Exploring the circular economy in the concrete sector

Lessons learned from two case studies: 'Replacement of 50 locks between 2020 and 2040' and 'Resource-efficient procurement of infrastructural concrete products by Dutch municipalities'

CE Delft

Committed to the Environment

Exploring the circular economy in the concrete sector

Lessons learned from two case studies: 'Replacement of 50 locks between 2020 and 2040' and 'Resource-efficient procurement of infrastructural concrete products by Dutch municipalities'

This report is prepared by:
Marit van Lieshout
Delft, CE Delft, June 2016

Publication code: 16.2F06.60

Concrete / Resources / Economy / Reuse / Reduction / Infrastructure / Governmental policy / Municipalities / Stakeholders / Decision-making
FT: Procurement

Client: Directorate-General for Public Works & Water Management (*Rijkswaterstaat*).

With the contribution of the LIFE financial instrument of the European Community.

CE publications are available from www.cedelft.eu

Further information on this study can be obtained from the contact person, Marit van Lieshout.

CE Delft
Committed to the Environment

Through its independent research and consultancy work CE Delft is helping build a sustainable world. In the fields of energy, transport and resources our expertise is leading-edge. With our wealth of know-how on technologies, policies and economic issues we support government agencies, NGOs and industries in pursuit of structural change. For 35 years now, the skills and enthusiasm of CE Delft's staff have been devoted to achieving this mission.

Contents

Summary

The European REBus project brings together a unique partnership of expertise and knowledge to enable the advancement of resource-efficient business models. Resource-efficient business models extract the maximum value from products by using them more intensively, extending their lifetime or enabling them to be reused - increasing business resilience and reducing resource dependency.

The first step towards establishing a resource-efficient business model is to evaluate the resource efficiency of bids made in tender procedures.
Today, price is generally far more important than resource efficiency in such procedures. Within the framework of the REBus project two pilots were therefore organised to explore ways in which resource efficiency can be factored in to public tenders in the field of infrastructure projects.

Pilots

Both pilots were organised in the form of a workshop.

Pilot with Rijkswaterstaat

Rijkswaterstaat, the Directorate-General for Public Works and Water Management, is the Netherlands' major contracting authority for infrastructure projects, which generally involve large volumes of concrete. During this workshop, participants explored future opportunities for including use of recycled concrete in public tenders for replacement of about 50 locks scheduled for between 2020 and 2040.

Pilot with representatives of the three largest Dutch municipalities

These municipalities are the Netherlands' largest procurers of non-structural concrete products in infrastructure applications. During this workshop, participants from municipalities and the concrete sector explored the scope available in public tender procedures for challenging market parties to use state-of-the-art technical know-how in order to reduce the lifecycle environmental impact of concrete.

Outcomes

At this moment, informing stakeholders throughout Europe on the lessons learnt is the direct outcome of these pilots. The long-term goal is to develop commercial practices that intrinsically challenge suppliers to come up with the most sustainable alternative.

In these pilots insights were gained on all four aspects of procurement, viz.:
1. Setting procurement goals.
2. Choosing the criteria.
3. Ranking tender offers.
4. Attestation, proof, monitoring.

Setting procurement goals

Sustainable procurement offers government at all levels an opportunity to achieve significant reductions in environmental impact, especially in the case of large infrastructure works and other projects involving large volumes of concrete. To exploit this opportunity, governments must make choices, though, because 'doing everything is doing nothing'. In order to make such choices, relevant impacts need to be evaluated. Given the relatively large environmental impact of most infrastructure projects, it is reduction of this impact, that should be one of the main goals.

Choosing the criteria

To assess resource efficiency and environmental impact requires a yardstick meeting the following conditions:

- it must be politically relevant; and
- it must involve a metric for impact quantification.

Furthermore, the metric used to quantify the environmental impact should be compliant with the European Environmental Product Declaration. The tool currently being developed by SBK, SBR Curnet and the Dutch concrete sector promises to be a very cost-effective way to meet these criteria.

Ranking tender bids

For a tender procedure to be both swift and adequate, objectivity is essential. The choice of yardsticks adopted to quantify goals, in the present context with respect to environmental impact, is therefore of the greatest importance.
In addition, ranking of offers via a scoring system should be transparent and comprehensible to all contenders. The ranking should also be challenging, in the sense that the best score should always represent a significant advantage over the worst.

Attestation, proof, monitoring

To actually speak of 'proof' requires additional warrant systems in the form of a chain of custody. Although the concept of so-called material passports has been under discussion in Dutch industry for some years now, no practical experience has yet been gained with such a system.

1 Introduction

Within the framework of the European REBus project, two pilots were organised to explore ways in which resource efficiency can be included in public tenders for infrastructure projects. This reports presents the outcomes of these projects and the lessons learned.

1.1 Background

The REBus project is looking for forward-thinking businesses to pilot and develop resource-efficient, resilient and profitable business models. Resource-efficient business models extract the maximum value from products by using them more intensively, extending their lifetime or enabling them to be reused - increasing business resilience and reducing resource dependency.

The lead partner of the project is the British organisation WRAP, the others being:
- *Rijkswaterstaat*, the Dutch Directorate-General for Public Works and Water Management;
- the Environmental Sustainability Knowledge Transfer Network;
- the University of Northampton; and
- the Aldersgate Group.

The pilots described in this report were organised by *Rijkswaterstaat*.

Rijkswaterstaat is a partner in the 'Green Deal on Concrete' between the Dutch government and Dutch companies representing various activities in the supply chain and lifecycle of concrete products, the aim of which is to develop a knowledge base for improving the resource efficiency of concrete use. The organisations that are partner in the Green Deal on Conrete cooperate within the CSR Concrete Network. The CSR Concrete Network is an informal partnership between 24 companies and 7 trade associations in the concrete supply chain under the flag of CSR Netherlands, an organisation promoting Corporate Social Responsibility.

1.2 Relevance of the Green Deal for resource efficiency in the EU28

Two aspects of concrete production are relevant to resource efficiency:
- the relatively high CO_2 emissions associated with concrete production, and
- the low percentage of concrete recycled in production of new concrete.

These points are elaborated below.

Relatively high CO_2 emissions associated with concrete production

CO_2 emissions in the EU28 in 2012:
Total, including aviation: 4,679 million tonnes (Mt)
Total, industrial sources: 321 Mt
Total, cement industry: 109 Mt
Fuel mix of cement industry 38 Mt

In 2012,the gross CO_2 emissions due to cement production in the EU28 (excluding CO_2 from power generation) equalled 109 million tonnes per year (Cement Sustainability Initiative). According to the Eurostat CO_2 emission statistics for 2012, this is 2.3% of total EU CO_2 emissions (including aviation) and 34% of CO_2 emissions from industrial processes in the EU28.

Of these emissions, 38 million tonnes are due to the fuel mix used in cement production, with the remainder deriving from the decarbonisation process involved in producing the most commonly used type of cement (lime-based Portland cement).

It is estimated that by 2020 the measures supported by the CSR Concrete Network will be able to reduce the CO_2 emissions associated with concrete use in the Netherlands by 30% (CE Delft, 2014). If implemented on a European scale, these measures would have a significant impact on the total CO_2 emissions of the EU28, at the same time significantly reducing the energy intensity of concrete. As such, the results emerging from the Dutch Green Deal on Concrete could make a substantial contribution to improving the resource efficiency of the entire EU28.

Low percentage of concrete reused in producing new concrete
Used concrete (the end-of-life phase) forms a significant waste stream. Although this waste is not harmful to humans or the environment, reusing this material to produce new concrete could have environmental benefits, especially in urban areas. Insights gained under the Green Deal with respect to concrete recycling technologies and other 'circular economy' aspects could therefore provide additional scope for boosting resource efficiency.

1.3 Aim of the pilots

To explore opportunities for implementing the insights gained in the Green Deal on Concrete, two pilots were organised in the form of workshops.
1. Pilot with *Rijkswaterstaat*, the Netherlands' major contracting authority for infrastructure projects, which generally involve large volumes of concrete. During this workshop, participants explored future opportunities for including use of recycled concrete in public tenders for replacement of about 50 locks scheduled for between 2020 and 2040.
2. Pilot with representatives of the three largest Dutch municipalities, the country's leading procurers of non-structural concrete products in infrastructure applications. During this workshop, participants from municipalities and the concrete sector explored the scope available in public tender procedures for challenging market parties to use state-of-the-art technical know-how in order to reduce the lifecycle environmental impact of concrete.

At this moment informing stakeholders throughout Europe on the lessons learnt is the direct outcome of these pilots. The long-term goal is to develop commercial practices that intrinsically challenge suppliers to come up with the most sustainable alternative.

1.4 Reading guide

In the next three chapters the two pilots are presented along with the lessons learned.

In Chapter 2 we describe the pilot on the national programme for lock replacement over the period 2020-2040 with *Rijkswaterstaat* in the role of commissioning party. This pilot focusses on the future scope for concrete use in this specific application that is line with the idea of a 'circular economy'.

In Chapter 3 we describe the pilot on resource-efficient procurement by Dutch municipalities. This pilot focusses on procurement of non-structural concrete products in infrastructure applications and especially the current scope for reducing the environmental impact of these products.

In Chapter 4 we present the lessons learned from these pilots.

2 National programme for lock replacement, 2020-2040

Within the CSR Concrete Network the Circular Economy working group was set up to investigate the potential and limitations of more resource-efficient use of concrete.

On 19 May 2014, the CSR Concrete Network's Circular Economy working group held a workshop to explore the potential for more resource-efficient material use in the specific case of replacement of 50 locks scheduled for the period 2020-2040[1].

This chapter presents the participants and the main outcomes of this workshop.

2.1 Participants

The workshop participants were as follows:
- Evert Schut (Directorate-General for Public Works and Water Management, *Rijkswaterstaat*; coordinator of the CSR Concrete Network);
- Jack van der Palen (Archiview architects; chair, Circular economy working group, CSR Concrete Network);
- Klaas Visser (construction company Ballast Nedam);
- Michel Schuurman (CSR Netherlands, Circular economy programme);
- Anne ten Brummelhuis (CSR Netherlands);
- Marianne Kalkman (CSR Netherlands);
- Leonie van der Voort (construction company Cascade);
- Peter Broere (industry organisation BRBS);
- Murk de Roos (Ministry of Infrastructure and Environment);
- Marie van der Poel (industry organisation VBON);
- Oscar Dekkers (supplier of cementitious products Bruil Construction Group);
- Merijn Vijfhuizen (concrete supplier Besix);
- Nico Vonk (certification body for construction materials KIWA BMC);
- Toine van Casteren (concrete technology company BAS Research & Technology);
- Mandy Willems, Edwin van der Wel, Arjen Hijdra (*Rijkswaterstaat*).

2.2 Background of the workshop

The aim of the CSR Concrete Network is not only to solve yesterday's problems, but also to prevent generation of tomorrow's waste. This workshop therefore, focused on non-technical aspects, such as organizational innovations required to close the material cycle loop, introduction of new business models, supply chain management and use of 'commodity passports' for tracking materials in their various applications.

[1] Replacement as scheduled on recommendation of the National Delta Commission, having reached the end of their technical lifetime.

To make the subject less abstract, the working group decided a real-world case was needed, so all the practical aspects of more resource-efficient material use could be dealt with. When approached on the matter, *Rijkswaterstaat* offered the preliminary phase of this lock replacement project as a suitable case study for exploring possibilities.

2.3 The lock replacement project

In this project, known at *Rijkswaterstaat* as the 'Multiwaterwerken' project, some 50 locks are to be replaced during the period 2020-2040. The contract value of this replacement is estimated at between 2 and 4 billion euros (additional to an existing lock replacement programme entailing about 3.2 billion euros).

Anticipating this will lead to more predictable construction costs, *Rijkswaterstaat* has taken standardization and sustainability as leading aspects in the tendering procedure for replacement of these locks. In respect of standardization, modular building is expected to offer the flexibility for lock widening or narrowing in the future, to cater for future ship sizes, for example. As to sustainability, the goal is to reduce the carbon footprint by 20% compared with 2010.

There is no special preference for any particular material: concrete, steel or bricks will do, as long as the materials are durable and effective. As other parameters may also be important in the future, though, tenders should focus on a sustainable and resource-efficient design.

2.4 Discussion points

During the workshop, participants explored the potential for environmental gains through more resource-efficient use of materials from the design to the demolition phase of the 50 locks scheduled for replacement. This section summarizes the main discussion points.

What is the added value of resource-efficient material use in the case of lock replacement?

The materials most widely used in the locks in question are steel and concrete. Since the economic value of used steel is high enough to guarantee reuse, recycled steel will be used to produce the new steel required.
The economic value of used concrete is much lower and the question is therefore whether this should be reused if it means transporting it over large distances, with the additional CO_2 footprint implied.

This topic was addressed in a recent study by CE Delft commissioned by the CSR Concrete Network:

Life cycle assessment (LCA) studies on transport emissions show that transport of concrete by road over 350 km causes approximately the same emissions as can be saved when reusing the material in the same form in a different application. If transport is by water, however, the distance travelled can be up to 6,000 km before equalling the emissions avoided by reusing the concrete. If waste concrete is used as a feedstock for producing new concrete, these distances will be much lower. In all cases one should strive for local processing when recycling concrete as feedstock for the production of new material or building block in a new building (Handelingsperspectieven verduurzaming betonsector, 2014).

This quote supports the case for reusing portions of the concrete that are of sufficient technical quality (for example, if the lock is replaced by a larger one for economic reasons long before it has reached the end of its technical lifetime). Other arguments for more sustainable use of concrete include the following.

Optimizing the concrete recipe for recycling means making the concrete more suitable as a feedstock for producing new concrete or even cement, implying higher-value demolition-phase material in the future. One way to improve recyclability is to avoid all kinds of additives and fillers that are required to improve the processing of poorly composed material. Use of these can be avoided by optimizing the composition of the concrete for reprocessing rather than merely producing the cheapest product. Among the knowledge that can be used to optimise this composition are theories on the optimization of grain packing.

Last but not least, 'construction for demolition' may imply using industrial construction methods regarded as more precise and less time-consuming on the construction site.

How to take responsibility for the entire lifetime, including the demolition phase?

As owner of the locks and organisation responsible for their technical quality, *Rijkswaterstaat* is widely seen as bearing de facto responsibility for their entire lifecycle, including the demolition phase. However, although the agency is already organised into 'regional services'(Dutch: 'omgevingsdiensten') with responsibility for lock construction, maintenance and replacement, the respective budgets are still separate, providing little incentive to shoulder responsibility for the whole lifetime of a lock when putting replacement out to tender. To remedy this situation, budgets should be dedicated to a lock or similar piece of infrastructure for its entire lifetime.

Merging the *Rijkswaterstaat* budgets for lock procurement, maintenance and replacement would make it more natural to include the whole lifespan, including the demolition/recycling phase, in the design phase of the lock. Unless this is done, resource-efficient material use is unlikely to be taken into account in design, implying less likelihood of value creation in the demolition/recycling phase. Having said this, such an alteration of budgeting will require considerable technical knowledge and expertise on the part of *Rijkswaterstaat*, to evaluate contenders' claims regarding reduced maintenance and higher value in the demolition phase during procuring procedures for the new locks.

What needs to be changed in procurement procedure to encourage resource-efficient material use combined with minimum lifecycle environmental impact?

Optimal functionality and costs in each phase of the lock's lifecycle, including demolition/recycling, should obviously carry significant weight in selecting the best offer. In any procurement procedure, use of a maximum or minimum value under or above which all tenderers achieve an equal score should also be avoided. Instead, scores should be established such that the bid with the worst score on a particular element of the tender gets 0% of the potential points on that element and the bid with the best score 100%.

The impact of the best score on environmental impact should be significant, furthermore: in the range of 3-8% of the overall score, depending on the improvement over current practice. Finally, when calculating the environmental footprint, at least one full reuse or recycling cycle should be

taken into account if reuse or recycling are enabled by the design offered.
If no reuse of recycling is involved, an additional fee will need to be taken into account that compensates for the fact that the resulting waste stream has to be cleaned, controlled for cleanliness and transported to a site where it can be safely disposed.

An alternative approach is for *Rijkswaterstaat* to opt for an integrated design, construction, maintenance and replacement contract, making the construction company responsible not only for construction and maintenance but also for the demolition/recycling phase. However, a lock lifespan is generally around a hundred years. A reasonable long contract its span does not exceed 25 years. Therefore it is not likely that replacement would be included in such a contract form.

Both these approaches should provide sufficient scope for challenging construction companies to optimise their design for recycling/reuse.

Does procurement of resource-efficient locks require a change in funding structures?
The single most important change required is for the costs of maintenance and demolition/recycling to be included in the initial investment budget.
Experience with design, construction and maintenance contracts over the last 10 years show that this appoach is likely to reduce an engineering structure's lifetime costs, implying feasibility within the current funding environment, especially if *Rijkswaterstaat* opts for a form of contract that encompasses replacement as well as just design, construction and maintenance.
An alternative option is to involve an investor with a long-term horizon such as a pension insurer, in combination with a user fee if so required.

Can modular engineering add to optimal resource efficiency?
During the discussions there was confusion about what aspects of a lock need to be standardized to permit reuse of elements like lock door panels. It was argued that it is not only the size of the panels but also maximum door weight that determines the scope for panel reuse. This would imply that *Rijkswaterstaat* needs to define different categories of lock and prescribe, for each, the size and weight of the panels that the door operating mechanism must be able to handle.

Unless *Rijkswaterstaat* defines in advance these and other such minimum standards relevant for reuse, reuse of modules between locks is unlikely to be feasible. It is equally important, though, that *Rijkswaterstaat* only prescribes the minimal functionality required for material reuse between locks, for otherwise the badly-needed innovations would be hampered.

What is required to make resource efficiency technically feasible?
As the agency responsible for the selecting the design, construction, maintenance and demolition/recycling methods from among the offers tendered, *Rijkswaterstaat* is best-placed to take appropriate action, though further details will depend very much on the particular situation.

We distinguish the following situations:
1. Recycling of materials:
   a in the case of current locks;
   b in the case of future locks.
2. Reuse of materials from future locks, by then designed for deconstruction if replaced for non-technical reasons (elements still technically sound).

In the second of these situations, recycling implies reuse of the materials freed up in the demolition phase, as an input for production of new materials. For a high percentage of the metals recovered this is already standing practice, but this is not currently the case for concrete. At present, the concrete rubble from lock demolition is reduced further in size until it is suitable for use as a sub-base in road construction.

To improve the recyclability of concrete as a feedstock for producing new concrete and thus increase its value requires more than a change to recipes. The most important step is to improve demolition methods such that sand, pebbles and other aggregate can be recovered in a similar or better quality than when they were used the first time round. In addition, the fine fraction of the cement stone must be clean enough for it to be reused as an ingredient in concrete or cement production. The working group on Innovative recycling methods examining this issue in the framework of the Green Deal on Concrete foresee improved demolition methods meeting these requirements being available by around 2020.

Besides demolition methods, there also seems to be a need for 'material passes' that provide a detailed description of the composition of relevant materials and the methods used to produce them, making it easier to determine the quality of each material and the applications in which it can be reused.

3 Resource-efficient purchasing by Dutch municipalities

On 26 November, 2014 a so-called ‘LEF-session’ workshop was organised by *Rijkswaterstaat* and the Municipality of Rotterdam on resource-efficient procurement of non-structural concrete products for infrastructure purposes by Dutch municipalities. The aim of this workshop was to bring representatives of the Netherlands’ largest municipalities into contact with representatives of the CSR Concrete Network to explore common ground for organising resource-efficient purchasing.

3.1 Participants

The workshop participants were as follows:
- Evert Schut (Directorate-General for Public Works and Water Management, *Rijkswaterstaat*; coordinator, CSR Concrete Network; co-organiser of the meeting);
- Léon Dijk (sustainability consultant, Engineering Office, Municipality of Rotterdam; co-organiser of the meeting);
- Richard Hermans (Business Group Manager Infra at MBI Beton BV);
- Han Briellestijn (sewer pipe procurement, Municipality of Utrecht);
- Renske Zengers (project manager, concrete reuse and recycling, Municipality of Amsterdam);
- Rense Kuil (business developer, KIWA);
- Jeroen van Alfen (*Rijkswaterstaat*);
- Yvo Provoost (Rijkswaterstaat);
- Pieter Lanser (Dutch Centre for Cement and Concrete);
- Rick Bron (project consultant, Struyk Verwo Infra/CRH Products Nederland);
- Marko van Mingeren (procurement of non-constructive materials for infrastructure projects, Municipality of Rotterdam);
- Marit van Lieshout (sustainability consultant, CE Delft);
- Frans Scheepens (facilitator, LEF).

3.2 Introduction to the workshop

To provide participants with sufficient background knowledge, there were three short introductions:
1. Marit van Lieshout (CE Delft) presented numbers on the environmental impact of concrete use and production in general and of non-structural concrete products in infrastructure applications in particular. In addition, the seven resource efficiency improvement options supported by the CSR Concrete Network were presented, including two ways to improve the resource efficiency of concrete use.
2. Léon van Dijk (Municipality of Rotterdam) outlined the city’s current policies on sustainability and resource-efficient procurement. The ultimate goal is to challenge procurers to take responsibility for opting for products that are as sustainable as possible, by following four basic principles:
   a the greatest resource-efficiency gains can be accomplished in the supply chain;
   b offers should be comparable;

c offers should be scored objectively and transparently;
d to give suppliers maximum freedom to innovate, the request for tender should be formulated in functional terms.

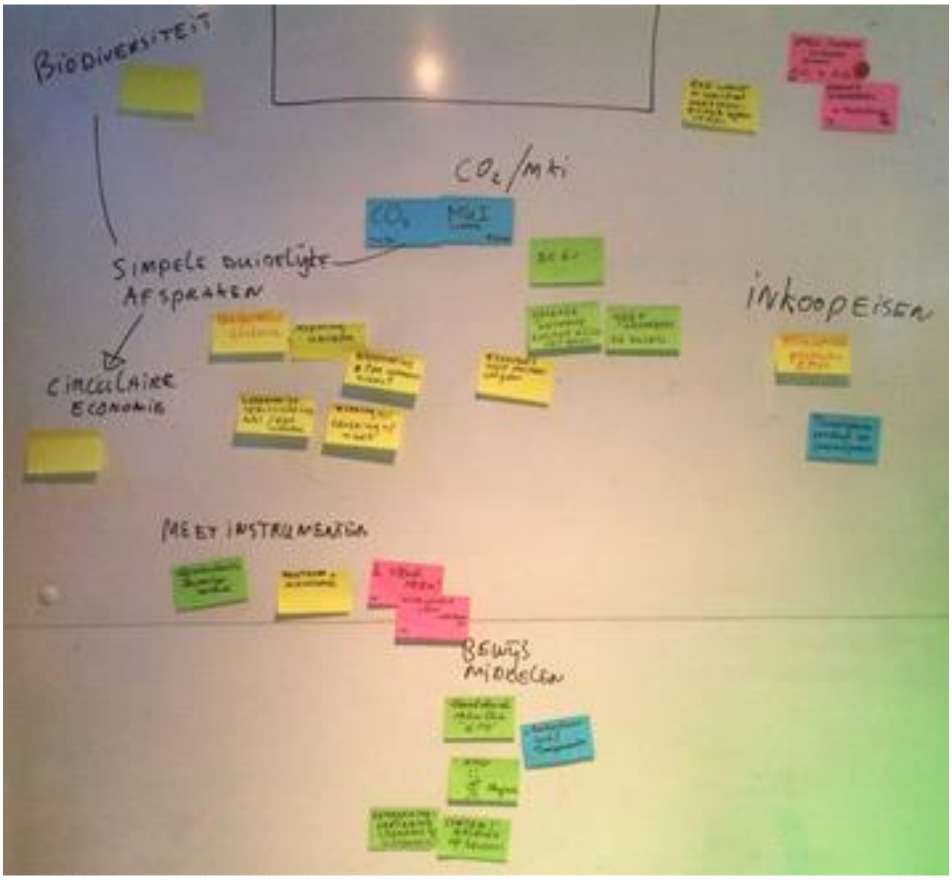
3. Evert Schut (*Rijkswaterstaat*; coordinator, CSR Concrete Network) presented the Network's activities, and inventoried the main barriers to greater sectoral resource efficiency. The main barrier lies not in legislation and standards, but in deficiencies in current 'sustainable procurement' practises:
   a While there are stated ambitions on CO_2 emission cuts and environmental impact reduction, nobody is accountable for securing them.
   b There is no monitoring of any emission cuts or environmental improvements achieved via resource-efficient procurement.

   The CSR Concrete Network is therefore keen to come to agreement on a management level with municipalities and *Rijkswaterstaat* on how to organise an effective, efficient, transparent and objective procurement procedure for resource-efficient concrete products.

3.3 Workshop ('LEF session')

After the introduction, participants were asked to write on a post–it the three aspects that had stuck in their minds and that needed to be addressed in the workshop. This resulted in the overview shown in Figure 1):

Figure 1 Outcome of the central discussion emerging from the brainstorming sessions



During the discussion these post-its were categorised into four groups:
1. Setting procurement goals.
2. Choosing the criteria.
3. Ranking tender offers.
4. Attestation, proof, monitoring.

Setting procurement goals
The goal is unambiguous, objective and transparent procurement in which environmental performance carries significant weight.

Choosing the criteria
In the Netherlands alone, there are multiple ways to express the environmental impact of a material, structure or activity, differing significantly in terms of objectivity and scientific rigour. The greatest challenge lies in the often major differences in the method used to determine environmental impact.

While these divergent methods may have the advantage of better suiting local preferences, in the end they will be unable to provide the required guidance towards reducing environmental footprints. If the marketplace is to have any steering force, there needs to be a limited number of objective and scientifically rigorous yardsticks for environmental impact.

Regardless of which yardstick is chosen, it must meet the following conditions:
- it must be politically relevant; and
- it must involve a metric for impact quantification.

During the presentation three different types of yardstick for environmental impact were identified as being important and politically relevant enough for discussion:
- carbon footprint or Environmental Product Declaration (EPD);
- resource efficiency/circularity of resource use;
- biodiversity impact.

During the workshop only the EPD/carbon Footprint ended up on the board. Participants motivated this with reference to a need for uniformity and the fact that for this yardstick a quantitative metric is already almost available. The Dutch construction sector has an environmental database with EPDs of the most commonly used building materials and has also developed a computer tool for calculating the environmental impact per volume of a specific concrete mixture according to LCA methodology. The outcome is ready for use in the company's environmental database. All that is lacking is validation of the database input against actual deliveries of the concrete.

At present, there are no such quantitative systems for measuring circularity of resource use or biodiversity impact. The measures available to address and assess these issues are far more qualitative and less direct.

To promote circularity of concrete use, two types of measures can be considered:
- setting limits on the amounts of the elements sulphur, aluminium, chlorine and heavy metals;
- supporting development of a new generation of recycling technologies aiming at resource retrieval.

Biodiversity can be supported through greener city design and by promoting maximum local reuse and recycling of concrete.

Such issues are harder to weigh up in a tender procedure and participants therefore felt that implementing EPD/carbon footprint as a discriminating factor in tender procedures was the first step that needed to be taken.

Participants underlined the key importance of a standardized, trustworthy method for calculating EPD/carbon footprint. This can be achieved by combining the program Dubocalc with the tool, developed by the sector for calculating the environmental footprint of concrete of any composition according to internationally agreed LCA standards.

Ranking tender bids

Participants emphasized the need for employing uniform criteria in requests for tender to achieve both for an objective tender procedure and a steering effect on the market.

Another point regarded as important by participants is the obligation to specify according to a Most Economically Advantageous Tender method, providing functional specification of needs rather than a prescription of means. In this method, superior environmental performance can be scored accordingly. It was suggested that the most objective and transparent way to formulate a tender request is to indicate the method to be used for calculating the EPD and provide a 5% price reduction to the party with the best EPD.

During this discussion it became clear that not all participants were familiar with the EPD concept.

Attestation, proof, monitoring

As mentioned earlier, there is a need for parties to provide testimony and evidence of their environmental claims, particularly as these can have a significant influence on the tender outcome. As yet, however, there are no methods for attesting to the validity of the EPD. For this purpose, a ‘chain of custody’ needs to be developed. Although considerable experience has been gained with the issues involved in the food, timber and other industries, this concept is still new for the construction industry.

The idea of the chain of custody is in line with the concept of ‘materials passports’, intended as a means of documenting material alterations, processing methods, additions, etc. Such a passport would ultimately have to be retained along with the building documentation, so that when alterations or demolition occur, the quality of the materials involved is known. This would greatly improve the potential for reuse and recycling of concrete when buildings and other structures are altered or demolished.

4 Lessons learned

In the pilots presented in this report, insights were gained on all four aspects of procurement:

1. Setting procurement goals.
2. Choosing the criteria.
3. Ranking tender offers.
4. Attestation, proof, monitoring.

4.1 Setting procurement goals

Sustainable procurement offers government at all levels an opportunity to achieve significant reductions in environmental impact, especially in the case of large infrastructure works and other projects involving large volumes of concrete. It is an opportunity authorities should seize.

In a sustainable procurement procedure it is important to prioritise the weight of environmental effects in projects with a large environmental footprint and to prioritise other sustainability effects in projects where these effects are more significant. If several environmental effects are of importance these effects should also be individually prioritised.

Whatever the outcome, procurement should have a limited number of goals, three at most: price, functionality and environmental impact, for instance. In some situations, two goals will even be sufficient, for example when the price is fixed and contenders are asked only to compete on functionality and environmental impact. This situation generally results in better functionality and lower environmental impact than when price is also a variable.

4.2 Choosing the criteria

To assess resource efficiency and environmental impact requires a yardstick meeting the following conditions:

– it must be politically relevant; and
– it mustinvolve a metric for impact quantification.

Furthermore, the metric used to quantify the environmental impact should be compliant with the European Environmental Product Declaration. The tool currently being developed by SBK, SBR Curnet and the Dutch concrete sector promises to be a very cost-effective way to meet these criteria. This tool should not be seen as a stand-alone tool, but as a route to standardised and cheap calculation of the environmental impact of any concrete recipe, so these data can be fed into the Dutch environmental database. This database must be at the heart of any system providing transparent comparison between alternative construction solutions.

4.3 Ranking tender bids

For a tender procedure to be both swift and accurate, objectivity is essential. The choice of yardsticks adopted to quantify goals, in the present context with respect to environmental impact, is therefore of the greatest importance.
In addition, ranking of tenders via a scoring system should be transparent and comprehensible to all contenders. The ranking should also be challenging, in the sense that the best score should always represent a significant advantage over the worst.

As already stated, to achieve the goals of the tender the number of goals should be limited, so that each has sufficient weight in the final decision on the winning bid.

4.4 Attestation, proof, monitoring

While the database developed by the concrete sector and *Rijkswaterstaat* for calculating the footprint of specific types of concrete provides parties a good way to calculate the environmental impact of production methods and recipes, there is no proof that the product delivered at the construction site has actually been produced accordingly. Additional warrant systems are therefore required, in the form of a chains of custody, or so-called material passports. The industry has been discussing the concept for some years now, but there has to date been no practical experience with such a system.