CIRCULAR CONSTRUCTION.
THE FOUNDATION UNDER A RENEWED SECTOR

circle economy
One of the most sustainable buildings in the world right now is the Bullitt Center in Seattle (US). This building distinguishes itself in various ways and shows how circular building is focused on the design, the choice of materials and the use phase. The building has seven floors, an area of circa 4,600 m² and proves that a self-sufficient office building is commercially achievable.

The drinking water and energy requirements are largely reduced and sustainably supplemented. The building thus uses a net of no water: rain is captured and filtered into drinking water. Waste water is composted in the cellar; grey waste water is biologically purified. The building also uses no energy, but produces some 230,000 kWh annually, thanks to a roof covered in solar panels.

The choice of materials and the design are also circular. As many as 350 damaging substances are excluded, including lead and fire retardants, all substances or materials that would normally have been used in the construction. The construction is of wood, steel and concrete, and built for a lifespan of 250 years. The façade has a lifespan of 50 years and can easily be replaced and modified.
BULLITT CENTER: COMMERCIAL SUCCESS

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INTRODUCTION

The circular Construction and demolition sector is set up radically differently than the current, linear chain. Construction is an important economic engine, but also one of the largest consumers of resources and energy. Smarter and more efficient resource management is also crucial, then, in order to continue to make prosperity possible. The circular economy is a framework for managing scarcity and to let prosperity flourish, safely within important limits that protect the planet.

Therefore, it is interesting to investigate how we can apply the assumptions of a circular economy to the Construction and demolition sector, and thereby create opportunities for businesses. This report is intended for both entrepreneurs and investors. See it as a first impetus, an invitation to involve all the players in the sector in the realisation of the circular economy.

The first part of the report describes the current state of affairs in the sector. We then discuss the greatest bottlenecks when it comes to inefficient use of resources and the impact on the climate and biodiversity. In the third part, we give our vision of a circular future for the Dutch Construction and demolition sector. Finally, with an analysis of material and energy streams, we go into the most important opportunities for entrepreneurs. The transition to a circular Construction and demolition sector namely offer possibilities, in both the short and long term. At the end, we have listed the most important conclusions and recommendations.
The circular economy is waste-free and resilient. We have used these assumptions in order to identify the most important characteristics of this economic model, formulated in a deliberately broad and ambitious way, as an ideal, theoretical end stage. Although they are probably difficult goals to achieve, these six points on the horizon offer a context for setting the right course:

1. All materials will - in theory - be infinitely recycled.
2. All energy is derived from renewable or otherwise sustainable sources.
3. Human activities support and strengthen the ecosystem and are natural capital.
4. Human activities contribute to a diverse society.
5. Human activities support and strengthen health and happiness.
6. Resources will be used to create more than just financial value, for example, ecological or social value.

### THE FINAL GOAL IS AN ECONOMY:
- in which materials streams are efficiently managed and recycled;
- that runs entirely on the basis of renewable energy;
- without negative effects on human life or the ecosystem.
ABN AMRO has made sustainability part of its strategy. We see worldwide sustainability developments with major consequences for the businesses of our customers. Growing scarcity of important resources is one such development. Working toward a circular economy is a solution for letting this shortage go along with economic prosperity.

1. STATE OF AFFAIRS IN THE DUTCH CONSTRUCTION AND DEMOLITION SECTOR

With building production of 72 thousand million euros, the Construction and demolition sector represents an important share (4.8% in 2013) of the added value within the Dutch economy. The sector is still recovering from the crisis of the past five years. For 2015, ABN AMRO expects a growth in building production of 2%, driven by the recovery of the Dutch economy.

1.1. Mismatch of building supply: vacant locations keep increasing, new construction at a historical low

The facts:
• In the absolute sense, the number of buildings is still growing. But the share of ‘new construction’ in the annual production is falling with respect to the share of ‘restoration and renovation’ [3]
• The market for restoration and renovation projects in housing construction has significantly increased (50%), while for utility construction, it has fallen by 25% [3].
• The number of vacant residences [1] slightly increased and was nearly 6% at the beginning of 2014. This is remarkable, since in comparison with 2000, there were 70% fewer residences built.
1.4. Mismatch between demand and supply
There is difficulty in matching demand and supply at one transaction, which is mainly due to the fact that demolition sites each produce only a relatively small amount of construction waste. Even though waste is available at different locations, it does not match with the required amount for new constructions, which is much greater than the supply. Waste is therefore not directly used in another building construction.

1.5. Limited know-how on reuse options:
Before buildings are demolished, contractors want to sell or even to give away the materials for free to companies in order to get rid of waste management costs. This creates the supply in the market. In spite of this, architects and building companies do not know the potential applications of the waste and are not willing to buy it.

1.6. Technological developments
Technological developments also contribute to becoming sustainable. Research is thus being done into and experimentation is being done with:

- The rate of vacant offices has significantly increased. In 2014, this amounted to nearly 17%. In half of the cases today, these are structural vacancies, that is to say, three years or longer. This represents an increase of circa 10% since 2010.
- In 2014, nearly 9% of the shop area was vacant [2], 3% more than in 2008. Just as with offices, the share of structural vacancies has grown.
- Energy savings in existing construction (More with Less) and new construction (Spring Agreement). One of the goals is energy-neutral new construction in 2020. In addition, everlower EPCs must be realised at a national level. In 2015, the standard goes down to 0.4. [8]
- The National Action Plan (in Dutch ‘Landelijk Actie Plan’; LAP) sets a recycling goal of 95% for the Construction and demolition sector. This is well above the agreed-upon 70% within the EU Waste Framework Directive. The sector currently has a recycling percentage of 97% [17], but lacks clear guidelines, for both the quality of re-used materials and the use of sustainable materials. The greatest part of materials recycling in the sector is also low-value (downcycling).
- Due to the increasing complexity of construction and infrastructure projects, integrated procurement is now official government policy. Integrated contracts include the costs and environmental impact for the entire lifecycle. Because contractors collaborate and are responsible for the complete lifecycle of the project, planning and prices will be optimised. They also therefore choose more responsible materials. Compared with regular contracts, this leads to a potential cost savings of 10 to 20%. [14]
Furthermore, the urban environment is increasingly SMART. Thanks to automation, lighting, heating, ventilation and humidity, for example, can be monitored and adjusted in real time. This has significant advantages for the environmental performance of buildings.

In an earlier stage of the construction process, Building Information Modelling (BIM) [15] is a way of building virtually. BIM gives information not only about the functional and physical characteristics of the building, but also ensures more effective and more efficient management of the construction process. This prevents failure costs, increases the quality and strengthens lifecycle-thinking. [13]
2. NEGATIVE EFFECTS OF THE SECTOR (CIRCULARLY SEEN)

2.1. Large-scale use of raw materials, strongly dependent on natural resources

The greatest impact of the Dutch Construction and demolition sector is caused by the dependence on fossil fuels; this amounts to 96%. In addition, the sector is more than 90% dependent on raw materials such as iron, aluminium, copper, sand, clay, limestone and wood. Collectively, that accounted for some 260 million tons in 2010. Because the harvesting and processing of these materials is so complex, most of them have a high energy value. The necessary energy and CO2 emissions per kilogram of materials are relatively high.

Energy use for raw materials

In 2010, the primary energy use for materials harvesting for the Dutch Construction and demolition sector domestically and abroad amounted to 172 petajoules, or 47 thousand million kWh. That is 4.5% [17] of the total primary energy use in the Netherlands. This excludes energy use during the use phase.

Greenhouses gases and particulates

The climate impact of the sector is 9.6 million tons CO2 eq. This comes to 5% of the national greenhouse gas emissions. The particles that are released in the harvesting and production phase for building materials are good for more than 70% of the total particulate emissions of the Dutch Construction and demolition sector.

The harvesting of resources brings along noticeable consequences for the environment. This land use leads to:

- habitat destruction and fragmentation;
- reduction of biomass;
- soil erosion and soil acidification;
- increased sedimentation and turbidity of bodies of water.

Secondary impact

In addition, noise, dust, waste and contamination (toxins and chemicals) have significant secondary impacts. The hazardous and unhealthy labour conditions in the mines also threaten the physical and mental health of labourers. [19][20] The origin of materials can also contribute to the impact. In comparison with, for example, Germany, where steel is made from scrap using the electric arc furnace (EAF) process, China has a much higher environmental impact due to less energy-efficient steel manufacture, less environmentally friendly energy production and transport.

Transportation pollutes

The transportation of resources and building materials represents 20% of all the goods transportation over the roads in the Netherlands. The transport of heavy building materials also contributes significantly in our country to the CO2 emissions, particulate emissions and soil acidification.

5% OF THE GREENHOUSE GAS EMISSIONS ARE PRODUCED BY MAKING BUILDING MATERIALS
2.2. CONCRETE RESPONSIBLE FOR THE LARGEST PART OF THE IMPACT

Concrete, with 25% of the total energy use in the Dutch Construction and demolition sector, is the primary cause of the total energy impact that the sector has. In addition, the material is responsible for more than 35% of the total climate impact of the sector, which corresponds to 1.7% of the total climate impact for the Netherlands. [12] Cement is the biggest culprit. Its production emits 2.2 million tons CO₂ eq. That is equivalent to 95% of the total climate impact of concrete. The use of Portland cement in CEMI accounts for the largest share. The concrete sector as a whole represents 13% of the PM10 eq. particulate emissions that all economic activities in the Netherlands cause.

2.3. CURRENT FORM OF RECYCLING IS SUBOPTIMAL

The Dutch Construction and demolition sector, with 23 million tons of construction and demolition waste per year, is responsible for 37% of the total waste stream in the Netherlands. [17] Although more than 95% will be re-used or gets another application, the recycling of it is suboptimal. More than 75% is stony rubble, of which only 2% will be re-used as a replacement for gravel in new concrete. The vast majority of the gravel ends up in roads. The processing of this fraction is very energy intensive, and the recycled waste will - in other words - be “downcycled”. As much as 15% of all the Dutch waste that will be dumped or burned originates in the sector. Nearly 20% of this share is ‘hazardous’. Figure X1 shows the current state of material flows in the Dutch construction and demolition sector.

On the next page, you can find FIGURE X1: Current state of material flows in construction and demolition.