cables.

The Dutch canals
The Dutch canals offer extensive opportunities for smart piping solutions. The canals themselves are very suitable for the placement of heat pipes. Creating hollow spaces behind quay walls generates space for the heat network and water storage during heavy rainfall. Construction works on a quay wall can be done from the water, which limits the inconvenience during construction and maintenance.

Smart tree walls
The Dutch soil is very soft: it exists of peat, loam, clay and sand. This enables the placement of pipes and cables underneath the surface. Countries with a more rocky subsurface do not have this possibility. A charming solution for cables above ground is to make use of consecutive tree walls, hedges and espaliers. Cables and pipelines could find their way within these, and street lightning and sprinkling systems could be applied as well. Trash bins, mailboxes and EV charging stations could be concealed around or in these tree structures. The growth of actual trees around such structures results in an attractive image and creates shadow to cool the pipes and cables. Looking at the space above ground differently can unburden the underground space and contribute to a future proof living environment.

Involved parties
COB, De Bouwcampus, Antea Group



3.5 The sharing economy is much bigger than we think

Working with multifunctionality gives rise to a sort of sharing economy, but one that goes further and deeper than the standard definition. The sharing economy is well-known from the sharing of cars, tools and, for example, holiday homes or parking lots. The principle is based on sharing end-products with time slots: one user uses the product after the other. Producers can also share means of production. Examples include caterers who use restaurant kitchens in the mornings. Here, kitchens are shared after one another. Time sharing can be consecutive but also simultaneous. In the case of carpooling, different users can share a product simultaneously. The same idea applies to the shopping bus in Bellingwedde. This bus brings people in a shrinking area to and from the shops and, in this way, helps to strengthen social bonds at the same time.

Sharing means to realise several goals

The shopping bus of Bellingwedde is a means to several ends, just like all other examples in this book. For example, the pump of a pumping station used for water level management can also serve as a pump for storing heat and cold. A water pipe can transport heat, a sewer can generate energy. In this case, producers share resources to achieve two or more goals. Another example is a noise barrier near Zwolle that also serves as a dike. The users have shared protection against noise and water, and the producers, namely the municipality and water board, share too. They share the space, the land for the barrier and the building, management and maintenance costs. In addition, both receive returns in the form of protection against noise and high water. Although this is not known to be part of the sharing economy, the sharing of means to various purposes can be considered as such.

Temporary alternative usage

Another example of consecutive sharing that is unknown in the current understanding of the sharing economy is temporary alternative usage. Examples include an empty office building that will serve as accommodation for students or asylum seekers for five years. Temporary use can also involve nature, such as the creation of temporary nature on derelict building land or the use of this land for urban farming. Here we see space being shared consecutively, but that can also be simultaneously, as in the case of high-rise and building underground.

Smart planning

The phenomenon of ‘combining work with work’ can be seen as part of the sharing economy too. An example of this is replacing the gas mains at the same time as laying a new sewer; construction capacity is then shared.

Circularity

Finally, waste as raw material forms the basis of the circular economy. This revolves around maximising the recyclability of products and raw materials. Recycling is a type of time sharing of raw materials and can therefore be considered as an element of the sharing economy.

A disadvantage of thinking about the circular economy is that many see it as a kind of end-point of economic renewal: after linear comes circular. Another disadvantage is that most examples of circularity only focus on raw materials. This approach works for metal, that can be reused in the same function over and over again. However, most raw materials take a different path. The sugar beet production of Royal Cosun shows this (see p. 35).Cosun shows that raw materials for agriculture can be recycled excellently. An example is foliage that is left behind after harvesting sugar beet, on every hectare 20 to 30 tons; this releases nutrients to the soil for the next harvest.

Cosun leads the way with closing cycles around sugar beet cultivation. Almost all raw materials are used and there is practically no waste left behind. CO_2 emissions still remain, partly as beet transport is difficult. The company has investigated that from those 20 to 30 tons between 180 and 280 kg rubisco can be obtained, a high-quality protein. Transport is tricky, hence the question is whether the extraction process can be done on site. If that is not possible, then the beet leaves are removed and it cannot release nutrients to the soil. At the same time, this foliage is then at a central location where it can be fermented, with a residual product that is absorbed much better by soil than foliage.

In the meantime, Cosun is looking a step further and regards agriculture as part of numerous related production processes, as is already happening on a smaller scale on the Groote Voort Farm (see p. 25). At the Groote Voort, agriculture serves many purposes, such as management of nature and landscape, retention and purification of water, storage of CO_2. Agriculture can also serve recreation and care due to the therapeutic value of working with plants and animals. Integration of all these goals through the use of agriculture as a means to achieve these goals can lead to a competitive farm.

Case description

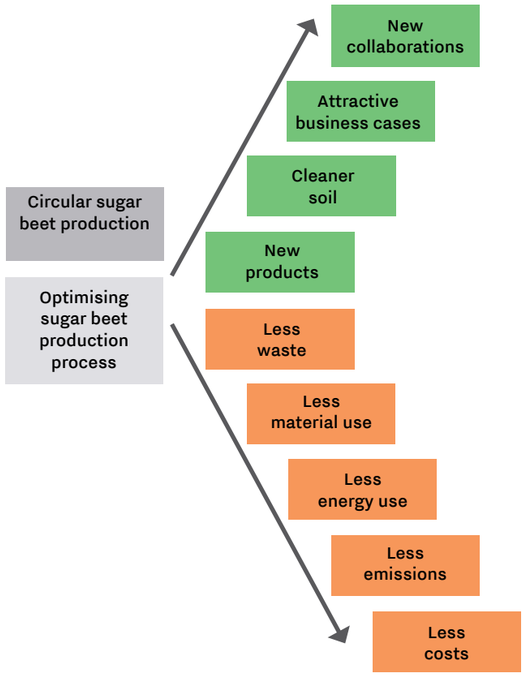
Circular sugar beet production

Royal Cosun is an agro-industrial group that uses raw materials as much as possible, with almost no waste. Core business is the production of sugar and bio-ethanol from beets. Beet pulp remains as residu after production, the vast majority of which is used as animal feed. In addition to animal feed, beet pulp has value as a raw material for biobased products. Especially for use in detergent and dishwasher tablets. Currently, Cosun is investigating the production of bioplastics with beet pulp. Subsequently, Cosun is looking into the value of parts of the plant that are left over prior to processing into pulp To illustrate, green leaves contain 1% to 3% protein, which is extracted.

Another use of beet residues is fermentation for the production of biogas. Cosun produces a third of the biogas in the Netherlands - over 25 million cubic meters - and another 10 million in Germany. This biogas is generated through fermentation of beet residues, extracted from water used to clean the beets in the production process. Since 2011, Cosun’s sugar trucks run on 2/3 diesel and 1/3 own generated biogas.

Since 2019, there are even trucks that run 100% on biogas produced bu Cosun. In addition, villages in the vicinity of Cosun are heated with biogas. When this gas comes from water from the process, Cosun cleans this water. It is then stored underground and reused. Cosun Therefore, Cosun does not have to use groundwater.

Lime is added in the production process to bind substances from the beet. This lime is subsequently sold again as betacal, a fertiliser that goes back to agriculture. Digestate, the solid fraction that remains after the fermentation of beet residues, also goes back to farmers as a vegetable fertiliser. Finally, there are pebbles between the harvest that are collected by garden centers. Sand and clay that sticks to the outside of the beet is used for raising agricultural land, road construction and dike reinforcement.



Currently, Cosun is working together with North Brabant Province and Naturalis Biodiversity Center on the ambition to achieve a circular society. The ideas include closing cycles between sugar beet growers and dairy farmers. In addition to livestock farming, Cosun can link up with the production chains of many more organisations. For example, water boards are prepared to invest in agricultural projects if this contributes to fewer pesticides in the water or better water level management. Improving soil quality is important for water boards and producers of drinking water. Better soil quality also contributes to CO2 storage, which is valuable for many public and private parties. To conclude, the production process of sugar beet offers numerous options for sustainability and circularity.

More information

Suikerunie.com, naturalis.nl

An ever better functioning landscape has growing value for soil and recreation, and perhaps for more. It can thus protect against both drought and flooding, two elements of climate change. The landscape can fulfill that function better and better if it can develop. This goes beyond circular economy and you can call it an integrated economy, possibly a regenerative economy, because it helps a lot to recover from what has been lost in the last century.

Cosun is taking a step towards an integrated economy by investigating whether its own cycles around sugar beet cultivation can be linked to animal husbandry. A further step is connection with water level management and water purification. What is interesting about the Cosun case is that it sheds light on cycles and their relationship to integration. They are part of the sharing economy that is much bigger than you might think.

3.6 Conclusion

The sharing economy is much more than simply time sharing end products. The sharing economy also covers means of production such as raw materials and space, and sharing can be both simultaneous and consecutive. This economy encompasses all stages of production and use and can develop into an alternative to the economy as we know it and in which sharing plays only a small role.

The current economy throws away waste, focuses on individual clients who all have their own end product instead of sharing it, and invests separately in, for example, a noise barrier and a dike. This is less sustainable. Therefore a serious alternative needs to be realised: the sharing economy. Sharing means to realise several goals, the subject of this book, is an element of this.

By looking carefully at what a place has to offer, it is possible to integrate. Many different parties are already making use of this: water boards, care providers, school boards, farmers, nature managers, carriers, food producers, energy companies. They save on resources, and thus on raw materials, and generally speaking cause a lot less damage to the environment, meaning that no or little money has to be paid in compensation. The fundamental change lays in coordinating goals, so that a single means can be deployed; multifunctionality in this book. This concerns sharing means, and deepens thinking about the sharing economy. The coordination of goals calls for knowledge of the place and the resources available there, and of the goals people on the spot consider to be important.

What if people consider a goal to be important at one location and think it a good idea to integrate it with a goal at another location? Is multifunctionality perceivable on two or more locations, with transport in between? Or can the means of transport be the single means that people share for two or more goals? Such questions will be answered in the next chapter on transportat and mobility.

Case description

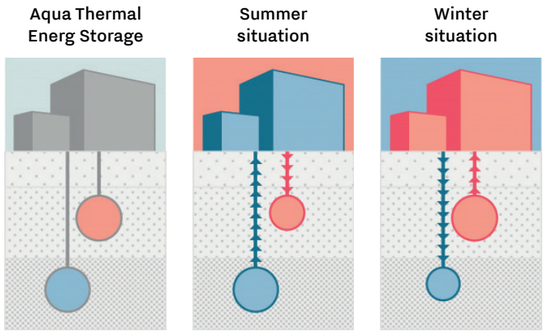
Low temperature aquathermal heat networks I

Most buildings in the Netherlands are heated by systems that make use of water of high temperature. Last years, different systems have been invented that make use of low temperature. This has several benefits, such as reduced warmth losses during transport and less energy use for warming up water. An elaboration on some of the most innovative systems used in the Netherlads is given here.

Aqua thermal energy storage (ATES)
The soil of the Netherlands is filled with aquifers: sand layers on a depth between 30 and 250 meters that are suitable for stable water storage. Aquifers can retain very large amounts of heat and cold with little loss of energy. ATES systems use the water in such aquifers to heat a building during winter using summer heat, and cooling it during summer using winter cold.

The cold and heat are added to the water by means of a heat exchanger. That could be, for example, the roof of a building under which water pipes run, absorbing the heat and cold. This heat goes up to to 18 - 20 degrees Celsius, and the cold can go as low as 6 – 8 degrees. A heat pump is added to this system in order to warm up water during winter, and cool down during summer if necessary.

The benefits of ATES are numerous. Aquifers provide water between 6-20°C for free, while not requiring any space. It mitigates the use of fossil fuels, is an environmental friendy way of cooling as it does not use any chemicals, and results in considerable financial savings. In the Netherlands, thousands of aquifers are already used for this purpuse.



Aqua thermal energy from surface water
Surface water is all around in large parts of the Netherlands. To illustrate, around 25% of the surface of Amsterdam Municipality is water, including the famous canals, two rivers and a harbour. This surface water can be used for way more powerful ATES Systems. The energy that can be collected from such water could provide more than 50% of the total heat needed in the whole country. As a result, less additional measures such as the installation of PV panels and windmills is required.

The Maastower in Rotterdam, the tallest building of the Netherlands, makes use of the principle mentioned above. The building uses an ATES system with a heat pump that uses water from the nearby Meuse River (Dutch: Maas). The water of the Meuse is led past a heat exchanger that is connected to the building's climate control system. In this way, the building can 'absorb' the warmth which is still present in the river in the autumn. A storage for summer heat makes it possible to make use of this system during winter too.

Low temperature heat network as standard solution
ATES systems can be perceived as very local heat networks. Anyone with an excess of heat or cold is able to join as it is always possible to store more thermal energy. Besides that, it lowers the investment costs per user. This invitation to feed in makes these networks open source, and adds to the idea that low temperature heat networks will and can be the standard solution. An extra argument for this, is that ATES networks create viable business cases for other sustainable energy sources. Some interesting examples are described below.

Aqua thermal energy from waste water and drinking water
Thermal energy from waste water concerns energy from sewage, sewage pumping stations, sewage press pipes and the effluent from sewage treatment plants. Drinking water can be used as well to extract heat and cold to heat or cool buildings.

In Utrecht, around 10.000 dwellings will be heated by heat from waste water by 2022. The municipality, an energy supplier and a waterboard who processes waste water and an energy supplier collaborate to make this happen.

Chapter 4

Transport and mobility

4.1 Introduction

A care institution in Amsterdam has a minibus to transport its clients. This minibus is maintained by students as part of their vocational training as car mechanics. In return for their services, the students are allowed to use the minibus at the weekend for their sports club activities. A similar example of the multifunctional use of transport is the shopping bus in Bellingwedde in the province of Groningen. Instead of delivering items to people, it takes groups of residents to do their shopping. In a shrinking economy like that of eastern Groningen, transport is a way to reduce the degree to which the loss of retail outlets is accompanied by the disappearance of residents and their social connections. Both of these examples illustrate how transport can be a means of achieving two or more goals, thus making it multifunctional in the context of this book.

In recent years, the idea that a means may serve two or more ends has become part of current practice in the Netherlands in sectors including water safety, nature conservation, education and healthcare. In the traffic and transport sectors, examples of means, transfer points and mobility services illustrate how a means may serve two goals in this area too. This chapter will provide further elaboration on that topic. The first step, however, is to gain a better oversight of the means themselves. Clearly, minibuses are not the only example. Physical transfer hubs are available, as well as software apps that help people make informed transportation choices involving a combination of means: a bus ride followed by train travel, for example. Does such an app serve a single purpose, i.e. to improve the functionality of bus and train networks, or does it help achieve multiple goals, such as increasing the functionality of an area in general? Demonstrating the app's multifunctionality is the next logical step. Particularly where apps are concerned, IT is a component that can expand the possibilities by which transport can be a means to serve two or more ends.

4.2 Means of transport in the traffic and transport sector

Walking, and taking the bike, car, train, boat or airplane are all means of transport. Transport is optimal when passengers and goods are transported using the proper means, or the proper combination of means. That is to say: when the passenger or package arrives at the destination in the most sustainable way possible. In other words, it is best to avoid transporting cargo containers by road when a ship could do it in a more sustainable way. Optimal therefore means choosing the mode of transport that will maximise accessibility in the most sustainable way. Cars and bicycles are examples of means, the goal is transportation and the underlying concern is sustainable accessibility. Accessibility does not only mean getting from A to B as quickly as possible, but doing so in the greatest comfort while minimising the environmental impact. With regard to the latter, CO_2 emissions are an important indicator.

Choosing the means of transport that will maximise accessibility in the most sustainable way may involve substituting one mode of transport for another: people who no longer drive to work but instead drive only part of the way before getting on a train, for example. For this reason, it is important to create hubs where commuters can easily transfer from one type of transport to another. Picture a train and bus station with parking facilities readily available for cars and bicycles. Along with the means of transport themselves, a transfer hub is a measure that contributes to effective transportation. An additional measure that can reinforce the means of transport and hubs is mobility management.

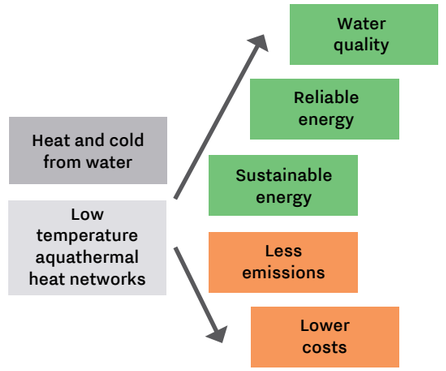
Mobility management concerns influencing travellers pre-trip to choose between the alternatives to travel or to travel at a different moment in time. The aforementioned apps, in particular, often involve mobility management – like a mobile app on your phone that plots your trip from A to B. There is also traffic management, which involves measures for regulating traffic during the trip (on-trip). Real-time traffic information that alerts you of traffic congestion and alternate routes, for example (see p. 41 and p. 47). It is important to consider how mobility management can increase the pleasure and comfort of travel for passengers, as well as limiting the impact on the environment by reducing the number of cars on the road.

Case description

Low temperature aquathermal heat networks II

Residual energy

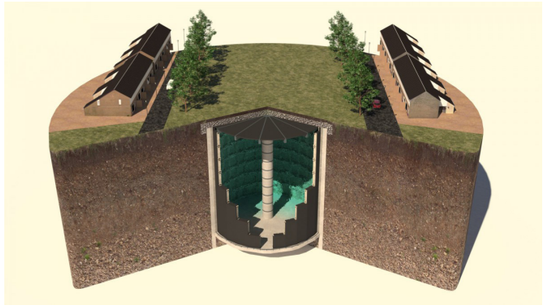
The Waerdse Energie Circuit connects businesses, institutions and residential complexes with one another for the purpose of using residual energy, achieving an optimum reduction in CO_2 and creating additional employment opportunities in the sustainability sector. The Circuit allows a surplus of heat or cold from one structure to be delivered to another.As a result, the participants do not need to generate the heat/ cold themselves, which leads to lower costs, prices are less subject to increase than market prices. CO_2 emissions are reduced, and each participant is financially compensated for its 'leftover' heat and/ or cold.



Smart grid

Temperatures up to 25°C are allowed in aquifers. As aquifers are quite large, this implicates a lot of heat can be stored, for example heat from surplus energy. When there is a surplus of energy on windy or sunny days, this energy can be converted into heat and stored in an aquifer. By doing so, a low temperature heat network becomes a smart grid that balances supply and demand of heat, cold and electricity all year round.

An example of such a smart grid is the Ecovat. The Ecovat energy storage system is built around a large-scale subterranean vessel for storage of thermal energy. It is able to store high temperatures (up to 90°C) efficiently over a longer period (> 6 months) with a loss of heat in this period less than 10%. The Ecovat system provides a reliable and affordable energy supply system for a long time, i.e. 25 to 50 years. The L sized barrel can provide heating, cooling and hot tap water year round for 200 to 1.000 houses.



Geothermal energy

Main sources of high temperature networks concern residual energy. This is not regarded to be sustainable. Geothermal energy can replace this, but has some important disadvantages like high costs and high risk. These can be lowered when working with shallow geothermal wells that provide temperatures suitable for low temperature heat networks.

Combinations with other services

The Bio Washing Machine (see p. 23) is a sound example of how to combine a low temperature heat network with other services than energy production and storage. It combines ATES systems with soil remediation. Another example is extracting heat from surface water during summer. This cools down the water a few degrees, which has a positive effect on the quality of the surface water. It helps to prevent issues such as blue algae, scum and botulism.

The use of pumping plants used to manage water levels is interesting too. These installations can also add warmth from surface water to the ATES. They have a high capacity, and therefore even a limited change in temperature makes very high heat or cold output possible. This concept is called the Smart Polder and it will be developed in Arnhem in the Vredenburg/ Kronenburg neighborhood.

More information

Dutch-ates.com; https://english.rvo.nl/initiatives/energy-innovation-projects/; vpdelta.nl

Traffic management contributes to the latter by minimising the number of traffic jams; the environmental impact of backed-up traffic is much greater than that of traffic moving in a normal flow. While other measures could be envisioned, the scope of this chapter will be limited to means of transport, hubs and mobility and traffic management. These themes should prove sufficient to explore whether these measures can serve additional purposes besides transport and are therefore multifunctional.

4.3 Goals besides transport

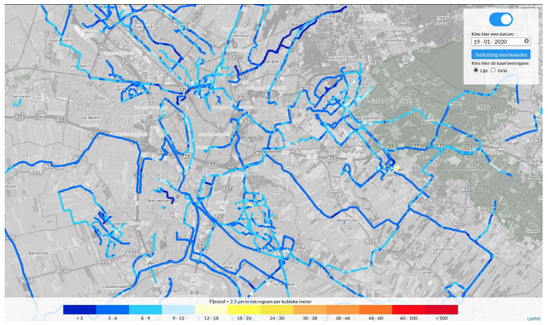
Means of transport, hubs and mobility and traffic management are measures that contribute to effective transportation. This goal, in turn, serves the interest of sustainable accessibility. Other goals and interests may be considered too. Two examples of means of transport that serve two or more ends were given at the start of this chapter: the minibus belonging to the care institution in Amsterdam and the shopping bus in Bellingwedde. These means promote a wide array of interests like education, sport and wellness, as well as the higher goal of spatial quality, due to their role in providing accessibility for these facilities in a given area. Transfer hubs may also serve these purposes when facilities for education, sport and wellness are present at the location. For example, at least three railway stations in Rotterdam are next door to faculties of major educational institutions.

Case description

Future City: smart cities network

Future City is the first smart city network that focuses on the demand of the city. It is a creative breeding ground where municipalities and other governmental bodies can experiment and develop new solutions. Future City aims to stimulate the exchange of knowledge, ideas and solutions between technology professionals, administrators and urban developers.

One of the projects launched by the Future City Foundation network is the sniffer bike. It's a project by the Dutch firms Civity and Sodaq, together with Utrecht Province and the Dutch National Institute for Public Health and the Environment. It regards a sensor that is voluntarily installed on bicycles. This gives local authorities insight into air quality, road quality and cycle routes. The data is shared via an open data platform. The sensor measures temperature, humidity, particulate matter, volatile organic compounds and vibrations. This image shows the amount of particulate matter less than 2.5 micrometers on a road around the Dutch city of Utrecht on January 19, 2020. In the Utrecht region, 500 bicycles are cycling with a sensor.



Future City is a FIWARE iHUb. FIWARE is a framework of open source platform components to accelerate the development of smart solutions. Their mission is "to build an open and sustainable ecosystem around public and implementation-driven software platform standards that facilitate the development of new smart applications in multiple sectors."

Involved parties
Future City Foundation, Utrecht Province, Civity, Sodaq, Dutch National Institute for Public Health and the Environment

More information
Book: 'A Smart City, this is how you do it'. Can be downloaded at https://future-city.nl/smart-city-book-eng/
www.future-city.nl, www.fiware.org

Case description

Smart mobility management

The corona crisis forced a substantial part of society to work from home. This mitigated travelling time and resulted in less pressure on the infrastructure during rush hours. As a result, more and more people started to realise how useless and uncomfortable spending time in traffic jams or crowded trains is. This emphasised the value of minimising peak pressure during rush hours. Governments and institutions are already working on this topic for years. Below, some smart solutions are described.

Flexible working hours, flexible workplaces and working from home has resulted in less peak pressure than before.This goes hand in hand with mobility management: influencing a traveller pre-trip to choose an alternative to the car or to travel at a different time. This mainly involves measures to enable workers to avoid rush hours during their commute. They can choose between the car, cycle or public transport, facilitated by the provision of covered cycle parking facilities, allowances for cycles and public transport season tickets. An integrated approach to smart working and smart travelling leads to working from home, which reduces commuter traffic. This results in savings too, as less workplaces are needed at the office.

A smart working/ smart travelling policy has contributed to the relocation of energy company Vattenfall to Amsterdam. The new location is more easily accessible by car and public transport, and travelling time is expected to increase less in the future than at the previous locations. A severe reduction in the number of parking lots, combined with promoting the use of cycles and public transport and teleworking, is leading to an improvement in the mobility of staff and the accessibility of Vattenfall. Altogether, this results in substantial savings on accomodation, reduced carbon emissions and the need for less parking lots for Vattenfall.

Parking is an important theme in mobility management. It can reinforce mobility management in the pursuit of accessible and liveable cities. The Bronovo Hospital, one of the largest hospitals of The Hague, has taken part in two experiments concerning parking and mobility in recent years. A crowded parking area results in patients arriving too late for their appointments at the hospital. This is confusing the entire logistics. One solution to this problem is to encourage staff to avoid parking, for example by cycling to work. Another solution is introducing flexible parking prices, which is organised by HR management via payroll administration. Having to pay more at peak times is an incentive to leave the car at home. This is called Peak Shaving: charges and rewards are differentiated according to the day of the week, time of the day, parking location, distance between home and work and staff sector. In other words: with a smart HR arrangement, employees can help optimise the logistics.

The second experiment concerns parking as well. Every year, more than 1,500,000 people visit The Hague for major events. 27% of them travel by car: 160,000 cars on a limited number of days of the year. The dual use of parking lots can be advantageous for the user. Based on this idea, the first parking lots have been made available at the Bronovo Hospital in 2015. The UIT-JE AUTO (out of your car) service yields extra revenues for the hospital. The parking lots are made available to visitors outside peak hours; they can reserve a spot via a website or app. This assures them of a parking lot during busy moments. The app provides navigation to the destination point. Visitors can book a taxi or day ticket for public transport in The Hague in advance with discount.

Involed parties
Bronovo, Montefeltro, Municipality of The Hague

Websites
Dutchmobilityinnovations.com; montefeltro.nl

Railway station Schiphol primarily enhances the quality of the transport network through its role as a transfer hub. However, the station has additional functions with regard to work, retail and the hospitality industry. It is a multimodal hub that allows all of these functions to achieve added value. Thus working or shopping at Schiphol becomes more attractive since it is so highly accessible, while waiting to transfer to another means of transport becomes more enjoyable due to the shops, restaurants and cafes. A transfer hub like Schiphol serves multiple ends as well as the higher interest of any effectively functioning area – spatial quality. Is it also possible for mobility and traffic management to serve both similar ends and the higher interest?

With a view to mobility management, some businesses are offering their employees so-called 'mobility packages': the employee may select their own means or combination of transport within a given budget. Such measures can reduce the number of single-occupant car commuters by 5-20%. This does not only reduce the amount of traffic on the road but also the costs per employee, parking expenses and the cost of work delays resulting from employees arriving late. As a tool of government policy, mobility management can focus on reducing the number of car movements, especially during rush hour, by offering travellers incentives to travel at another moment in time, or to choose a different means of travel. As such, the intended result of mobility management is sustainable accessibility. Reduced traffic enhances spatial quality because it allows the area to function more effectively. IT, and certainly the advent of mobile apps, has greatly improved the effectiveness of mobility management and traffic management as well.

Traffic management does not reduce traffic, but it does contribute to a more efficient flow of traffic, which in turn improves the functioning of a given area. Another precondition of an efficient flow of traffic is the presence of separate infrastructures for pedestrians, cyclists and cars. Together with strong transfer hubs, these infrastructures allow the transportation system to function more effectively. For their part, mobility and traffic management ensure that all infrastructures and transfer hubs are operating properly. This improves accessibility, which contributes to the good functioning of regions and cities. Means of transport, hubs and mobility and traffic management have historically served as instruments for that purpose. Their effectiveness can be increased by exploring what other ends they might serve, such as education, wellness or work. That extra effectiveness enables these instruments to contribute to multifunctionality.

It is interesting to ask ourselves whether there is a link between transport and combinations of means and ends described in other sections of this book. For example, what factors are at play in the combination of housing and care? The strength of combining housing and care in residential care facilities lies in that shared space, makes them more affordable as well as reinforcing their efficiency. The quality of care improves as it is administered in the living environment, and the quality of life increases as residents know they do not have to leave their house in case they require care. What part of this mutual benefit can be maintained if housing and care are physically separate, yet effectively connected by good transport? One aspect lost would be the cost effectiveness of sharing physical space, although the feeling of quality can be maintained in the continued connection between care and the individual's home. The quality of care and the quality of the living environment are increased as a result.

Increasingly, in order to maintain the quality of care and the living environment, residents are working together within care cooperatives. They might establish a daycare, for example, to which care clients are transported. This could potentially offer solutions for the future, especially in shrinking areas. This might be a reason to maintain traffic and transport as well as possible in those areas. This brings us to another purpose of means of transport: if a minibus is already providing transport for care patients, for example, could it transport students—or even goods—at the same time? Through their cooperatives, local communities are increasingly using minibuses and car services to serve two or more ends at once. Based on the example of combined housing and care, it is possible to assume that transport can help promote the mutual reinforcement of functionality within an area, and thus its multifunctionality.

Case description

Nature inclusive construction

The construction sector is well-known for its negative impact on the environment and climate: construction works generate substantial nitrogen and CO2 emissions, use a lot of material, result in less green and biodiversity, contribute to the urban heat island effect and negatively influence groundwater levels. In the last years, more and more projects have been initiated in which one or more of these negative effects are tackled. A selection of them is described below.

De Groene Mient, The Hague
De Groene Mient consists of 33 dwellings located at a former school site. The materials of the demolished school building have been reused in this new project. This results in less material use and transportation. Besides this, the dwellings are energy efficient. They use solar water heating systems and geothermal heat pump systems.

The communal building in the middle of the communal garden is made of hempcrete: hemp fibers, slaked lime and water. The roof of this building is covered with peat and grass seed, which can absorb over 110l of rainwater per square meter. The sheds in the back of the garden have green moss-sedum roofs, which functions as natural cooler of the spaces underneath and increases the rain water buffer capacity. Other measure have been taken to increase this buffer capacity. The communal garden encompasses four infiltration fields — wadis — and all pavement is porous, which means rainwater can penetrate it. This all results in a better balanced groundwater level, which minimises the negative impact of drought during summer.

Wonderwoods, Utrecht

The Valley, Amsterdam

Maasbode, Rotterdam

High-rise buildings

The Netherlands has a rapidly growing number of high-rise projects that carry greenery on the facade, for example Wonderwoods, Valley, Maasbode, Binck Blocks and the Funen. This greenery results in an attractive living environment, natural cooling during summer and contributes to biodiversity. To illustrate, at Wonderwoods, particular plants and trees are used to generate an attractive living environment for endangered birds that naturally occur in the surrounding area.

Greening of urban landscapes

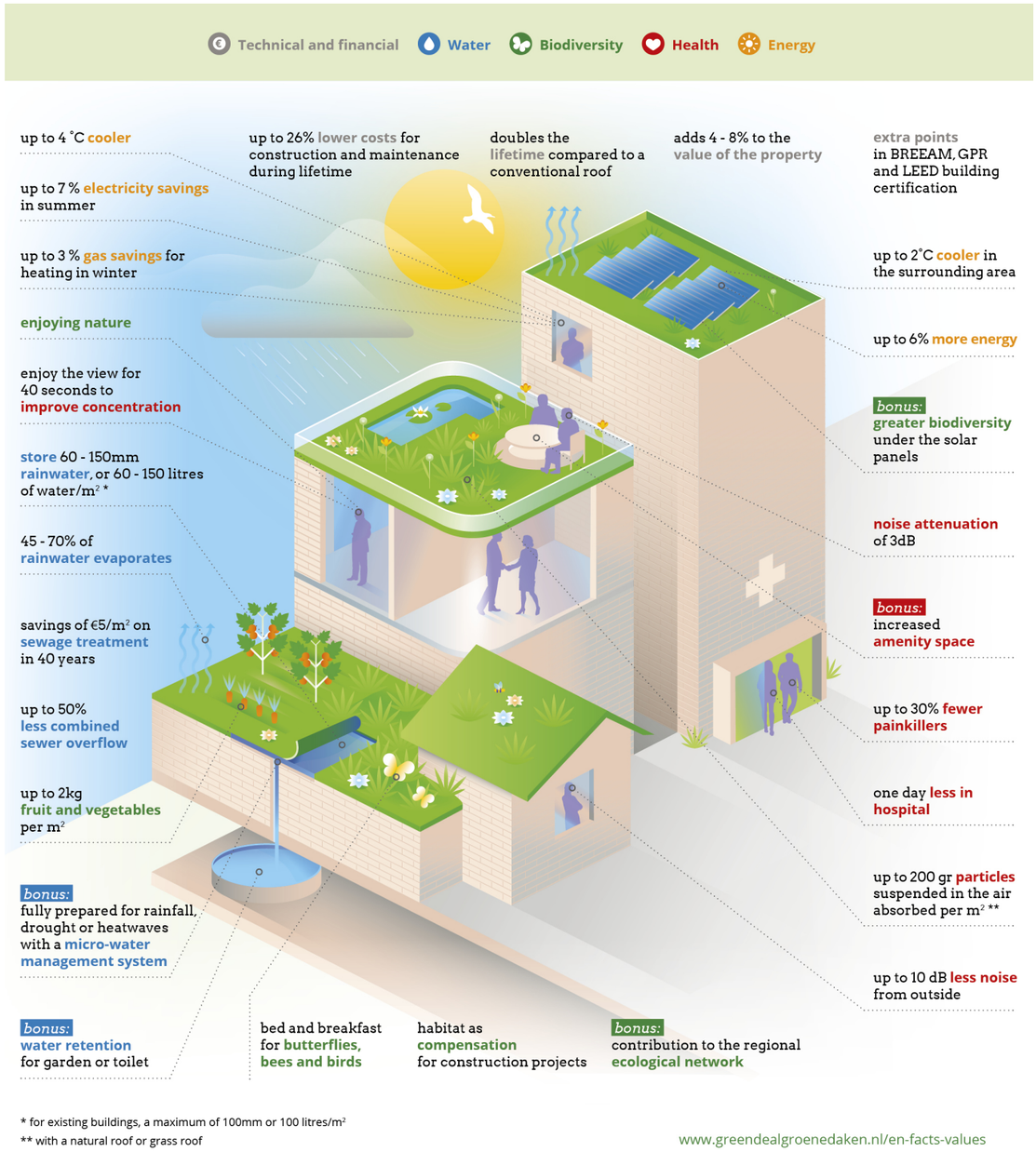
The realisation of climate goals can be integrated by greening cities. Research by the Delta Metropolis Association shows that dwellings in urban greenery are worth 7-11% more than comparable dwellings without greenery around it. 'Investing in more forest can combined well with urban development. By developing urban areas, investments in trees can be made.' This approach is part of the vision of the Green Metropolis program through which Staatsbosbeheer (Dutch governmental body responsible for managing and maintaining Dutch forests and nature) wants to contribute to an attractive living and business climate in Dutch cities. An example is Breda that wants to become a 'city in the park'.

Tiny forests

In the Netherlands, small forests are created by planting so-called Tiny Forests: mini forests with an area of approximately 200 square meters. Wageningen Environmental Research (WER) has found 595 different animal and plants species in such Tiny Forests. In 2020, WER will look into the buffering capacity of water and CO2.

National Rooftop Plan

A community of governmental bodies, NGOs, companies, knowledge institutions and citizen initiatives is currently working on the National Rooftop Plan 2020-2023. This plan emphasizes the importance of integrated multifunctionality in the roofing landscape in order to achieve a greater impact than just focusing on using roofs for solar panels. Besides generating energy, rooftops can provide solutions for nature, heat stress, flooding, well-being and the growing demand for the limited space that is available in built environments. Goal of the National Rooftop Plan is to accelerate the transition towards multifunctional rooftops by: promoting a broader mindset, integration of their plan into local and national policy, incentivizing financial models and creating skilled professionals and innovation.



* for existing buildings, a maximum of 100mm or 100 litres/m²
** with a natural roof or grass roof

www.greendealgroenedaken.nl/en-facts-values

Websites

Groenemient.nl, wonderwoods.com, valley.nl, nieuwbouw-demaasbode.nl, levs.nl, cie.nl, deltametropool.nl, staatsbosbeheer.nl, nextgreen.nl, amsterdamsmartcity.com/projects/rooftop-revolution

4.4 Conclusion

As a conclusion to this chapter, it is an interesting exercise to reverse the order of operations here. We might view transport not as a measure to be implemented in order to exert influence on goals and interests, but as the object of the implementation of other measures. In this view, transport is subject to the effects of other aspects. Take the ability to work from home, for example. The current coronacrisis showed us that working from home is possible for a great share of our office work. After the coronacrisis, it might be possible that most people do not want to return to a full week at the office. One might imagine a workday consisting of a few hours' work at home, followed by a trip to the office for some meetings, then heading off before rush hour to pick up the kids from school or do some shopping.

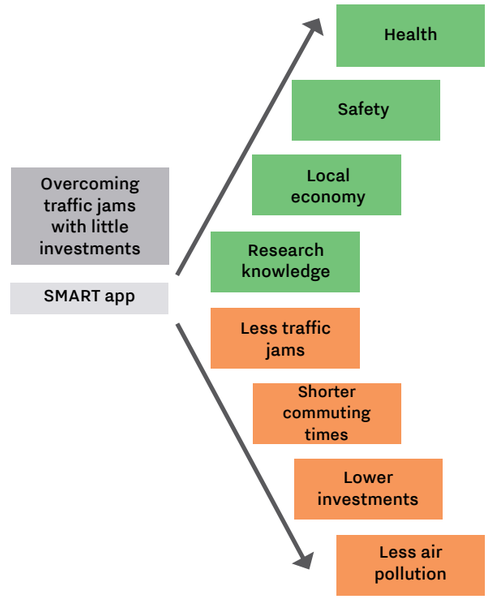
This will reduce the amount of office space required as well as distributing traffic volume more evenly throughout the day. If employees are able to work from home for entire days, organisations will be able to achieve substantial savings to their transportation budgets. Traffic will also be reduced, resulting in more effective use of both traffic junctions and the spaces at the traveller's destination. Businesses requiring an office would be able to rent less floor space if not all employees were present during working hours, for example.

Such an organisation might choose to promote working from home among its employees, which would affect traffic in the surrounding area. The area would suffer less from traffic to and from the workplace, and more importantly, the environmental impact would be reduced. This organisation might also implement mobility management, with apps being particularly useful for this purpose. Local councils could also take steps to manage mobility, through measures aimed at avoiding traffic congestion during rush hour, for example. Together, working from home and mobility management by businesses and local councils can have an effect on more than transportation alone. They can also improve the proper operation of the area as a whole. This chapter, and its position in the book, is intended to make clear to the reader how transport fits into the argument that a means can serve two or more ends. This clears the way for us to discuss the issue further in the next chapter. How are areas developing now that they are subject to the influence of increasing multifunctionality, in which transport plays a part?

Case description

IoT as crowd management tool in Enschede

The city of Enschede attracts more and more visitors every year, which results in traffic jams and increasing commuting times. To overcome this, the city planned to increase the capacity of the main entrance road, which included a new bridge and larger tunnel. Costs: €36 million. Since this is a considerable investment, the city started looking for alternatives to solve their accessibility problems. This resulted in the launch of an app: SMART Enschede, which stands for Self-Motivated and Rewarded Travelling.



The SMART app shows people alternative routes and includes a rewarding system. App-users retrieve points through certain challenges, such as avoiding main roads during rush hours, taking the bike or using public transport. What distinguishes this system from most rewarding-systems, is that it does not only include general rewards — a certain amount of points per kilometer commuted by bike — but also specific challenges. For example, extra points can be earned by avoiding the car during events. These specific challenges are related to expected peaks, which enables the city to influence and diminish peaks. Earned points can be used in several companies in Enschede, such as bike shops and supermarkets. Almost every week, a new company is connected to this system. This makes the use of the app attractive and contributes to the local economy.

The use of the app has been made even more attractive by enabling users to set specific goals. Users can choose to base the recommendations, routes and challenges on minimising their travel costs, travel time, environmental impact or on increasing the distance they make by bike and foot. As a result, more people will start using the app, which results in less congestion, but also less air pollution and more biking kilometers, which contribute to public health.

Recently, the app launched a new functionality: traffic lights will turn green faster for app users. The WiFi signal of the app will be detected by traffic lights, which turns green when the biker comes close. In the near future, this system enables elderly or disabled people to state that they need more time at traffic lights, which will then be automatically detected. This will increase safety, especially for more vulnerable people.

The SMART app started as a collaboration between Enschede Municipality and research institutes Twente University, Queen Mary University London, University of Leeds and the Swedish research and development institute Viktoria. Later on, several companies joined as well. For them, this results in more brand awareness and higher revenues. Last year, other municipalities joined as well. This case shows that one means, an app, can fulfil a range of different goals for different involved parties.

Involved parties

Enschede Municipality, Doetinchem Municipality, several research institutes and companies

Websites

Future-city.nl, smartintwente.nl, Enschedefietsstad.nl

Chapter 5

Multifunctional area development

5.1 Introduction

An area is nearly always multifunctional since a wide variety of functions occurs within it: for example, living, working, water and nature. The previous chapter emphasised that transport connects all these functions. However, do these functions reinforce each other as well? For the purposes of this book, ‘multifunctional’ means that mutual reinforcement occurs as parties have integrated goals and are sharing means. A closer look tells us that many areas are lacking in this regard. The functions in these areas are often separated in order to minimise hinder. With this vision in mind, transport does only move people and goods from one function to another, without creating mutual reinforcement. Nevertheless, this is changing. To illustrate, several cases in this book demonstrate how public health is more and more embraced as an intersectional theme. In an effort to build healthy cities, it is examined how elements such as housing, greenery, water and transport can contribute to public health.

Climate resiliency is another example of an intersectional theme that connects functions in a given area. Parks, public gardens, green roofs, surface water and many other elements are ways to make a city climate resistant. These elements all promote good health too. In other words, the themes of public health and climate resiliency intersect each other, resulting in multifunctionality. The same principle applies to other themes as well, e.g. the connection between living, working and transportation.

The previous chapter recognised the importance of IT as a tool for mobility and traffic management. These two instruments help to connect the functions within a given area and designate a role for IT in the management and development of areas. The importance of IT does not only apply to the infrastructure of roads and train tracks that transport people and goods. It applies to other infrastructures too. To illustrate, the efficient distribution of energy by using a smart grid, supported by IT, can add significant value to an area. This results in an overview of all functions and a cleverly arranged flow of transport between them. This enables the mutual reinforcement of an increasing numbers of functions. At that point, all aspects of the area are brought together, drawing attention to area development as a subject that certainly deserves to be included in this book on multifunctionality.

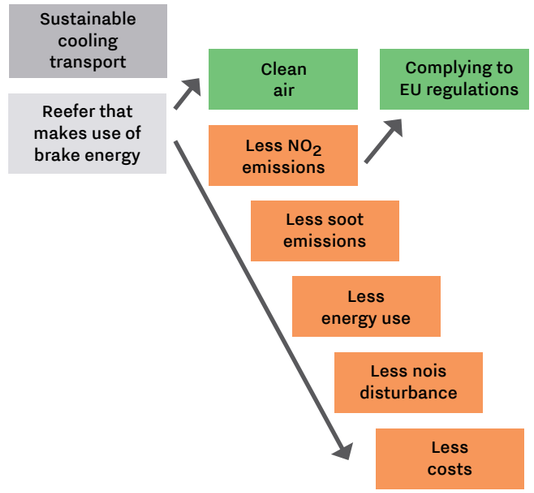
This chapter will focus on area development. In particular on arranging areas to achieve multifunctionality. The first step focuses on area development. The second step will add new ideas to existing ones by indicating how area development can be guided by principles for achieving multifunctionality. This principle states that multifunctional area planning will achieve better economic and sustainability outcomes than the traditional, more mono-functional forms of area planning. This could inspire the creation of an area-specific fund, in which revenues resulting from multifunctional area planning are deposited. The capital in this area-specific fund can be used for re-investments in the subsequent step of the area planning process. This sometimes involves investment in temporary functions. Altogether, a vision is emerging: a future of multifunctional areas in which temporary and permanent functions jointly form a cohesive whole and are connected by intelligent transport and smart grids. This chapter outlines this future.

Case description

Innovative cooling transport

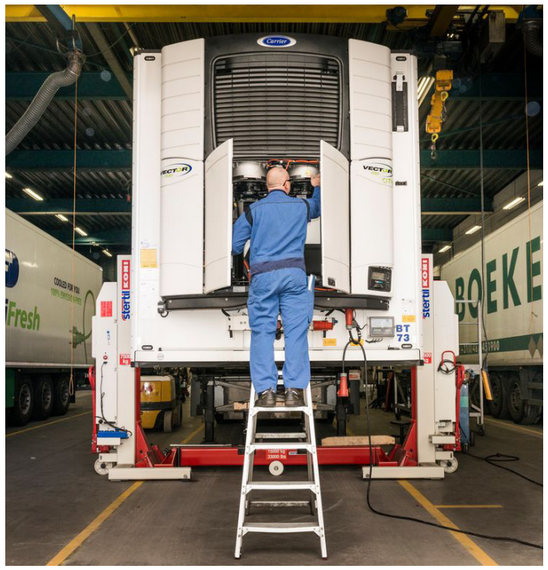
In Europe, over a million trucks transport goods that have to be cooled. Typically, this is done with large reefers that are powered by a contaminating diesel engine. These engines do not have to comply to the strict emission rules of trucks, which means that diesel engines are generating fifteen times more emissions than the truck connected to it. Reefers are responsible for 15% of the total nitrogen and soot emissions in cities. The New Cool, a Dutch-based startup, therefore decided to come up with a more sustainable alternative.

The New Cool makes use of energy generated through braking. A reefer contains disk brakes with a diameter of 43cm that generate a tremendous amount of energy by slowing down the heavy weight of the reefer. This energy is stored in a large battery that provides enough energy to cool the reefer. The energy can be used at every suitable moment, which is a large advantage over traditional reefers. Traditional reefers have a power plug that enables running its cooling systems on electricity during night. However, most parking places lack a suitable connection to the electricity net. As a result, a lot of truckers let their diesel engine run during the night to cool their reefer. This results in unnecessary waste of diesel and emissions, and generates noise disturbance.



The new reefer of the New Cool therefore solves several problems. It makes a diesel engine unnecessary, which results in less emissions. This increases the air quality, especially in urban areas. Besides that, it mitigates noise disturbance as this system is almost silent. The system is lighter than a diesel engine and therefore generates less pressure on the rear axe, which results in less energy use for transportation and a longer life-span of the axe.

The new reefer system is more expensive than existing technologies, but earns itself back in seven years through savings in diesel, while the installation has a lifespan of ten to twelve years. At the moment, 150 sustainable reefers are driving around, but it is likely that this number will grow substantially the coming years as The New Cool shows that a sustainable option can be financially attractive too.



Involved parties
THT New Cool, TMC, TRS/ Carrier, TRTA, Valx, TPTS

Websites
Thenewcool.nl, Volkskrant.nl

Case description

Climate adaptation in cities

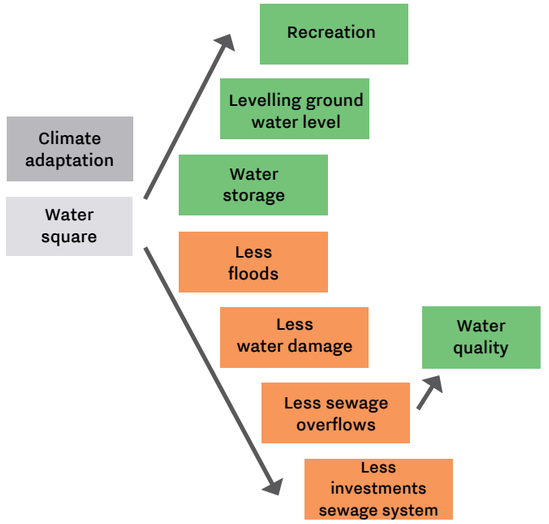
The climate is changing: summers are getting hotter, dry periods longer and rain showers more extreme. Especially cities are not designed to deal with these changes. Cities contain a high percentage of paved ground. This amplifies high temperatures during summer and reduces the buffer capacity of the soil, which results in flood risks and dry soil. To combat these negative effects of climate change, measurements are taken all over the Netherlands. Many measurements are multifunctional, as climate change influences city life in so many different ways. Some of these measurements are described here.

De Doorbraak, Rotterdam

Het Oude Westen is a neighbourhood in Rotterdam that is characterised by long streets, squares and courtyards. Most public areas in Het Oude Westen are paved and therefore non-permeable. This makes the neighbourhood susceptible for floods during heavy rain fall. Besides that, the neighbourhood becomes rather warm in the summer due to all the paved surface that retains heat.

As reaction to the floods and heat, inhabitants of Het Oude Westen wanted to take action to improve the climate in their neighbourhood. Several initiatives to implement more green in the neighbourhood popped up. One of these initiatives is the redevelopment of the Doorbraak [Eng = breakthrough]. The Doorbraak is a street situated perpendicular on the structure of long streets in Het Oude Westen. It has been created about 50 years ago to make it easier to go from one street to another. Nowadays, it is a grey, paved street without any character.

Inhabitants initiated the idea to transform the Doorbraak into a green street. They consulted and involved several parties, such as the area committee, a landscape architect and the water board, to shape and execute their plan. This resulted in a walking lane with a 4m wide green border that can collect large amounts of rain water, which results in less pressure on the sewage system. This capacity is even increased by using lava stones underneath the border that can store water too. As a result, the water board expects to make less costs for flood prevention and upgrading the sewage system. These expected savings are invested in the realisation of the Doorbraak.



The Doorbraak also contributes to an attractive temperature as it tempers the heat in summer. Besides that, it increases the air quality by increasing the percentage of oxygen and capturing dust. It contributes to an attractive living environment too, as the new design of the street invites people to recreate and play outside, which generates social interaction.

The border is filled with a wide variety of strong plants, which results in year-long green and easy maintenance. The inhabitants itself planted all plants and maintain the border themselves, which results in a strong community. The municipality enables this by providing this community with their maintenance budget for the area.

The positive results of the Doorbraak inspired the community to broaden their scope and stimulate others in the neighbourhood to realise similar ideas. For example, a green facade for a local cinema and green roofs on dwellings. All these projects are initiated by inhabitants or local entrepreneurs and financially supported by the municipality and water board and result in win-win situations.

Water squares

More and more water squares are realised in neighbourhoods with a risk of flooding. And not without reason: such water squares can fulfil several goals and can be realised within an attractive business case. This often results in interesting collaborations between users of the area, architects, the municipality and water board.

The first water square of the Netherlands, the Benthemplein, is realised in Rotterdam in 2013. The Benthemplein can store up to 1.7 million liters of water, which results in less pressure on the sewage system. The stored water does not end up in the sewage system, but infiltrates in the ground or flows back into open water. This diminishes the change of flooding of dirty water from the sewage system into open water. The gradual release of water into the ground also keeps the ground level in balance, which makes it easier for plants and trees to cope with dry periods. When not wet, the square is used as skate park and place to do sports and relax.

A water square that will be realised next year and in which different actors work together towards an attractive business case, is water square Oudenbosch. This square will be located at a current basketball field in a neighbourhood that often suffers from water in the streets, which results in disturbance and damage. Realising a water square at this particular spot makes it possible to avoid a considerable investment that the municipality would have made otherwise for installing new sewage pipe lines. These savings can be used for the development of the water square, which can also improve the function of the area as playground. The Hollandse Delta Water Board will save costs for flood prevention. Altogether, the water square improves the living environment of the inhabitants and contributes to awareness concerning climate change by making water storage visible.

Involved parties

De Doorbraak: Aktiegroep de Doorbraak, Het Oude Westen Area Committee, Wolbert van Dijk landscape architect, Rotterdam City Maintenance, Schieland & Krimpenerwaard Water Board
Water square Oudenbosch: Halderberge Municipality, Hollandse Delta Water board, Buro Topia, inhabitants

Websites

Aktiegroepoudewesten.nl, Schielandenkrimpenerwaard.nl, Wow-rotterdam.nl, waterbewustbouwen.be

5.2 Views on area development

During the final decades of the twentieth century, ‘planning by permission’ has been dominant. This means that an initiator is granted permission for a project that is profitable to him. This is not only a permit to build, but also permission to burden the area with negative side effects, for example noise pollution. Positive side effects occur as well, for example improved social safety. Such positive side effects have retrieved little attention within the practice of ‘planning by permission’. After all, profit is created through realising the permitted project as quickly and affordable as possible. Side-effects that only generate value after realisation do not create any profit for the initiators.

Around thirty years ago, the term ‘development planning’ made its breakthrough. This term links the significance of a project for the area as it was before, now and in the future. Underlying idea is that the value of an area develops steadily through the projects and activities that occur there. In this way, using what is already there is an economic motor of area development. In ‘development planning’, both negative and positive side-effects matter. Every project is an integrated part of the environment and is assessed and evaluated as such. Simply building a residential neighbourhood without thinking about social safety proves to be expensive in the long run, as an unsafe neighbourhood will become less attractive and therefore less valuable.

This integrated approach, whereby a project adds value to the area, is an important feature of the original view of ‘development planning’. With the introduction thereof, people established the idea that an area integrates functions, such as housing, work, recreation, water, nature and culture. However, their way of thinking is still old-fashioned, with a planner that oversees al functions from above and attributes them to an area from the drawing board. In other words, the integration is generated from above. Nowadays, integration does mainly come from below. The users are most often the ones who notice the opportunities for reinforcement between functions in an area. Many parents and teachers have worked to set up community schools. As users, they realised that this would enable them to retain functions such as a school, library, childcare and a music school for their area.

Area development with focus on the user calls for accompanying spatial policy. The government does no longer decide what is desirable, as it is unable to realise these desires itself. Additional funding from local users, such as residents and companies, is required. As a result, they are the motor for development. This is in accordance with the old triad: interest, payment and say. The one who is interested, pays. The one who pays, has something to say. Governmental bodies and market parties that take part in an area development, should therefore, enable participation of local actors. This results in the next step in planning: ‘planning by invitation’. In this principle, the government and market must actively seek partners to realise area developments.

Within ‘planning by invitation’, governments roughly map desired and undesired spatial interventions. In order to do so, they take into account the values of an area and its long-term forecasts. The wishes and demands of the current and future users are taken into account as well.

The desired direction of the development is then set down in an appropriate vision that is inviting to users. The governmental party itself does not execute these spatial interventions itself. Instead, initiators to whom this appeals, see opportunities for realising their ideas and dare to take risks. With their initiative, they develop the area, which results in increased value. This fits with the principle of ‘development planning’, in which links are made between the significance of a project for the area as it was before, now and in the future. The revenues generated by this approach can be reinvested in new project in the same area, but will this create multifunctionality?

Case description

Integrating amenities in a shrinking municipality

Kloosterburen is one of the oldest former monastery areas of the Netherlands, with a history that dates back to the twelfth century. The area, situated in the rural part of Groningen, in the North of the Netherlands, contains a church, monastery garden, care home, a monumental farm and a deer park. The population of the municipality in which Kloosterburen is situated shrunk with 6,6% between 2000-2015. As a result, the number of amenities in the area decreased, monuments and the monastery garden suffered from physical decay and care institutions left the area. Instead of accepting these effects as a given, the inhabitants of Kloosterburen decided to establish the Sint Jan Foundation to fight these effects.

Main goal of the Sint Jan Foundation is strengthening the liveability of the area through connecting care, work, living and preservation. First step in reaching this goal was providing day care for disabled people. Afterwards, the foundation started maintaining the church, monastery garden, deer park and care house. By connecting these different activities with each other, the foundation could reach interesting results. For example, disabled people work in the monastery garden as day care. This day care is more attractive for them than general day care as working with plants has a therapeutic effect. The maintenance level of the garden improved too as the disabled could spend more time on it than professional gardeners.

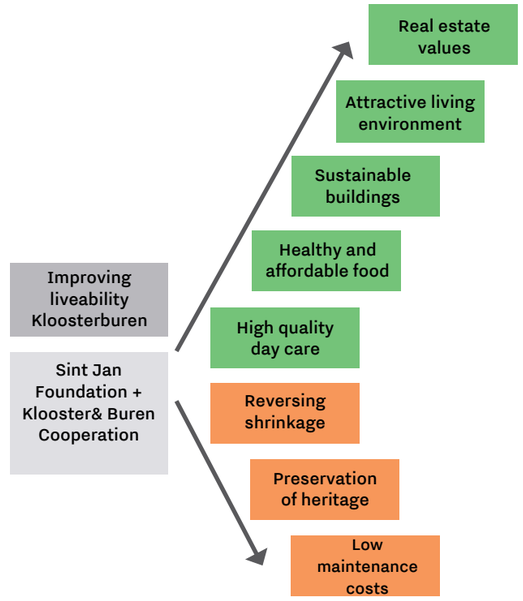
The success of the foundation motivated the inhabitants to come up with more goals: preserving the old library, exploiting the church, offering living space for care clients, making buildings more sustainable. Connecting the different goals results in effectivity and efficiency per goal that would not have been reached by focusing on the goals separately. To illustrate, the church is warmed by solar panels that are situated on the care institution and the meals of this care institution contain vegetables from the monastery garden.

In 2016, the last professional elderly care provider left the area. As reaction to this, the foundation decided to start providing care themselves. To do so, they founded a cooperation called Klooster&Buren. The main goals of this cooperation are similar to the ones of the foundation: offering a living environment for people that cannot live independently, maintaining cultural-historic heritage and creating a healthy ecology. These goals are combined as much as possible.

For care tasks, the cooperation hired seventeen care professionals. Integrating care with other goals and tasks has not been an easy step for them. In 2019, they decided to split off from the cooperation as they wanted more focus on care. This resulted in some difficulties between the care professionals and the cooperation, but these are solved by now. This shows that the process of integration of goals is not smooth and linear, but can rather be perceived as an ongoing process. Problems like this — and the ability to solve them — only emhpasise the maturity of this initiative.

Altogether, the foundation and cooperation have reached some interesting socioeconomic effects. The number of inhabitants living in the municipality around Kloosterburen is stable and real estate values increase. The supply of amenities and quality of care has improved too. Besides that, a more resilient community has evolved.

Involved parties
Inhabitants, Sint Jan Foundation, Klooster&Buren Cooperation



5.3 Developing multifunctionality

A multifunctional project frequently involves adding a second function at a later date, sometime after the first function has been taken into use. Take the Orlyplein as example. This square is located in front of Sloterdijk Station, the second largest railway station in Amsterdam. A decades old station square has been refurbished to create an area with green value. The current square also collects rainwater and is still a place for relaxing and enjoying shops, cafes and restaurants. In fact, the renovation created potential for adding another function in the future, urban farming for example.

Multifunctionality, integrating goals and sharing means, can be an ongoing activity. New goals can be added along the way in case it shares some of the means that were already used by the existing goals. An example is a green roof that, in addition to water storage and insulation, serves the purposes of urban agriculture and increases biodiversity as well. When the amount of greenery around these roofs is increased as well, the Water Board may decide to disconnect the rooftops from the public sewer system, which results in less pressure on this system. On the long term, this can result in less floods and savings on future investments in increasing the capacity of the sewer system (see p. 43-45 and p. 50-51).

This shows an upward trend in investments that stimulate and reinforce each other. This results in less costs on the long term. The investments therefore build on each other. This is 'planning by invitation', in which one function invites and enhances the other.

Landfill management is an example of this (see p. 54-55). Landfills can be used for e.g. agriculture and housing. Solar panels can be placed on top of the agriculture, reducing energy costs for the households. In this way, the chain extends from the former landfill, to agriculture and housing, and it can perhaps be extended even further by, for example, energy generation. Such activities add value and make the area more sustainable. This is an alternative to the old policy, in which money was spent on keeping the landfill as it were, without generating any value or revenues.

Sustainability increases when new activities are being undertaking in already existing areas. By doing so, value is added on the basis of already existing means. This results in creating value while requiring less money. In urban areas, this approach is adopted more and more.In rural areas, the point of departure is different. Less money is available here. In addition, inhabitants of rural areas often value their green and serene

Case description

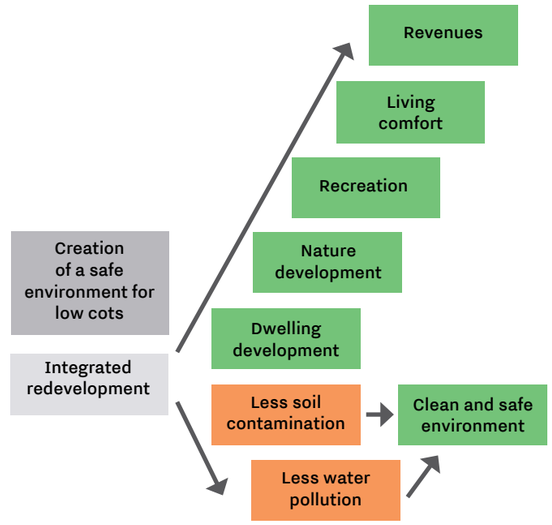
Landfill management

The Netherlands contains around 4000 former landfills. They can be considered as dynamic stocks of resources that can be integrated into the economy. Landfill management supports reclaiming land and avoids astronomic remediation and aftercare costs. It results in recovering resources – landfill gas, water and other resources – and in land. By doing so, future environmental hazards are avoided. COREL is an example of a landfill management strategy in which several functions are integrated in order to realize an attractive business case and generate societal value.

Developing clean energy, a park, agriculture, housing, industry and more functions is a way to regenerate a former landfill with a sound business case. The viability of this business case increases when these various functions share costs, and enhance one another. Yields generated by these functions can be used to manage the landfill. A good illustration is Groenewoud, a project of Afvalzorg, a publicly owned company that manages landfills.

The heavily contaminated soil of Groenewoud makes active sanitation of the area inevitable. This soil will be isolated and covered with a layer of new soil. As a result, the contamination does not get in contact with the surrounding nature and water. This results in a clean and safe environment. Groenewoud is situated in an agricultural area of peatland and forest. The adjacent area is partly designated as protected nature. A landscape architect has made a design to increase the spatial quality and transform Groenewoud in a full nature area.

All these measures will transform Groenewoud into an attractive living environment. Therein around 70 water dwellings will be developed. These dwellings are carefully positioned into their surroundings. They are all located next to the water and surrounded by nature, in order to generate the most attractive living environment for the inhabitant while maintaining the natural character of the area. The profits generated by the sale of these dwellings are used to finance the sanitation, development and maintenance of the area.



Financiers can then choose to finance all clean energy projects as a whole for the whole portfolio, or all housing projects, or all agriculture projects. This approach enables the comprehensive and integrated management of landfills while making it attractive for investors to invest in them.

Both government and financiers often have difficulties to take responsibility for multifunctional business cases such as Groenewoud. COREL is a method to take responsibility for the multifunctional regeneration of former landfills. A way to overcome these difficulties is to create larger portfolios of landfills. To illustrate, a portfolio manager who manages 20 landfills, makes a comprehensive plan for each individual landfill in which for instance clean energy, housing and agriculture enhance one another. This manager makes packages for all energy, housing and agriculture projects and offers these packages to public and private investors.

Involved parties
CoCoon, COREL, Afvalzorg Nederland, Ministry of Infrastructure and Water Management, Gelderland Province, several municipalities in Gelderland Province, Clean Tech Region,Wijdemeren Municipality.

Websites
Cleantechregio.nl, interregeurope.eu/policylearning/good-practices/item/2280/collective-regeneration-of-former-landfills-corel

environment, and will be careful to embrace new developments. It is questioned whether it is possible to develop an area and earn from it, while concurrently maintaining the generated value at the area in the long term. The challenge is, therefore, to 'harvest' from an area in a sustainable way, e.g. by generating sufficient returns to further develop an area in the long term. In other words, to make an area self-supporting, or even beter, self-sustaining. An area-specific fund can contribute to this.

5.4 Area-specific fund

Several pumping stations in the Netherlands, whose initial function is water level management, currently generate energy (see p. 37-39). This concept is called the 'Smart Polder'. In many cases, investment in the pumping station took place long ago and has already been amortised for a long time. The Smart Polder case demonstrates that investments from the past can result in unforeseen yields in the future. Previous investments

Case description

Flexible, affordable housing for single households

The current housing shortage for starters requires quick expansion of the housing stock. But while construction processes have become faster and faster in the last decades, legal processes can take years. Several Dutch companies developed concepts to overcome this.

Building company Heijmans aims to solve the housing shortage with their tiny house for single households: the Heijmans ONE. The Heijmans ONE is a dwelling of 39 square meter that contains a living room, kitchen, bathroom and bedroom. The dwelling is designed in a way to meet the demands of single starters: it is made of high-quality materials and has an energy performance close to zero. The total costs of ownership are low, which results in affordable rents. The Heijmans ONE is prefabricated in two pieces and can be installed or relocated within one day. The size and weight of the two compartments enables regular transport without the need for exemption. The Heijmans ONE is considered as temporary housing and not as real estate, which makes the legal procedures easier and faster. This makes the dwelling suitable to make temporary vacant areas more attractive or to fulfil an urgent housing need, for example for asylum seekers. The Heijmans ONE is therefore an attractive, affordable and sustainable solution for current urgent problems of the housing market.

In 2020, the association for social housing in the Netherlands, Aedes, published a brochure about flexible housing. This brochure describes the benefits of this type of housing. Among them are the low costs, quick procedures and urgent need it fulfills. This brochure introduces an energy neutral option for flexible housing: the Finch. The Finch looks like a wooden container, which makes it easy to stack them on top of each other.

Websites
Heijmans.nl, aedes.nl, finchbuildings.com

Case description

Circular waste water processing

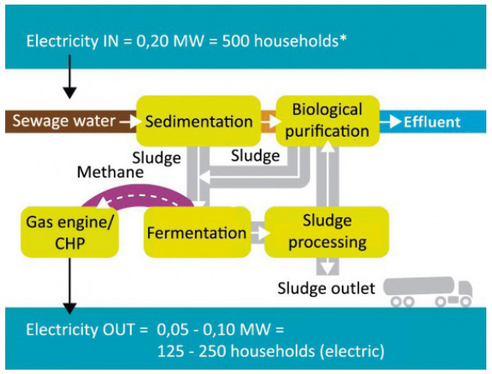
The Netherlands is a country of water. Water — and especially water safety — is such an important subject that it even has its own governmental body: the water boards. The Netherlands is divided in 21 areas all managed by another water board. Historically, water boards control water levels and secure water safety, but nowadays, they do way more.

Water boards are responsible for the water cleaning process and all have their own waste water treatment plants. The 'waste' produced during this process can be used for several purposes. Some components that can be distracted from waste water are:

- Cellulose (toilet paper) which is used to produce building materials
- Phosphate for the production of fertilisers
- Alginate that can be integrated in alginate-based coatings
- Water, which is very important given the increasing heat and dryness during summer, causing extreme drought.

Another interesting aspect of the waste water treatment plants is the energy it uses for its cleaning process. Waste water treatment plants use enormous amounts of waste water. During this process, biogas is produced. In fact this produces more energy than the whole plant needs. At most plants, this energy is not utilised yet. Being a nett-energy supplier could provide waterboards with new perspectives.

The waste water treatment plant of Aa en Maas Water Board in 's-Hertogenbosch processes waste water of 350.000 citizens, which equals 14 million litres of waste water per hour. This results in the production of 5.5 million Nm^3 of biogas a year. Aa en Maas Waterboard does not use this biogas for their own process, which means that other purposes and stakeholders can be served. The waste water treatment plant of Aa en Maas Water Board is located next to the local waste service, owned by the municipality. This waste service uses energy, which is now provided by the water board. In order to so, the water board converts its biogas into a compressed natural gas and delivers it to the local waste service. As a result, 50 garbage trucks of the waste service do no longer need diesel. In return, the water board retrieves a financial compensation and access to the biomass power plant of the municipality. The biomass offers enough energy to heat the digesters used during the waste water treatment process.



Not very long after Aa en Maas Water Board and 's Hertogenbosch Municipality got in touch with other, Heineken joint the conversations. Heineken, the largest Dutch brewing company, aims to be the most sustainable brewer of the world. There steam boilers use 12 million Nm3 of natural gas each year. Using the natural gas of the waste water treatment plant in 's-Hertogenbosch could help Heineken to become more sustainable. At the moment, Heineken purchases 4.5 million Nm^3 biogas on a yearly basis.

The collaborations with 's Hertogenbosch Municipality and Heineken results in a net-operating advantage of approximately €500.000 a year. Besides that, it is not a purely financial collaboration. The cooperation is a two-way street of organic compounds.

Setting up this collaboration has not been easy. Several issues have been considered such as possible state aid, the limitations of the current tendering laws and the role of Dutch waterboards in these business cases. The responsible minister even has to change the law. Nevertheless, the benefits of this collaboration were so clear to the involved parties that they were steadfast. And their efforts have been rewarded.

Involved parties
Aa en Maas Waterboard, 's-Hertogenbosch Municipality, Heineken

Websites
Efgf.nl, urbangreenbluegrids.com

can often be utilised in order to achieve new yields, resulting in significant savings. The Smart Polder concept provides a series of examples of functions that may then ensue, such as surface water purification. The surface water is cooled as its warmth (heat energy) is stored in the soil.

The pumping station is a means that becomes the lynchpin anchoring subsequent investment by attracting other investors to join in. These investors might make use of the stored energy or the clean water present at the pumping station. Area development then resembles a kind of 'hopping procession of Echternach', taking one step back before taking two steps forward again. A step back is the revaluation of a past investment for its current function. The first step forward is the innovation that bestows a new function on the old object. In the case of the Smart Polder, this is the subterranean heat and cold storage. The next step forward is the future value that is being created. With the Smart Polder, this value is water purification and thermal energy. The procession continues when this realisation of future value eases and encourages the next round of investment. This method of area development is particularly efficient in economic terms, as it brings new value to old investments while minimising the cost of new investments.

'Clearing the way' for new investments has been intentionally put into practice in the Self-Supporting River Systems (SSRS) project (see p. 27). The maintenance contract of the project provides for an 'Innovation Team'. This team assesses innovative ideas, consults specialists, makes business cases and starts pilots. The Innovation Team aims to process a continuous stream of innovation. Its starting point is acknowledgment of interests involved in the areas wherein the SSRS-project takes place. Fundamental understanding thereof facilitates the shared responsibility for innovations and risks. In this way, innovations that contribute to the interests of most actors can be enhanced.

When the future value of an investment is clear, it is not necessary to have a party lined up to make an immediate investment. Take the relocation of a dike in order to give a river more room to rise as example. This relocation makes it possible to develop a harbour. Imagine that certain parties are interested in developing the harbour, but they are unable to invest at the same time as the initiators. Funding from a public or private financier can bridge this gap. By doing so, the financier enables the creation of an integrated plan in which the different functions and goals reinforce each other. This will result in future profits. By establishing an area-specific fund, revenues generated from investments in the area are collected in this fund. These revenues are partly seen as profit for the investors, and the rest can be invested back in the area to add new functions. These new functions can be added easily, as many investments are already made.

Case description

Temporary redesign

Temporary redesign means temporarily making use of a building or area for a function other than that for which it was originally intended. This can involve all manner of situations, including using an existing building for a different purpose for a time or erecting a temporary structure. It might additionally mean the short term use of areas for purposes of nature, energy, recreation, water and events, cultural or otherwise. Naturally, a temporary redesign is not the same thing as combining functions. But flexible use does broaden the basis for combinations, certainly if various uses are permitted. Two other examples are the Strijp-S area in Eindhoven and the ACTA building in Amsterdam.

Strijp S
Strijp S is a former office park of some 27 hectares in the Eindhoven neighbourhood known as Strijp that was formerly home to the Philips company. The neighbourhood has been in the process of redevelopment into an urban residential area since 2000, see www.strijp-s.nl/en/home. Due to the vast size of the office park, the redevelopment project is expected to continue for quite some years. Temporary functions have been authorised within a 2,500 m2 space known as Plug-In-City, www.plugincity.nl. There is plenty of room for creativity, providing it meets the single condition that it is safe. Plug-In-City has developed rapidly since 2015 into a place of collaboration and creative diversity. The possibilities are endless, from studio to gallery, from temporary events to a pavilion or unique hotel room. New life grows in this former sterile area, leftover materials are reborn into new objects and temporary buildings; plants are slowly invading roofs and open spaces. The circular principle promotes warmth and respectful interaction.

The ACTA building
The ACTA building is an empty office building in Amsterdam, converted into temporary accommodation for students. The building is managed by two orgaisations: the Temporary Living Amsterdam Foundation (TW-A) and Urban Resort. TW-A is responsible for 460 student rooms. Urban Resort created a cultural breeding ground in the form of business units with a café-restaurant, a reception hall and studios. A unique aspect of the approach is the self-motivation of the residents. Management is in their hands and active 'handymen' will get discount on their rent. This made the conversion of offices into living accommodation on the basis of temporary redesignation feasible.

More flexibility when designating buildings or areas for a particular use means that they can grow over time. With temporary redesignation, municipalities seek to maximise the elasticity by allowing flexible use. This gives the initiator a lot of freedom, which increases the feasibility of projects. The municipality hands over part of the control to private parties. This has many potential advantages, such as less chance of buildings being permanently unoccupied and deteriorating, more rapid response to market demand, better chances of funding due to greater sales opportunities, more possibilities for temporary (living) accommodation and freedom for the end user to use the area as he wishes.

Websites
Strijp-s.nl, urbanresort.nl, sociuswonen.nl

5.5 Conclusion

Investing is among the primary instruments to achieve virtually any goal, particullary for government bodies and market parties. This has been the case for many years, and will continue to be in the future. However, the way in which investments are made will change. Investments will increasingly take the form of co-investment in the future. Co-investment has been around for years as well, meaning that multiple parties are investing to realise one common goal. Co-investment in the context of integrated area development implicates that multiple parties invest in the same means in order to reach their different, individual goals. In order to do so, these goals have to be integrated. This obviously means that each investor provides funds to support his own goal, but also that he collaborates with one or more other investors and their respective goals. Together they can achieve more. Costs are shared and efficiency increases as all parties reinforce the fulfilment of each other's goals. Co-investment is therefore investing in a means together with other parties, so that one's own goal becomes more affordable and easier to achieve. An area-specific fund can allocate financial means for just that purpose.

A quick glance at urban and rural areas is enough to be certain that these areas have seen a long term pattern of investment in goals that exist independently and have not been combined with each other. Business parks are often located next to residential areas, yet the two share little to nothing in common. They do not balance their energy use, their traffic flows are not alighned, and they are not integrated into their natural surroundings that could have ensured the retention of water and a cooling effect.

A well informed observer of urban and rural areas will note that goals are being coordinated with each other with increasing frequency and that areas are gaining a more multifunctional aspect. As many of the examples in this book illustrate, a dike is not just a dike: it is nearly always a road as well, and with increasing frequency, a part of nature too. In most cases, energy is still delivered from a distant country through cables or pipelines. However, more and more energy is generated in a smart and sustainble way in our own backyards (see p. 13, p. 29-31 and p. 37-39). Residential care is slowly being integrated into the living environment, while a number of transport solutions have been created to bring care to individuals in their own homes. Transport and the road infrastructure are also being integrated into the total environment.

In order to generate energy from an area and to distribute the energy among users, smart grids are vital. Smart grids are control systems that make it possible, in combination with IT, to optimally coordinate goals. Ingenious use of various energy sources ensures the lowest possible energy consumption. Control systems are also necessary to coordinate flows of traffic. These are equipped with IT and increasingly make use of Big Data in order to understand traffic flows and thereby manage them more efficiently (see p. 47).

Altogether, it can be concluded that the multifunctional character of areas is increasing. The creation of the Schoonschip neighbourhood as a sustainable area would have been impossible without the coordinated investment in buildings, energy systems and control systems: in other words, without co-investment (see p. 69-71).

'Co-creation' is a more apt term than 'cooperation' for indicating that individuals are not only pursuing the same objective, but are combining means and goals as well. This term, co-creation, is generally used in the context of methods aimed at improving collaborative ability, such as in the field of area development.

In search of a method for using multifunctionality as an instrument for area development, the following questions arise: which approach is most appropriate to let the involved parties realise that together they can take advantage of an unmissable opportunity. How can the parties acknowledge and capitalise on the (potential) benefits by entering into new coalitions? We will get into these questions in the next chapter in which we focus on how to transition from sectoral to integrated working methods.

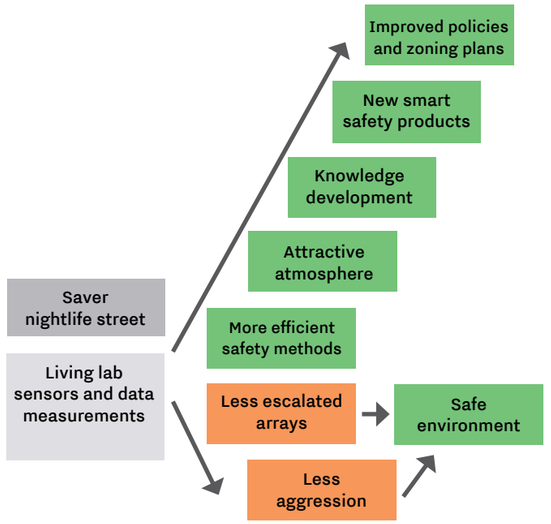
Case description

Stratumseind, living lab for safety

Stratumseind in Eindhoven is the longest nightlife street in the Netherlands and attracts between 10.000 and 15.000 visitors a night. This number of young, partying people often results in disturbance or small accidents,which negatively influences the perceived safety of the visitors. Eindhoven Municipality therefore decided to setup a Living Lab that experiments with big data measurement techniques in order to improve safety.

The Living Lab has two main goals. The first one is improving the safety and atmosphere at Stratumseind. The second one is creating knowledge and insights concerning data in order to increase the efficiency of safety measurements. These goals are realised through installing several cameras and different types of sensors. All this data is collected with privacy in mind.

The collected data is used to explore new ways to improve the safety. To illustrate, certain movement patterns are related to aggression. However, groups of men celebrating a bachelor's party show the same pattern. Linking video to sounds gives a more reliable conclusion. At the moment, the accuracy of the system is close to 80%. As soon as the 80% accuracy is reached, the local police will receive automatic messages of aggression detected by the software. This shortens the time to arrive at the place where aggression takes place and avoids escalation of affrays.



The Living Lab collaborates with the Intelligent Lighting Institute of Philips as well. For this collaboration, led-lights with adjustable colours and intensities have been installed. An insight that is directly applied is the brightness of the lighting at the end of the night. The police favours very bright light with a lot of blue in it. However, this turned out to be the same intensity as used in wake-up lights: not particularly the effect you are striving for as you want people to go home peacefully.

The Living Lab is connected to several European projects. One of them applies machine learning to translate videos into text. To illustrate, when someone searches for 'man with dog', all video fragments with a man with a dog are shown. This technique will save a lot of time.

Privacy is often an issue in big data projects. The Living Lab in Eindhoven works with 'Privacy through Design', which implicates that privacy is always the number one precondition. For example, cameras show dots instead of recognisable people. This prerequisite makes this project attractive for private parties as well: they are really interested in how to use the latest technologies in a way that privacy is secured.

The Living Lab is mainly leaded by the Dutch Institute for Technology Safety (Security (DITSS), an innovation platform in which Brabant Province, Tilburg and Eindhoven Municipality, different research institutions and private organisations collaborate. For public organisations, the results generated by DITSS contribute to safer areas and input to improve policies and zoning plans. DITTS generates academic knowledge for the research institutions and leads to new and more efficient safety and security products and services for the private organisations. The project has another positive side-effect too: the Living Lab increased collaboration between local entrepreneurs, who started to improve the physical appearance of their bars and clubs and planted trees as they expected this to contribute to the atmosphere.

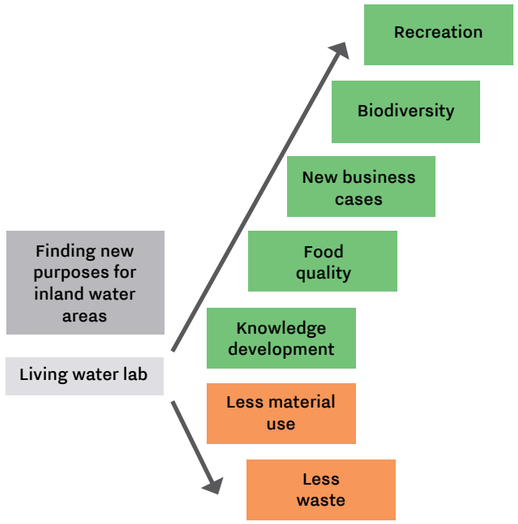
Involved parties
Eindhoven Municipality, Dutch Institute for Technology Safety & Security, Sorama, ViNotion, several local entrepreneurs

Websites
Future-city.nl, securitymanagement.nl

Case description

Climate adaptive agriculture

A substantial part of the Netherlands is used for agriculture. Areas along rivers and lakes are especially suitable for this purpose. Climate change has a considerable effect on these agriculture areas: soil is becoming saline or the risk of floods becomes so large that safe farming is not possible anymore. In the last twenty years, several innovations to adapt agriculture to climate change have been developed. In most of these innovations, integration has been the key to success.



Achteroevers: living labs for water functions

The Netherlands possesses a lot of fresh water. This water is mainly stored as buffer in the IJsselmeer and Markermeer, but it can fulfil way more purposes. Rijkswaterstaat decided to develop two 'Achteroevers' in the North of the Netherlands: areas where fresh water is kept behind the dikes to function as testing ground for new ecological, economic, safety and recreational functions. One of them is the Wieringermeer. The Wieringermeer is a 20 hectare living lab that focuses on exploring new business cases for food production in both fresh and saline water (water that contains salt). At the moment, fish and Chinese mittencrabs are breeded here and several plants and fruits are grown. This results in a closed loop in which the waste from fish and crabs is used as fertiliser for the plants. The waste from the plants is then used as food for black solder flies, of which the larvae are used as food for the fish and crabs.

The experiments at the Wieringermeer generated some interesting insights. First, the experiments show that several plants and fruits can be cultivated in saline water: their taste even becomes more intense due to the salt. Secondly, connecting the different material streams results in less waste and lower costs, which makes this type of agriculture financially attractive for private parties, while areas with saline water have been considered to be unprofitable for agriculture till now. These results are interesting for agri- and horticulture in other areas with saline water all over the world.

Room for the River

Both the Rhine and Meuse flow through the Netherlands and split up in several rivers such as the Waal and IJssel. In the 1990s, the Netherlands experienced extreme high tides, which resulted in the evacuation of more than 250.000 people and a flood that covered large parts of the southern province of Limburg. To avoid situations like this, the Dutch Government launched a programme to create more room for the river.

This new programme implicated the start of a new approach in water safety management. The focus shifted from building higher and stronger dikes towards providing more room for water. Different measures have been taken to realise this goal. Examples are deepening the river bed to increase its capacity and constructing high water channels through which excess water can flow during high tides, but also assigning certain areas for water storage and relocating dykes land-inwards to increase the width of flood plains.

One of these areas is the Overdiepse Polder in North Brabant. The Bergsche Meuse River in this areas causes potential flood risks for several villages and cities along the river. To ensure the safety of the inhabitants of these villages and cities, Rijkswaterstaat decided to transform the Overdiepse Polder into a water storage area. However, the Overdiepse Polder has been used by farmers for ages, and they did not want to give up their farmland and residences. Instead of rejecting the plans of Rijkswaterstaat, the farmers came up with the innovative idea to rebuild their farms on artificial dunes (terpen). In this way, water storage can be combined with farming and living.

Rijkswaterstaat adopted the plan of the farmers and made an integral plan for the redevelopment. The existing dike along the North side of the Bergsche Meuse River has been lowered in a way that water can flow in when water levels are high. A new dike is built along the border of the Overdiepsche polder in order to protect the land behind the Overdiepsche Polder. As a result, the Overdiepsche Polder can store 9 billion liter of river water which results in a tide difference of 27cm. Eight terpen are developed along the new dike. On these terpen, the farms and their animals are protected against the water. The area from which the sand for the terpen is delved, is transformed in a natural recreation area. To conclude, the redevelopment of the Overdiepsche polder into water storage created a lot of value: it lowered the chance on floods, remained its function as working and living area and generated a new recreation area.

Involved parties

Rijkswaterstaat, Deltares, Meromar Seafood BV, Sportvisserij Nederland, Zilt Proefbedrijf, Medemblik Municipality, FishFlow Innovations, Staatsbosbeheer

Websites

Helpdeskwater.nl, ruimtevoorderivier.nl

Chapter 6

Instruments and perspectives

6.1 Introduction

Multifunctionality means crossing sectoral boundaries and making connections. It means being curious about the other party, willing to learn each other's language, and compromising to optimise other functions. It calls for courage to leave your own safe, compartmentalised cocoon and to go beyond your own limits. This courage is necessary; only then you can take the step from simply fitting and tweaking your own goals into the goals of someone else to actively seeking and finding co-creating and synergy. The users of the area always play a key role as they have knowledge of the area, and everything happens in their backyard. Only if they realise that there are advantages for them, integration can occur.

Successful multifunctionality is usually characterised by simplicity; the integrated goals seem to have a sort of natural coherence. Despite this, it is often a long process to set up integration. That is related to the transition from a sectoral to an integrated working method. The challenge lies not in the technical solution, but in the process, in bringing together people who are willing to put effort into integration. How do you achieve multifunctionality? That's the question in this chapter. To answer this question, we will look at the obstacles and ways to overcome them. Afterwards, we will focus on how to transform stakeholders into shareholders and how to achieve multifunctionality.

6.2 Obstacles

In multifunctional projects, the budgets of two or more projects are often combined. An initial obstacle occurs if these budgets are inadequate to fund the investment. A second obstacle is the earmarking of a budget for a specific purpose. To illustrate, a budget for dike reinforcement cannot be used for other purposes such as water storage or nature development. A third obstacle can be that the advantage of the integration is not clear enough. For instance, it might not have been demonstrated convincingly that a climate buffer will strengthen the flood defences. A fourth obstacle can arise from the risks that can accompany cooperation between different parties. Joining together in a multiple solution is not something that every organisation dares to do, or is allowed to do legally.

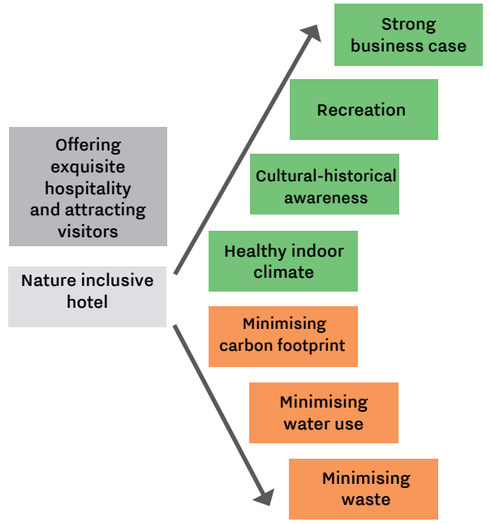
Another obstacle of multifunctionality, often described as the largest one, is the split incentive. This concept means that integration does not occur as the advantages of the integration are not clear for the party that has to bear a part of the costs. As a result, several parties miss the benefits of the missed integration. Just think of a Water Board that, unlike a nature manager, does not feel any incentive to develop a dike in an environmentally friendly way. If there is an advantage for them to be gained, that helps a lot in preventing the split incentive.

The sectoral way of working and strict division of responsibilities can be an obstacle for multifunctionality too. To illustrate, a dike manager cannot make any concessions concerning water safety, even if this results in considerable benefits for other parties. As a result, it is challenging to grant a permit in which a flood defence is combined with other functions. It is imaginable that individuals at parties that work in a sectoral way, do not feel any incentive to combine, as they clearly see the obstacles and do not see it as their responsibility. Nevertheless, there are several exceptions. The Gouda case study, shows how one employee can be succesful in achieving multifunctionality by speaking up (see p. 5). Achieving multifunctionality calls for a willingness and the leeway for those involved to look beyond these limits.

Case description

Nature inclusive construction at Hotel Jakarta

Hotel Jakarta is a luxurious 4-stars hotel with 200 rooms in Amsterdam. It is located at Java Island, the location of which thousands of Dutchmen left in the 20th century to head towards Indonesia. This country is therefore used as source of inspiration in every aspect of the design of the hotel. This strong conceptual design combines well with high sustainability standards, which results in an interesting multifunctional business case.



The main goal of Hotel Jakarta is offering exquisite hospitality services and attracting a high number of visitors. The high sustainability standards contribute to this. The hotel building has a BREEAM Excellent Certificate, which generates a lot of attention. This certificate is earned by integrating several sustainability measures into the design. To ilustrate, almost 80% of the building is made of bamboo. This material grows so fast, that its impact on the environment is small.

Sustainability has been the main design principle on the level of the hotel room as well. Every room encompasses solar thermal collector cells at the facade that generate warm and cold water. Glass panels in front of the balconies function as climate buffer to minimise the need to warm or cool the room. Even the restaurant of the hotel integrates sustainability in every aspect of its processes. It uses local and seasonal products to minimise transportation and the need for cooling.

The most remarkable aspect of the design is the large botanical garden at the heart of the hotel. Guests like to reside in this tropical atmosphere, but the garden generates a healthy indoor climate too. The plants and trees purify the air and evaporate a lot of water. The plants have a cooling effect during summer. To water the garden, a large concrete basin that collects rain water is constructed in the foundation.

The botanical garden is not the only part of the building that refers to Indonesia. There are traditional wood carvings and the Amsterdam Meuseum of the Tropics has borrowed some treasures to the hotel. The restaurant serves traditional Indonesian food. The hotel therefore contributes to more cultural-historical awareness of the interwoven history of the Netherlands and Indonesia. The garden is open to residents of Java Island too, as well as the restaurant, pool and fitness club. As a result, the hotel functions as a social hot spot for the island's residents.

Developing this hotel has been more expensive than average, but this will be earned back due to its attractive character.

Websites
Architectenweb.nl, deondernemer.nl

Involved parties
WestCordHotels; SeARCH architecten; De Nijs

Nonsynchronous money flows of various parties can form a major stumbling block as well. Funds have a planning cycle and it is possible that a golden opportunity to integrate cannot be funded simply because no money has been set aside. For this reason, the Water Board in the Gouda case advanced a sum that had to come from the Province at some point. The Water Board showed courage here, because there was no certainty that this sum would ever be paid back.

In addition to a shaky planning cycle, the fact that various decision-making processes do not link up with each other can be a further obstacle to multifunctionality. If such processes fail to connect with each other, no window of opportunity can be found to realise the integration of goals.

6.3 Stakeholders become shareholders

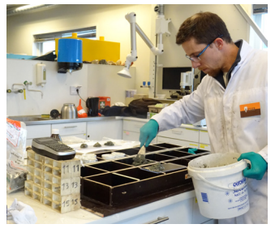
During the past decades, numerous methods have emerged, enabling people to co-create and find out what they can expect from one another when it comes to making joint social and economic profits. Since area development has such a profound significance for society and economy, many methods have evolved within that practice. Virtually every method capable of involving stakeholders has been developed to facilitate capital-intensive project development that is linked with powerful public and private investors who want to implement large, often very large, projects and get a quick return. In such processes, stakeholders tend to play a subordinate role; they have no interest in the project and merely wish to safeguard their own interests with respect to the project.

This is not the case with multifunctionality in which parties combine their funds to gradually build up value. Such collaboration changes the relationship between initiators and stakeholders. Stakeholders do not only include people who reject the initiators' project, but also people who represent an interest that combines well with the interests of the initiators. However, the initiators often have no inclination to combine, due to the high transaction costs and delaying effect of it.

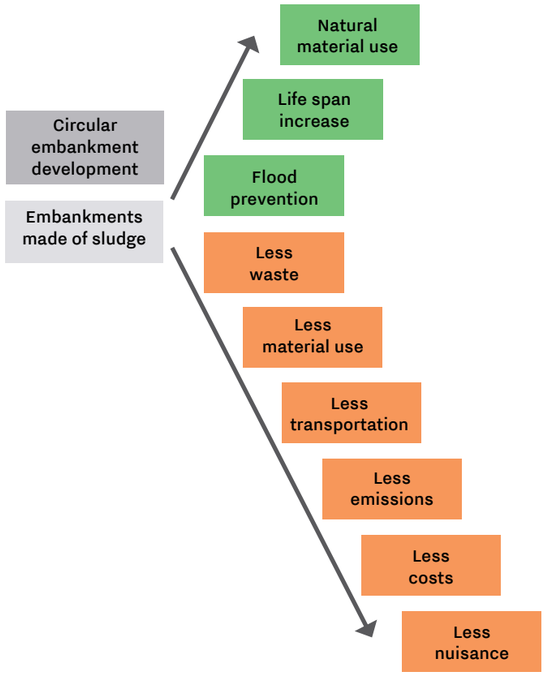
Case description

Building dikes with sediment

Keeping rivers in the right shape requires a lot of work. On the one hand, higher dikes and better flood prevention are required due to the rising sea level. On the other hand, sediment from lakes, canals and rivers needs to be dredged continuously to maintain water depth, flow capacity and water storage. On top of that comes the standard replacement of wooden and steel walls among canals that avoid erosion. Currently, these processes are not connected to each other, which results in separated material streams and high costs. Netics, an innovative civil engineering company, noticed the inefficiency of this and came up with GEOWALL®: embankment made of sediment.



GEOWALL uses locally obtained sediment to make ecologic embankment blocks that can be used as flood prevention or can replace wooden or steel walls among water ways. In order to do so, sediment is combined with the organic addition zeolite, which creates a chemical reaction that dries the sediment and makes it strong enough to function as flood barrier. This process can be conducted on location and optimises the traditional processes in different ways. First, the different material stream of the separate processes are combined. Sediment that would have been considered as waste transforms into valuable material here. This leads to less material use and less costs. Dredged sediment does not have to be transported anymore as well, which results in less emissions. The same benefits are generated because of the lower demand for new materials. Altogether, the environmental footprint of GEOWALL-embankments is considerably lower than traditional embankments.



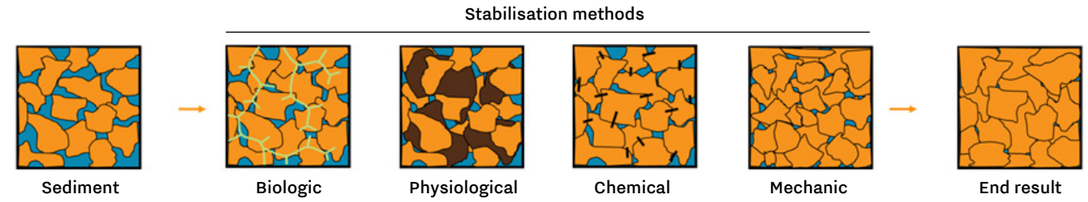
Besides the benefits generated due to smarter connection of material streams, are some other benefits. The first one is the lifespan. Embankments made of GEOWALL material do have a life span of around 50 years, more than twice the life span of wooden panels. Altogether, the total life cycle costs of GEOWALL-embankments are 20 to 50% lower than traditional wooden panels. The second one is the speed in which GEOWALL-embankments can be realised. It is possible to realise up to 50 meters a day, which results in minimum nuisance for users of water ways, for example the shipping industry or rowers.

The GEOWALL-technology is currently being applied in several projects. A public-private partnership realised an embankment of 100 meters along the Oranjekanaal in Drenthe and a pilot to use GEOWALL-material as construction material for dwellings takes place in Groningen. The ambitions even go beyond the borders of the Netherlands. There is a realised breakwater in the harbour of Norwich made from sediment of that same harbour, and Royal IHC, an international dredging company, bought a share in Netics. This enables Netics to contribute to projects worldwide. To illustrate, Netics is currently participating in projects to investigate how the coast line of Jakarta, Indonesia, can be strengthened with local sediment instead of expensive building sand.

Netics always tries to innovate. At the moment, they are developing a building block made of sediment. Not all sediment is suitable for this function. The sediment needs to possess certain geophysical characteristics. Sediment of the right quality can then be stabilised in order to make it suitable as building material. At the moment, Netics is testing which way of stabilising works best. To do so, they are testing real size building blocks in a natural environment. The first results of this pilot are promising: the material offers algae and seaweed a perfect environment to flourish. This strengthens aquatic biodiversity and generates an aesthetically attractive environment.

Involved parties
Netics, TNO

Websites
Netics.nl, English.rvo.nl/initiatives/energy-innovation-projects/innovative-dikes, waterwindow.nl, nlo.eu



Interest in multifunctionality increases when less capital is available to simply push through a project. The mutual gains approach, which Lawrence Susskind introduced in 1987, is a method that can help in outlining multifunctionality as an instrument. Mutual gains is a feature that is strongly associated with both area development and multifunctionality. After all, combined functions cost less and produce greater returns together. The mutual gains approach is part of the tradition of instruments devised for settling conflicts between initiators and stakeholders with an interest that is negatively affected by the project of the initiator. Nowadays, this approach focuses on the development of projects by a wide variety of involved parties.

The joint business case of multifunctionality (Chapter 3) gives substance to a process that involves a search for mutual gains. The returns and savings on the social, ecological and economic front determine what these mutual gains are. By taking the joint business case of multifunctionality as starting point, conflicts between initiators and stakeholders are not completely mitigated. There will always be disagreements among stakeholders. However, the starting point is no longer formed by conflicting aspects, but by potential advantages in a joint business case. Starting with a collaborative mindset, makes it easier to overcome disagreements too.

After the publication of the mutual gains approach, a diverse set of instruments has emerged. The key in most of these instruments is to look for shareholders among the stakeholders. Stakeholders are influenced by a project, but do officialy not take part in a project. Shareholders do. Therefore, with them, you can seek mutual gains.

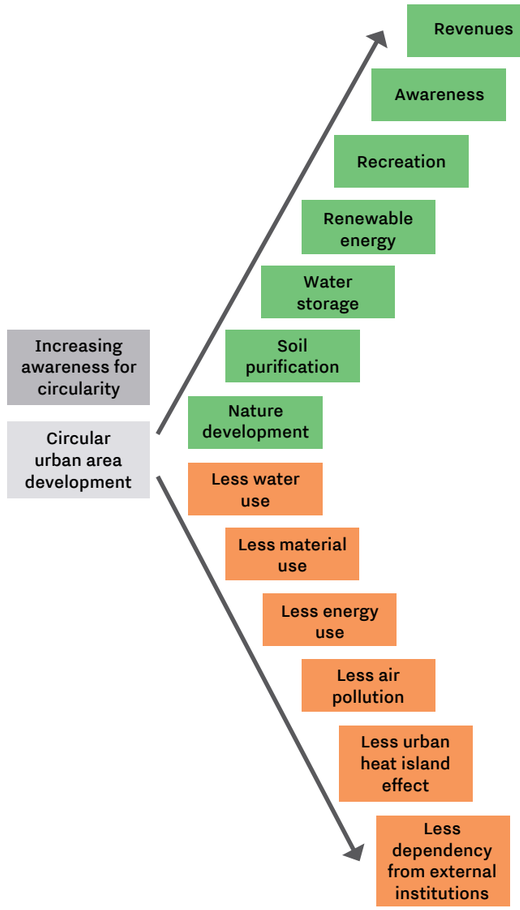
In area developments, the search for multifunctionality starts with bringing together stakeholders in a transparant process. Within this proces, practical solutions for uniting diverse interest are explored in order to find the shareholders among the stakeholders. In general, every interested party has a share in at least one , but usually several functions within the area. Shareholders that are the users of an area as well, have the mental ownership of the area, which results in positive involvement.

The group of shareholders organises itself with the aim of realising concrete area investments in order to generate added value. Instruments inspired by mutual gains facilitate coming together, provide space for co-creation, creativity, experimentation and risk-taking. On top of that, they enable adjustments and correction and finally produce sustainable area investments. Many of these instruments can also inspire to achieve multifunctionality outside the practice of area development.

Case description

Circular area development in Buiksloterham I

Buiksloterham is a neighbourhood along the North bank of the IJ river in Amsterdam. Once, it was a ship wharf that housed heavily polluting industries, resulting in contaminated soil full of metals and oil. The area is situated near to the city centre of Amsterdam and is therefore appointed by Amsterdam Municipality to be redeveloped into a lively neighbourhood for mixed use. The ambition is to develop the most circular neighbourhood of the world. In order to realise this goal, a wide range of actors joined forces and signed a declaration of intent. At the moment, the area is in the middle of its transformation from polluted industrial area to circular neighbourhood. Numerous circular projects are being realised at the moment, of which two are described here.



Former ship wharf 'Ceuvel Volharding'
The heavily polluted soil at Buiksloterham makes developing the area in a traditional way impossible. Therefore, Amsterdam Municipality organised a tender that provided this plot of land for a period of 10 years to a party that came up with an innovative idea to develop this area. This tender has been won by a group of professionals and individuals that transformed the Ceuvel in an area for experiment concerning circularity.

First of all, the group came up with an idea to clean the soil. Most techniques to clean soil cover the contaminated soil to close it off from clean soil, or simply move it to another site. The initiators of the Ceuvel did not perceive this as a satisfying solution and decided to use plants that stabilise, absorb and extract contamination from the soil. This technique, called phytoremediation, is clean, affordable and easy to maintain.

Digging in the ground, and therefore developing buildings or a sewage system is not possible due to the heavy contamination. Boathouses are therefore simply installed on land and transformed into sustainable ateliers. These boathouses are insulated and equipped with a sustainable heating system, green roofs and solar cells. Bio-toilets purify wastewater in biofilters, and abstract organic waste that can be used as fertiliser for plants. As a result, no connections to the electricity and gasnetwork are required, and the use of water and generation of waste is minimised.

The Ceuvel also contains a cafe that offers local vegetarian and vegan food. This cafe is really popular among young people and therefore generates a lot of exposure. Besides this, a comprehensive programme of activities is organised, for example workshops about circularity, arthouse films and exhibitions. A farmers market where local farmers directly sell their goods to consumers takes place weekly. Altogether, this results in a lot of awareness about circularity.

Initially, the Ceuvel wanted to be a testing ground for circular city development. However, cities require other tools than a small and commited community as the Ceuvel. Therefore, the initiators are now focusing on raising awareness and spreading information. Most people still have limited knowledge about circularity. The Ceuvel can give them knowledge and inspiration on what they can do themselves.

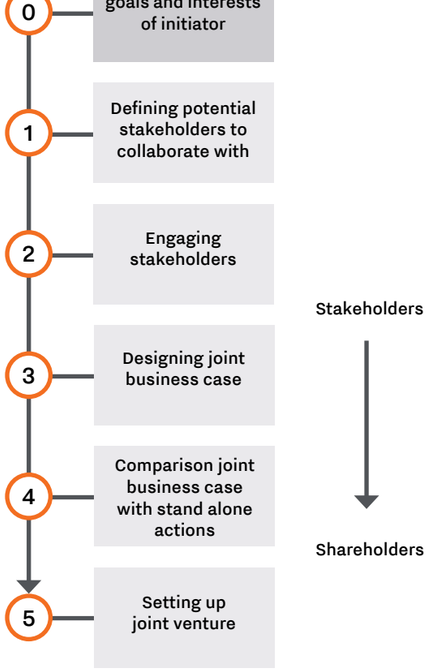
6.4 How to achieve multifunctionality

An initiator must be present first in order to successfully identify stakeholders. After all, if a primary party fails to take initiative, it remains unclear which other parties might benefit from participation. These other parties will be determined by examining the interest of the initiator, the goal that it is pursuing and the means that the initiator intends to implement to reach its goal (0).

Potential stakeholders can be recognised by their desire to put the same means to use, in order to achieve their own goals (1). Engaging them in an initial discussion may serve to confirm whether they are indeed eager to participate in the initiative (2). If signs are positive, they can develop a joint business case, in which they integrate their goals and share the same means (3). To what extent the business case is beneficial to all parties must be demonstrated through a comparison. The costs and revenues of each individual party in a potential joint venture are compared with the costs and revenues that each party would have achieved if they would have acted independently (4). If the results of the comparison are favourable for the joint venture, the parties can then reach agreement on how best to proceed together. At that point, the initiator and involved stakeholders all become shareholders in the new joint venture (5).

Step 4 is crucial: the comparison of the costs and revenues of each individual party in a potential joint venture with stand alone actions. The diagram below illustrates the benefits of the joint venture, and may help compare the costs and revenues of each individual party. In principle, the costs and revenues are already known quantities when making the comparison. The additional categories of costs and revenues involved in the joint venture are listed below. The extra revenues consists of shared savings achieved by dividing the costs, as well as new revenues resulting from more effective achievement of goals due to the mutual reinforcement of goals.

Reducing costs starts with the joint purchase of space (A) and organising construction or renovation together (B). Sharing space ensures savings, as the costs of maintenance, management and usage are all shared (C). Reducing costs together results in increased yields and extra yields as a result of the joint venture itself. This results in more effective realisation of goals through the mutual reinforcement of goals, and therefore higher yield in terms of money or societal benefit (D). In Chapter 5, we explained the concept of future value: more parties are able to join in by combining their goals and sharing their means. This allows the costs to be divided among a greater number of participants and further strengthens the mutual reinforcement of goals (E).



	Extra costs	Shared savings	New revenues
A Sharing space	-	Costs are shared	-
B (Re)building together	More complex building	Costs are shared	-
C Joint exploitation	More complex building, maintenace, exploitation	Costs are shared	-
D Joint venture	-	-	Mutual reinfor-cement of goals
E Future value	More complexity of adding extra goals	Costs are shared	More mutual reinfor-cement

Case description

Circular area development in Buiksloterham II

Schoonschip

Schoonschip is the most sustainable floating neighbourhood of Europe. It entails 30 water dwellings with 46 households at a side canal of the IJ river, a fifteen minutes boat drive from Amsterdam Central Station. Smart technologies and conscious design are deployed to minimise the need for electricity, gas and water.

The water dwellings are almost self-supporting concerning energy. There is no gas connection and only one electricity connection for the whole neighbourhood. The dwellings are designed in a way that the need for heating or cooling is minimised, through strong insulation and orientation towards the sun. The remaining required heating is generated by pumps that abstract heat from canal water. Electricity is obtained from renewable energy sources such as PV panels. All these energy sources are connected to a smart energy grid that levels the deficits and surpluses between the dwellings through the use of two-way cables and batteries. This smart grid is developed 'behind the meter', which implicates that inhabitants do not have to pay taxes for supplying energy to other households at Schoonschip.

The water dwellings are developed in collective private commissioning (CPO), which means that individuals collaborated to develop and design the area and dwellings. This resulted in the forming of a cooperation that exchanges knowledge and takes initiative to share amenities. To illustrate, the inhabitants created an open source data base of circular measures and materials for dwellings and decided not to buy their own cars, but share a few. The smart energy grid is a strong example of a result that could not have been realised without the existence of the cooperation. The community that is generated through the existence of this cooperation, stimulated inhabitants to take even more sustainable measures and to collaborate in order to realise this. The social structure of this neighbourhood is therefore as important as the technical solutions in order to realise the high sustainable measures.

Future plans

In 2020, Amsterdam Municipality released a policy document for new area development projects in Buiksloterham: the 'investeringsbesluit Buiksloterham'. This policy document defines four main objectives for the development of the neighbourhood: circularity, increasing the number of dwellings, productive businesses and social mixing. To guarantee the achievement of the objectives, certain conditions have to be met to start a project. The conditions regarding circularity are a closed land balance, nature inclusive measures to improve biodiversity, re-use of water, re-use of construction materials, energy neutral construction, rainproof developments, and implementation of in-building grinders for organic waste.
By setting these conditions and working towards these objectives, Buiksloterham will become one of the most circular neighbourhoods of the world.

Involved parties

Metabolic, DELVA landscape architects, Space and Matter architects, Amsterdam Municipality, inhabitants, Amsterdam Municipality, North Holland Province, DOEN Foundation

Websites

Deceuvel.nl, advalvas.vu.nl, spaceandmatter.nl, schoonschipamsterdam.org, detechniekachternederland.nl

6.5 Conclusion

It is not easy to just impose multifunctionality from above. A statement such as 'we must get that community school' is even dangerous and can actually result in the failure to achieve clever combinations. It is only possible to combine in the right place, with knowledge of the physical surroundings and with a support base of shareholders. Integrated thinking and action are abstract concepts, whilst successful projects tend to have a concrete starting point. A farmer who starts to produce organically and therefore cooperates with nature and water managers no longer utilises his freedom to continually produce more or faster, but trades this in for a new freedom: the freedom to work with partners. The water manager trades in his freedom to take increasingly technical measures for the freedom to cooperate with other parties who contribute towards making the system climate proof. It is growth, but growth that takes the preconditions set by those involved in the collaboration into account. It means a different way of working, very much attuned to the other party and designed on the basis of the situation of cooperation, resulting in better quality in the area, for lower costs.

Within one sector, everyone speaks the same language and production is optimised. There is a straightforward, closed system. You could say that the transaction costs between supplier and customer are low. With a combination of functions, different sectors are involved and there is virtually always a question of customisation. For this reason, some free space is needed at the start of the process. Freedom in which individuals can get to know one another so that they can better understand each other's products and activities. Freedom so that they can work out the practices and the areas within which these will take place. Freedom and sense of urgency so that innovative ideas can arise on the interface between sectors. This requires time. Transaction costs are relatively high during this phase. However, these transaction costs are earned back in a later stage, when the combination starts to bear fruit. Tenacity and patience are therefore required.

Case description

Natural climate buffers

More than half of the Dutch population lives below sea level, which makes flood protection an important task. The whole coast line of the Netherlands is part of a flood defence structure of dikes, dams and dunes. One of these dikes is the Hondsbossche Zeewering (Eng = sea defence). The Hondsbossche Zeewering was a 5.5 kilometers long dike made of clay, basalt and asphalt. It contained breakwaters and even a metal dam, which resulted in a functional, but unattractive appearance. A few years ago, the area has been redeveloped competely. A 300m wide landscape of dunes has been constructed to assure safety of the resident living behind the dike. This new nature also offers opportunities for tourism and strengthens biodiversity in the area.

The area in front of the Hondsbossche Zeewering had been a landscape of dunes till the Middle Ages. Over the centuries, this landscape became smaller and smaller and eventually disappeared. In 1792, the first version of the current Hondsbossche Zeewering had been constructed to protect the hinterland from floods. The current flood defence structure had been developed in 1981. Only 23 years later, this structure turned out to be too weak to comply to the safety regulations of Rijkswaterstaat. Rijkswaterstaat and the water board therefore decided to start a tender for contractors. They requested the contractors to come up with an integrated plan to redevelop the area into a safe and more attractive place.

A consortium of Boskalis and Van Oord — well-known for their palm islands along the coast of Dubai — won this tender. This consortium created an artificial landscape of dunes, exactly at the location of the dunes of the Middle Ages. This new landscape is created by the supplementation of 35 million m^3 of sand. It contains a sandy beach and lagoon and protects the hinterland from superstorms that normally occur only once in 10,000 years. After redevelopment, the Hondsbossche Zeewering has been renamed into the Hondsbossche Duinen (Eng= dunes). The minister of Infrastructure and Environment declared the area to be safe in 2015. The final costs of the project turned out to be €20 million lower than the initial budget of €250 million.

The design of Boskalis and Van Oord fits the new strategy for Dutch coastal defence structures. Instead of increasing the height of dikes and dunes, safety is assured by supplementing sand to the coast. By doing this, the coast line of 1990 is retained. This new strategy is more successful as dunes are less vulnerable than dikes; the sea does not have to be obstructed by one object, but is separated from the hinterland by a broader area of dunes. Besides that, dunes are more dynamic. Recovering from high tides and reacting to rising sea levels is easier through small-scale supplementations.

Besides safety, the new Hondsbossche Duinen fulfil several other functions. The new dunes form new nature that attract different species. To illustrate, seals are using the sand plates to rest. The dunes also create new opportunities for recreation. People visit the Hondsbossche Duinen to take a walk, watch the seals or recreate along the beach and lagune. This is beneficial for local companies.

The redevelopment of the Hondsbossche Zeewering into the Hondsbossche Duinen shows that combining water safety with other goals such as developing nature and strengthening the local tourism sector, can result in integrated solutions, enabled by interesting collaborations between public and private parties.

Inner land water safety

The Hondsbossche Duinen and dike-in-dune at Katwijk (see p. 14) show the value of a more natural approach and multifunctional plan concerning coastal flood defence. The same approach can be found concerning river flood defence. An example of such a project is the development of nature conserve Tusschenwater in Groningen. The river that crosses this area, the Hunze, has gained back its initial meandering course and water levels in the area are managed carefully. As a result, the area can temporarily store 1.3 million m^3 of drinking water, which contributes to the resilience of cities around the area. Tusschenwater fulfils more functions than water safety. Around 10 million m3 drink water is annually extracted from the area. Besides that, the area is gradually transforming in a swamp, which attracts different species such as the avocet and osprey, but also otters and beavers. This makes the area attractive for recreation too.

Involved parties

Hondsbossche Duinen: North Holland Province, the municipalities of Camperduin, Petten and Callantsoog, nature organisations, Rijkswaterstaat, Hollands Noorderkwartier Water Board, Boskalis, Van Oord.
Tusschenwater: Hunze en Aa's Water Board, Groningen Water Company, Drentse Landscape Foundation, Drenthe Province, Tynaarlo Municipality, HAZ Infra.

Websites

Elsevierweekblad.nl, noord-Holland.nl, hunzeenaas.nl

Chapter 7

Conclusion

7.1 Introduction

Universities have been sharing premises and personnel for educational and research purposes for more than a thousand years. This saves costs by reducing the need for separate buildings and separate people for education and research. In addition, the teaching staff provide better education, since conducting research leads to a better understanding of the subject matter. Furthermore, the staff performs better research by also teaching this subject. An even older example is the road on top of a dyke; it is not necessary to build a separate road, and a dyke provides access to areas which would otherwise be difficult to reach.

Apart from the examples of universities and dykes, there are only a few other historical examples of integrating goals and sharing means. Only the last decades, we can see a rapid increase of cases. That is what this book is about, as well as the massive social and economic potential that exists if we utilise the integration of goals and sharing of means. We present this with the aid of a large number of examples and an explanation of the phenomenon multifunctionality. This chapter is the place to draw a number of conclusions. First step is to extract a number of main points from the examples and case studies. This is followed by some ideas for further discussion.

7.2 Lessons learned

Using one means to reach several goals in order to reduce costs and generate value: that is what this publication is about. By combining means and sharing goals in this way, unexpected business cases suddenly become highly promising. They unlock the value of what already exists. By putting the focus on the user, it is possible to keep the flows of funds in the area and reinvest available funding in further quality improvements. Working ‘mono-measure-multi-purpose’ leads to new partnerships, which help in achieving ambitions faster, more simply and more cheaply.

In several cases, multifunctionality occurs in the built environment. For these cases, it is often a matter of integrated developing, constructing and operating. Integrated construction results in less material use and thus lower costs. Integrated planning leads to thoughtful plans. As a result, raw materials are used in a careful and sustainable way that fits the circular economy. The involved parties also benefit in the operational stage. Just take the Gouda case study, where the constructional integration yields a substantial financial advantage and then its operation offers numerous further opportunities for earning money (see p. 5). While integration of just one phase of the process occurs, it is concluded that integration is usually a question of both construction and operating together.

Multifunctionality is not seldom the result of coincidence. However, there are numerous examples of successfull planned integration: the flood defence combined with a parking and nature park in Katwijk is an integration of goals that has been developed consciously (see p. 14). It is definitely possible to bring area partners together in a planned way, to let them feel the tension in a planned way and, in this way, come to integration. In order to do so, stakeholders must be turned into shareholders by using the right process. This process enables the shareholders to become mutually reinforcing. The lessons and cases in this book can stimulate and inspire them.

Multifunctionality is a way of working for people who want to go beyond the boundaries of their own sector, and who want to achieve outstanding, sustainable solutions. Multifunctionality is a question of logical integration. This logic might seem easy, but does not come quickly. It is the result of a development process in which retrieving adequate quality in terms of people

Case description

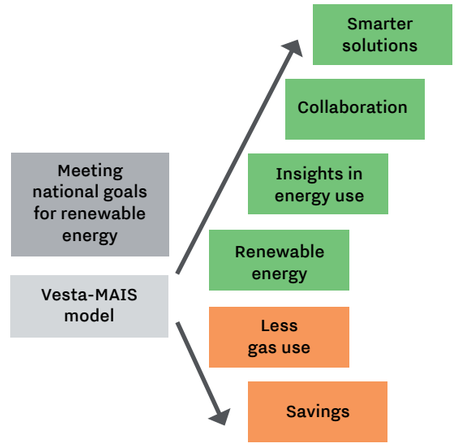
Using data for the energy transition

At the moment, municipalities are developing transition visions for heat. Such visions show a realistic time schedule for the energy transition and identify alternatives for natural gas in their municipality. In order to achieve a careful assessment process, authorities and stakeholders are supported by a set of guidelines, in which objective information will be made available based on transparent and validated factual data on both municipal and regional level.

On municipal level, the guidelines consist of two components. The first component is the technical-economic analysis, based on an open source model. This analysis shows the impact of various heating options, the required level of insulation and required investments. The second component is a document of directives that municipalities can use to enrich the open source model with their own, local data. These guidelines enable municipalites to select the most cost-effective plans.

On regional level, Regional Energy Strategies (RES) are developed. A RES includes regional commitments on electricity, (green) gas and heating. In respect to electricity, the RES makes an allocation of the national target for the generation of renewable electricity. Different thermal energy resources are explored, for example geothermal resources, aqua thermal resources and using residual heating from the industry.

There are several tools to analyse the best solutions for replacing natural gas combustion as thermal energy resource . The mathematical model Vesta-Mais is a spatial energy model which is capable of calculating the energy use and the CO2 emissions of the built environment and the horticulture in the Netherlands until 2050. This model is developed by the Netherlands Environmental Assessment Agency (PBL).



The Vesta-mais model defines the built environment as a collection of model objects representing i.e. horticulture, houses, and utility buildings. Each object has its own thermal energy demand, based on three aspects: construction year, type of building, and energy label. The spatial expression of the energy demand per model object can be used in order to calculate different technical alternatives which meet the energy demand. These technical alternatives are considered and recommended as the most suitable alternative based on the profitability of the alternatives. By using the Vesta-Mais model, municipalities and regions can make substantiated decisions based on the optimal solution for all actors. This results in integrated solutions that are affordable, smarter and cleaner.

Websites

www.pbl.nl/en, klimaatakkoord.nl, expertisecentrumwarmte.nl

and areas is central.
In multifunctional projects, governmental bodies, companies, organisaties and citizens join forces in new constellations and partnerships. They save money and improve the quality of their own environment by looking for more intensive and more efficient forms of use, and through local production under their own management. New forms of area development emerge in this way. Area development that still aims for growth, but no longer at the expense of space and resilience. It is a question of sustainable, inner growth, of intensification and adding new qualities to the existing ones.

Case description

Football court as urban water buffer

In 2018, the first football Court with a subsurface water buffer underneath has been opened at the Sparta Square in Rotterdam. This innovative concept aims to retain the rainwater for longer in the city's subsurface, thereby preventing flooding and making extra water available in times of drought.

The water storage under the Cruyff Court can harvest around 30 millimetres of rainfall from about 4 hectares of streets, roofs and squares, thereby reducing the risk of flooding. This water is stored in a 20 meters deep sand aquifer by using a water well. The water is pre-treated in a compact vegetation bed that contains a natural sand filter with reeds and sedges. This water can subsequently be pumped up to water the Sparta's grass pitch, for cooling, and for supplying water for recreation on the square. A completely circular system is created. The local Water Boards invested in this project as it results in savings for them.

The Cruyff Court at the Sparta Square is not the first urban water buffer. Two months before, an urban water buffer opened in Rheden, at the border of National Nature Reservation the Veluwe. In Rheden, large volumes of water flow from the slopes of the Veluwe to lower situated roads and buildings during heavy downpours. This regularly causes street flooding. With the urban waterbuffer, the water is infiltrated to a depth of 10 meters via three water wells. By doing so, rainwater is discharged quickly, groundwater levels can be managed and minimum space is used.

Involved parties
Cruyff Foundation, Rotterdam Municipality, the Delfland, Schieland and Krimpenerwaard Water Boards and many others.

Websites
kwrwater.nl; www.cruyff-foundation.org

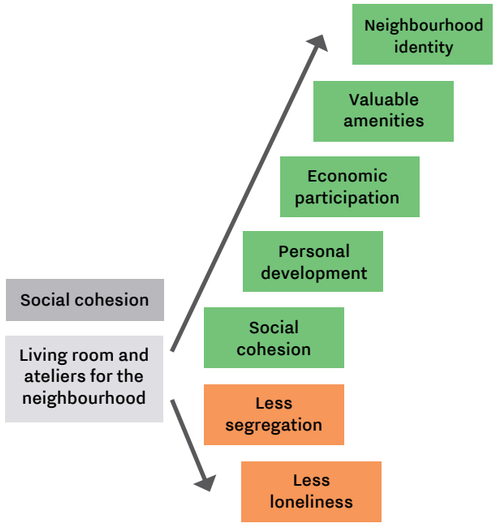
Case description

Social cohesion and placemaking at the Wijkpaleis

The Wijkpaleis is a neighbourhood initiative that started in Middelland, Rotterdam in 2015. It offers a living room and different ateliers. The living room is open to all inhabitants and the ateliers are shared among professional craftsmen from the neighbourhood, but open to inhabitants too. Several workshops, courses and events are organised at the Wijkpaleis. Main goal of the Wijkpaleis is increasing social interaction and cohesion in the neighbourhood, but it creates a whole range of other effects too.

The ateliers are the heart of the Wijkpaleis. The kitchen, wood workshop and textile workshop are used by different craftsmen and inhabitants with an idea. This results in a wide range of activities that attracts a wide range of inhabitants. Examples are an open dinner table twice a week, sewing lessons and furniture building workshops. This brings inhabitants with different backgrounds in contact with each other, which contributes to social cohesion and combats segregation. Next to that, it contributes to the supply of amenities and services in the neighbourhood, all offered for an affordable price.

What distinguishes the Wijkpaleis from similar initiatives, are the substantial opportunities for self-development. Inhabitants can participate in activities and use ateliers to develop skills or simply enjoy themselves, but they are also encouraged to develop their own events. This results in a lot of knowledge and a diverse network. As a result, several inhabitants gained the right competences and self-esteem to start an own business. Sharing an atelier with other craftsman enables them to do so without considerable own investments. The Wijkpaleis could therefore be considered as an incubator for local craftsmen.



There are numerous examples of inhabitants who developed themselves at the Wijkpaleis. Fatma did not have a job when she decided to do something for lonely inhabitants. Her dinners attract over 50 people every Wednesday and are the start of many interactions. She can make a living of it now. Samir, a sewer from Syria, learned Dutch through teaching his sewing skills to others and has a job as a professional sewer at a well-known luxury retailer now. The Wijkpaleis offers a stimulating and positive environment where people can (re)discover their talents and become motivated to do something with these talents. This applies especially to vulnerable inhabitants, for example people that do not master the Dutch language, have no formal education or do not have a job for a long period already.

The Wijkpaleis became so popular, that it moved to a larger location with 2000 square meter of ateliers in the winter of 2019. It contributes to the image of Middelland too. Citizens from the whole city come to Middelland to visit the dinners at the Wijkpaleis. The Wijkpaleis can therefore be considered as a successful example of placemaking.

Involved parties
Het Wijkpaleis, DOEN Foundation, Rotterdam Municipality

7.3 Food for thought

A number of points are apt for a future agenda. Multifunctionality is more topical than ever. But it has a long way to go from being generally accepted and can still use plenty of support. Multifunctionality is an established, but at the same time, a relatively unknown phenomenon. There are plenty of examples, but many people do not recognise them as such. They only form the tip of the iceberg. Many more is possible. Below, we discuss some topics that would be good for theoreticians and practitioners to tackle.

Paradigm chance

Flood defence structures are used to protect the hinterland from floods. Yet, the presence of water can also yield added value for such functions as living and working. A flood defence can therefore be used to realise other functions that benefit from the presence of water. Water is no longer an enemy that has to be kept out, but the opposite: the water actually yields added value. This is possible through e.g. integration of nature, roads, housing, energy and tourism. This turn is the inspiration in this book to speak of a paradigm change, and not only regarding water safety. The change is to turn away from concentrating on one goal, and using all available means to reach this goal, and turn to others who have means to share. The result is multifunctionality since the means will be used for more goals at the same time, and these goals are aligned.

Finiteness and inexhaustability

To further strengthen multifunctionality, it is a good idea to look in more depth at the terms finiteness and inexhaustibility. The finiteness of the planet seems fairly evident, but the notion of inexhaustibility is still firmly anchored in our actions when we use all available means to reach a goal. What is the reason for this, what does it signify that this is so deeply ingrained, what can we do about it? The idea of inexhaustibility is also deeply rooted in our legal system. To us, thinking about this in more depth seems relevant for the debate on sustainable area development, as is the question of whether there is more to consider than just natural resources and resilience. Are these two the right phenomena to look at in relation to (in)finiteness, or are there more relevant phenomena?

Good spatial planning

The ideology of ‘planning by invitation’ might well have been embraced now, but its implementation is often accompanied by a lot of resistance. Precursors in the field of multifunctionality are faced with a barrage of sectoral laws and regulations, all of which are well intended but miss the mark as they make an integrated approach impossible. Also, vested interests often make it difficult to build new coalitions. A compelling Dutch example is the energy transition. The system of laws and regulations, and the capacity of transportation infrastructure, contain a number of important obstacles at a local level. Maybe in the nearby future it will be easier for consumers to produce, distribute and feed in energy themselves. Nonetheless, many examples in this publication show how parties already come up with original multifunctional combinations. This also shows that there are opportunities to create viable business cases.

New Dutch environmental law (Omgevingswet)

The Dutch environmental law is currently under fundamental revision. The new environmental law matches well with the principles behind ‘planning by invitation’. The law enforces the initiators of new developments to take the integrated character of the environment into account. The principle of good planning is therefore tightened; it requires that every intervention strengthens all the elements of the area and their coherence as much as possible. This is not enough, however. The modification of sectoral regulations is required to make integrated assessments possible, which enables bringing ‘planning by invitation’ into practice.

To stimulate multifunctionality, it is important to raise the issue of such obstacles. Precursors in the field of multifunctionality prove that it helps to put things on the agenda. Although the new environmental law will only take effect on 1 January 2022, there are already some quite promising signs that it develops in the right direction.

Circularity and resilience

The circular economy concept gives recycling a new boost. Recycling is about re-using raw materials from old products for new products. The idea of circularity adds extra meaning to this by not only focusing on re-use of materials after the use of a product, but by smart designs and building processes that decrease the need for products and creation of waste from the beginning. It focuses on closing material loops.

Cases like Fairphone and Cosun show that circular business cases are often multifunctional too (see p. 17 and p. 35). Circularity easily leads to serving one or more goals, since a product is made and at the same time nature, well-being, renewable energy and other interests are furthered. Many circular business cases are multipurpose like multifunctional business cases, and most often these purposes are for the better, not the worse. They develop the sustainability of the environment, and interesting is how this can grow. Where expansion of standard business cases puts pressure on the

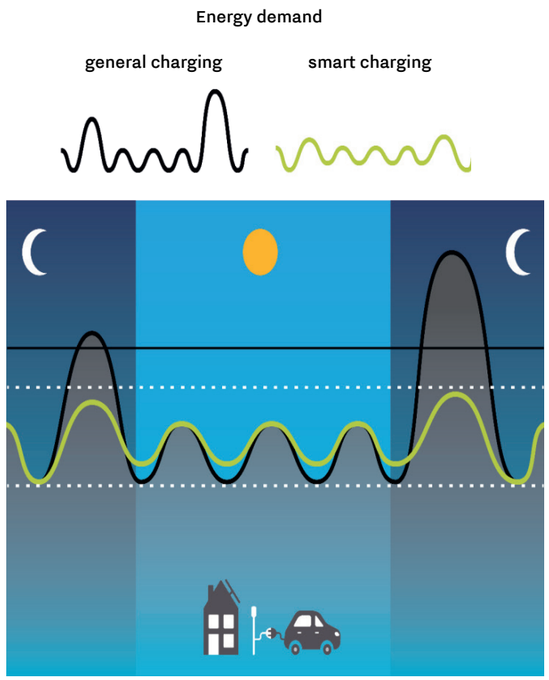
Case description

Smart energy grid in Lombok, Utrecht

Renewable energy is gaining ground. This results in positive effects such as less emissions, but it generates new challenges as well. The living lab of Lombok, Utrecht, aims to overcome a lot of these challenges.

A first challenge is related to the unpredictable supply of several renewable energy sources; solar and wind energy is everything but stable. This creates a disbalance between supply and demand and the need to store energy. The second one is the capacity of the electricity net. This net is designed to transfer energy from a large energy creation center to end-users. The cables close to this center have a large capacity, but the closer to the end-user, the smaller the capacity becomes. Last years, more and more end-users started to generate energy as well, for example through solar panels or wind mills. The generated energy that is not directly used by these end-users is fed into the electricity net. As a result, a lot of energy is transferred in the other direction. This results in capacity problems when a lot of energy is generated by end-users. Broadening the capacity of the energy net requires substantial investments. The third challenge is the offsetting regulation that will disappear in a few years. At the moment, energy costs €0,19/kWh for end-users. The market price for feeding 1kWh into the net is €0,07. The difference of €0,12 is rewarded by the national government to the end-user that supplies back to the net to make it more attractive to invest in renewable energy. This regulation will disappear in a few years, which makes it more attractive to balance the own demand and supply instead of supplying back to the net.

In June 2015, Lombok experienced a world’s first with the revolutionary Vehicle-to-Grid system. This system aims to overcome the problems described above. At the heart of the Vehicle-to-Grid system is a smart charging point that conveys locally generated solar energy to electric cars in the street. When the dwellings in this area need electricity, the smart charging point also feeds energy back from the connected car batteries. This implicates that residents of Lombok can power their houses in the evening with energy generated by their own solar panels during the day. The system is currently operational in Utrecht and includes a car sharing platform as well.



This system has several benefits. The use of electrical vehicles powered by renewable energy decreases emissions in the neighbourhood and the generation of CO2 elsewhere. This results in cleaner air and less climate change. Besides that, sharing cars results in the use of less cars, and therefore less material. Another major benefit is that the residents of Lombok can level their own demand and supply. This is more affordable, as using your own generated energy is cheaper than supplying back to the net in case of oversupply, and then using energy from the net again when not enough energy is generated. It also results in lower costs for network operators as they do not have to invest in increasing the capacity of the net. The knowledge and insights generated in Lombok can be applied in numerous neighbourhoods all over the world.

Involved parties
LomboXnet, Stedin, General Electric Benelux, Utrecht Province, Utrecht Municipality and many others

Websites
Lombox.nl

planet and its resources, multifunctional and circular business cases achieve the opposite. Many have a future value and can spiral up when an extra function is added. Will this help create resilient environments that can adapt to climate change?

Business cases

When a measure serves two or more goals, these goals share the resources necessary for this measure. This results in savings as resources are shared. Often, sharing resources can result in extra returns too. For example, a home is an excellent environment in which one can also receive care. This avoids the costs of a nursing home and the care is often more effective than in the latter, since a lot of people feel better in their own home. A beneficial relationship between one measure and two or more purposes is not a matter of course. It only occurs if resources are shared. This phenomenon is not investigated in depth in academia yet. We have never really familiarised ourselves with the phenomenon of multifunctionality and we are only starting to do it now. This book makes a contribution to that process.

7.4 Opening the treasure chest

What would have happened in Gouda if there had been no integration of goals (see p. 5)? A new, high dike would have been built in front of an old levee, with an empty space in between. It would have been a lot more expensive to build, would have required more raw materials, and would have resulted in inefficient use of space, with fragmentation and suboptimal social integration as a result. What if the integration of housing and care would be at a higher level than nowadays, 2020, the year in which the covid-pandemic struck? What appears on the horizon is an integration between hospitals and neighbourhoods; even activities to cure patients will move from hospitals to dwellings. This does not prevent a pandemic, of course, but it increases the capacity to take care of large groups of patients at reasonable costs.

Integration of goals is only possible if it is socially profitable. But how does this happen? When do people dare to integrate? When are they convinced that a project will help them and is a real business case? Multifunctionality is the best kept secret in the economy and society. The opportunities have been there for the taking for a very long time. Nevertheless, the ambition, the necessity and the preconditions for realising them were not yet present to an adequate degree.

The treasure chest of integration is only opening slowly as the next combination becomes profitable due to the pressure of economic and/or social circumstances. The trends in many sectors of society show how multifunctionality helps to shape the environment. Shareholders start working together and find out what they can expect from one another. This happpens step by step. For example by people that discover that agriculture, care and education integrate well. Once a new combination has been tried out, it is easier for people in other places to set up comparable combinations.

Naturally, it is important to work on creating the right preconditions, to look for better methods and to gather more knowledge about where and how we can put them into practice. The most important item on the agenda, however, is simply to get down to work. Make use of the new awareness of finiteness, study the specific qualities of the area, decide what your aim is and look for supporters and shareholders to capitalise existing qualities. Multifunctionality creates a sense of freedom. You can turn around, step out of your ‘box’, make a difference. Co-create. The cage is open. Where there is a will, there is always an appropriate way to be found for tackling a project. Open the treasure chest and discover the power of multifunctionality, and in the process, help to reinvent multifunctionality.

Case description

Public procurement of innovation

Social challenges for which no solution is available on the market often require innovation. In such cases, a client can switch to an innovation-oriented tender. Such a tender can also help to achieve multifunctional projects. Innovation can be developed and purchased in various ways, using more conventional processes or using special procedures.

This book focuses on the ‘special procedures’ in the Dutch Tendering Act to facilitate public procurement of innovation. These procedures are used to allow market parties to demonstrate and contribute their added value during and after the procedure. The starting point for all these procedures is therefore that the client cannot specify everything upfront.

Innovation in a competitive dialogue
Contracting authorities can use a competitive dialogue (CD) if their needs are known but their specification cannot yet be precisely defined. In a series of dialogues with selected parties, the first call is adjusted to a final call, whereby the selected parties have sufficient space to make an optimal offer. Part of this offer can be innovation, for instance a multifunctional project.

An example of an innovative competitive dialogue can be seen at the Wilhelmine Gasthuis Terrain. At this terrain, a heat network based on ATES and aquathermal energy (see p. 37-39 for more information) will be developed. In order to realise this network, the building owners in the area establised an energy cooperative. This energy cooperative decided to follow a procurement procedure with a competitve dialogue, even when they are not obliged by law as they are a private party. By doing this anyway, they ensured the realisation of their own ideas combined with the right knowledge from market parties.

R&D services by an entrepreneur in a SBIR of Pre-Commercial Procurement procedure
The European pre-commercial procurement (PCP) and Dutch Small Business Innovation Research (SBIR) are procedures that are used to procure R&D services to develop a marketable product. Such a procedure is commonly used for complex problems for which market parties as well as governments have not yet found a solution(direction). In the PCP or SBIR, entrepreneurs and client work together to develop solutions. After a solution is found and tested, the procedure ends and the client decides whether to specify and tender the innovation for commercial purposes.

R&D services and innovation by an entrepreneur in an Innovation Partnership
An Innovation Partnership procedure is a tendering procedure that basically combines a PCP with procurement and implementation of the developed solution. The procedure has been available since 2016 for Dutch contracting authorities and is used over 30 times in the first 4 years. An Innovation Partnership is used for problems for which no available solutions suffice. Commonly the client knows however that there are market parties working on a solution or have solutions that need altering before they can be used. The procedure consists of three phases: 1) the tender, where contestants are selected; 2) the R&D contract, when solutions are selected and contestants can (be forced to) drop out; and 3) the commercialisation in which (a) successful solution(s) can be procured on a large scale.

An example in which an innovative partnership is established, is at a project concerning fish migration. The last years, Rivierenland Water Board, located in the center of the Netherlands, has been working on connecting their rivers and waterways in order to stimulate fish migration. The picture below shows a fish lift, designed for this purpose. In 2017, the Water Board wanted to know whether their migration routes were actually used by fish. In order to achieve better monitoring results, the board wanted agencies to join forces and come up with innovative ideas from that collaboration. The contract to monitor how fish in this area use the available migration routes has been awarded to a combination of four agencies that combine their research methods and tools.

Websites
pianoo.nl

Picture sources

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31	Solarpark de Kwekerij (netbeheernederland.nl)
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	DELVA Landscape Architecture Urbanism (delva.la)
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